PUBLICATIONS

OF THE NATIONAL BUREAU OF STANDARDS

NBS SPECIAL PUBLICATION 305

SUPPLEMENT NO. 7

1975 Catalog

U.S. Department of Commerce

75 YEARS NBS 1901-1976

NATIONAL BUREAU OF STANDARDS

The National Bureau of Standards[1] was established by an act of Congress March 3, 1901. The Bureau's overall goal is to strengthen and advance the Nation's science and technology and facilitate their effective application for public benefit. To this end, the Bureau conducts research and provides: (1) a basis for the Nation's physical measurement system, (2) scientific and technological services for industry and government, (3) a technical basis for equity in trade, and (4) technical services to promote public safety. The Bureau consists of the Institute for Basic Standards, the Institute for Materials Research, the Institute for Applied Technology, the Institute for Computer Sciences and Technology, and the Office for Information Programs.

THE INSTITUTE FOR BASIC STANDARDS provides the central basis within the United States of a complete and consistent system of physical measurement; coordinates that system with measurement systems of other nations; and furnishes essential services leading to accurate and uniform physical measurements throughout the Nation's scientific community, industry, and commerce. The Institute consists of the Office of Measurement Services, the Office of Radiation Measurement and the following Center and divisions:

Applied Mathematics — Electricity — Mechanics — Heat — Optical Physics — Center for Radiation Research: Nuclear Sciences; Applied Radiation — Laboratory Astrophysics[2] — Cryogenics[2] — Electromagnetics[2] — Time and Frequency[2].

THE INSTITUTE FOR MATERIALS RESEARCH conducts materials research leading to improved methods of measurement, standards, and data on the properties of well-characterized materials needed by industry, commerce, educational institutions, and Government; provides advisory and research services to other Government agencies; and develops, produces, and distributes standard reference materials. The Institute consists of the Office of Standard Reference Materials, the Office of Air and Water Measurement, and the following divisions:

Analytical Chemistry — Polymers — Metallurgy — Inorganic Materials — Reactor Radiation — Physical Chemistry.

THE INSTITUTE FOR APPLIED TECHNOLOGY provides technical services to promote the use of available technology and to facilitate technological innovation in industry and Government; cooperates with public and private organizations leading to the development of technological standards (including mandatory safety standards), codes and methods of test; and provides technical advice and services to Government agencies upon request. The Institute consists of the following divisions and Centers:

Standards Application and Analysis — Electronic Technology — Center for Consumer Product Technology: Product Systems Analysis; Product Engineering — Center for Building Technology: Structures, Materials, and Life Safety; Building Environment; Technical Evaluation and Application — Center for Fire Research: Fire Science; Fire Safety Engineering.

THE INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY conducts research and provides technical services designed to aid Government agencies in improving cost effectiveness in the conduct of their programs through the selection, acquisition, and effective utilization of automatic data processing equipment; and serves as the principal focus within the executive branch for the development of Federal standards for automatic data processing equipment, techniques, and computer languages. The Institute consists of the following divisions:

Computer Services — Systems and Software — Computer Systems Engineering — Information Technology.

THE OFFICE FOR INFORMATION PROGRAMS promotes optimum dissemination and accessibility of scientific information generated within NBS and other agencies of the Federal Government; promotes the development of the National Standard Reference Data System and a system of information analysis centers dealing with the broader aspects of the National Measurement System; provides appropriate services to ensure that the NBS staff has optimum accessibility to the scientific information of the world. The Office consists of the following organizational units:

Office of Standard Reference Data — Office of Information Activities — Office of Technical Publications — Library — Office of International Relations — Office of International Standards.

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[1] Headquarters and Laboratories at Gaithersburg, Maryland, unless otherwise noted; mailing address Washington, D.C. 20234.

[2] Located at Boulder, Colorado 80302.

Publications of the National Bureau of Standards 1975 Catalog

A Compilation of Abstracts and Key Word and Author Indexes

Betty L. Hurdle, Editor

Office of Technical Publications
National Bureau of Standards
Washington, D.C. 20234

U.S. DEPARTMENT OF COMMERCE, Elliot L. Richardson, *Secretary*

Dr. Betsy Ancker-Johnson, *Assistant Secretary for Science and Technology*

U.S. NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Acting Director*

Issued June 1976

Library of Congress Catalog Number: 48-47112

National Bureau of Standards Special Publication 305 Supplement 7

To Accompany National Bureau of Standards Special Publication 305; and its Supplements 1, 2, 3, 4, 5, and 6

Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 7, 595 pages (June 1976)

CODEN: XNBSAV

Issued June 1976

U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON: 1975

For Sale by Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402
(Order by SD Catalog No. C13.10:305 Suppl. 7). Price $7.55. (Add 25 percent additional for other than U.S. mailing.)

PREFACE

As the National Bureau of Standards celebrates the Bicentennial of the United States as well as its own 75th Anniversary (1901–1976), it is interesting to take note of the Bureau's total published output over the years—papers which have played a significant role in the growth of science and technology in this country and indeed throughout the World. Since the turn of the century, some 32,363 NBS papers have been published in the open literature, a grand total of 606,854 printed pages. Many of the Bureau's early publications were classic contributions that still stand as scientific and scholarly references.

Included in the 75 year total is the published 1975 output cited in this annual catalog—1948 papers and 41,183 printed pages. About one-half of these papers were issued in the Bureau's own publication series; the other half in non-NBS journals, books, and proceedings.

The citations for all NBS papers, whatever the publication medium, include the full title, author(s), place of publication, abstract, and key words. Permuted author and key word indexes facilitate use of this catalog as a reference source. In addition, all NBS publications are categorized by major primary subject area for convenient browsing by specialists.

Included is information on previous NBS catalogs, availability information for NBS papers published in past years, and Tables of Contents for the twelve 1975 issues of the Bureau's monthly newsmagazine, DIMENSIONS/NBS.

NBS papers published by the Government Printing Office are sold by the Superintendent of Documents and also, in microfilm form, by the National Technical Information Service. The complete citations for these publications are organized in this catalog by the respective NBS publications series. NBS-authored papers published in non-NBS media are cited separately in numerical sequence. For completeness, papers published but not reported in previous years have been included in this supplement.

Included also among the NBS publications series are citations for the papers which have appeared in the *Journal of Physical and Chemical Reference Data*, published for NBS by the American Institute of Physics and the American Chemical Society.

This 1975 catalog was produced utilizing computer-assisted photocomposition techniques, as were past supplements to NBS Special Publication 305.

W. R. Tilley, *Chief*
Office of Technical Publications

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1. NBS PUBLICATION PROGRAM

1.1. INTRODUCTION

The formal publication of the National Bureau of Standards—some 1948 papers in 1975—provide the primary means of communicating the results of NBS programs to its varied technical audiences, as well as to the general public. Publications thus constitute a major end product of the Bureau's efforts. These take the form of the Bureau's three periodicals, its ten nonperiodical series, interagency reports, and articles in the journals of professional organizations and technological associations.

This annual catalog, Publications of the National Bureau of Standards, cites the 1975 output of papers that document the results of the Bureau's current programs. The various media in which these papers appeared are as follows:

1.2. PERIODICALS

1.2.1. JOURNAL OF RESEARCH

JOURNAL OF RESEARCH reports National Bureau of Standards research and development in physics, mathematics, and chemistry. It is published in two sections, available separately:

- **Physics and Chemistry** (Section A)

Papers of interest primarily to scientists working in these fields. This section covers a broad range of physical and chemical research, with major emphasis on standards of physical measurement, fundamental constants, and properties of matter. Issued six times a year.

Editor: C. W. Beckett
Associate Editor: D. D. Wagman

- **Mathematical Sciences** (Section B)

Studies and compilations designed mainly for the mathematician and theoretical physicist. Topics in mathematical statistics, theory of experiment design, numerical analysis, theoretical physics and chemistry, logical design and programming of computers and computer systems. Short numerical tables. Issued quarterly.

Editor: M. Newman
Associate Editor: F. W. Olver

1.2.2. DIMENSIONS/NBS

This monthly magazine is published to inform scientists, engineers, businessmen, industry, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on the work at NBS. The magazine highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, it reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing.

The table of contents for each issue in 1975 are listed in Section 3.3, pages 37–39. Issued monthly.

Managing Editor: S. A. Washburn

1.2.3. JOURNAL OF PHYSICAL AND CHEMICAL REFERENCE DATA (JPCRD)

This Journal is published quarterly by the American Chemical Society and the American Institute of Physics for the National Bureau of Standards. The objective of the Journal is to provide critically evaluated physical and chemical property data, fully documented as to the original sources and the criteria used for evaluation. Critical reviews of measurement techniques, whose aim is to assess the accuracy of available data in a given technical area, are also included. The principal source for the Journal is the National Standard Reference Data System (NSRDS). The Journal is not intended as a publication outlet for original experimental measurements such as are normally reported in the primary research literature, nor for review articles of a descriptive or primarily theoretical nature. (See also Section 1.3, National Standard Reference Data Series.)

1.3. NONPERIODICALS

Ten categories of nonperiodical publications, described as follows, are listed in this catalog:

MONOGRAPHS—major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

HANDBOOKS—recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

SPECIAL PUBLICATIONS—include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

APPLIED MATHEMATICS SERIES—mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

NATIONAL STANDARD REFERENCE DATA SERIES—provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS. Program under authority of National Standard Data Act (Public Law 90–396). See also Section 1.2.3.

BUILDING SCIENCE SERIES—disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

TECHNICAL NOTES—studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other government agencies.

VOLUNTARY PRODUCT STANDARDS—developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The purpose of the standards is to establish nationally recognized requirements for products, and to provide all concerned interests with a basis for common understanding of the characteristics of the products. The National Bureau of Standards administers the Voluntary Product Standards program as a supplement to the activities of the private sector standardizing organizations.

FEDERAL INFORMATION PROCESSING STANDARDS PUBLICATIONS (FIPS PUBS)—publications in this series collectively constitute the Federal Information Processing Standards Register. Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89–306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

CONSUMER INFORMATION SERIES—practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

1.4. NBS INTERAGENCY REPORTS

A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution is by the National Technical Information Service (Springfield, VA. 22161) in paper copy or microfiche form. (See pages 21 to 25 for price lists.)

1.5. NBS BIBLIOGRAPHIC SUBSCRIPTION SERVICES

The Cryogenic Data Center and the Electromagnetics Division of the National Bureau of Standards, Boulder, CO. have developed specialized bibliographic issuances designed to provide interested audiences with information on latest developments in certain specialized fields. These issuances, together with subscription information, are listed below:

CRYOGENIC DATA CENTER CURRENT AWARENESS SERVICE (Publications and Reports of Interest in Cryogenics). A literature survey issued weekly. Annual subscription: Domestic, \$20.00; Foreign, \$25.00.

LIQUEFIED NATURAL GAS. A literature survey issued quarterly. Annual subscription: $20.00.

SUPERCONDUCTING DEVICES AND MATERIALS. A literature survey issued quarterly. Annual subscription: $20.00.

Send subscription orders and remittances for the preceding bibliographic services to the National Bureau of Standards, Cryogenic Data Center (275.02), Boulder, CO. 80302.

ELECTROMAGNETIC METROLOGY CURRENT AWARENESS SERVICE (Selected electro-optic subjects). Issued monthly. Annual subscription: $24.00.

Send subscription order and remittance made payable to the Dept. Comm./NBS to the Electromagnetic Metrology Information Center, Electromagnetics Division, National Bureau of Standards, Boulder, CO. 80302.

1.6. PAPERS PUBLISHED BY OTHERS

Many significant contributions by NBS authors are published in other journals. Up-to-date listings of these articles are carried regularly in each section of the Journal of Research, along with selected abstracts. A complete listing is published annually in NBS SP305, along with abstracts, key words, and author/subject indexes.

2. PURCHASE PROCEDURES AND DOCUMENT AVAILABILITY

2.1. PURCHASE PROCEDURES

The publications of the Bureau are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, at the prices listed in this publication. However, prices are subject to change without notice. You may also order through the U.S. Department of Commerce Field Office nearest you (see Appendix C for list of Field Offices of the U.S. Department of Commerce). Microfiche copies of all recent NBS publications, and paper copies and many non-periodicals, may be ordered through the National Technical Information Service, U.S. Department of Commerce, Springfield, VA. 22161.

This section includes prices lists of available publications, plus instruction on how to acquire reprints of articles by NBS authors, and how to get out-of-print material.

How To Make Remittances. Remittances for publications for which individual sales or subscription prices are shown should be mailed to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, by coupon, postal money order, express money order, or check. Postage stamps will not be accepted. Publications cannot be mailed before remittances are received. *Foreign remittances should be made either by international money order or draft on an American bank.*

The letter symbol, publication number, full title of the publication, SD catalog number, and SD stock number MUST be given when ordering. The Superintendent of Documents allows a discount of 25 percent on orders of 100 or more copies of one publication.

For the convenience of the general public, coupons in the denomination of five cents may be purchased from the Superintendent of Documents. These may be exchanged for Government publications sold by the Superintendent's office. Address order to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

Persons who make frequent purchases from the Superintendent of Documents may find a deposit account convenient. Deposits of $25 or more are accepted against which orders may be placed without making individual remittances or first obtaining quotations. Order blanks are furnished for this purpose. After the order has been processed, the order itself is returned, showing the publications supplied, explanations regarding those not sent, the amount of charge, and the balance on deposit.

No charge is made for postage on documents sent to points in the United States and its possessions. In computing foreign postage, add one-fourth of the price of the publication to cover the cost of shipping and handling charges.

Orders for publications purchased from the National Technical Information Service (NTIS) must be accompanied by postal money order, express money order, or check made out to the NTIS and covering total cost of the publications order. Information concerning NTIS coupons can be obtained directly from NTIS. All inquiries or orders should be addressed to: National Technical Information Service, Springfield, VA. 22161.

SD and NTIS order forms are included at the end of this publication for your convenience in ordering.

2.2. ANNOUNCEMENTS OF NBS PUBLICATIONS

The National Bureau of Standards and the agencies mentioned below regularly issue the following official announcements dealing with NBS publications.

DIMENSIONS/NBS. Issued monthly by the National Bureau of Standards. In addition to publishing technical news of the Bureau, this periodical announces selected new publications in an NBS series. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription, $9.45; $11.85 foreign. Single copies, 65 cents each.

NBS JOURNAL OF RESEARCH. Both Sections A and B carry a listing of all NBS publications as issued. See 2.6 for subscription information.

Monthly Catalog of United States Government Publications. Issued monthly by the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription, with consolidated annual index, $27.00; $33.75 foreign.

Selected List of U.S. Government Publications. Issued monthly by the Superintendent of Documents. Each list is arranged by subject, with annotations, prices, and order form. May be obtained free from the Superintendent of Documents, Attn: Selected List, P.O. Box 1821, Washington, D.C. 20013.

Business Service Check List. Weekly announcement of publications of the Department of Commerce. Lists titles and prices of National Bureau of Standards Publications, as well as those of other offices of the Department of Commerce. Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402. Annual subscription, $9.70; $12.15 foreign.

2.3. CATALOGS OF NBS PUBLICATIONS

Previous catalogs, plus this publication, constitute a complete list of the titles of the Bureau's publications through December 31, 1975. The catalogs are available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402, or may be consulted in a library which maintains sets of National Bureau of Standards publications.

Circular 460: Publications of the National Bureau of Standards 1901 to June 30, 1947. 375 pages, including subject and author indexes. Brief abstracts are included for the period January 1, 1941 to June 30, 1947 .... $1.25

Supplement to Circular 460: Publications of the National Bureau of Standards, July 1, 1947 to June 30, 1957. 373 pages, including subject and author indexes $1.50

Miscellaneous Publication 240: Publications of the National Bureau of Standards, July 1, 1957 to June 30, 1960. First NBS Catalog to include Titles of Papers Published in Outside Journals 1950 to 1959. 391 pages, including subject and author indexes $3.50

Supplement to Miscellaneous Publication 240: Publications of the National Bureau of Standards published by NBS, July 1960 through June 1966; published by others, 1960 through 1965. 740 pages, including subject and author indexes $4.00

Special Publication 305: Publications of the National Bureau of Standards, published by NBS. July 1966 through December 1967; published by others, 1966–1967. 223 pages, a citation of titles and abstracts, with key words and author indexes $2.00

Supplement 1 to Special Publication 305: Publications of the National Bureau of Standards, 1968 through 1969. 497 pages, a citation of titles and abstracts, with key words and author indexes... $5.55

Supplement 2 to Special Publication 305: Publications of the National Bureau of Standards, 1970. 378 pages, a citation of titles and abstracts, with key words and author indexes $4.30

Supplement 3 to Special Publication 305: Publications of the National Bureau of Standards, 1971. 342 pages, a citation of titles and abstracts, with key words and author indexes $3.95

Supplement 4 to Special Publication 305: Publications of the National Bureau of Standards, 1972. 449 pages, a citation of titles and abstracts, with key words and author indexes $4.20

Supplement 5 to Special Publication 305: Publications of the National Bureau of Standards, 1973. 349 pages, a citation of titles and abstracts, with key words and author indexes $4.15

Supplement 6 to Special Publication 305: Publications of the National Bureau of Standards, 1974. 523 pages, a citation of titles and abstracts, with key words and author indexes $6.80

Supplement 7 to Special Publication 305: Publications of the National Bureau of Standards, 1975, 595 pages, a citation of titles and abstracts, with key words and author indexes $7.55

2.4. FUNCTIONS OF DEPOSITORY LIBRARIES IN THE UNITED STATES

The Superintendent of Documents, United States Government Printing Office, is authorized by law to furnish Government publications to designated depository libraries.

Under provisions of Title 44 of the United States Code, certain libraries are designated depositories for Government publications. Through them Federal Government documents are made available to residents of every State, District of Columbia, Guam, Puerto Rico, and the Virgin Islands. Distribution to the libraries is made by the Office of the Superintendent of Documents.

It is sometimes impossible to obtain desired publications by purchase from the Superintendent of Documents. Stocks may have been exhausted or the document may be permanently out of print. In these instances the depositories render an invaluable service by keeping such publications permanently available. Every Government publication cannot be consulted at all depository libraries. Designated Regional Depositories are required to receive and retain one copy of all Government publications made available to depository libraries either in printed or microfacsimile form. All other libraries are allowed to select the classes of publications best suited to the interest of their particular clientele.

The libraries listed in Appendix A are now receiving selected publication series of the National Bureau of Standards for general reference use. Whether a given library has a copy of a particular publication can be determined by inquiring at the library.

2.5. FUNCTIONS OF U.S. DEPARTMENT OF COMMERCE DISTRICT OFFICES

Department of Commerce District Offices are maintained in the cities listed in Appendix B. Their purpose is to provide ready access, at the local level, to the services of the Department of Commerce as well as to its reports, publications, statistical statements, and surveys. Each District Office serves as an official sales agent of the Superintendent of Documents, U.S. Government Printing Office, making available for purchase locally a wide range of Government publications. The reference library maintained by each District Office contains many Government and private publications, periodicals, directories, reports, and other reference materials.

2.6. AVAILABILITY OF NBS PUBLICATIONS

A. PERIODICAL SUBSCRIPTION RATES

Periodical	Domestic [1]	Foreign [2]
Journal of Research of the National Bureau of Standards:		
Section A. Physics and Chemistry, issued six times a year, paper covers	$17.00	$21.25
Bound volume (1 volume per year), blue buckram	([3])	([3])
Section B. Mathematical Sciences, issued quarterly, paper covers	9.00	11.25
Bound volume (1 volume per year), green buckram	([3])	([3])
DIMENSIONS/NBS, 12 monthly issues	9.45	11.85

NOTE.—Send order, with remittance, to Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

[1] United States and its possessions, Canada, Mexico, Newfoundland (including Labrador), and certain Central and South American countries.

[2] Foreign price includes the cost of the publication and postage.

[3] Prices of the bound volumes vary. The Superintendent of Documents will furnish prices on request.

B. PRICE LISTS FOR NONPERIODICALS

The following lists give the numbers and prices of all NBS publications issued from 1901 through 1975 which are still in print. Those items in **boldface** denote the 1975 publications cited in this supplement. The prices shown herein supersede prices quoted in previous catalogs of NBS publications. The prices shown are those in effect as of the date this publication went to press. Prices are subject to change without notice, and the prices that will be charged on your order will be those in effect as of the date your order is processed. Publications may be ordered from the Superintendent of Documents, U.S. Government Printing Office or from the U.S. Department of Commerce District Office nearest you. SD order forms are included at the end of this publication. Some NBS publications may be purchased from the National Technical Information Service. (See Section 2.1.)

Publications not listed are out of print. In such cases, your nearest depository library may still have a copy of that item. (See Section 2.4 and Appendix A.)

PRICE LISTS
NBS PUBLICATIONS
CIRCULARS

No.	Price
3 see C547, Sec. 1, in part	OP
see Mono. 90	OP
9 see C602	OP
10 see C425	OP
12 see C440	OP
16 see C555	OP
17 see Mono. 47 (COM71-00691)	**
25 see SP260	1.50
29 see C60	OP
31 see H100	**
32 see C405	OP
35 see M183	OP
40 see C381	OP
44 see C440	OP
47 see M286	3.15
49 see H8	OP
51 see C432	OP
52 see C387	OP
54 see H3 & H4	OP
57 see C410	*
61 see H44, 4th Ed	5.40
62 see C424	OP
65 see C417	OP
75 see C397	OP
76 see C346	OP
82 see C361	OP
83 see C333	OP
95 see C426	OP
100 see C592	OP
101 see C447	OP
131 see C385	OP
138 see C385	OP
139 see C390	OP
154 see H71	*
239 see C363	OP
257 see C365	OP
280 see C406	OP
294 see C407	OP
300 see C418	OP
319 see C378	OP
322 see C360	OP
328 see Mono. 15	OP
330 see C362	OP
332 see Mono. 15	OP

No.	Price
339 see C363	OP
371 see C378	OP
375 see C457	OP
380 see C418	OP
383 see C424	OP
390 see H71	*
392 see C432	OP
396 see C418	OP
398 see SP260	1.50
399 see C406	OP
400 see C426	OP
402	.25
410	*
413 see C426	OP
414 see H71	*
415 see Mono. 47	**
428 see SP374	5.20
434 see C602	OP
435 see H71	*
438	*
454 (PB192338)	**
450 see C579	*
456 see Mono. 47	**
460	1.25
460 Supplement	1.50
462 see Mono. 80 in part	OP
464	*
465 see H90 (PB188654)	**
466 see H71	*
467 Vol. I see NSRDS 35 Vol. I	9.25
467 Vol. II see NSRDS 35 Vol. II	7.95
467 Vol. III see NSRDS 35 Vol. III	8.30
470 (COM75-10206)	**
474 see C576	*
477 see C555	OP
478 see Mono. 104	.90
482 see C509	OP
485 see Mono. 106	OP
488 Sec. 1 & 2	**
488 Sec. 3, 4, & 5	**
495 see Mono. 88	1.05

No.	Price
499	*
500 see TN270-3; 4; 5; and 6	
506 see C576	*
508 see C561	OP
510 (PB192339)	**
510 Suppl. 1 (PB192340)	**
510 Suppl. 2 (PB192341)	**
518 see Mono. 70 Vol. I in part (PB168072)	**
533 see SP374	5.20
536	.55
537 see NSRDS-NBS 10	**
539 Vol. 1 to 10 are now PB178902 to PB178911	**
542 (PB188806)	**
552 see SP260	1.50
553 (COM73-11112)	**
556 (PB172004)	**
559 see H71	*
561 see Mono. 125	4.55
563 & 563 Suppl. 1, see M274	OP
564	*
567 see M271	OP
571 (PB175659)	**
572 see Mono. 15	OP
576	*
577 & 577 Suppl	*
579 (PB168350)	*
580 see M251	OP
582 (COM75-10277)	*
583 & Suppl. see NSRDS-29	1.25
592 see Mono. 106	OP
593 (COM75-10234)	**
589 (PB188296)	**
596 (PB172059)	**
600 see Mono. 90	OP
602 (COM73-10504)	**

*See page 27 for additional information.

**Available from the National Technical Information Service; use "PB", "COM", or NBS publication identification if no specific NTIS number is assigned.

MONOGRAPHS

No.	Price
2 (PB187752)	*
3 Vol. I (COM71-01000-1)	*
3 Vol. II (COM71-01000-2)	*
4 (PB174987)	*
7	*
8 (PB186237)	*
10 (COM75-10235)	*
13 (PB172156)	*
17 Being revised	
18 see Mono. 88	1.05
20 (PB195221)	*
23 (PB183992)	*
25 Sec. 1 (PB178429)	*
25 Sec. 2 (PB178430)	*
25 Sec. 3(PB178431)	*
25 Sec. 4	*
25 Sec. 5	*
25 Sec. 6	*
25 Sec. 7	*
25 Sec. 8 (PB194872)	*
25 Sec. 9 (COM72-50002)	*
25 Sec. 10 (COM72-51079)	*
25 Sec. 11	1.55
25 Sec. 12	**1.50**
27 and Supplements. see SP373	2.00
28 see BSS17	*
30 (PB193908)	*
31 (COM75-10045)	*
32 Pt. I & II (See Mono. 145, Pts. I & II).	
32 Suppl. to Pts. I & II (See Monogr. 145, Pts. I & II).	
34 Vol. 1 (COM71-00631)	*
34 Vol. 2	*
36 (COM75-10175)	*
39 (COM74-10933)	*
40 (COM71-00693)	*
41 (PB191728)	*
42 (COM72-10377)	*
43 Vol. I (COM73-10636)	*
43 Vol. II (COM73-10637)	*
44 see BSS50	.55
45 (PB186433)	*
46 (PB17690)	*
47 (COM71-00691)	*
47 (COM71-00691)	*
48 (PB246865)	*
50 see SP320 (AD701614)	*
52 (COM73-10500)	*
56 (COM75-10244)	*
57 see M274	OP
58 (PB193909)	*
60 (COM75-10053)	*
63 (COM74-10737)	*
66 (COM75-10245)	*
67 (PB186426)	*
68 (COM71-00692)	*
70 Vol. I (PB168072)	*
70 Vol. II (PB189714)	*
70 Vol. III (COM74-10794)	*
70 Vol. IV (COM74-10795)	*
70 Vol. V (COM74-10796)	*
72 (PB186427)	*
73 (PB186432)	*
74 (PB195213)	*
75	*
76 (COM73-10502)	*
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H81 amends in part: Part 2, Definitions and the Grounding Rules of these Handbooks.

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73-344 (COM74-10749)	4.00	73-421 (COM74-11224)	4.00
73-345 (COM74-10239)	4.50	73-422 (COM74-11240)	4.50
73-346 (COM74-10240)	4.00	73-423 (COM74-11722)	6.75
73-347 (COM74-10674)	4.50	73-424 (COM74-10867)	3.50
73-348 (COM74-10241)	4.00	74-426 (COM74-11074)	5.50
73-349 (COM74-11374)	4.50	74-430 (COM74-10724)	5.50
73-351 (COM74-10784)	4.50	74-432 (COM74-10751)	4.50
74-355 (N74-30195)	**4.50**	74-434 (COM74-11079)	3.50
74-357 (COM74-10551)	4.50	74-438 (COM74-10980)	4.00
74-359 (AD780596)	13.50	74-439 (COM74-10985)	3.50
74-361 (COM74-11222)	4.50	74-442 (AD787743)	4.00
74-363 (COM74-11053)	6.00	74-443 (COM74-11003)	3.50
74-364 (COM74-11208)	5.00	74-444 (COM74-10548)	4.00
74-365 (COM74-11375)	4.00	**74-449 (COM75-10049)**	**4.00**
74-366 (COM74-11076)	5.00	74-451 (COM74-11385)	3.50
74-369 (COM74-11688)	4.00	74-454 (COM74-10988)	3.50
74-371 (COM74-11567)	4.50	74-455 (COM74-10865)	4.00
74-372 (ADA006037)	**5.00**	74-456 (COM74-11793)	3.50
74-374 (N75-22407)	5.50	74-457 (COM74-11792)	5.00
74-375 (COM74-11657)	4.50	74-458 (AD776337)	3.50
74-377 (COM74-11449)	4.00	**74-461 (PB246623)**	**4.00**
74-378 (COM74-11450)	4.50	74-464 (COM74-10785)	5.00
74-379 (PB247658)	**4.00**	74-465 (COM75-10417)	4.50
74-380 (COM74-11686)	5.50	74-466 (COM74-10700)	12.50
74-381 (COM75-10522)	**4.50**	74-467 (COM74-11754)	4.50
74-382 (AD783433)	7.75	74-469 (PB234348)	4.50
74-387 (COM74-11643)	4.00	74-470 (PB232629)	5.00
74-388 (COM74-11687)	6.00	74-471 (COM74-10981)	3.50
74-389 (COM74-11717)	6.75	74-473 (COM74-11719)	4.50
74-390 (COM74-11718)	5.50	74-474 (AD778340)	4.00
74-391 (COM74-10258)	**4.00**	74-477 (COM74-11784)	4.00
74-393 (COM75-10768)	**9.25**	74-479 (PB239420)	6.00
74-394 (COM75-10126)	**4.00**	74-481 (COM74-11794)	4.50
74-395 (COM75-10161)	**4.00**	74-482 (**COM75-10147**)	**7.75**
74-396 (COM74-11766)	4.00	74-485 (AD780704)	3.50
74-398 (COM75-10130)	**10.00**	74-486 (AD780705)	4.50
73-402 (COM74-10472)	6.00	74-487 (COM74-10886)	13.00
73-403 (COM74-10016)	6.00	74-488 (**COM75-10088**)	**5.50**
73-404 (PB230952)	4.00	74-493 (PB243545)	3.50
73-405 (COM74-10131)	3.50	74-495 (COM74-11575)	5.00

No.	Price	No.	Price
74–496 (COM74–11576)	5.00	74–580 (PB248465)	3.50
74–497 (COM74–11269)	3.50	74–581 (COM75–10127)	4.00
74–499 (COM74–11378)	4.00	74–582 (COM74–11645)	4.00
74–501 (COM75–10131)	3.50	74–583 (AD/A003900)	5.00
74–506 (COM74–11632)	5.00	74–586 (COM75–10525)	3.50
74–507 (AD/A000343)	4.00	74–588 (COM75–10040)	4.00
74–509 (COM74–11377)	3.50	74–590 (COM75–11434)	3.50
74–510 (AD782793)	4.00	74–594 (PB243546)	3.50
74–511 (COM74–11448)	3.50	74–591 (COM75–10101)	3.50
74–514 (COM75–10102)	4.50	74–595 (COM75–10057)	3.50
74–515 (COM74–11498)	7.50	74–596 (COM75–10209)	4.00
74–516 (COM74–11384)	4.50	74–597 (COM75–11069)	4.00
74–518 (PB239633)	5.00	74–600 (AD/A008935)	7.50
74–520 (COM74–11480)	6.00	74–602 (COM75–10048)	4.00
74–519 (PB238284)	4.00	74–605 (COM75–10464)	4.00
74–521 (COM75–10187)	4.50	74–606 (COM75–10340)	5.00
74–522 (COM75–10080)	3.50	74–608 (COM75–10056)	3.50
74–523 (COM75–11126)	3.50	74–610 (COM75–10072)	4.00
74–524 (COM74–11568)	4.00	74–612 (COM75–10414)	3.50
74–525 (AD782564)	3.50	74–613 (COM75–10059)	4.00
74–526 (COM75–10087)	4.50	74–614 (COM75–11013)	4.00
74–527 (COM74–11720)	4.50	74–618 (COM75–11014)	3.50
74–529 (COM74–11495)	4.50	74–619 (COM75–10047)	3.50
74–530 (COM75–10041)	4.00	74–620 (PB246622)	3.50
74–533 (PB238573)	5.50	74–621 (COM75–10422)	4.00
74–535 (COM74–11659)	5.00	74–623 (COM75–10210)	5.00
74–537 (COM74–11577)	3.50	74–624 (COM75–10412)	4.00
74–539 (COM74–11574)	5.00	74–625 (PB243547)	4.00
74–541 (COM75–10618)	4.00	74–626 (COM75–10411)	3.50
74–542 (COM75–10081)	4.00	74–627 (COM75–10134)	3.50
74–543 (COM74–11772)	6.00	74–628 (COM75–10514)	3.50
74–544 (COM74–11525)	4.00	74–629 (COM75–11281)	4.00
74–545 (COM74–11656)	4.50	74–631 (COM75–10208)	3.50
74–550 (COM74–11721)	5.00	74–632 (PB246554)	5.00
74–551 (COM74–11658)	5.50	74–633 (COM75–10691)	4.50
74–552 (COM74–11644)	5.00	74–634 (COM75–10685)	4.00
74–553 (COM75–10058)	4.50	74–635 (COM75–10276)	4.50
74–554 (COM74–10703)	3.50	75–637 (COM75–10055)	3.50
74–555 (COM74–10704)	4.00	75–638 (AD/A011485)	4.50
74–556 (COM74–10703)	5.00	75–639 (AD/A005410)	3.50
74–557 (COM75–11439)	4.00	75–641 (COM75–11209)	5.00
74–561 (COM75–10413)	4.00	75–647 (COM75–10418)	4.00
74–564 (COM74–11726)	4.50	75–649 (PB241237)	3.50
74–567 (COM74–11631)	9.25	75–651 (COM75–11211)	5.00
74–568 (COM74–11578)	4.50	75–652 (COM75–11399)	5.00
74–569 (AD/A002289)	4.00	75–653 (PB248097)	4.00
74–572 (COM74–11791)	4.50	75–654 (COM75–10367)	3.50
74–577–1 (COM74–11723)	7.50	75–658 (AD/A007445)	4.00
74–577–2 (COM74–11724)	9.75	75–659 (AD/A008538)	4.00
74–578 (COM74–11765)	3.50	75–660 (COM75–10609)	4.00

No.	Price	No.	Price
75-661 (COM75-10763)	4.00	75-738 (COM75-11279)	4.00
75-662 (COM75-10420)	3.50	75-739 (COM75-11189)	3.50
75-664 (AD/A007447)	4.00	75-740 (COM75-11127)	4.00
75-665 (COM75-10421)	4.00	75-741 (COM75-11136)	4.00
75-666 (COM75-11381)	4.00	75-744 (COM75-11072)	3.50
75-667 (PB241267)	4.00	75-745 (PB347657)	4.00
75-672 (COM75-10338)	4.00	75-746 (COM75-11432)	4.50
75-673 (COM75-10921)	4.00	75-747 (COM75-11131)	4.00
75-675 (COM75-10686)	3.50	75-748 (COM75-11031)	5.00
75-676 (COM75-10697)	5.00	75-752 (PB245013)	5.00
75-677 (COM75-10516)	4.50	75-754 (N75-31909)	5.00
75-679 (COM75-10419)	4.00	75-760 (AD/A016843)	7.75
75-680 (COM75-10423)	5.50	75-761 (COM75-11377)	5.50
75-682 (COM75-10524)	3.50	75-763 (COM75-11276)	7.75
75-685 (COM75-10690)	5.00	75-766 (COM75-11376)	4.50
75-687 (COM75-11137)	6.00	75-767 (PB246879)	4.00
75-688 (COM75-11222)	5.50	75-769 (PB246978)	8.00
75-689 (COM75-11190)	4.50	75-770 (COM75-11370)	4.00
75-690 (COM75-11207)	5.00	75-772 (PB246861)	4.50
75-691 (COM75-11015)	5.00	75-774 (COM75-11364)	4.50
75-693 (COM75-11194)	3.50	75-778 (PB246435)	4.50
75-696 (COM75-10527)	5.00	75-781 (AD/A015630)	3.50
75-697 (COM75-10920)	4.50	75-784 (PB246862)	4.50
75-699 (COM75-11016)	4.00	75-785 (PB246345)	3.50
75-700 (COM75-11280)	4.50	75-787 (AD/A016844)	4.50
75-701 (COM75-11282)	3.50	75-793 (PB247538)	4.50
75-702 (COM75-11433)	4.00	75-794 (PB247203)	4.00
75-703 (COM75-11278)	4.00	75-795 (PB246866)	4.50
75-705 (COM75-11277)	4.00	75-796 (PB247656)	3.50
75-707 (COM75-11017)	4.00	75-797 (COM75-11465)	3.50
75-708 (COM75-10817)	3.50	75-804 (COM75-10395)	4.00
75-710 (COM75-11030)	3.50	75-806 (COM75-10368)	4.50
75-711 (COM75-10689)	4.50	75-807 (COM75-10396)	5.00
75-712 (COM75-11070)	4.00	75-809 (COM75-10989)	4.50
75-713 (COM75-11134)	4.50	75-810 (COM75-10919)	5.50
75-715 (COM75-11208)	3.25	75-812 (AD/A012889)	4.00
75-716 (COM75-11210)	6.25	75-814 (COM75-11132)	4.50
75-718 (COM75-10750)	3.25	75-816 (AD/A001250)	4.50
75-721 (PB246864)	4.00	75-818 (PB246439)	4.00
75-723 (COM75-10753)	4.75	75-820 (PB246436)	4.50
75-728 (AD/A014830)	4.00	75-822 (PB246933)	4.00
75-729 (PB246858)	4.00	75-823 (PB246658)	5.00
75-730 (AD/A018451)	3.75	75-901 (PB246860)	4.00
75-731 (COM75-11071)	3.75	75-903 (PB246859)	4.00
75-732 (COM75-11022)	3.25	75-908 (PB247270)	3.50
75-733 (COM75-11139)	3.25	75-909 (PB246863)	3.50
75-734 (COM75-11212)	4.25	75-917 (PB247655)	3.50
75-736 (COM75-11018)	3.50	75-956 (PB247654)	3.50
75-737 (COM75-11472)	4.00	75-962 (PB247639)	3.50

C. SUPERSEDED NBS REFERENCE PUBLICATIONS

Those NBS publications not listed in the Price Lists are out of print and are not available from the Superintendent of Documents. Many can be consulted at libraries. Also, in many cases, photoduplicated copies can be purchased from the Library of Congress. For full information concerning this service, write to the Photoduplication Service, Library of Congress, Washington, DC 20540.

Certain NBS publications are out of print because they have been replaced, or partially replaced, by material issued by other organizations. In this connection NBS is able to offer the following information:

Circular 410, National Standard Petroleum Oil Tables. Information in this Circular has been incorporated in the ASTM-IP Petroleum Measurement Tables issued by the American Society for Testing and Materials, 1916 Race Street, Philadelphia PA 19103. Available at $12.75, 20% off to ASTM members. Tables 5 and 7 of the ASTM-IP Tables may also be purchased from the ASTM in separate reprint form at $1.75 and $1.50 per copy respectively.

Circular 438, Static Electricity. The National Fire Protection Association, 60 Batterymarch Street, Boston, MA 02110, has issued a publication by the same title, available from them as NFPA Publication 77, at $2.00.

Circular 499, Nuclear Data. Replaced by Atomic and Nuclear Data Tables, published by Academic Press, 111 Fifth Avenue, New York, NY 10003. Available by subscription for $69.00 per year.

Circular 564, Tables of Thermal Properties of Gases. A reprinted edition is available from University, Microfilms, Inc., Ann Arbor, MI. 48106. Order as OP 12,192 for $25.00. Microfiche of this Circular is available from Cryogenic Data Center, National Bureau of Standards, Boulder, CO 80302 for $4.50

Circular 576, Automotive Antifreezes. For information on this subject consult American National Standards Institute, 1430 Broadway, New York, NY 10018.

Circular 577 and Supplement, Energy Loss and Range of Electrons and Positrons. These have been superseded by NASA Special Publication 3012, available from the National Technical Information Service, Springfield, VA 22161, at $5.75 hardcopy and $2.25 microfiche number N65-12506.

Miscellaneous Publication 179, American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures. The American National Standards Institute, 1430 Broadway, New York, NY 10018, has issued a publication on this subject. Available from them as A58.1-1969, at $7.50.

Miscellaneous Publication 187, Directory of Commercial and College Laboratories. A new Directory of Testing Laboratories is published by the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103, at $3.75.

Miscellaneous Publication 211, American Standards Building Code Requirements for Masonry. The American National Standards Institute, 1430 Broadway, New York, NY 10018, has issued a publication on this subject. Available from them as A41.1-1953-R1970, at $4.50.

Handbook 30, National Electrical Safety Code (also H81 and its Supplements and H110-1). The American National Standards Institute, 1430 Broadway, New York, NY 10018, has issued a publication on this subject. Available from them as ANS C2, at $6.40.

Handbook 46, Code for Protection Against Lightning. A United States of America Standards Institute Code for Protection Against Lightning (NFPA-78-1969) is available from the American National Standards Institute, 1430 Broadway, New York, NY 10018, at $3.00, as C5.1-1969.

Handbook 48, Control and Removal of Radioactive Contamination in Laboratories. Reprints of this Handbook can be purchased as NCRP Report 8 at $2.00 from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 49, Recommendations for Waste Disposal of Phosphorus-32 and Iodine-131 for Medical Users. Reprints of this Handbook can be purchased as NCRP Report 9 at $2.00 from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 58, Radioactive Waste Disposal in the Ocean. Reprints of this Handbook can be purchased as NCRP Report 16 at $2.00 from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 59, Permissible Dose from External Sources of Ionizing Radiations. Reprints of this Handbook can be purchased as NCRP Report 39 at $4.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 63, Protection Against Neutron Radiation up to 30 MeV. Reprints of this Handbook can be purchased as NCRP Report 38 at $5.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 65, Safe Handling of Bodies Containing Radioactive Isotopes. Reprints of this Handbook can be purchased as NCRP Report 37 at $4.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 69, Maximum Permissible Body Burdens and Maximum Permissible Concentrations of Radionuclides in Air and in Water for Occupational Exposure. Reprints of this Handbook can be purchased at $3.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 71, Specifications for Dry Cells and Batteries. Available as C18.1–1972 from the American National Standards Institute, 1430 Broadway, New York, NY 10018, at $6.25.

Handbook 73, Protection Against Radiations from Sealed Gamma Sources (Supersedes H54). Reprints of this Handbook can be purchased as NCRP Report 40 at $4.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 74, Building Code Requirements for Reinforced Masonry. The American National Standards Institute, 1430 Broadway, New York, NY 10018 has issued a publication on this subject. Available from them as A41.2–1960 (R1970), at $3.25.

Handbook 75, Measurement of Absorbed Dose of Neutrons and of Mixtures of Neutrons and Gamma Rays. Reprints of this Handbook can be purchased as NCRP Report 25 at $2.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 76, Medical X-ray Protection Up to Three Million Volts. Now NCRP 33 and 34 respectively. Purchase from NCRP Publications, Post Office Box 30175, Washington, DC 20014, at $3.00 and $4.00 respectively.

Handbook 80, A Manual of Radioactivity Procedures. Reprints of this Handbook can be purchased as NCRP Report 28 at $3.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 81 and its Supplements, Safety Rules for the Installation and Maintenance of Electric Supply and Communication Lines (also H30 and H110–1). The American National Standards Institute, 1430 Broadway, New York, NY 10018 has issued a publication on this subject. Available from them as ANS C2, at $6.40.

Handbook 84, Radiation Quantities and Units. Reprints of this Handbook can be purchased as Report 19 at $2.50 per copy from ICRU Publications, Post Office Box 30165, Washington, DC 20014.

Handbook 89, Methods of Evaluating Radiological Equipment and Materials. Reprints of this Handbook can be purchased as ICRU Report 10F at $2.50 per copy from ICRU Publications, Post Office Box 30165, Washington, DC 20014.

Handbook 96, Inspection of Processed Photographic Record Films for Aging Blemishes. Reprints of this Handbook can be purchased as PH 1.28–1973 at $4.00 per copy from The American National Standards Institute, 1430 Broadway, New York, NY 10018.

Handbook 97, Shielding for High-Energy Electron Accelerator Installations. Reprints of this Handbook can be purchased as NCRP Report 31 at $2.00 per copy from NCRP Publications, Post Office Box 30175, Washington, DC 20014.

Handbook 102, ASTM Metric Practice Guide. Available as Z 210.1–1973 from the American National Standards Institute, 1430 Broadway, New York, NY 10018 at $1.75.

Handbook 110–1, National Electrical Safety Code. Part 1. Rules for Installation and Maintenance of Electric Supply and Communication Lines (also H30 and H81 and its Supplements). The American National Standards Institute, 1430 Broadway, New York, NY 10018 has issued a publication on this subject. Available from them as ANS C2, at $6.40.

3. TITLES AND ABSTRACTS OF NBS PUBLICATIONS, 1975[1]

3.1. PAPERS FROM THE JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, SECTION A. PHYSICS AND CHEMISTRY, VOLUME 79A, JANUARY-DECEMBER 1975

January-February 1975

Polarization effects on fluorescence measurements, E. D. Cehelnik, K. D. Mielenz, and R. A. Velapoldi, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 1-15 (Jan.-Feb. 1975).

Key words: emission anisotropy; fluorescence; fluorescence quantum yield; fluorescence standards; fluorimetry; polarization; spectrofluorimetry; viewing angle.

Polarization effects on fluorescence measurements are a function of four independent variables. The first is F, the polarization ratio of the exciting light which reaches the sample. The second is r, the emission anisotropy of the sample, which is the polarization "response" of the sample to plane polarized exciting light. The third is G, the polarization ratio of the emission detection system, which is the ratio of the sensitivities of the detection system to vertically and horizontally polarized light. The fourth is α, the viewing angle, which is the angle between the direction of the propagation of the exciting light and the direction from which the emission is being detected.

The intensity and the degree of polarization of the fluorescence emission that the sample exhibits are functions of F, r, and α, while the actual readings obtained with a typical spectrofluorimeter are functions of all four variables, F, r, α, and G. A theoretical analysis is made taking all these factors into account, and proper mathematical models are developed for the different modes of operation in which a fluorimeter can be used. These are verified experimentally with data obtained for a sample which has a high degree of emission anisotropy (Nile Blue A Perchlorate in glycerol). A recently designed goniospectrofluorimeter was used. Calibration procedures are developed and recommendations are made for modes of operation and fluorescence standards.

The iron-neon hollow-cathode spectrum, H. M. Crosswhite, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 17-69 (Jan.-Feb. 1975).

Key words: hollow cathode; iron; neon; wavelength standards.

Over 4000 wavelengths are listed between 1900 and 9000 Å for Fe I, Fe II, Ne I and Ne II lines measured in a hollow cathode discharge tube with iron electrodes and a neon gas filling. Photoelectric traces between 2400 and 5700 Å on a semiquantitative intensity scale are also included. For Fe I, energy values for 124 even and 240 odd levels have been computed. These have been used to calculate Ritz standards for most of the Fe I lines.

Equation of state for thermodynamic properties of fluids, R. D. Goodwin, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 71-79 (Jan.-Feb. 1975).

Key words: coexistence boundary; critical point; ethane; equation of state; fluids; methane; orthobaric densities; specific heats; vapor pressures.

This equation of state was developed from PVT compressibility data on methane and ethane. The highly-constrained form originates on a given liquid-vapor coexistence boundary (described by equations for the vapor pressures and the orthobaric densities). It then requires only five least-squares coefficients, and ensures a qualitatively correct behavior of the $P\ (\rho, T)$ surface and of its derivatives, especially about the critical point. This nonanalytic equation yields a maximum in the specific heats $C_v(\rho, T)$ at the critical point.

Thermodynamic studies of the $\alpha \rightarrow \beta$ phase transformation in zirconium using a subsecond pulse heating technique, A. Cezairliyan and F. Righini, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 81-84 (Jan.-Feb. 1975).

Key words: electrical resistivity; high-speed measurements; high temperature; solid-solid phase transformation; thermodynamics; zirconium.

Measurements of the temperature and energy of the $\alpha \rightarrow \beta$ phase transformation, and the electrical resistivity near and at the transformation point of zirconium using a subsecond duration pulse heating technique are described. The results yield 1147 K for the transformation temperature and 3980 J · mol^{-1} for the transformation energy. Electrical resistivity is found to decrease by 17 percent during the transformation. Estimated inaccuracies of the measured properties are: 10 K for the transformation temperature, 5 percent for the transformation energy, and 2 percent for the electrical resistivity.

March-April 1975

Thermal conductivity of gases. III. Some values of the thermal conductivities of argon, helium, and nitrogen from 0 °C to 75 °C at pressures of 1×10^5 to 2.5×10^7 pascals, L. A. Guildner, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 407-413 (Mar.-Apr. 1975).

Key words: excess thermal conductivity of N_2; thermal conductivity of Ar; thermal conductivity of He; thermal conductivity of N_2.

Accurate measurements of the thermal conductivities of Ar and He agree with the theoretical value of 2.5 $\phi\eta c_v$ (η= viscosity, c_v= specific heat capacity at constant volume, ϕ is a number slightly greater than 1 depending upon the intermolecular potential). Measurements of the thermal conductivities of N_2 at 9.6 and 75 °C as a function of pressure up to 2.53×10^7 Pa help to appraise the validity of other measurements of the thermal conductivities of dense gases. The excess conductivity of

[1] The various NBS publications series are grouped under subjeadings within this section. The several volumes of the Journal of Research are presented consecutively within their appropriate subheadings. If a particular publications series is sought, consult the table of contents or the edge index on the back cover.

nitrogen (the additional conductivity resulting from pressure) is shown to be a function of only the density of the nitrogen from 0 to 700 °C and pressures up to 1.3×10^8 Pa.

On the differential cross section for x-ray inelastic scattering, M. Kuriyama, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 415-417 (Mar.-Apr. 1975).

Key words: differential cross section; real metals; theory; x-ray inelastic scattering.

A formal formulation of the differential cross section for x-ray inelastic scattering is given for a real solid, in particular, in terms of the polarization propagator and the inverse dielectric function. The differential cross section is related to the causal functions of electron properties rather than those retarded functions.

Simplification of van der Poel's formula for the shear modulus of a particulate composite, J. C. Smith, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 419-423 (Mar.-Apr. 1975).

Key words: composite materials; elastic constants; filled polymers; mechanical properties; particulate composites; shear modulus; theory of elasticity.

The coefficients in van der Poel's equation for calculating the shear modulus of a particulate composite have been greatly simplified, making the calculation much less unwieldy. Approximate solutions of van der Poel's equation are also derived, and it is shown that one of the low order approximations is Kerner's equation, or Hashin and Shtrikman's equation for the highest lower bound. The Kerner approximation is often too low in value when the volume fraction of filler exceeds 0.2, but it can be used to provide further simplification in van der Poel's equation, or it can be used as a first approximation in a Newton's method of solution.

The enthalpies of combustion and formation of nicotinic acid and creatinine, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 425-430 (Mar.-Apr. 1975).

Key words: calorimetry; combustion; creatinine; enthalpy; formation; heat; nicotinic acid.

The enthalpies of combustion of nicotinic acid and creatinine have been determined in an adiabatic rotating-bomb calorimeter. The enthalpies of formation have been obtained by combination of the experimental data with the accepted values for the enthalpies of formation of carbon dioxide and water. The results of other investigations on creatinine are discussed briefly. The resulting values and their estimated uncertainties are as follows:

	Nicotinic acid	*Creatinine*
$\Delta Hc°$(25 °C)	−2730.67±0.57 kJ/mol	−2334.53±0.86 kJ/mol
$\Delta Hf°$(25 °C)	−344.97±0.62 kJ/mol	−239.93±0.88 kJ/mol

Simultaneous measurements of specific heat, electrical resistivity, and hemispherical total emittance by a pulse heating technique: Hafnium-3 (wt. %) zirconium, 1500 to 2400 K, A. Cezairliyan and J. L. McClure, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 431-436 (Mar.-Apr. 1975).

Key words: electrical resistivity; emittance; hafnium; high-speed measurements; high temperatures; specific heat; thermodynamics.

Simultaneous measurements of specific heat, electrical resistivity and hemispherical total emittance of hafnium containing 3.12 weight percent zirconium in the temperature range 1500 to 2400 K by a subsecond duration, pulse heating technique are described. The measurements indicate decreases in specific heat (by about 13%) and in electrical resistivity (by about 8%) as the result of the $\alpha \rightarrow \beta$ transformation. Estimated inaccuracies of the measured properties are: 3 percent for specific heat, 1 percent for electrical resistivity and 5 percent for hemispherical total emittance.

Heat capacities of polyethylene III. One linear and one branched sample from 5 to 350 K, S-S. Chang, E. F. Westrum, Jr., and H. G. Carlson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 437-441 (Mar.-Apr. 1975).

Key words: adiabatic calorimetry; branched polyethylene; calorimetry; cryogenic temperature; heat capacity; linear polyethylene; polyethylene; thermodynamic properties.

Heat capacities of two polyethylene samples, one linear with a density of 0.973 g cm^{-3} and one branched with a density of 0.91 g cm^{-3}, have been determined by adiabatic calorimetry from 5 to 360 K in a different experimental arrangement than employed for studies of other polyethylene samples in this series. The heat capacity behavior of these two samples confirms expectations for samples with corresponding densities.

May-June 1975

The enthalpies of combustion and formation of ortho- and parafluorobenzoic acid, W. H. Johnson and E. J. Prosen, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 3, 481-486 (May-June 1975).

Key words: combustion; enthalpy; formation; heat; isomerization; secondary standard.

The enthalpies of combustion and formation of one sample of ortho- and two samples of parafluorobenzoic acids have been determined by combustion in an oxygen-bomb calorimeter. The data obtained by other investigators are discussed briefly. The values obtained and their estimated uncertainties are as follows:

	o-Fluorobenzoic acid
$\Delta Hc°$ (25°C) $\Delta Hf°$ (25°C)	−3080.00±1.02 kJ/mol −568.52±1.10 kJ/mol
	p-Fluorobenzoic acid I
$\Delta Hc°$ (25°C) $\Delta Hf°$ (25°C)	−3062.97±0.70 kJ/mol −585.56±0.81 kJ/mol
	p-Fluorobenzoic acid II
$\Delta Hc°$ (25° C) $\Delta Hf°$ (25° C)	−3063.78±0.80 kJ/mol −584.74±0.90 kJ/mol

where $\Delta Hc°$ corresponds to the reaction:

$$C_7H_5O_2F(c) + 7\ O_2(g) + 48\ H_2O(liq) \rightarrow 7\ CO_2(g) + [HF + 50\ H_2O](liq).$$

The enthalpies of combustion and formation of acetanilide and urea, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 3, 487-491 (May-June 1975).

Key words: combustion; enthalpy; formation; heat; secondary standard; thermochemical standard.

The enthalpies of combustion of acetanilide and urea have been determined in an oxygen-bomb calorimeter. The following values and their estimated uncertainties were obtained.

	Acetanilide	Urea
$\Delta Hc°$(25°C) $\Delta Hf°$(25°C)	−4224.88±0.93kJ/mol −209.40±1.00 kJ/mol	−631.78±0.16 kJ/mol −333.39±0.17 kJ/mol

A comparison with previously reported data is given.

The enthalpies of combustion and formation of cholesterol [cholest-5-en-ol (3β)], W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 3, 493-496 (May-June 1975).

Key words: cholesterol; clinical standard; combustion, heat of; enthalpy; formation, heat of; reference material.

The enthalpy of combustion of cholesterol was measured in an adiabatic, rotating-bomb calorimeter capable of high precision with relatively small samples. The random error for the experimental measurements was 0.006 percent which may be compared with approximately 0.3 percent for prior investigations on this substance. The results obtained for the enthalpy of combustion and the derived enthalpy of formation together with the estimated overall uncertainties are:

$$\Delta Hc^{\circ}(25\ ^{\circ}\mathrm{C}) = -16524.0 \pm 3.9\ \mathrm{kJ/mol}$$

$$\Delta Hf^{\circ}(25\ ^{\circ}\mathrm{C}) = -674.8 \pm 4.1\ \mathrm{kJ/mol}$$

The results of prior investigations are discussed briefly.

The third spectrum of copper (Cu III), A. G. Shenstone, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 3, 497-521 (May-June 1975).

Key words: atomic energy levels; atomic spectrum; copper; doubly ionized copper; electron configuration; ionization potential; wavelengths.

An analysis of Cu III based on observations from 500 to 6900 Å is presented. The low structures $3d^9$ and $3d^84s$ are complete, including the rarely, if ever before, found $3d^8(^1S)4s\ ^2S$. The $3d^74s^2$ includes ^4F, ^2F, ^2G, and ^2H but the ^4P, ^2P, $a\ ^2D$, $b\ ^2D$ have eluded all attempts to find them. The ionization potential calculated from $4s$, $5s$, $6s\ ^4F_4 1/2$ is 296 980 cm^{-1} but by a comparison with Ni II which has a longer series an approximate value of 297 140 can be estimated. The $3d^84d$ group is complete, except for one level, as is $5d$ based on ^3F and ^1G, the other $5d$ groups being incomplete. $3d^8(^3F)4f$ is complete and 26 levels based on ^1D, ^3P, ^1G are known. $3d^8(^3F)5g$ is incomplete and a few levels based on ^1D and ^1G have been found. A discussion of the validity of the analysis of Cu IV by J. F. Schröder and Th. A. M. Van Kleef is given.

July-August 1975

Radiance temperature (at 653 nm) of iron at its melting point, A. Cezairliyan and J. L. McClure, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 4, 541-544 (July-Aug. 1975).

Key words: high-speed measurements; high temperature; iron; melting; normal spectral emittance; radiance temperature.

Radiance temperature (at 653 nm) of iron at its melting point was measured using a subsecond-duration pulse heating technique. Specimens in the form of strips with initially different surface roughnesses were used. The results do not indicate any dependence of radiance temperature (at the melting point) on initial surface or system operational conditions. The average radiance temperature (at 653 nm) at the melting point for 13 specimens is 1670 K on IPTS-68, with a standard deviation of 0.8 K and a maximum absolute deviation of 1.7 K. The total error in the radiance temperature is estimated to be not more than ± 6 K.

Precision measurements of the dimensional stability of four mirror materials, B. Justice, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 4, 545-550 (July-Aug. 1975).

Key words: dimensional stability; glass; glass-ceramic; interferometry.

There are several glasses and glass-ceramics available today which have low coefficients of thermal expansion—some near zero. For this reason they often serve as substrates for massive mirrors in orbit. In order for such a mirror to enjoy a lifetime of 5 years or more of diffraction-limited service, the substrate must be dimensionally stable and thereby preserve the original figure.

Early in 1967, it was decided that the National Bureau of Standards and Corning Glass Works would undertake a joint effort to measure the lengths of small samples of such materials over a period of years. These measurements were completed in 1971.

The average length changes in parts per million of the four materials selected are as follows:

Corning Code 9623 a glass ceramic − 0.30

Corning Code 7971 a titanium silicate − 0.37

Corning Code 7940 a vitreous silica − 0.47

Corning Code 9622 a glass-ceramic − 1.03.

A correlation for the second interaction virial coefficients and enhancement factors for moist air, R. W. Hyland, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 4, 551-560 (July-Aug. 1975).

Key words: enhancement factor; equation of state; interaction virial coefficients; moist air; saturated air; second virial coefficients; virial coefficients.

Experimental measurements of the enhancement factors for mixtures of water vapor and CO_2-free air have been made at −20, −10, and +70 °C. The results, coupled with previous experimental enhancement data, have been used to calculate the second interaction virial coefficients, B_{aw}, for water vapor air mixtures from −50 to +90 °C. Within this temperature range, an error analysis shows that the uncertainties in B_{aw} are between 6 and 10 percent. The calculated B_{aw} values are used in deriving enhancement factors at 10 °C intervals for $-50 < t < 90$ °C, at varying pressure intervals from 0.25 to 100 bar. The associated uncertainties are shown as a function of pressure and temperature. The enhancement factors are extrapolated to −80 °C.

The enthalpies of combustion and formation of thianthrene, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 4, 561-564 (July-Aug. 1975).

Key words: combustion; enthalpy; formation; heat; secondary standard; sulfur compound; thianthrene.

The enthalpy of combustion of thianthrene (diphenylene disulfide) has been determined in an oxygen-bomb calorimeter. The enthalpy of formation has been derived using data from the available literature. The results obtained are as follows:

$$C_{12}H_8S_2(c) + 17\ O_2(g) + 228\ H_2O(liq) =$$

$$12\ CO_{2(g)} + 2\ [H_2SO_4 + 115\ H_2O]\ (liq).$$

$$\Delta H_c^{\circ}(25\ ^{\circ}\mathrm{C}) = -7253.27 \pm 1.40\ \mathrm{kJ/mol}$$

$$(-1733.65 \pm 0.33\ \mathrm{kcal/mol}).$$

$$\Delta Hf^{\circ}(25\ ^{\circ}\mathrm{C}) = 184.23 \pm 1.50\ \mathrm{kJ/mol}\ (44.03 \pm 0.36\ \mathrm{kcal/mol}).$$

A comparison is given of the results of this investigation with those of previous investigators.

Unbound water content from application of adsorption theory, W. V. Loebenstein, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 4, 565-576 (July-Aug. 1975).

Key words: adsorption; computer application; desorption;

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dry weight determination; moisture content; surface area; water content; water vapor adsorption.

It is standard procedure to fit an applicable isotherm equation to water vapor adsorption data using the method of least squares in arriving at a value for the surface area accessible to the water molecule. The least squares technique has been extended in the present investigation to determine, in addition and simultaneously, a "best value" for the zero-humidity sample weight of the material. The application is equally valid for desorption insofar as the zero-humidity weight is concerned, although the derived value for "surface area" from desorption data will be over-estimated in the general case because of hysteresis. There is no limitation on the range of humidities since the method is not restricted to the BET equation (i.e., between 0.1 and 0.3 r.h.). In fact, good agreement with the zero-humidity points measured experimentally has been obtained even from drying curves in which the relative humidity has been confined to the region above 50 percent. An iterative method is employed in the calculations for which computer assistance is especially adaptable. Fortran IV programs are included in the appendix whose use requires no extensive computer experience. A fraction of a second in computer processing time is all that is required for each determination.

September-October 1975

Surface films on polyoxymethylene single crystals, J. E. Breedon and P. H. Geil, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 609-611 (Sept.-Oct. 1975).

Key words: adsorbed polymer; deformation; fold surface; gold decoration; polymer crystals; poly(oxymethylene); surface layer.

The deformation of single crystals of poly(oxymethylene) grown from 0.01 percent bromobenzene solution has been studied by deposition on a deformable substrate. Slight decoration of the crystal surfaces with gold prior to mechanical deformation of the composite reveals breaks in the gold which are displaced with respect to cracks in the underlying polymer crystals. These observations are interpreted to imply the existence of a very thin discrete film on the surface of the polymer crystals which can slip during deformation. Such a film might arise from polymer molecules adsorbed on the crystal surface.

On the origin of the amorphous component in polymer single crystals and the nature of the fold surface, J. D. Hoffman and G. T. Davis, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 613-617 (Sept.-Oct. 1975).

Key words: adsorbed layer; amorphous component; fold surface; polymer crystals; regular folds.

A model for the surface of folded-chain polymer single crystals is presented in which the "amorphous" phase is composed of polymer molecules physically adsorbed on surface sites of a fairly regularly folded surface. The evidence for the presence of an amorphous phase in polymer single crystals is reviewed briefly as well as the evidence for regular folding and adjacent reentry. The proposed model would allow simultaneous acceptance of the evidence for both an amorphous layer and a surface composed of regularly folded molecules; such evidence was heretofore contradictory. Experimental evidence for such a model is discussed and some predictions are made concerning the properties of such an adsorbed layer.

Some thermodynamic properties of bromobenzene from 0 to 1500 K, J. F. Masi and R. B. Scott, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 619-628 (Sept.-Oct. 1975).

Key words: bromobenzene; calorimetry; enthalpy; entropy; Gibbs energy; heat capacity; heat of fusion; heat of vaporization; thermodynamic properties, triple point.

Measurements were made of the heat capacity of crystalline and liquid bromobenzene from 11 to 300 K, of the triple point and heat of fusion at the triple point and of the heat of vaporization at one temperature. The adiabatic calorimeter used was precise over most of its range to ±0.1 percent; the purity of the sample was 99.998 mol percent. The triple point of pure bromobenzene is 242.401 K (−30.749 °C) ±0.010°; the enthalpy and entropy of fusion are, respectively, 10702±5 J mol^{-1} and 44.150±0.022 J K^{-1} mol^{-1}. The heat and entropy of vaporization at 293.00 K are, respectively, 43 963±60 J mol^{-1} and 150.0 ±0.2 J K^{-1} mol^{-1}. Tables are given for the thermodynamic functions of the condensed phases from 0 to 300 K; the functions for the ideal gas from 100 to 1500 K, calculated from spectroscopic and molecular data using statistical mechanical methods, are also tabulated. The entropy of the ideal gas at 293.00 K and one atmosphere, from statistical mechanics, is 323.63 J K^{-1} mol^{-1}; the same quantity from the experimental measurements (third law) is 323.73 J K^{-1} mol^{-1}. No anomalies or additional transitions were observed.

Relativistic effects on line strengths for transitions in the hydrogenic isoelectronic sequence, S. M. Younger and A. W. Weiss, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 629-633 (Sept.-Oct. 1975).

Key words: Dirac theory; hydrogen; line strength; oscillator strength; relativistic corrections; spectroscopy.

Relativistic line strengths have been computed for a large number of transitions using Dirac wave functions for the one-electron, hydrogen-like ions. As expected, the results indicate that relativistic effects are quite small for low stages of ionization. However, in general, they also remain small throughout a large portion of the isoelectronic sequence, becoming typically of the order of 10 percent in the vicinity of $Z=50$, after which they grow quite rapidly. This suggests that for multielectron ions a basically nonrelativistic theory might well be adequate for light atom isoelectronic ions through as much as 30 or 40 stages of ionization.

The enthalpies of combustion and formation of 2,2′-dichloroethyl sulfide, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 634-638 (Sept.-Oct. 1975).

Key words: combustion; dichloroethyl sulfide; enthalpy; formation; heat; mustard gas.

The enthalpies of combustion and formation of 2,2′-dichloroethyl sulfide (mustard gas) have been determined by combustion in an adiabatic rotating-bomb calorimeter. The bomb process has been corrected to:

$$C_4H_8Cl_2S(liq) + 7O_2(g) + 98\ H_2O(liq) \rightarrow$$
$$4\ CO_2(g) + [2\ HCl + H_2SO_4 + 100\ H_2O](liq)$$

for which the following values were obtained:

$$\Delta Hc°(25\ °C) = -3163.49 \pm 1.26\ \mathrm{kJ/mol}\ \text{and}$$
$$\Delta Hf°(25\ °C) = -200.57 \pm 1.58\ \mathrm{kJ/mol}.$$

Barothermal theory of two devices for measuring absorption coefficients, H. S. Bennett, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 5, 639-648 (Sept.-Oct. 1975).

Key words: absorption coefficients; barothermal behavior; Green's function; heat diffusion; weakly absorbing materials.

Two devices are proposed for measuring absorption coefficients in weakly absorbing materials. The first device measures cylindrical samples and the second device measures flat plate or disk samples. This paper reports on the derivations for the steady-state and transient solutions to the heat diffusion equations which describe the barothermal behavior of the two proposed devices. In addition, Green's function techniques are used to describe the cyclic heating and cooling of the cylinders and plates.

November-December 1975

On the growth rate of spherulites and axialites from the melt in polyethylene fractions: regime I and regime II crystallization, J. D. Hoffman, L. J. Frolen, G. S. Ross, and J. I. Lauritzen, Jr., *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 671-699 (Nov.-Dec. 1975).

Key words: axialite; chain folds; crystallization rate; molecular weight; nucleation theory; polyethylene; regime I; regime II; spherulite.

The growth rate G of the crystalline bodies appearing in each of a set of 35 characterized polyethylene fractions ranging from 3600 to 807,000 in molecular weight has been measured as a function of the undercooling ΔT. In isothermal crystallization, only axialites were found from $M_w = 3600$ to 18,000. (For these runs, $\Delta T < 17.5$ °C.) From $M_w = 18{,}000$ to $M_w \cong 115{,}000$ coarse-grained nonbanded spherulites were found for $\Delta T > 17.5$ °C, and axialites for $\Delta T < 17.5$ °C; a rather sharp break occurred in the $\log_{10}G$ versus T data at $\Delta T \cong 17.5$ °C. Above $M_w \cong 115{,}000$, only nearly structureless "irregular" spherulites were found at all undercoolings corresponding to isothermal growth. Typical ringed spherulites were obtained only on quenching. Wide-angle x-ray data showed that the usual orthorhombic subcell predominated in all the morphologies encountered. Low-angle x-ray data showed that the specimens exhibited lamellar crystallization irrespective of the particular gross morphology involved. The growth rate data on each fraction were analyzed using $G = G_o\exp[-U^*/R(T-T_\infty)]\exp[-K_g/T(\Delta T)f]$ where $f \cong 1$ to obtain values of K_g and G_o. The value of Y in $K_g = Yb\sigma\sigma_e/(\Delta h_f)k$ was obtained for each morphology by applying the "Z" test of Lauritzen. $Y = 4$ for regime I crystallization (single surface nucleus leads to completion of substrate) and $Y = 2$ for regime II crystallization (numerous surface nuclei involved in substrate completion). It was found that the axialites obeyed regime I kinetics ($Y = 4$), the coarse-grained spherulites regime II kinetics ($Y = 2$), and the irregular spherulites "mixed" kinetics ($Y \sim 3$). The assumption that the substrate length L in Lauritzen's regime theory was ~ 5 μm led to the prediction of a rather sharp regime I $\rightarrow$ regime II transition (corresponding to a break in the $\log_{10}G$ versus T data) at $\Delta T \cong 17.5$ °C, in accord with experiment. The $\sigma\sigma_e$ value calculated from K_g and Y for $M_w \geqslant 20{,}000$ was approximately constant with molecular weight and independent of morphology; the limiting value of $\sigma\sigma_e$ from kinetic measurements was about 1285 erg^2/cm^4, corresponding to $\sigma_{e(\infty)} = 90.5$ erg/cm^2 and $\sigma = 14.2$ erg/cm^2. (This value of $\sigma_{e(\infty)}$ compares favorably with $\sigma_{e(eq)} = 93 \pm 8$ erg/cm^2 from melting point experiments.) The increase of $\sigma\sigma_e$ and σ_e that took place at low molecular weights on up to $\sim 20{,}000$ was treated using an expression given by Hoffman, *viz* $\sigma_e = \sigma_{e(\infty)}[(\nu + \beta_i)/(\nu + 1)]$ where ν = number of folds per molecule, $\beta_i = \sigma_{e(cilium)}/\sigma_{e(\infty)}$. Intermittent high and low values of σ_e were found experimentally in this region, showing that β_i varied intermittently with increasing molecular weight between 0.15 and ~ 0.7. Theoretical estimates of these upper and lower bounds for β_i are given. The variation of σ_e between its upper and lower bounds was tentatively explained in terms of the alternate appearance of short and long terminal cilia, few if any of the latter exceeding l_g^* in length, as the molecular weight increased. Estimates of the initial lamellar thickness l_g^* were made from σ_e, and compared with the appropriate low-angle x-ray spacings. A theoretical estimate of the ratio of the preexponential factors $G_{o(I)}$ and $G_{o(II)}$ for regimes I and II was compared with experiment with satisfactory results. The value of G_o is not strongly dependent upon the viscosity of the melt. The work of chain folding deduced from the growth rate data is close to 4.1 kcal/mol, which is in good agreement with other estimates.

Homogeneous nucleation in polyethylene: molecular weight dependence, G. S. Ross and L. J. Frolen, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 701-711 (Nov.-Dec. 1975).

Key words: chain folds; fractions; homogeneous nucleation; molecular weight; nucleation theory; polyethylene; surface free energies.

The droplet technique was used to obtain estimates of the isothermal rate of homogeneous crystal nucleation in highly supercooled melts of 8 characterized fractions of linear polyethylene (weight average molecular weights from 3,100 to 249,000). The data obtained from these experiments were analyzed in accord with current theories of homogeneous nucleation of chain folded crystals. Values for the quantity $\sigma^2\sigma_e$, where σ and σ_e are the lateral and end-surface free energies of the crystal, were estimated as a function of molecular weight.

Sample 3.2 K was found to be anomalous in its nucleation behavior. When we assume that this sample crystallizes in the extended chain form and calculate σ^3 instead of $\sigma^2\sigma_e$ the value for σ is found to be 10.57 ergs/cm^2 which is in reasonable agreement with the value 9.6 ergs/cm^2 found by other investigators for linear hydrocarbons. However, there remains the question as to whether sample 3.2 K ever underwent homogeneous nucleation.

For samples 9.70 K, 11.74 K and 23.0 K, $\sigma^2\sigma_e$ was found to increase rapidly due to a decrease in the number of cilia per chain fold as the molecular weight increases. For higher molecular weights the value for $\sigma^2\sigma_e$ levels off and the average value of $\sigma^2\sigma_e$ for samples 23.0 K to 249 K was found to be 19,000 ergs^3/cm^6.

The experimental value of the absolute nucleation frequency I_0, was found to differ from the theoretical value by approximately 1×10^{12}. If one assumes that the surface free energies are temperature dependent [i.e., $\sigma = \sigma_1(1 + \bar{x}\Delta T)$ and $\sigma_e = \sigma_{e1}(1 + \bar{y}\Delta T)$ where $\bar{x} = -0.0073$ and $\bar{y} = 0.014$] the average value of $\sigma^2\sigma_e$ changes only slightly (to 19,800 ergs^3/cm^6) due to the compensating effects in the signs of the temperature corrections and I_0 is close to the theoretical value, 1×10^{34} nuclei/cm^3/s.

Absolute isotopic abundance ratios and the atomic weight of a reference sample of potassium, E. L. Garner, T. J. Murphy, J. W. Gramlich, P. J. Paulsen, and I. L. Barnes, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 713-725 (Nov.-Dec. 1975).

Key words: absolute ratios; atomic weight; isotopic abundance; potassium; reference standard.

Solid sample, thermal ionization, mass spectrometry has been used to obtain absolute values for the isotopic abundance ratios of a reference sample of potassium. Standards of known isotopic composition, prepared by gravimetrically mixing nearly isotopically and chemically pure separated isotopes of ^{39}K and ^{41}K, were used for calibration. The absolute isotopic abundance ratios are $^{39}K/^{41}K = 13.8566 \pm 0.0063$ and $^{40}K/^{41}K = 0.0017343 \pm 0.0000061$ which yield atom percent compositions of $^{39}K = 93.2581 \pm 0.0029$, $^{40}K = 0.01167 \pm 0.00004$, and $41K = 6.7302 \pm 0.0029$. The calculated atomic weight for potassium is 39.098304 ± 0.000058. The indicated uncertainties are overall limits of error which are the sum of the uncertainty components for ratio determinations and the components covering the effects of known sources of possible systematic error.

Absolute isotopic abundance ratios and the atomic weight of a reference sample of silicon, I. L. Barnes, L. J. Moore, L. A. Machlan, T. J. Murphy, and W. R. Shields, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 727-735 (Nov.-Dec. 1975).

Key words: absolute ratios; atomic weight; isotopic abundance; silicon.

Absolute values have been obtained for the isotopic abundance ratios of a reference sample of silicon using electron impact mass spectrometry. Samples of known isotopic composition prepared from nearly isotopically pure separated silicon isotopes were used to calibrate the mass spectrometers. The resulting absolute $^{28}Si/^{30}Si$ ratio $= 29.74320 \pm 0.00747$ and the $^{29}Si/^{30}Si$ ratio $= 1.50598 \pm 0.00086$ which yield atom percents of $^{28}Si = 92.22933 \pm 0.00155$, $^{29}Si = 4.66982 \pm 0.00124$ and $^{30}Si = 3.10085 \pm 0.00074$. The atomic weight calculated from this isotopic composition is 28.085526 ± 0.000056. The indicated uncertainties are overall limits of error based on 95 percent confidence limits for the means and allowances for the effects of known sources of possible systematic error. A study of natural $^{28}Si/^{30}Si$ ratio variations reported in the literature extends the estimated uncertainty in the atomic weight of natural silicon to ± 0.00039.

Absolute determination of electrochemical equivalent and the atomic weight of zinc I. Method, apparatus, and preliminary experiments, G. Marinenko and R. T. Foley, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 737-745 (Nov.-Dec. 1975).

Key words: atomic weight; coulometry; electrochemical equivalent; zinc atomic weight.

The use of a specially designed coulometer and a high accuracy coulometric circuit resulted in the accurate measurement of the electrochemical equivalent and atomic weight of zinc. The experimental conditions to make possible the final precise and accurate measurements were established. These include a study of mechanical losses from the anode during the electrolysis and the corrosion of zinc in various media used in the determination. The effects of both of these sources of error may be controlled. Mechanical losses are minimized when an amalgamated electrode is used; corrosion when an amalgamated electrode is used in an air free system. An electrolyte, 25 wt. percent NH_4Cl and 3 molal $ZnCl_2$, was used in these determinations. This report presents the account of research which was prerequisite for subsequent accurate determination of the electrochemical equivalent and the atomic weight of zinc.

Absolute determination of the electrochemical equivalent and the atomic weight of zinc. II. Final determination, G. Marinenko and R. T. Foley, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 747-759 (Nov.-Dec. 1975).

Key words: atomic weight; coulometry; electrochemical equivalent; zinc atomic weight.

A new, successful approach to the determination of atomic weights of suitable elements has been demonstrated in this research. An absolute constant-current coulometric method was employed for the determination of the electrochemical equivalent and the atomic weight of zinc. The effects of possible sources of systematic error were investigated and appropriate corrections applied. The newly determined values of the two constants are 0.3387958 mg C^{-1} and 65.3771 respectively. The uncertainty in the atomic weight of zinc was reduced by more than an order of magnitude. The publication of partial data resulted in the revision of the value of the atomic weight of zinc by the International Union of Pure and Applied Chemistry.

The use of synchrotron radiation as an absolute source of vuv radiation, D. L. Ederer, E. B. Saloman, S. C. Ebner, and R. P. Madden, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 761-774 (Nov.-Dec. 1975).

Key words: irradiances; radiometry; spectrometer calibration; standard source; synchrotron radiation; vacuum ultraviolet.

Synchrotron radiation has been used as a standard source to calibrate spectrographic instruments at the National Bureau of Standards (NBS). Conceptually it is straightforward to apply the calculable continuum distribution of synchrotron radiation to problems requiring a source of known irradiance if the electron energy, the radius of the electron orbit, and the beam current are known. In practice many factors affect the accuracy of such a calibration, such as temporal and spatial variations in electron beam, uncertainties in the orbital radius and maximum energy of the orbiting electron beam. These sources of error are discussed and the method of calibration on SURF-I is specified. A storage ring synchrotron radiation facility (SURF-II) is now operational at NBS. The calibration techniques developed for SURF-I are applied to SURF-II with anticipated improvements in calibration accuracy. For SURF-I the incident flux was determined with an accuracy of 15 percent while for SURF-II we anticipate accuracies of about 7 percent.

Corrections to paper entitled "Third Virial Coefficient for Air-Water Vapor Mixtures," R. W. Hyland and E. A. Mason, *J. Res. Nat. Bur. Stand. (U.S.)*, **79A** (Phys. and Chem.), No. 6, 775-776 (Nov.-Dec. 1975).

Key words: chemical association; Lennard-Jones potential parameters; third interaction virial coefficients; virial coefficients; water vapor-air mixtures.

This note points out errors in the values of the third virial coefficients for pure water vapor which appeared in a 1967 paper by Hyland and Mason. The errors arose while converting from the units of Goff and of Keyes to the desired units of $(l/mol)^2$. The consequences of the errors are outlined, and it is shown that there is no effect on the primary results of the paper, namely, in the preferred values of the third interaction virial coefficient for air-water vapor mixtures, C_{aaw}.

3.2. PAPERS FROM THE JOURNAL OF RESEARCH OF THE NATIONAL BUREAU OF STANDARDS, SECTION B. MATHEMATICAL SCIENCES, VOLUME 79B, JANUARY-DECEMBER 1975

January-June 1975

Ideal elements for perturbed Keplerian motions, A. Deprit, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 1-15 (Jan.-June 1975).

Key words: celestial mechanics; orbit perturbation; satellite ephemeris; variation of parameters.

A new set of elements is proposed to describe Keplerian motions subject to perturbing forces. The resulting equations do not break down for small eccentricities, small inclinations and rotations of the ideal frame reference that are half turns. The parameters are selected with a view of simplifying the programming of the right-hand members.

Generalized or adjoint reciprocity relations for electroacoustic transducers, A. D. Yaghjian, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 17-39 (Jan.-June 1975).

Key words: linear differential operators; reciprocity relations; scattering matrix; transducers.

The "equations of motion" of a linear electroacoustic transducer are written in the alternative forms $L^{-}X=0$, $L^{-}\bar{X}=0$, where the matrices $L^{\pm}$ are linear differential expressions. $X=(\bar{E},\bar{H},\bar{u})$ represents electroacoustic fields, and the superscripts distinguish selected normalizations of the equations of motion. To each operator $L^{\pm}$ corresponds a mathematically defined adjoint operator $(L^{\pm})^{a}$ and an associated adjoint transducer, whose material tensor parameters are given by certain transpositions and interchanges of the parameters of the given transducer. Dissipative characteristics (lossiness, losslessness, or "gaininess") of the material of the given transducer are preserved pointwise in the adjoint transducers. A generalized reciprocity lemma leads to relations of reciprocal type between external properties of the given and the adjoint transducers. In the self-adjoint cases, the conventional electroacoustic reciprocity and antireciprocity relations are obtained and the derivation of those relations is critically confirmed. The generalized or adjoint reciprocity relations have been applied in the plane-wave scattering-matrix formalism developed for electroacoustic transducers by D. M. Kerns.

Corollaries of the adjoint reciprocity relations, analogous to conventional reciprocity theorems, but involving properties of adjoint pairs of transducers, are derived. Examples are discussed of transducers for which it is feasible to form the adjoint tranducers.

The diophantine equation $p^2x^4+3px^2y^2+y^4=z^2$, p an odd prime, T. N. Sinha, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 41-44 (Jan.-June 1975).

Key words: diophantine equation; infinite descent; quadratic residues.

The object of this paper is to prove:

THEOREM 1. *The equation*

$$p^2x^4+3px^2y^2+y^4=z^2$$

where p *is an odd prime, has no solutions in integers with* xy $\neq 0$ *if* p=5 *or* p $\equiv$ 3,7 *(mod 20) or* p $\equiv$ 13 *(mod 40)*.

A condition for the diagonalizability of a partitioned matrix, C. R. Johnson and M. Newman, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 45-48 (Jan.-June 1975).

Key words: diagonalizable matrix; partitioned matrix.

When U and V are diagonalizable matrices the diagonalizability of

$$\begin{bmatrix} U & N \\ 0 & V \end{bmatrix}$$

is equivalent to the solvability in X of

$$UX-XV=N.$$

A corollary and simple generalization are given.

Linearly independent sets of isotropic Cartesian tensors of ranks up to eight, E. A. Kearsley and J. T. Fong, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 49-58 (Jan.-June 1975).

Key words: algebra; alternating tensor; Capelli's identity; Cartesian tensor; group representation; invariant; isotropic tensor; Kronecker delta; orthogonal group; tensor.

This paper contains a complete listing of isotropic Cartesian tensors of ranks up to eight with their associated reduction equations for obtaining linearly independent sets whenever the reduction is called for. In particular, the listing is compiled only for isotropic tensors associated with the rotation group $O^{+}(3)$ of the three-dimensional underlying vector space. Based on an identity originally due to Capelli (1887), reduction equations for tensors of odd ranks beginning at rank five and even ranks beginning at rank eight are shown to be nontrivial. Significance of the computational result in both pure and applied mathematics is discussed.

Maximal network flows, matroids and matchings, E. Minieka, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 59-62 (Jan.-June 1975).

Key words: independence properties; matroids; maximal flows; network flows.

This paper represents new proofs for some known network flow results. First, maximal network flows are expressed as matroids, and then Gale's characterization of matroids is used to prove the existence of various lexicographic network flows. Second, an independence property of maximum flows is proved and this property is related to an independence property of Brualdi and Scrimger.

A note on the metrizability of spaces with countably based closed sets, R. R. Sabella, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nov. 1 and 2, 63-64 (Jan.-June 1975).

Key words: co-convergent; contra-convergent; Nagata spaces; open neighborhood assignments; stratifiable spaces; U-linked sequences.

The main result of this note is a generalization of an earlier theorem on the metrizability of spaces with countably based closed sets. Use is made of some results related to co-convergent spaces which are spaces having countably based compact sets.

Charge profiles in parallel-plate ionization chambers, G. F. L. Ferreira, L. Nunes de Oliveira, and B. Gross, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 1 and 2, 65-75 (Jan.-June 1975).

Key words: charge profiles; ionization chambers; numerical integration.

Numerical integration of the differential equations describing charge transport in plane-parallel ionization chambers allows to obtain charge profiles in addition to current-voltage curves. It is found that charge densities may exhibit maxima within a certain range of saturation. The effect is interpreted in terms of field modulation of carrier velocities.

July-December 1975

Two submatrix properties of certain induced norms, C. R. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 97-102 (July-Dec. 1975).

Key words: consistency; matrix norm; monotonicity; principal submatrix; spectral radius; vector norm.

Induced matrix norms N, defined consistently for all orders up to a given order, which have the property:

$$N(\hat{A}) \leq N(A)$$

for all principal submatrices $\hat{A}$ of an arbitrary m x m complex matrix A are characterized. Conditions are also given which insure that

$$N(A \oplus B) = \max \{N(A), N(B)\}$$

Properties of neighboring sequences in stratifiable spaces, R. R. Sabella, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 103-105 (July-Dec. 1975).

Key words: co-convergent; contra-convergent; Nagata spaces; open neighborhood assignments; stratifiable spaces; U-linked sequences.

In T_0-spaces metrizability can be characterized in terms of mutual convergence of "neighboring sequences." In this paper Nagata spaces are characterized in terms of a convergence property of neighboring sequences and more generally it is shown that in all stratifiable spaces, neighboring sequences satisfy a similar convergence property.

Maximin facility location, P. J. Slater, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 107-115 (July-Dec. 1975).

Key words: center; centroid; facility location; graph; tree.

Using the criterion that vertex u of a graph G is "more central" than vertex v if there are more vertices closer to u than to v, the security center and security centroid of a graph are defined. Several results, including the fact that the security center of a tree is the centroid, are presented. A simple algorithm to find the security center (centroid) of a tree is presented. The problem of finding the security center of G is shown reducible to a search over a single block of G.

Similarity of partitioned matrices, R. B. Feinberg, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 117-125 (July-Dec. 1975).

Key words: matric equation; partitioned matrix; rational canonical form; similarity.

Suppose that A, B, and T are matrices of order $r \times r$, $s \times s$, and $r \times s$ respectively over a field F. We prove that

$$\begin{bmatrix} A & T \\ 0 & B \end{bmatrix}$$

is similar to

$$\begin{bmatrix} A & 0 \\ 0 & B \end{bmatrix}$$

if $AX-XB=T$, for some matrix X. We also give some corollaries and a simple generalization.

On the dimension group of classical physics, C. H. Page, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 127-135 (July-Dec. 1975).

Key words: angle; dimension; logarithm; neper; radian.

The basic principles of the group properties of physical quantities are reviewed. The problems associated with the dimensions of *angle* and *logarithm* are solved by using functional equations, instead of analytic expressions, for defining functions of non-numerical quantities. It is concluded that the neper and radian are related by $Np = -j$ rad, so that when the radian is considered as a base unit, the neper becomes a derived unit, and is the SI unit for logarithmic quantities.

Complete elliptic integrals resulting from infinite integrals of Bessel functions. II., S. Okui, *J. Res. Nat. Bur. Stand. (U.S.),* **79B** (Math. Sci.), Nos. 3 and 4, 137-170 (July-Dec. 1975).

Key words: Bessel functions; complete elliptic integrals; hyperbolic function; infinite integrals; modified Bessel functions; noise theory; signal statistics; trigonometric functions.

Infinite integrals involving products of Bessel and trigonometric or hyperbolic functions reducible to complete elliptic integrals are compiled. The table also contains certain types of infinite double integrals of modified Bessel functions. All results are expressed in conveniently compact form suited for practical applications.

3.3. DIMENSIONS/NBS (Formerly Technical News Bulletin), ARTICLE TITLES ONLY

This monthly magazine is published to inform scientists, engineers, businessmen, industry, teachers, students, and consumers of the latest advances in science and technology, with primary emphasis on the work at NBS.

DIMENSIONS/NBS highlights and reviews such issues as energy research, fire protection, building technology, metric conversion, pollution abatement, health and safety, and consumer product performance. In addition, DIMENSIONS/NBS reports the results of Bureau programs in measurement standards and techniques, properties of matter and materials, engineering standards and services, instrumentation, and automatic data processing. Issued monthly.

January 1975

DIM/NBS 59, No. 1, 1-24 (1975).

Key words: computers; energy research; ethylene; fabric flammability; glass standards; household fires; jet engines; measurement seminars; metric; protecting nuclear fuels.

Computers Automate Jet Engine Tuneups

NBS Camera Keeps Eye on Nuclear Fuels

Crime Labs Aided by NBS Glass Standard

Survey Results in New Data on Household Fires

Energy Research: The Long-Term Perspective

Highlights

NBS to Hold Measurement Seminars

Survey Shows Schools Going Metric

NBS Strengthens Consumer Programs

NBS, Industry to Join in Ethylene Study

New Flammability Standard for Sleepwear

Publications

February 1975

DIM/NBS 59, No. 2, 25-48 (1975).

Key words: energy conservation; fires; gasoline consumption; glass SRM; hazardous chemicals; leap second; playground equipment safety; scientific data; silicon devices; time.

NBS, FEA Help Homeowners Make the Most of Their Energy Conservation Dollars

Estimating Gas Consumption

Good Science, Bad Data

Assessing the Hazard Potential of Chemical Substances

Safety of Playground Equipment

Highlights

New Time Rules

1975 Arrived Late

Fifty Glass Standard Reference Materials Available

Facts on High Rise Fires

Workshop on Surface Finish of Silicon Devices

Publications

March 1975

DIM/NBS 59, No. 3, 49-72 (1975).

Key words: accelerator facilities; computers; court records; fire safety; forensic science; law enforcement; methane; metric; police protection; safer streets; security systems; WWV/WWVH.

The Law Enforcement Standards Laboratory

Safer Streets Through Improved Communication

Guidelines for Keeping Better Court Records

Helping Improve Police Protection

Toward More Objective Evidence

Investigating the Performance of Security Systems

Patrolcar Performance and Safety Studied

Highlights

New Flowchart Template for Federal Computer Users

Call for Papers Issued for NBS/ANSI Symposium

Proceedings of Fire Safety Research Symposium Available

Metric Kit Published

New Data on Methane

Particle Accelerator Facilities Upgraded

WWV/WWVH Users Queried

April 1975

DIM/NBS 59, No. 4, 73-96 (1975).

Key words: buildings; computers; computer codes; computer networks; copyrights; energy; epoxies; hazard; metric conversion; piezoelectric accelerometers; sun.

Computer Networks Are Here

There's More to Comfort Than Hot Air

Laser-Induced Photochemical Enrichment of Isotopes

NBS Tests Epoxies to Protect Bridges

Harnessing the Sun

Highlights

Managing Information as a Resource

Effects on Piezoelectric Accelerometers Determined

NBS to Study Computers and Copyrights

New Standards for Computer Codes and Controls

Revised Bill for Voluntary Metric Conversion Submitted to Congress

Natural Hazard Evaluation of Existing Buildings

Publications

May 1975

DIM/NBS 59, No. 5, 97-120 (1975).

Key words: air pollution; camera guidelines; computerized elections; dental fillings; metre; ozone problem; police communications; water pollution; x rays.

NBS Proposes Guidelines for Computerized Elections

New Air Pollution Standards Developed by NBS

The Treaty of the Metre 1875-1975

Beyond X-Rays

A Look at the Ozone Problem

Highlights

ETIP, Utility Commissions and Policy Experiments

Instrument Evaluates Wear of Dental Filling Materials

Surveillance Camera Guideline to Help Cut Thefts

NBS Tests "Little Box" That Speeds Police Communications

New NBS Mercury Standards Will Aid Water Pollution Studies

Publications

June 1975

DIM/NBS 59, No. 6, 121-144 (1975).

Key words: air conditioners; appliance; bone cement; computer; energy; energy labels; fire fatalities; hydrogen fuel; magnetohydrodynamics; metric changeover; safety.

More on the Metric Changeover

New Insights on the Causes of Fire Fatalities

Magnetohydrodynamics – An Old Idea with More Power to It

You, the Computer and Our Society in the Next Two Decades

Mobile Home Safety, Durability Studied

Highlights

Bone "Cement" Characterized

Major Appliance Manufacturers Support Energy Efficiency Program

Hydrogen Fuel Topics Published

Check Energy Labels on Room Air Conditioners

Publications

July 1975

DIM/NBS 59, No. 7, 145-168 (1975).

Key words: air conditioners; buses, subway cars; centennial; electric power; environment; ethane data; facilities; fire research; fire safety; graffiti; product standards; programming language.

Banking the Environment

NBS Studies Ways to Prevent and Remove Graffiti

Monitoring Electric Power Network for Dollar Savings and Quality Control

NBS Tests Buses, Subway Cars for Fire Safety

Product Standards for a Summer Afternoon

Highlights

Centennial Volume Published

Equipment, Facilities for Shared Use

Fire Research Programs Outlined

Computer Symposium Planned

New Air Conditioners Save Energy, Money

Ethane Data Available

Standard for APT Programming Language

Publications

August 1975

DIM/NBS 59, No. 8, 169-192 (1975).

Key words: auto fuels; energy; highway safety; lead; pressure transducer; railway safety; silicon devices; water heaters; windowless buildings.

Working for Railway Safety

A New Look at the View From Within

NBS Brightens the Way for Highway Safety

Making the Most of Your Energy Dollars

Highlights

Surface Analysis for Silicon Devices

Energy-Efficient Water Heaters to Save Money

Pressure Transducer Service Available

Measuring Lead in Auto Fuels

Publications

September 1975

DIM/NBS 59, No. 9, 193-216 (1975).

Key words: computer; cryogenic; cryptography; data; energy labeling; energy needs; fluid safety; materials; NBS, GSA experiment; optical spectra; plastic pipes; thermal conductivity.

Data Protection Through Cryptography

Determining the Effect of Weather on Building Materials

Plastic Pipes, Pros and Cons

Energy Needs: Newest Challenge to Yankee Ingenuity

Highlights

Cryogenic Fluid Safety Data Compiled

Optical Spectra Table Revised

Energy Labeling Explained for Consumers

NBS, GSA Experiment for Savings and Product Improvement

Thermal Conductivity Discussed

Computer Program Announced

Publications

October 1975

DIM/NBS 59, No. 10, 218-239 (1975).

Key words: construction; dry weight; ears; energy; health care; hospitals; measurement science; meter; metric; pulses; robot; sound.

Now Hear This! Protect Your Ears or Don't Shoot

Energy Strategies for Health Care Institutions

An International Meeting, A Century Celebration

World Conference Updates Vocabulary of Measurement Science

Metric Vocabulary: A Reference Guide

Highlights

NBS Tests Six-Axis Robot

NBS, EPA to Offer Sound Level Meter Workshop

Health Care Delivery in Hospitals Being Aided

Symposium on Building Construction to be Held at NBS

Elusive Pulses Measured

New Technique in Predicting Dry Weight

NBS, ERDA Sign Agreement on Energy R&D

Publications

November 1975

DIM/NBS 59, No. 11, 1-24 (1975).

Key words: computer security; energy efficiency; electrocatalysis; fluorides; heart; heat pump; laser; ozone; radiometer; stabilizer; toy safety.

Is There a Heat Pump in Your Future?

Research Provides New Insight into Ozone Controversy

Pacing the Heart with Improved Reliability

Fluorides and Sealants: Stopping Cavities Before They Start

Highlights

NBS Three in the I-R 100: Radiometer, Laser, Stabilizer, Dew/Frost Detector

Fifty-Seven Major Appliance Manufacturers Support Efficiency Program

NBS Circulates Voluntary Toy Safety Standards

Guidelines for Computer Security Published

NBS Workshops to Study Electrocatalysis Processes

December 1975

DIM/NBS 59, No. 12, 1-32 (1975).

Key words: calculable capacitor; color; computer simulation; electricity; energy-environment; fire safety; measurement system; nuclear power plant; productivity; subway.

NBS Guides Consumers in Use of Color

Computer-Aided Manufacturing Can Increase National Productivity

Energy-Environment Workshops Planned

Using Computer Simulation to Solve Problems

Highlights

Lag Time for Nuclear Power Plant Standards Reduced

The Rise of the Calculable Capacitor

Basis of the U.S. National Measurement System in Electricity

Fire Safety for New Subway in Nation's Capital

3.4. PAPERS FROM THE JOURNAL OF PHYSICAL AND CHEMICAL REFERENCE DATA, VOLUME 4, JANUARY-DECEMBER 1975

This journal is published quarterly by the American Chemical Society and the American Institute of Physics for the National Bureau of Standards. The objective of the Journal is to provide critically evaluated physical and chemical property data, fully documented as to the original sources and the criteria used for evaluation. Critical reviews of measurement techniques, whose aim is to assess the accuracy of available data in a given technical area, are also included. The principal source for the Journal is the National Standard Reference Data System (NSRDS). The Journal is not intended as a publication outlet for original experimental measurements such as are normally reported in the primary research literature, nor for review articles of a descriptive or primarily theoretical nature.

Volume 4, No. 1

JANAF Thermochemical Tables, 1975 supplement, M. W. Chase, J. L. Curnutt, H. Prophet, R. A. McDonald, and A. N. Syverud, *J. Phys. Chem. Ref. Data* **4**, No. 1, 1-176 (1975).

Key words: critically evaluated data; enthalpy; entropy; equilibrium constant of formation; free energy of formation; Gibbs energy function; heat capacity; heat of formation; thermochemical tables.

The thermodynamic tabulations previously published in NSRDS-NBS-37 and the 1974 Supplement (J. Phys. Chem. Ref. Data 3, 311 [1974]) are extended by 158 new and revised tables. The JANAF Thermochemical Tables cover the thermodynamic properties over a wide temperature range with single phase tables for the crystal, liquid, and ideal gas state. The properties given are heat capacity, entropy, Gibbs energy function, enthalpy, enthalpy of formation, Gibbs energy of formation, and the logarithm of the equilibrium constant for formation of each compound from the elements in their standard reference states. Each tabulation lists all pertinent input data and contains a critical evaluation of the literature upon which these values are based. Literature references are given.

Diffusion in copper and copper alloys. Part III. Diffusion in systems involving elements of the groups IA, IIA, IIIB, IVB, VB, VIB, and VIIB, D. B. Butrymowicz, J. R. Manning, and M. E. Read, *J. Phys. Chem. Ref. Data* **4**, No. 1, 177-250 (1975).

Key words: alloy diffusion; beryllium; cerium; cesium; chromium; copper; diffusion; electromigration; europium; grain boundary diffusion; hydrogen; impurity diffusion; interdiffusion; lanthanum; liquid metal diffusion; lithium; lutetium; magnesium; manganese; molybdenum; niobium; plutonium; potassium; praseodymium; promethium; rhenium; rubidium; sodium; surface diffusion; tantalum; terbium; ternary diffusion; thermomigration; thulium; titanium; tungsten; uranium; vanadium; zirconium.

A survey, comparison, and critical analysis is presented of data compiled from the scientific literature concerning diffusion in copper alloy systems involving elements in Groups IA, IIA, IIIB, IVB, VB, VIB, and VIIB. Here the term "copper alloy system" is interpreted in the broadest sense. For example, the review of diffusion in the Cu-M system reports all diffusion situations which involve both copper and element M, including diffusion of Cu in M or in any binary, ternary or multicomponent alloy containing M; diffusion of M in Cu or in any alloy containing Cu; and diffusion of any element in any alloy containing both Cu and M. Topics include volume diffusion, surface diffusion, grain boundary diffusion, tracer diffusion, alloy interdiffusion, electromigration, thermomigration, dislocation-pipe diffusion, and diffusion in molten metals. An extensive bibliography is presented along with figures, tabular presentation of data and discussion of results.

Ideal gas thermodynamic properties of ethylene and propylene, J. Chao and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4**, No. 1, 251-261 (1975).

Key words: critically evaluated data; enthalpy; enthalpy function; enthalpy of formation; entropy; equilibrium constant of formation; ethylene; Gibbs energy function; Gibbs energy of formation; heat capacity; ideal gas thermodynamic properties; internal rotation; internal rotation barrier height; propylene; torsional frequency.

The ideal gas thermodynamic properties [$H°-H_0°$, $(G°-H_0°)/T$, $(H°-H_0°)/T$, $S°$, $C_p°$, $\Delta Hf°$, $\Delta Gf°$, and $\log K_f$] for ethylene and propylene in the temperature range 0 to 1500 K and at 1 atm have been calculated by the statistical thermodynamic method employing the most recent fundamental and molecular spectroscopic constants. The internal rotational contributions to thermodynamic properties for propylene were generated based on an internal rotation partition function formed by summation of internal rotation energy levels. The energy levels were derived from the potential function $V(\mathrm{cm}^{-1}) = 349.2\ (1 - \cos 3\theta) - 6.5\ (1 - \cos 6\theta)$. The calculated heat capacities and entropies were compared with the available experimental values.

Volume 4, No. 2

Atomic transition probabilities for scandium and titanium. (A critical data compilation of allowed lines), W. L. Wiese and J. R. Fuhr, *J. Phys. Chem. Ref. Data* **4**, No. 2, 263-352 (1975).

Key words: allowed transitions; line strengths; oscillator strengths; scandium; titanium; transition probabilities.

Atomic transition probabilities for about 1500 allowed spectral lines of the elements scandium and titanium through all stages of ionization have been critically evaluated and compiled. All available literature sources have been utilized. The data are presented in separate tables for each element and stage of ionization and are arranged according to multiplets and, when appropriate, also to transition arrays and increasing quantum numbers. For each line the transition probability for spontaneous emission, the absorption oscillator strength, and the line strength are given along with the spectroscopic designation, the wavelength, the statistical weights, and the energy levels (when available) of the upper and lower atomic states. In addition the estimated accuracy and the literature reference is indicated. In short introductions, which precede the tables for each spectrum, the main justifications for the choice of the adopted data and for the accuracy rating are discussed. A general introduction contains some more details on our evaluation procedure.

Energy levels of iron, Fe I through Fe XXVI, J. Reader and J. Sugar, *J. Phys. Chem. Ref. Data* **4**, No. 2, 353-440 (1975).

Key words: atomic energy levels; atomic spectra; iron.

The energy levels of the iron atom in all of its stages of ionization, as derived from the analyses of atomic spectra, have been compiled. In cases where only line classifications are given in the literature, level values have been derived. The percentages for the two leading components of the calculated eigenvectors of the levels are given where available. Ionization energies are also given.

Ideal gas thermodynamic properties of six fluoroethanes, S. S. Chen, A. S. Rodgers, J. Chao, R. C. Wilhoit, and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4**, No. 2, 441-456 (1975).

Key words: barrier height to internal rotation; fluoroethanes with a symmetric top; ideal gas thermodynamic functions; reduced and principal moments of inertia; standard heat of formation; structural parameters; torsional mode; vibrational fundamentals.

The molecular structural parameters, the vibrational fundamentals, the potential barrier height to internal rotation, and the standard enthalpy of formation for each of the six fluoroethanes in which at least one of the internally rotating groups is a symmetric top have been extensively studied and recommended values selected. Chemical thermodynamic properties of molecules in the ideal gas state at temperatures from 0 to 1500 K have been calculated with the rigid-rotor harmonic-oscillator approximation. The calculated values are in a very good agreement with the existing third-law entropies.

Ideal gas thermodynamic properties of the eight bromo- and iodomethanes, S. A. Kudchadker and A. P. Kudchadker, *J. Phys. Chem. Ref. Data* **4**, No. 2, 457-470 (1975).

Key words: bromomethanes; critically evaluated data; ideal gas thermodynamic properties; iodomethanes.

The available molecular parameters, fundamental frequencies, and enthalpy of formation for eight bromo- and iodomethanes have been critically evaluated and recommended values selected. This information has been utilized to calculate the ideal gas thermodynamic properties, $C_p°$, $S°$, $H° - H_0°$, $(G° - H_0°)/T$, $\Delta Hf°$, $\Delta Gf°$, and log Kf from 0 to 1500 K using the rigid rotor-harmonic oscillator approximation.

Volume 4, No. 3

Atomic form factors, incoherent scattering functions, and photon scattering cross sections, J. H. Hubbell, W. J. Veigele, E. A. Briggs, R. T. Brown, D. T. Cromer, and R. J. Howerton, *J. Phys. Chem. Ref. Data* **4**, No. 3, 471-538 (1975).

Key words: atomic form factor; Compton scattering; cross sections; gamma rays; incoherent scattering function; photons; Rayleigh scattering; tabulations; x rays.

Tabulations are presented of the atomic form factor, $F(x,Z)$, and the incoherent scattering function, $S(x,Z)$, for values of x (= $\sin(\theta/2)/\lambda$) from 0.005 Å^{-1} to 10^9 Å^{-1}, for all elements $A = 1$ to 100. These tables are constructed from available state-of-the-art theoretical data, including the Pirenne formulas for $Z = 1$, configuration-interaction results by Brown using Brown-Fontana and Weiss correlated wavefunctions for $Z = 2$ to 6 nonrelativistic Hartree-Fock results by Cromer for $Z = 7$ to 100, and a relativistic K-shell analytic expression for $F(x,Z)$ by Bethe and Levinger for $x > 10$ Å^{-1} for all elements $Z = 2$ to 100. These tabulated values are graphically compared with available photon scattering angular distribution measurements. Tables of coherent (Rayleigh) and incoherent (Compton) total scattering cross sections, obtained by numerical integration over combinations of $F^2(x,Z)$ with the Thomson formula and $S(x,Z)$ with the Klein-Nishina formula, respectively, are presented for all elements $Z = 1$ to 100, for photon energies 100 eV ($\lambda = 124$ Å) to 100 MeV (0.000124 Å). The incoherent scattering cross sections also include the radiative and double-Compton corrections as given by Mork. Similar tables are presented for the special cases of terminally-bonded hydrogen and for the H_2 molecule, interpolated and extrapolated from values calculated by Stewart et al. and by Bentley and Stewart using Kolos-Roothaan wavefunctions.

Binding energies in atomic negative ions, H. Hotop and W. C. Lineberger, *J. Phys. Chem. Ref. Data* **4**, No. 3, 539-576 (1975).

Key words: ab initio calculations; atomic negative ions; binding energy; electron affinity; excited states; experimental methods; fine structure splitting; recommended values; semiempirical calculations.

A survey of the electron affinity determinations for the elements up to $Z = 85$ is presented, and based upon these data, a set of recommended electron affinities is established. Recent calculations of atomic electron affinities and the major semiempirical methods are discussed and compared with experiment. The experimental methods which yield quantitative electron binding energy data are described and intercompared. Based primarily upon extrapolation techniques, fine structure splittings for these ions and excited state term energies are given.

A survey of electron swarm data, J. Dutton, *J. Phys. Chem. Ref. Data* **4**, No. 3, 577-856 (1975).

Key words: electrical breakdown of gases; electrical discharges; electron attachment coefficient; electron detachment coefficient; electron diffusion coefficient; electron drift velocity; electron excitation coefficient; electron ionization coefficient; electron-ion recombination coefficient; electron swarm; electron transport coefficients; ionized gases.

An electron swarm consists of a small number density n of electrons in a gas of much higher number density N. The mean energy and energy distribution of such a swarm are determined by the value of E/N, where E is the electric field. At any given value of E/N the swarm may be characterized by the values of eight parameters, viz: drift velocity, diffusion coefficient, (diffusion coefficient)/mobility, excitation coefficient, electron attachment coefficient, electron detachment coefficient, ionization coefficient, recombination coefficient. In this survey, data on these parameters obtained by a variety of experimental techniques are collected, discussed, and compared graphically. Also included on the graphs are computed values of the parameters obtained in many cases from cross sections and energy distributions chosen to give the best fit with the swarm data. Selected tabulations of the data are also given except in cases for which the accuracy of the data is not sufficient to warrant numerical presentation. The mean energy of the electron swarms ranges from thermal to several electron volts and the gases for which data are given are the rare gases, the common molecular gases (H_2, N_2, O_2, CO, NO, CO_2, NO_2) and air. The survey also contains an extensive bibliography which includes references (i) to publications on electron swarms in a much wider range of gases than those for which data are given and (ii) to papers concerned with energy distributions, conductivity, and ionization coefficients in crossed electric and magnetic fields in addition to those relating to the eight parameters listed above.

Volume 4, No. 4

Ideal gas thermodynamic properties and isomerization of n-butane and isobutane, S. S. Chen, R. C. Wilhoit, and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4**, No. 4, 859-870 (1975).

Key words: equilibrium compositions; heat of isomerization; ideal gas thermodynamic properties; isobutane; n-butane; potential barrier to internal rotation.

Reported values of structural parameters, vibrational fundamentals, and potential energy functions for internal rotation of n-butane and isobutane are reviewed. The selected values were used to calculate the thermodynamic properties $(C_p°, S°, (H° - H_0°)/T, (G° - H_0°)/T)$ in the temperature range of 0 to 1500 K by the usual statistical thermodynamic methods using the rigid-rotor and harmonic-oscillator model. Contributions of internal rotation were evaluated by the direct sum of terms containing energy levels which were calculated with a one-dimensional potential model. For internal rotation about the central C—C bond in n-butane, energy levels were approximated by two procedures. A unique potential function was assumed for each methyl rotor of n-butane or of isobutane. Top-top interactions in isobutane were approximated by the potential parameter V_6 which was determined empirically by comparison with thermodynamic data. The calculated and observed values of heat capacities and entropies agree well within experimental uncertainties. Standard enthalpies of formation at 298.15 K for the ideal gaseous state were selected from measured values of heats of combustion and third-law enthalpies for isomerization. Corresponding values of $\Delta Hf°$, $\Delta Gf°$ and log Kf are tabulated over the same temperature range.

Molten salts: Volume 4, part 2, chlorides and mixtures. Electrical conductance, density, viscosity, and surface tension data, G. J. Janz, R. P. T. Tomkins, C. B. Allen, J. R. Downey, Jr., G. L. Gardner, U. Krebs, and S. K. Singer, *J. Phys. Chem. Ref. Data* **4**, No. 4, 871-1178 (1975).

Key words: chlorides; data compilation; density; electrical conductance; molten salt mixtures; standard reference data; surface tension; viscosity.

Data on the electrical conductance, density, viscosity, and surface tension of chloride mixtures have been systematically collected and evaluated. Results are given for 124 binary mixtures over a range of compositions and temperatures. Values of the above properties for the single salts have been updated in accord with previously advanced recommendations.

3.5. MONOGRAPHS

Major contributions to the technical literature on various subjects related to the Bureau's scientific and technical activities.

Monogr. 25, Section 12. **Standard x-ray diffraction powder patterns. Section 12-data for 57 substances,** H. F. McMurdie, M. C. Morris, E. H. Evans, B. Paretzkin, J. H. de Groot, C. R. Hubbard, and S. J. Carmel, Nat. Bur. Stand. (U.S.), Monogr. 25-Sec. 12, 90 pages (Feb. 1975) SD Catalog No. C13.44:25/Sec. 12.

Key words: crystal structure; integrated intensities; lattice constants; peak intensities; powder patterns; reference intensities; standard; x-ray diffraction.

Standard x-ray diffraction patterns are presented for 57 substances. Twenty-five of these patterns represent experimental data and 32 are calculated. The experimental x-ray powder diffraction patterns were obtained with an x-ray diffractometer. All d-values were assigned Miller indices determined by comparison with computed interplanar spacings consistent with space group extinctions. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. The calculated x-ray powder diffraction patterns were computed from published crystal structure data. Both peak height and integrated intensities are reported for the calculated patterns.

Monogr. 125, Suppl. 1. **Thermocouple reference tables based on the IPTS-68: Reference tables in degrees Fahrenheit for thermoelements versus platinum (Pt-67),** R. L. Powell and G. W. Burns, Nat. Bur. Stand. (U.S.), Monogr. 125, Suppl. 1, 46 pages (Jan. 1975) SD Catalog No. C13.44:125/Suppl. 1.

Key words: base metals alloys; noble metal alloys; temperature scale; temperature standards; thermoelements; thermometry.

Reference tables for several thermoelements versus platinum (Pt-67) are given with values of the thermoelectric voltage as a function of temperature in degrees Fahrenheit. Only tables for standard letter-designated thermoelements are included: Types BP, BN, JP, JN, KP (same as EP), KN, TP, and TN (same as EN). These tables supplement those given in NBS Monograph 125 and were calculated from the power series expansions presented in that Monograph. They are based upon the absolute electrical units and the International Practical Temperature Scale of 1968 (IPTS-68).

Monogr. 139. **Interactions of high energy particles with nuclei,** W. Czyż, Nat. Bur. Stand. (U.S.), Monogr. 139, 73 pages (Sept. 1975) SD Catalog No. C13.44:139.

Key words: diffractive production; diffractive scattering; Glauber model; hadronic components of photons; high energy scattering; multiple scattering; neutrino-nucleus interactions; shadowing effects.

Elastic scattering and diffractive production processes induced in nuclear targets by high energy projectiles are discussed in this article. Special attention is paid to the interaction of high energy hadrons and photons. Interactions of high energy electrons and neutrinos are briefly mentioned. The common features of all these processes are emphasized throughout the article: The multiple scattering and shadowing processes inside of the target nuclei. An effort is made to develop a unified way of treating nuclear interactions of particles which are either hadrons or exhibit some hadronic components in such interactions.

This article is divided into five sections: 1) Introduction, 2) Description of multiple scattering, 3) Elastic scattering of hadrons from nuclei, 4) Diffractive dissociation and diffractive excitation, 5) Diffractive production of hadrons in hadron-nucleon collisions.

Monogr. 143. **Analysis of optically excited mercury molecules,** R. E. Drullinger, M. M. Hessel, and E. W. Smith, Nat. Bur. Stand. (U.S.), Monogr. 143, 51 pages (Jan. 1975) SD Catalog No. C13.44:143.

Key words: dissociation laser; excimers; excited state kinetics; *f*-values; mercury molecules; new spectroscopic techniques; optical excitation; potential curves.

The Hg_2 molecule is representative of a class of molecules which have dissociative ground states and bound excited states. It can therefore be used as a prototype of this class of molecules which are of interest as potential new laser candidates. Because of the non-bound ground state, standard absorption spectroscopic techniques cannot be used to obtain the necessary information about the excited states. We have therefore developed new measurement techniques to obtain potential curves, *f*-values, and kinetic behavior for Hg_2. These techniques are applicable to this whole class of dissociation molecular systems.

Monogr. 144. **The rotary-vane attenuator as an interlaboratory standard,** W. Larson, Nat. Bur. Stand. (U.S.), Monogr. 144, 70 pages (Nov. 1975) SD Catalog No. C13.44:144.

Key words: attenuation; interlaboratory standard; measurement; rotary-vane attenuator.

This paper presents a comprehensive report on the measurement and the use of the rotary-vane attenuator as an interlaboratory standard.

Methods of attenuation measurement developed at NBS are used to supply data for the evaluation of the deviations from theoretical $\cos^2$ law due to rotor misalignment, gear eccentricity, resettability, resolution, and insufficient maximum attenuation.

A precision rotary-vane attenuator with an optical readout capable of 1 second of arc angular resolution has an effective attenuation resolution of 0.00005 dB at a 3 dB dial setting, and 0.0005 dB at a 30 dB dial setting. This type of precision attenuator is an effective standard for use in the dual detection microwave bridge measurement system.

Monogr. 145, Part I. **Tables of spectral-line intensities. Part I—Arranged by elements,** W. F. Meggers, C. H. Corliss, and B. F. Scribner, Nat. Bur. Stand. (U.S.), Monogr. 145, Part I, 403 pages (May 1975) SD Catalog No. C13.44:145/I.

Key words: classification of spectral lines; intensities of spectral lines; spectral-line intensities; tables of spectral-line intensities; wavelengths of spectral lines.

The relative intensities, or radiant powers, of 39 000 spectral lines with wavelengths between 2000 and 9000 Ångstroms have been determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 atomic percent of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the National Bureau of Standards spectral-line intensities may have average errors of 20 percent, but first of all they provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. These data are presented by element in part I, and all 39 000 observed lines are given in order of wavelength in part II. Supersedes Monograph 32, Parts I and II and its supplement.

Monogr. 145, Part II. **Tables of spectral-line intensities. Part II—Arranged by wavelengths**, W. F. Meggers, C. H. Corliss, and B. F. Scribner, Nat. Bur. Stand. (U.S.), Monogr. 145, Part II, 228 pages (May 1975) SD Catalog No. C13.44:145/II.

Key words: classification of spectral lines; intensities of spectral lines; spectral-line intensities; tables of spectral-line intensities; wavelengths of spectral lines.

The relative intensities, or radiant powers, of 39 000 spectral lines with wavelengths between 2000 and 9000 Ångstroms have been determined on a uniform energy scale for seventy chemical elements. This was done by mixing 0.1 atomic percent of each element in powdered copper, pressing the powder-mixture to form solid electrodes which were burned in a 10 ampere, 220 volt direct-current arc, and photographing the spectra with a stigmatic concave grating while a step sector was rotating in front of the slit. The sectored spectrograms facilitated the estimation of intensities of all element lines relative to copper lines which were then calibrated on an energy scale provided by standardized lamps, and all estimated line intensities were finally adjusted to fit this calibration. Comparisons with other intensity measurements in individual spectra indicate that the National Bureau of Standards spectral-line intensities may have average errors of 20 percent, but first of all they provide uniform quantitative values for the seventy chemical elements commonly determined by spectrochemists. These data are presented by element in part I, and all 39 000 observed lines are given in order of wavelength in part II. Supersedes NBS Monograph 32, Parts I and II.

Monogr. 147. **Relativistic many-body bound systems**, M. Danos and V. Gillet, Nat. Bur. Stand. (U.S.), Monogr. 147, 149 pages (Apr. 1975) SD Catalog No. C13.44:147.

Key words: composite particles; interacting quantum fields; nuclear structure; particle structure; relativistic bound systems; relativistic nuclear physics.

The principles and the mathematical details of a fully relativistic nuclear theory are given. Since the concept of nuclear forces is a strictly non-relativistic construct, it must be abandoned and the forces must be replaced explicitly by their physical origin, i.e., by the interaction between nucleons and mesons. Thus, in this monograph the description of a nucleus has been formulated as a problem of relativistic quantum field theory which is solved by nuclear physics methods. To wit: The physics is described by specifying a Lagrangian which is a functional of the constituent fields (= of the parton fields). The solutions for the physical systems then are obtained in a time-independent treatment as expansions in the parton fields: both particles and nuclei are composite systems, made up of parton configurations, which define a representation of the Hamiltonian (associated with the specified Lagrangian). The Hamiltonian is truncated by omitting all configurations having a diagonal element exceeding that of the lowest configuration by a pre-determined value, E_{max}, and is diagonalized. All formulae needed to carry out this program are derived and given in full detail for spin 0, 1/2, and 1 parton fields for PS, PV, and φ^4 interactions. Particular attention is devoted to the center-of-mass position coordinate which in relativistic kinematics is a non-separable many-body operator. Finally, the configurations up to $E_{max} = 1$ GeV are listed for the nucleon, the deuteron, and the pion.

Monogr. 148. **The role of standard reference materials in measurement systems**, J. P. Cali, T. W. Mears, R. E. Michaelis, W. P. Reed, R. W. Seward, C. L. Stanley, H. T. Yolken, and H. H. Ku, Nat. Bur. Stand. (U.S.), Monogr. 148, 56 pages (Jan. 1975) SD Catalog No. C13.44:148.

Key words: certification; meaningful measurement; measurement; measurement system; precision; reference method; specificity; SRM; standard reference material; systematic error.

This publication is a guide to the use of Standard Reference Materials (SRM's) and should be useful to all users of SRM's, particularly those in countries developing national measurement systems. It is not intended to be an exhaustive description of the NBS-SRM program, but rather a review of the role SRM's play in the measurement system, how SRM's are certified, and what the certification means. To illustrate the use of SRM's several selected industries are described in which SRM's have made significant contributions.

Monogr. 149. **Measurement assurance program—A case study: Length measurements. Part 1. Long gage blocks (5 in to 20 in)**, P. E. Pontius, Nat. Bur. Stand. (U.S.), Monogr. 149, 75 pages (Nov. 1975) SD Catalog No. C13.44:149.

Key words: measurement algorithm; measurement assurance; measurement process; measurement unit; process variability; uncertainty.

The differences between the methods of traditional metrology and the measurement assurance programs are briefly discussed. The historical data relative to long gage blocks (5 in to 20 in) are analyzed to provide a basis for comparison with results from new measurement processes formulated in accordance with the philosophies of the measurement assurance programs. The results from the new processes are in agreement with the work of the past. The current length values assigned and associated uncertainties are shown for selected long gage blocks used in the dissemination of length by the National Bureau of Standards. These long gage blocks are a part of a growing collection of similar well characterized artifact standards for use in comparative measurement processes. The methods and techniques used in developing the new measurement process are discussed in some detail. It is the author's intent that, in addition to the technical content, this paper be largely tutorial in the area of measurement process analysis. This paper is, in essence, a report on the extension of the techniques first suggested in NBS Monograph 103 "Realistic Uncertainties and the Mass Measurement Process" to the area of length measurement.

Monogr. 152. **A gage block measurement process using single wavelength interferometry**, J. S. Beers, Nat. Bur. Stand. (U.S.), Monogr. 152, 34 pages (Dec. 1975) SD Catalog No. C13:44:152.

Key words: calibration; gage blocks; interferometery; laser; length; measurement process; uncertainty.

The interferometric transfer of the length unit from its defined wavelength to NBS reference standard gage blocks is basic to the gage block calibration program at NBS. The interferometric measurement process using a laser light source and a Kosters type gage block interferometer is described here. Continuous evaluation and refinement of the process is aided by statistical treatment and control chart techniques. All error sources, both random and systematic, are evaluated and the process is maintained in a state of statistical control.

3.6. HANDBOOKS

Recommended codes of engineering and industrial practice (including safety codes) developed in cooperation with interested industries, professional organizations, and regulatory bodies.

H114. **General safety standard for installations using non-medical x-ray and sealed gamma-ray sources, energies up to 10 MeV.** *(ANS N543-1974)*, E. H. Eisenhower, Nat. Bur. Stand. (U.S.), Handb. 114, 69 pages (Feb. 1975) SD Catalog No. C13.11:114.

Key words: gamma-ray equipment; radiation installations; radiation safety; x-ray equipment.

This standard establishes requirements for the design and operation of common types of installations which use gamma and x radiation for non-medical purposes. Its objective is to protect persons who work with or are near such installations, as well as the general public, against excessive exposure to radiation. Maximum permissible dose limits established by the National Council on Radiation Protection and Measurements are cited. Methods for achieving adequate radiation protection are described, including structural details, surveys and inspections, and operating procedures. Appendixes contain technical information useful for design of radiation shielding barriers. (Revision of ANS Z54.1-1963, published as NBS Handbook 93).

H115. Supplement 1. **Energy conservation program guide for industry and commerce (EPIC)**, R. G. Massey, Ed., Nat. Bur. Stand. (U.S.), Handb. 115, Suppl. 1, 212 pages (Dec. 1975) SD Catalog No. C13.11:115/Suppl. 1.

Key words: energy conservation; energy conservation guide; energy conservation opportunities; energy conservation program; industrial energy conservation.

The Energy Conservation Program Guide for Industry and Commerce (EPIC) is a handbook to assist business firms to establish an on-going conservation program. Supplement contains simplified management program, additional conservation opportunities, case studies, and sources of information.

H117. **Examination of vapor-measuring devices for liquefied petroleum gas. A manual for weights and measures officials**, S. Hasko, Nat. Bur. Stand. (U.S.), Handb. 117, 25 pages (Dec. 1975) SD Catalog No. C13.11:117.

Key words: bell prover; calibration; inspection; liquefied petroleum gas; pressure; report form; temperature; temperature compensator; test; vapor meter; volume.

A manual for State and local weights and measures officials for the examination and test of liquefied petroleum gas vapor measuring devices. Definitions, test methods, and testing apparatus (including description and calibration procedures) are given. Inspection and test procedures are reviewed. A proposed test report form along with suggestions on reporting the results of a test are included. Provision is made for accommodating a changeover to metric units of registration in the definitions, correction tables, procedures, and in reporting a test. Supersedes NBS Handbook 45.

H118. **MUMPS Language Standard**, J. T. O'Neill, Ed., Nat. Bur. Stand. (U.S.), Handb. 118, 144 pages (Dec. 1975) SD Catalog No. C13.11.118.

Key words: data handling language; interactive computing; interpretive computer programming language and operating system; medical automation; minicomputer-based systems; MUMPS; MUMPS Development Committee; MUMPS Language Standard.

This NBS Handbook contains a three-part description of various aspects of the MUMPS computer programming language. Part I, the MUMPS Language Specification, consists of a stylized English narrative definition of the MUMPS language which was adopted and approved for publication as a Type A release of the MUMPS Development Committee on March 12, 1975. Part II, the MUMPS Transition Diagrams, represents a formal definition of the language described in Part I, employing a form of line drawings to illustrate syntactic and semantic rules governing each of the language elements; it was adopted and approved for publication as a Type A release of the MUMPS Development Committee on September 17, 1975. Part III, the MUMPS Portability Requirements, identifies constraints on the implementation and use of the language for the benefit of parties interested in achieving MUMPS application code portability; it was adopted and approved for publication as a Type A release of the MUMPS Development Committee on September 17, 1975.

A bibliography of other MUMPS Development Committee documents is included.

3.7. SPECIAL PUBLICATIONS

Include proceedings of conferences sponsored by NBS, NBS annual reports, and other special publications appropriate to this grouping such as wall charts, pocket cards, and bibliographies.

SP260, 1975-76 Edition. **Catalog of NBS Standard Reference Materials 1975-76 Edition,** R. W. Seward, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-1975-76 catalog, 92 pages (June 1975) SD Catalog No. C13.10:260-1975-76 cat.

Key words: analysis; characterization; composition; General Materials; properties; Research Materials; Standard Reference Materials.

This Catalog lists and describes the Standard Reference Materials (SRM's), Research Materials (RM's), and General Materials (GM's) currently distributed by the National Bureau of Standards, as well as many of the materials currently in preparation. SRM's are used to calibrate measurement systems and to provide a central basis for uniformity and accuracy of measurement. The unit and quantity, the type, and the certified characterization are listed for each SRM, as well as directions for ordering. The RM's are not certified, but are issued to meet the needs of scientists engaged in materials research. RM's are issued with a "Report of Investigation," the sole authority of which is the author of the report. The GM's are standardized by some agency other than NBS. NBS acts only as a distribution point and does not participate in the standardization of these materials. Announcements of new and renewal SRM's, RM's, and GM's are made in the semi-annual supplements of this Catalog, SRM Price List, and in scientific and trade journals.

SP260-46. **Standard reference materials: Thermal conductivity and electrical resistivity. Standard reference materials: Austenitic stainless steel, SRM's 735 and 798, from 4 to 1200 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-46, 42 pages (Mar. 1975) SD Catalog No. C13.10:260-46.

Key words: austenitic stainless steel; electrical resistivity; high temperature; low temperature; standard reference materials; thermal conductivity.

A historical review of the development of selected thermophysical standard reference materials, SRM's, is given and selection criteria for those SRM's are listed. Thermal conductivity and electrical resistivity data for austenitic stainless steel, SRM's 735 and 798, are critically evaluated. Recommended values are presented for the temperature range 4 to 1200 K. Material variability studies, including the effects of heat treatment, have been performed at low temperatures. No irreversible transformations are observed up to temperatures of 1200 K. Based on the results of several types of characterization measurements, effects of material variability are believed to be less than 1 percent in electrical resistivity and not significantly more in thermal conductivity. The uncertainty of the recommended electrical resistivity data is estimated at 1 percent at low temperatures and 2 percent at higher temperatures. The corresponding uncertainty for thermal conductivity is 2 percent below 100 K, increasing to 3 percent at 300 K, and 5 percent at higher temperatures.

SP260-50. **Standard reference materials: Thermal conductivity and electrical resistivity standard reference materials: Electrolytic iron SRM's 734 and 797 from 4 to 1000 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-50, 41 pages (June 1975) SD Catalog No. C13.10:260-50.

Key words: electrical resistivity; electrolytic iron; high temperature; iron; Lorenz ratio; low temperature; standard reference material; thermal conductivity; thermopower.

A historical review of the development of Standard Reference Materials, SRM's, is given and selection criteria of SRM's are listed. Thermal conductivity and electrical resistivity data for electrolytic iron and similar irons are compiled, analyzed, and correlated. Recommended values of thermal conductivity and electrical resistivity for electrolytic iron, SRM's 734 and 797, are presented for the range 4 to 1000 K. These values are based on NBS measurements up to 280 K and on measurements by Oak Ridge National Laboratory on a similar iron above 280 K. The average uncertainty of the thermal conductivity values below ambient is 1.5 percent and 3 percent above ambient. The corresponding uncertainties in electrical resistivity are 1 percent and 2 percent.

SP260-51. **Standard reference materials: Glass filters as a Standard Reference Material for spectrophotometry—selection, preparation, certification, use, SRM 930,** R. Mavrodineanu and J. R. Baldwin, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-51, 118 pages (Nov. 1975) SD Catalog No. C13.10:260-51.

Key words: accuracy in spectrophotometry; glass filters; spectral bandpass; spectrophotometry; standard reference materials; stray radiation; testing of spectrophotometers; transmittance (absorbance) accuracy; wavelength accuracy.

This publication describes various factors which can affect the proper functioning of a spectrophotometer and suggests means and procedures to assess and control these factors. Particular consideration is given to the long and short term stability of a spectrophotometer, to the wavelength accuracy, the spectral bandpass, the stray radiation, and the accuracy of the transmittance or absorbance scale. A description is given of the means and Standard Reference Materials (SRM's) which can be used to control these factors, together with the methods for the preparation, certification, and use of such materials (SRM 930). The results obtained in actual use of SRM 930 are examined in some detail. An appendix contains the reproduction of several publications relevant to the subject discussed in this work.

SP260-52. **Standard reference materials: Thermal conductivity and electrical resistivity standard reference materials: Tungsten SRM's 730 and 799, from 4 to 3000 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-52, 47 pages (Sept. 1975) SD Catalog No. C13.10:260-52.

Key words: electrical resistivity; high temperature; Lorenz ratio; low temperature; standard reference materials; thermal conductivity; thermopower; tungsten.

A historical review of the development of thermophysical Standard Reference Materials, SRM's, is given and selection criteria of SRM's are listed. Thermal conductivity and electrical resistivity data for arc cast and sintered tungsten are compiled, analyzed, and correlated. Recommended values of thermal conductivity (SRM 730) and electrical resistivity (SRM 799) for these lots of tungsten are presented for the range 4 to 3000 K. These values are based on low temperature NBS measurements and higher temperature measurements by participants of the AFML-AGARD project. The uncertainty of the thermal conductivity values below ambient is 2 percent and rises to 5 percent between ambient and 2000 K. Above 2000 K the uncertainty rises to a maximum of about 8 percent. The uncertainty of the electrical resistivity values is 2 percent over the entire temperature range.

SP260-53. **Standard Reference Materials: Standardization of pH measurements,** R. A. Durst, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-53, 48 pages (Dec. 1975) SD Catalog No. C13.10:260-53.

Key words: buffers; buffer solutions; glass electrode; pH; pH buffers; pH electrode; pH measurement; pH standards.

One of the most widely performed analytical measurements in chemical laboratories is that of pH using the glass electrode. In order to insure the consistency of these measurements, the National Bureau of Standards has adopted an operational scale of pH defined in terms of the pH(S) of a series of standard buffer solutions. Certified samples of buffer materials, from which the standard reference solutions of reproducible pH can be prepared, are issued by the NBS. At present, the operational scale is defined by the pH of seven primary and three secondary standard solutions.

This report is concerned primarily with a discussion of the method used at the NBS for the assignment of pH values to the standard buffer solutions, a description of the NBS measurement facilities, and a summary of the characteristics of these standards. A brief discussion of the types of electrodes used and the calibration of pH instrumentation is also presented.

SP304A, Revised August 1975. **Brief history of measurement systems with a chart of the modernized metric system,** Nat. Bur. Stand. (U.S.), Spec. Publ. 304A, 4 pages (Aug. 1975).

Key words: International system of units; measurement systems; metric system; modernized metric system; SI; weights and measures.

The Modernized Metric System (also called the International System of Units) is made up of seven base units, two supplementary units, and many derived units. The chart describes this entire system, including details about the standards for each base unit and information on how the system is used.

The reverse side of the chart contains a brief history of measurement systems. The need for measurement began with primitive man, who used parts of his body and his natural surroundings for measurement standards and measuring instruments. As societies evolved, weights and measures became more complex. Two systems became predominant: the English system, rooted in the history and tradition of England: and the metric system, a scientifically based system using decimal notation. The metric system, with its inherent decimal advantages, gained widespread acceptance and is now the official measurement system in nearly all countries of the world.

SP305. Supplement 6. **Publications of the National Bureau of Standards 1974 catalog. A compilation of abstracts and key word and author indexes,** B. L. Hurdle, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 6, 523 pages (June 1975) SD Catalog No. C13.10:305 Suppl. 6.

Key words: abstracts, NBS publications; key words; publications.

This supplement to Special Publication 305 Supplements 1 through 5 of the National Bureau of Standards lists the publications of the Bureau issued between January 1, 1974 and December 31, 1974. It includes an abstract of each publication (plus some earlier papers omitted from Special Publication 305 Supplement 4), key-word and author indexes; and general information and instructions about NBS publications.

Miscellaneous Publication 240 (covering the period July 1, 1957 through June 30, 1960) and its supplement (covering the period July 1, 1960 through June 30, 1966), Special Publication 305 (covering the period July 1966 through December 1967) and Special Publication 305 Supplement 1 (covering the period 1968-1969), Special Publication 305 Supplement 2 (covering the period 1970), Special Publication 305 Supplement 3 (covering the period 1971), Special Publication 305 Supplement 4 (covering the period 1972), Special Publication 305 Supplement 5 (covering the period 1973) remain in effect. Two earlier lists, Circular 460 (Publications of the National Bureau of Standards, 1901 to June 1947) and its supplement (Supplementary List of Publications of the National Bureau of Standards, July 1, 1947 to June 30, 1957) are also still in effect.

SP329. Supplement 2. **An index of U.S. voluntary engineering standards,** W. J. Slattery, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 329, Suppl. 2, 472 pages (May 1975) SD Catalog No. C13.10:329, Suppl. 2.

Key words: engineering standards, index of; index of standards, recommended practices, specifications, test methods; Key-Word-in-Context index of voluntary standards; KWIC index of standards; standards, voluntary, index of.

This supplement contains the permuted titles of more than 5,700 voluntary engineering standards, specifications, test methods, codes and recommended practices published by 164 U.S. technical societies, professional organizations and trade associations. 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.

SP366-2. **Bibliography on atomic line shapes and shifts (July 1973 through May 1975),** J. R. Fuhr, G. A. Martin, and B. J. Specht, Nat. Bur. Stand. (U.S.), Spec. Publ. 366 Suppl. 2, 75 pages (Nov. 1975) SD Catalog No. C13.10:366/Suppl. 2.

Key words: atomic; instrumental broadening; line shapes; line shifts; pressure broadening; resonance broadening; Stark broadening; van der Waals broadening.

This is the second supplement to the NBS Special Publication 366, "Bibliography on Atomic Line Shapes and Shifts (1889 through March 1972)." It contains about 400 references and covers the literature from July 1973 through May 1975. As before, the bibliography contains five major parts: (1) All general interest papers are catalogued according to the broadening mechanisms (and, further, according to special topics under several of the mechanisms) and as to whether the work is a general theory, a general review, a table of profiles or parameters, a comment on existing work, a study of general experimental measurement techniques, or an experimental effort of general importance. Also included are selected papers on important applications of line broadening and on miscellaneous topics relating to atomic spectral line shapes and shifts. (2) In Part 2, all papers containing numerical data are ordered as to element, ionization stage, and broadening mechanism (in the case of foreign gas broadening the perturbing species are listed), and it is indicated whether the data are experimentally or theoretically derived. (3) While in the two preceding parts of the bibliography the references are listed for brevity by identification numbers only, in Part 3 all references are listed completely by journal, authors, and title and are generally arranged chronologically and alphabetically within each year according to the principal author. (4) This section contains a list of all authors and their papers. (5) A final section provides corrections or additions to the first bibliography and supplement.

SP371-1. **Supplementary bibliography of kinetic data on gas phase reactions of nitrogen, oxygen, and nitrogen oxides (1972-1973),**

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F. Westley, Nat. Bur. Stand. (U.S.), Spec. Publ. 371-1, 88 pages (June 1975) SD Catalog No. C13.10:371-1.

Key words: bibliography; chemical kinetics; excited state; gas phase; nitrogen atom; nitrogen molecule; nitrogen oxides; oxygen atom; oxygen molecule; ozone.

A reaction-oriented list of references is provided for papers and reports published in 1972 and 1973, containing rate data for reactions of N, N_2, N_2O, N_2O_2, N_2O_3, N_2O_4, N_2O_5, NO, NO_2, NO_3, NO_4, O, O_2 and O_3 with each other. Some reactions of species in excited states are included. This bibliography, covering about 500 papers, extends the coverage of two previous bibliographies on the same subject, COM-71-00941, NBS-OSRDB-71-2, August 1971 and NBS Special Publication 371, February 1973. Some work published prior to 1972 omitted in the previous publications has been included here.

SP396-2. **Critical surveys of data sources: Ceramics**, D. M. Johnson and J. F. Lynch, Nat. Bur. Stand. (U.S.), Spec. Publ. 396-2, 52 pages (Dec. 1975) SD Catalog No. C13.10:396-2.

Key words: carbon (graphite); ceramics; composites; data sources; glasses; properties.

A directory was compiled for selected sources of property data of ceramics, glasses, carbon/graphite and composite materials containing a ceramic component. Included is an assessment of the scope, assets and deficiencies of the most prominent sources. These include handbooks, technical compilations, information/data centers, technical societies, and trade associations or institutes. The directory is indexed by materials and properties.

SP400-5. **Semiconductor measurement technology: Measurement of transistor scattering parameters**, G. J. Rogers, D. E. Sawyer, and R. L. Jesch, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-5, 53 pages (Jan. 1975) SD Catalog No. C13.10:400-5.

Key words: electronics; high-frequency probes; interlaboratory comparison; scattering parameters; S parameters; transistors.

Results of an interlaboratory comparison of transistor scattering-parameter measurements are reported for transistor types 2N709, 2N918 and 2N3960. From these results it is estimated that, for such devices, between-laboratory variability of transistor S-parameter measurements in the frequency range between 200 and 2000 MHz could be held to a maximum relative sample standard deviation of 7.5 percent in the measurement of magnitude and a maximum sample standard deviation of 8 degrees in the measurement of phase of s_{11} and 3.5 degrees in the measurement of phase of other S parameters. This could be done if all participants were required to use the same calibration procedure and to limit their test signal to a level that would assure small-signal operation. In a separate study, the equivalent circuit of high-frequency probes used in characterizing the parameters of integrated circuits was evaluated by measuring S parameters at the input connectors with the probe tips in contact with known loads. These measurements revealed a resonance which would limit the usefulness of the probes for measurements in the vicinity of 1.2 GHz. Work is underway to determine design changes needed to eliminate this resonance.

SP400-8. **Semiconductor measurement technology. Quarterly report, April 1 to June 30, 1974**, W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-8, 70 pages (Feb. 1975) SD Catalog No. C13.10:400-8.

Key words: Boron redistribution; Darlington pairs; dopant profiles; electrical properties; electronics; epitaxial layer thickness; flying-spot scanner; gold-doped silicon; hermeticity; measurement methods; microelectronics; micrometrology; MOS devices; oxide films; photomasks; photoresist; resistivity; scanning electron microscopy; semiconductor devices; semiconductor materials; semiconductor process control; silicon; spreading resistance; test patterns; thermal resistance; thermal response; thermally stimulated capacitance; thermally stimulated current; ultrasonic bonding; voltage contrast mode; wire bonds.

This quarterly progress report describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. The emphasis is on silicon device technologies. Principal accomplishments during this reporting period include (1) identification of surface preparation procedures which improve the quality of spreading resistance measurements, (2) preparation of a videotaped tutorial discussion of thermally stimulated current and capacitance measurements, (3) completion of an analysis of the apparent position of an opaque edge when viewed with incoherent and coherent illumination, and (4) completion of the construction of a flying-spot scanner. Results are also reported on capacitance-voltage and two-probe resistivity measurements; analyses of thermally stimulated current and capacitance measurements on metal-oxide-semiconductor (MOS) capacitors; a review of methods for characterizing interface states associated with thin oxide films on silicon; fabrication of a test pattern based on the charge-coupled device; a preliminary comparison of filar and image shearing eyepieces for line-width measurement; a review of technologies in use for photomask inspection and measurements; procedures for determination of correct photoresist exposure; epitaxial layer thickness; scanning electron microscopy; mathematical modeling of ultrasonic bonding; leak test procedures; thermal resistance measurements on transistors and Darlington pairs, and transistor thermal response measurements. Supplementary data concerning staff, publications, workshops and symposia, standards committee activities, and technical services are also included as appendices.

SP400-11. **Semiconductor measurement technology: A BASIC program for calculating dopant density profiles from capacitance-voltage data**, R. L. Mattis and M. G. Buehler, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-11, 39 pages (June 1975) SD Catalog No. C13.10:400-11.

Key words: BASIC; capacitance-voltage measurements; computer programs; dopant profiles; error function; Gaussian diffusion; plotting, computer; semiconductors; silicon.

A computer program is presented which is suitable for calculating dopant density vs. depth profiles from capacitance-voltage data for the case of a Gaussian-diffused *p-n* junction diode. The program includes corrections for peripheral capacitance of round or rectangular diodes and back depletion of the space charge region into the diffused layer. Inputs to the program consist of the surface dopant density, the junction depth, the background dopant density in the diffused layer, the junction diameter, three scaling parameters, and the capacitance-voltage data pairs. Output from the program is in the form of a plot and an optional listing of dopant density as a function of depth. The equations underlying the program are given and are related to the program whose operation is described in detail. A second program, for generating idealized capacitance-voltage data for a Gaussian-diffused diode on material with a constant dopant density is also included.

SP400-12. **Semiconductor measurement technology: Quarterly report, July 1 to September 30, 1974**, W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-12, 59 pages (May 1975) SD Catalog No. C13.10:400-12.

Key words: acoustic emission; beam-lead bonds; boron redistribution; Darlington pairs; dopant profiles; electrical properties; electronics; epitaxial layer thickness; flying-spot scanner; gold-doped silicon; hermeticity; incremental sheet resistance; measurement methods; microelectronics; micrometrology; MOS devices; oxide films; resistivity; scanning low energy electron probe; semiconductor devices; semiconductor materials; semiconductor process control; silicon; test patterns; thermally stimulated current; thermal resistance; thermal response; ultrasonic bonding; wire bonds; x-ray photoelectron spectroscopy.

This quarterly progress report describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. The emphasis is on silicon device technologies. Principal accomplishments during this reporting period include (1) completion of Hall effect measurements to determine activation energies of the gold donor and acceptor levels in silicon; (2) successful direct measurement of fast interface state density with the circular CCD test structure; and (3) demonstration of the feasibility of the use of acoustic emission as a non-destructive means for testing individual beam-lead bonds. Results are also reported on a holder for semi-automated sheet resistance measurements, progress on development of mathematical models of dopant profiles, analysis of thermally stimulated current and capacitance measurements on junction diodes, x-ray photoelectron spectroscopy, a comparative study of surface analysis techniques, design and fabrication of a test pattern for resistivity-dopant density evaluation, epitaxial layer thickness measurement, use of the flying-spot scanner, initial work on the scanning low energy electron probe, mathematical modeling of ultrasonic bonding, an improved method for force adjustment and measurement on beam lead bonders, helium mass spectrometery for leak testing, thermal resistance measurements on Darlington pairs, and transistor thermal response measurements. Supplementary data concerning staff, publications, workshops and symposia, standards committee activities, and technical services are also included as appendices.

SP400-13. **Semiconductor measurement technology: Improved infrared response technique for detecting defects and impurities in germanium and silicon *p-i-n* diodes,** A. H. Sher, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-13, 26 pages (Feb. 1975) SD Catalog No. C13.10:400-13.

Key words: carrier trapping; gamma-ray detector; germanium; Ge(Li) detector; infrared response silicon.

An infrared response (IRR) technique was evaluated for its utility in qualifying germanium for radiation detector use. Because of several improvements in the sensitivity and interpretation of the technique made during the evaluation, it was possible to observe a number of discrete energy levels lying within the forbidden energy gap of germanium which had passed unobserved in previous studies. These levels correlate with the type of defects and vacancies introduced by radiation damage into germanium as measured using such techniques as photoconductivity and Hall effect measurements after irradiation. Furthermore, the improved infrared response measurement method was used to identify impurities, such as copper, gold, and iron, and dislocations resulting from heat treatments in germanium. A major advance was made when it was determined that the IRR spectra could be grouped into five distinct types on the basis of spectral features observed in the energy range from 0.6 to 0.7 eV. One of the spectrum types represented crystals from which good quality detectors could be fabricated; the other four represented crystals that yielded poorer quality detectors due to carrier trapping, or crystals that presented problems such as low lithium drift mobility in detector fabrication. Three of the four spectrum types representative of poor crystal quality could be duplicated by suitably degrading specimens of a good quality crystal. The material and detector characteristics of crystals within each spectrum type were found to be similar.

SP400-17. **Semiconductor measurement technology: Progress report, October 1 to December 31, 1974,** W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-17, 79 pages (Nov. 1975) SD Catalog No. C13.10:400-17.

Key words: boron nitride; boron redistribution; capacitance-voltage methods; Darlington pairs; deep depletion; dopant profiles; electrical properties; electron beam evaporator; electron beam induced damage; electronics; epitaxial layer thickness; filar eyepiece; flying-spot scanner; hermeticity; hydrogen chloride gas; image shearing eyepiece; laser interferometry; measurement methods; microelectronics; micrometrology; MOS devices; oxide films; photomask inspection; resistivity; scanning electron microscope; scanning low energy electron probe; semiconductor devices; semiconductor materials; semiconductor process control; silicon; test patterns; thermally stimulated current; thermal resistance; thermal response; ultrasonic bonding; wire bonds; x-ray photoelectron spectroscopy.

This progress report describes NBS activities directed toward the development of methods of measurement for semiconductor materials, process control, and devices. The emphasis is on silicon device technologies. Principal accomplishments during this reporting period include (1) initiation of development of measurement technology for characterizing boron nitride diffusion sources and hydrogen chloride purging gas, (2) application of dc electrical methods with a sensitivity of about 0.1 μm to the measurement of critical dimensions such as the width of diffusion windows, (3) completion of an initial comparison of line-width measurements made with an image shearing eyepiece and a filar eyepiece, and (4) development of procedures for measuring electrically the thermal resistance of the output transistor of integrated Darlington pairs. Also reported are the intermediate results of an interlaboratory evaluation of standard reference wafers for resistivity, evaluation of the deep-depletion method for measuring dopant density with an MOS capacitor, progress on development of mathematical models of dopant profiles, initial results of the reevaluation of Irvin's curve for *n*-type silicon, analysis of thermally stimulated current and capacitance measurements on MOS capacitors, study of surface carbon contamination which occurs during measurement of silicon by x-ray photoelectron spectroscopy, preliminary measurements of absorbed dose from electron-beam evaporation of aluminum films, initial evaluation of the CCD test structure operating as an MOS capacitor and an MOS transistor, analysis of a TV-microscope system for photomask inspection, initial study of calibration procedures and artifacts for photomask metrology, analysis of the range of applicability of MOS C-V methods for epitaxial layer thickness measurement, use of an optical flying-spot scanner, assessment of damage to selected integrated circuits caused by inspection with a scanning electron microscope, mathematical modeling of ultrasonic bonding, a dry gas method for gross leak testing, and measurements of transistor thermal response. Supplementary data concerning staff, publications, workshops and symposia, standards committee activities, and technical services are also included as appendices.

SP400-20. **Semiconductor measurement technology: Optical and dimensional-measurement problems with photomasking in microelectronics,** J. M. Jerke, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-20, 42 pages (Oct. 1975) SD Catalog No. C13.10:400-20.

Key words: integrated circuits; microelectronics; micrometrology; photolithography; photomask; semiconductor technology.

Photomasks are the basic artifacts for transferring design geometry to the semiconductor wafer in integrated circuit (IC) production. Currently, photolithographic techniques using optical equipment are the primary means for both fabricating masks and using masks to print patterns on wafers. The present study was to identify the major optical and dimensional-measurement problems related to the fabrication and use of masks.

The results show that the primary optical problems are those related directly to the use of optical instruments for dimensional measurements of IC pattern geometry. Furthermore, most suppliers and users of optical equipment for mask fabrication do not conduct sufficient optical testing to determine imaging performance. The basic limitations derived from light diffraction and coherence continue to limit the quality of masks and IC devices with sub-micrometre geometry, and acceptable units are produced generally on a best-effort basis. The primary dimensional-measurement problems are (1) accurate measurements below about 10 μm, (2) edge definition or location of a physical edge for a line, and (3) mask registration. Recommendations to improve the accuracy of dimensional measurements are given.

A bibliography of publications related to the optical and micrometrological aspects of photomasking is included.

SP406. **Computer performance evaluation: Report of the 1973 NBS/ACM Workshop.** T. E. Bell, B. W. Boehm, and S. Jeffery, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 406, 180 pages (Aug. 1975) SD Catalog No. C13.10:406.

Key words: computer architecture; computer performance evaluation; installation management; measurement; modeling; monitoring; operating systems; performance objectives.

An ACM/NBS Workshop on Computer Performance Evaluation (CPE) was held in San Diego, Calif., in March 1973. The papers, workshop discussions, conclusions, and recommendations presented in this volume address specific problems in making computer performance evaluation a commonplace and productive practice.

While several of the conclusions indicate that improvements are needed in performance analysis tools, another suggests that improved application of CPE could be achieved by better documentation of analysis field to develop its full potential. Participants noted that the common emphasis on data collection or modeling, to the exclusion of considering objectives, often seriously degrades the value of performance analysis. *These proceedings include the following papers (indented):*

Computer system performance factors at Mellon Bank. G. P. DiNardo, *SP406*, pp. 27-31 (Aug. 1975).

Key words: reduction of measurement data; software measurement tools; total computing capacity; user satisfaction measurement.

Mellon Bank has acquired or developed a series of software measurement tools which gather statistics related to job production and system utilization. No one software tool meets all the bank's needs and, on occasion, resort is made to a hardware probe. Of particular benefit have been data reduction schemes, file managers, and query languages that facilitate rapid reduction, summarization, search, and calculation of the raw measurement data. A continuing aim has been to use the same body of basic measurement data for job production statistics, system tuning data, and user costing schemes. In spite of the use of benchmarks, etc., there is concern about a basic inability to access accurately total third generation computing capacity in a rapidly changing hardware and software environment. The increasing need and the capability to make more accurate, timely, usable, and meaningful data immediately available to the final user requires use of teleprocessing, file management, and query systems that in a narrow and traditional sense are "wasteful" of system resources on a massive scale.

Computer performance analysis: Industry needs. E. Seals, *SP406*, pp. 33-38 (Aug. 1975).

Key words: Computer Performance Evaluation (CPE); CPE education; CPE imagination; CPE instrumentation; CPE policy; EDP productivity.

The computer has grown in its ability to provide information processing support to the automobile industry. The budget for computers and related items has also grown, both in magnitude and as a percentage of the expense of sales. Computer Performance Evaluation (CPE) has begun to offer help in increasing the productivity of EDP equipment. The auto industry has recognized the need for CPE and engages in CPE programs with vigor. The general CPE consciousness taking hold within the EDP community promises benefits to the auto industry, which currently is involved with generating its own CPE talent and techniques.

This paper discusses the CPE needs of the automobile industry with specific references to General Motors where the author was previously involved in CPE activities.

Performance factors for university computer facilities. J. C. Browne, *SP406*, pp. 39-42 (Aug. 1975).

Key words: end-user satisfaction; performance evaluation; performance factors; resource utilization; user competence.

The unique problems of performance evaluation in a university computer facility arise because of the diversity of usage patterns and resource demand patterns with which a single facility must cope. In such an environment, one key element of performance evaluation is the characterization of the workload; another is that a high premium must be placed upon adaptability and flexibility of the management algorithm. Subsystem performance can normally be subdivided into the service given the different classes of users. It is a balanced and adequate performance in these subsystems which is basically the most important criterion in universities.

Certain performance factors are discussed, such as end-user satisfaction, resource utilization, and usage of system subcomponents. The skewed competence of users, peculiar to a university environment, is also discussed as a factor affecting performance.

Computer sub-system performance. G. Carlson, *SP406*, pp. 45-52 (Aug. 1975).

Key words: distribution; low utilization; overhead; suboptimization; subsystem measurement; variability.

The goal of performance measurement is to improve the performance of the system and reduce the cost. The present measurement tools start at the computer subsystem level. A thorough understanding of these tools seems to be necessary before we can move beyond the subsystem level into the overall system, then the computer operations, then the computer management, and hopefully beyond. Subsystem measurements have a direct impact on equipment configurations in terms of reduction of presently installed equipment, postponement of planned equipment, selection of new equipment, and comparison between different vendors. How to detect and interpret low and high device utilization and uneven distributions of activities is covered.

Overhead is explored in several contexts and an attempt to generalize the concept of overhead is made. Performance comparisons are made between theoretical and practical maximums. Suboptimization is discussed, pointing out that some suboptimization can have no bad side effects and should be achieved.

Variability in present measurement techniques is bothersome and is discussed briefly. A need for better reporting techniques is indicated.

Computer system performance factors—Their changing requirements, R. L. Morrison, *SP406*, pp. 53-60 (Aug. 1975).

Key words: computer system; factors; measurement; parameters; performance; performance terminology; predictability; requirements; variables; workload.

Advances in programming and computer system architecture are causing additional performance factors to be identified faster than the relationships among them are being understood. This must necessitate changes in the technology, terminology, and methodology, used to measure and describe computer system performance in the future. Problems and limitations resulting from using several measures of performance popular today, and suggestions for meeting tomorrow's needs, are noted in this paper. Insights gained from evaluating IBM's recently delivered storage systems during their development and early release stages provide the basis for discussing these changing requirements.

End-user subsystem performance, P. J. Kiviat, *SP406*, pp. 61-64 (Aug. 1975).

Key words: computer performance evaluation; efficiency measurement data; measures of computer performance; system effectiveness.

Subsystem end-users should be concerned primarily with measures of system effectiveness that are cost or value based. Only through these measures can they relate the operations of their subsystem to the goals of the larger system. Individual subsystem effectiveness measures should be related through a total systems effectiveness model to permit tradeoff and marginal allocation decisions to be made.

Subsystem end-users are usually not concerned with measures of system efficiency, which are the traditional computer performance measurements, but they are responsible for seeing that their effectiveness is achieved at minimum cost, which is determined and achieved by analysis of computer performance measurement data. Subsystem end-users therefore should see that their operating units receive system efficiency measurement data and that they understand how resource efficiency is related to system effectiveness.

End-user system performance, N. R. Nielsen, *SP406*, pp. 65-71 (Aug. 1975).

Key words: computer performance evaluation; computer resource allocation; computer service parameters; computer system performance; cost/effectiveness; cost/performance; performance evaluation; user control of computing; users' performance evaluation; users' performance measures.

The end-user's view of a computer system's performance is generally quite different from that of the computer professional or of the service provider. He is unconcerned about such traditional system performance measures as CPU utilization, channel balance, memory fragmentation, and I/O queues. He is concerned only with the indirect effects of these measures as manifested in the cost he incurs or in the performance he receives. Factors reflected in these measures encompass items in the areas of accounting cost, control, system service, reliability, user interface, output, programming, and user (rather than system) performance.

In addition to the usual perceptual differences that exist between server and user, there are also significant disparities in the items taken to define performance, in the measures used to reflect that performance, and in the criteria employed to evaluate the measured performance. The paper explores some of these differences as well as discussing certain aspects of system performance which are of particular concern to the end-users of computer systems.

Complementary pursuits—Computer design, W. T. Wilner, *SP406*, pp. 75-78 (Aug. 1975).

Key words: computer architecture; functional evaluation; hardware monitor; measurement tools; performance measurement.

The relationship between computer design and performance analysis is argumentatively claimed to be an information-producing symbiosis. Performance analysis can add precision to the conceptual models which designers use to generate new systems. Most of the major aspects of good models, however, are unquantifiable. Computer design can help or hinder performance analysis, mainly by adding or omitting those few components which allow hardware monitors to recognize significant system events.

Validation aspects of performance evaluation, R. J. Rubey, *SP406*, pp. 79-82 (Aug. 1975).

Key words: actual system performance; computer performance evaluation; performance prediction; simulation; software validation; tools.

This paper describes the relationship between software validation and computer performance evaluation. A brief review of validation objectives and methods is presented. With this background, three principal aspects of the relationship between validation and evaluation are explored.

The first aspect to be explored is the activity undertaken during validation to compare the actual system performance with performance predicted earlier. The second aspect, with which the paper is concerned, is the difficulty of validation. This should be an important consideration in the evaluation of a particular software or hardware system. The third aspect of the relationship is the similarity of the tools used in validation and performance evaluation.

Security vs. performance, D. R. Chastain, *SP406*, pp. 83-86 (Aug. 1975).

Key words: computer performance; computer security; hardware monitors; performance evaluation of secure computer systems; security, data transmission; security, file access; security, identification (password); security, input and output processing; security software; software monitors.

The necessity for security often overrides the concern for optimum performance of a computer system. However, it is important that the relationships between security and performance be recognized. In this paper three major areas concerning these relationships are discussed.

The first concern is with some of the types of hardware and software that are required in order to maintain security internally in an ADP system, and the effect of this hardware and software on the performance of the system.

The second area discusses some of the complex problems of evaluating the impact of security software on the performance of computer systems.

The final area discusses a number of other technical and human problems often associated with evaluating performance in a secure environment.

Performance evaluation techniques and system reliability—A practical approach, J. Hughes, *SP406*, pp. 87-96 (Aug. 1975).

Key words: hardware monitoring; monitoring register; software monitoring; system reliability.

A literature search discloses very few papers devoted to the improvement of system reliability through the use of performance evaluation techniques. A brief description is provided of an existing hardware monitor of advanced design which is capable of discerning both software and hardware events. In terms of such a tool, methods are discussed by which an attack may be launched on a number of the root causes of system unreliability. In order that new forms of packaging technology may not jeopardize the continuing use of such techniques, a proposal is made for the inclusion of a monitoring register in future computer systems.

Measurement tools, C. D. Warner, *SP406*, pp. 99-102 (Aug. 1975).

Key words: computer; evaluation; hardware monitors; measurement; performance; software monitors; throughput.

First generation computers were designed to operate in a serial fashion – performing one operation at a time (e.g., input, output, process). Performance evaluation was simply a matter of determining, with a watch or calendar, the time from the start of a job to the end. After several generations of computers, we now have systems with an enormous degree of complexity and parallelism.

In an effort to keep pace in the performance evaluation area, several computer manufacturers, as well as companies not directly involved in the manufacture of computers, have built a number of performance measurement tools. These tools cover the whole spectrum, from a simple device using electromechanical counters, to a system larger than most computers it would measure.

Future measurement systems will involve both hardware and software. Special software sometimes will communicate with the hardware monitor over a special I/O interface. These new measurement systems will then not only provide information about system performance, but will provide much more accurate job accounting information than is currently available, as well as doing a better job of scheduling.

State of the art: Experiment design and data analysis, H. D. Schwetman, *SP406*, pp. 103-108 (Aug. 1975).

Key words: computer system performance evaluation; experimental assessment of system behavior; performance data analysis; performance data presentation; performance monitoring.

Experimental observations form an important part of computer system performance evaluation. It is through experimentation that models are validated, simulations parameterized and systems tuned. This paper surveys several approaches to designing experiments to aid in the assessment of systems behavior. Data gathering tools and techniques are discussed, as are the important topics of data presentation and data analysis. The paper concludes with a critical examination of the state of the art of experimentation. The key problems are found to include: (1) a lack of generally applicable guidelines, (2) a missing link between low-level data and high-level questions, and (3) a lack of means for dealing with variations in behavior attributable to variations in the workload.

Computer performance variability, T. E. Bell, *SP406*, pp. 109-112 (Aug. 1975).

Key words: computer performance analysis; measurement; performance monitoring; performance variability.

The performance of a computer varies significantly, even when it is subjected to the same load. Analysts who are performing between-machine comparisons, predicting performance, or merely trying to understand performance can be led to incorrect decisions if random variability is interpreted as representing real differences. Tightly controlled tests employing a flexible synthetic job indicated that elapsed time, processor time, and response time vary enough to deceive analysts. Several trends seem to indicate that variability will increase with time, so the effect will increase in importance. Both computer manufacturers and performance analysts should take specific actions to preclude problems due to computer performance variability.

Domains for performance measurement, S. Jeffery, *SP406*, pp. 113-117 (Aug. 1975).

Key words: accounting systems; hardware monitors; performance evaluation; performance measurement; software monitors.

In lieu of an integrated approach to performance, it may be helpful to propose a structure for consideration of the entities of Performance Measurement: systems, applications, and measurement techniques. It is proposed that these entities can be compartmentalized into "domains," for the categorization of performance measurement. It is likely that definite domains will be uncovered indicating the use of performance measurement, or more important and less widely recognized, where it is not cost-effective to perform system measurement.

The tools for measuring performance – hardware monitors, software monitors, and accounting systems – are discussed in terms of system level or application level management programs.

Several tasks are suggested that need to be addressed: (1) the gathering of currently available information on the use of accounting systems, and the development and publication of guidelines for the employment of accounting data; (2) the development and postulation of a set of Computer Performance Evaluation domains; (3) a Performance Measurement Handbook comprising guidelines for utilization of computer performance evaluation over all domains.

Queueing theoretic models, P. J. Denning and R. R. Muntz, *SP406*, pp. 119-121 (Aug. 1975).

Key words: analytical models; evaluation; measurement; networks; performance; queues.

Tradeoffs between methods of solving analytical queueing models are discussed. It is suggested that representing the multiple (simply defined) resources of a computer system and the sequencing of tasks among these resources gives models which are simple enough to yield to analysis and yet are applicable to systems of interest. Theoretical results from the study of such networks are summarized and directions of future research are briefly discussed.

An analytic framework for computer system sizing and tuning, S. R. Kimbleton, *SP406*, pp. 123-126 (Aug. 1975).

Key words: analytical; computer systems modeling; end users; performance.

Performance analysis, as practiced by end users, appears to be dominated by the trial and error approach. Computer systems modeling techniques have received relatively little usage by such users except for the sporadic application of commercially available computer system simulators. Vendors, by contrast (cf. the various ACM and IEEE publications) have been extensive users of both analytical and simulation based techniques for performance analysis. This paper discusses some of the reasons underlying the lack of extensive usage of such techniques by end users, identifies an area of performance analysis appropriate to the usage of modeling techniques and discusses an approach to its investigation through their usage.

Relating time and probability in computer graphs, R. R. Johnson, *SP406*, pp. 127-130 (Aug. 1975).

Key words: evaluation; graphs; measurement; networks; performance; Petri Nets; probability.

Program behavior is discussed in terms of Petri Nets. Using probabilistic information, an experimental method is given to determine the time spent in each state. To illustrate the method, two examples are given for program graphs.

On the power and efficiency of a computer, L. Hellerman, *SP406*, pp. 131-134 (Aug. 1975).

Key words: computer efficiency; evaluation; measurement; performance; power; work.

The concept of power is defined and proposed as a new performance measurement tool for computer systems. Several examples are given that illustrate the calculation of power for small devices. The efficiency of a system is then discussed in terms of power. Finally, the new methods are compared with other methods of system evaluation.

The Weltansicht of software physics, K. W. Kolence, *SP406*, pp. 135-137 (Aug. 1975).

Key words: computer performance measurement; software physics; software units; software work.

This paper is a brief exposition of the idea that a "software physics" exists, and furthermore that it is based on the same concepts as used in the natural sciences. The idea of a software unit is introduced to name the entities embodying the basic observable properties of software physics. These properties are identified as work and time. (Another property, existence, is not referenced in this paper.) The relation of these properties, in a general sense, to the variables of performance monitors and modeling is commented on.

Standards in performance evaluation and measurement, R. W. Bemer, *SP406*, pp. 141-144 (Aug. 1975).

Key words: accuracy; audit; certification; code-independent; documentation; optimization; precision; run statistics; security; terminology; validation; warranty.

Giving "evaluation" equal billing with "measurement" opens the door to discussion of performance that is good or bad, as oppposed to fast or slow. Through this opening come considerations of security and confidentiality, validation of software and hardware means for performing arithmetic operations and evaluating mathematical functions (to varying degrees of precision and accuracy), code independency, auditing and warranty, optional optimization in compilation of running programs in high-level languages, and retention of statistics of every aspect of operation—for later analysis and reduction of duplicate work.

The role of the technical societies in the field of computer measurement, R. W. Hamming, *SP406*, pp. 151-153 (Aug. 1975).

Key words: computer measurement; technical societies.

It is comparatively easy to make measurements of computer performance, but this does not mean that there is, or can be, any single set of "right" measurements of performance—much as we may wish otherwise! This being the situation, the technical societies should not get themselves involved in trying to set standards of measurement (in the sense of what to measure), though they should encourage high quality measurement and subsequent data processing, publication, and oral presentation of results.

Computer performance evaluation—R&D, J. H. Burrows, *SP406*, pp. 155-157 (Aug. 1975).

Key words: accounting; computer performance evaluation; efficiency; measurement; research and development.

Computer performance evaluation has moved to the forefront of a long list of tools to help the field practitioner. However, as long as R&D is applied only to large installations pushing the margin of feasibility (a noble and rewarding effort) that R&D will not contribute to the majority of data processing installations. Something useful is needed for the more normal installation.

In addition, it is becoming increasingly clear that CPE leads one to discuss and evaluate procedures and goals set for and acting upon the whole "user" community and not just the hardware monitor. More needs to be done in the external environment.

University education in computer measurement and evaluation, J. D. Noe, *SP406*, pp. 159-163 (Aug. 1975).

Key words: computer measurement and evaluation; computer science curriculum; hardware monitors; modeling.

The paper presents the view that computer measurement and evaluation should be taught in universities to stimulate research activity and to establish in the minds of students the importance of the measurement and evaluation viewpoint. It is recommended that measurement and evaluation initially be taught as a separate course, but the ultimate aim should be for the viewpoint to pervade all course work on hardware and software systems, at which time the need for the specific course should vanish. A list of suggested concepts is included.

SP407. **59th National conference on weights and measures 1974,** S. J. Edgerly, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 407, 284 pages (June 1975) SD Catalog No. C13.10:407.

Key words: digital indicators; drained weight; laws and regulations; metrication; metric conversion; net weight; package control; petroleum products; scales; survey; temperature compensation; uniformity; weights and measures.

This is a report of the proceedings (edited) of the Fifty-Ninth National Conference on Weights and Measures, sponsored by the National Bureau of Standards, held in Washington, D.C., July 7-12, 1974, and attended by state, county, and city weights and measures officials, the Federal Government, business, industry, and consumer organizations. *These proceedings include the following papers (indented):*

Advancing measurement assurance in the marketplace, J. H. Lewis, *SP407*, pp. 1-6 (June 1975).

Address, Betsy Ancker-Johnson, *SP407*, pp. 6-11 (June 1975).

Expanding the Nation's measurement system, A. O. McCoubrey, *SP407*, pp. 11-23 (June 1975).

International diplomacy in weights and measures, B. Athané, *SP407*, pp. 26-34 (June 1975).

Observations on our mutual objectives, H. F. Wollin, *SP407*, pp. 35-45 (June 1975).

Weighing the future—A new challenge, J. D. Zelazny, *SP407*, pp. 46-54 (June 1975).

Metric conversion:

Role of the American National Metric Council, M. E. O'Hagan, *SP407*, pp. 54-60 (June 1975).

Consumers call for a rational approach, L. A. Young, *SP407*, pp. 61-66 (June 1975).

Conversion in Australia, J. A. Servin, *SP407*, pp. 67-79 (June 1975).

Metric plans, programs, problems:

The metric conversion of scales as viewed by the scale industry, W. N. Shannon, *SP407*, pp. 87-92 (June 1975).

Petroleum industry, K. E. Bailey, *SP407*, pp. 93-96 (June 1975).

Metric conversion for gasoline dispensing systems, A. C. Evans, *SP407*, pp. 97-107 (June 1975).

The implications of metrication for the packaging industry, W. E. Young, *SP407*, pp. 108-113 (June 1975).

NCWM committee on metric planning, E. H. Stadolnik, *SP407*, pp. 114-117 (June 1975).

Net weight—Policy and procedure:

Progress towards uniform compliance testing, C. S. Brickenkamp, *SP407*, pp. 131-136 (June 1975).

USDA net weight philosophy and procedures, I. Fried, *SP407*, pp. 136-142 (June 1975).

The case for state and local enforcement, H. Cohen, *SP407*, pp. 142-153 (June 1975).

An industry in-plant quality control program, E. E. Wolski, *SP407*, pp. 153-158 (June 1975).

Temperature correction of petroleum products at retail:

Why temperature correction?, G. E. Mattimoe, *SP407*, pp. 166-180 (June 1975).

Temperature correction of petroleum products at retail, H. E. Harris, *SP407*, pp. 181-196 (June 1975).

SP408. **Standard reference materials and meaningful measurements**, R. W. Seward, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 408, 820 pages (Mar. 1975) SD Catalog No. C13.10:408.

Key words: certification; certified reference materials; materials; meaningful measurements; measurement; reference materials; SRM's; standard materials; standard reference materials; standards.

This book presents the proceedings of the 6th Materials Research Symposium on "Standard Reference Materials and Meaningful Measurement" held at the National Bureau of Standards, Gaithersburg, Maryland, on October 29 through November 2, 1973. The symposium was sponsored by the NBS Institute for Materials Research. The purpose of the symposium was to explore ways that Standard Reference Materials (SRM's) could be used more effectively to bring about meaningful measurements both on a national and international scale, to explore the meaning of meaningful measurements, and to review the major paths now used to reach these measurements.

Starting with the relationship of SRM's to a national measurement system, the symposium reviewed SRM activities at the international level, various national programs, and industrial needs. The use of statistics, selection criteria, and steps for certifying SRM's were reviewed. Fifteen panel sessions reviewed the current status of SRM's and outlined future needs. *These proceedings include the following papers (indented):*

Standard reference materials and meaningful measurements—An overview, R. D. Huntoon, *SP408*, pp. 4-56 (Mar. 1975).

Possibilities for international cooperative efforts in standard reference materials, J. P. Cali, *SP408*, pp. 57-67 (Mar. 1975).

Activity by the International Organization for Standardization with respect to standard reference materials, F. L. LaQue, *SP408*, pp. 68-73 (Mar. 1975).

The analytical quality control programme of the International Atomic Energy Agency, O. Suschny and D. M. Richman, *SP408*, pp. 74-102 (Mar. 1975).

The activities of the European economic community in the field of reference materials and methods, K. F. Lauer and H. Laurent, *SP408*, pp. 103-117 (Mar. 1975).

Calibration and test materials for physicochemical measurements, H. Kienitz, *SP408*, pp. 118-126 (Mar. 1975).

Selection criteria of a material as standard reference material and steps for certification, G. Milazzo, *SP408*, pp. 127-145 (Mar. 1975).

Statistics and standard reference materials, J. Mandel, *SP408*, pp. 146-160 (Mar. 1975).

National SRM program in France, G. Denegre and A. Marschal, *SP408*, pp. 161-166 (Mar. 1975).

National RM program in Germany (FRG), R. J. A. Neider, *SP408*, pp. 167-188 (Mar. 1975).

The current status of SRM activities in Japan, T. Tsuchiya, *SP408*, pp. 189-200 (Mar. 1975).

National SRM programs in Poland, T. Plebanski, *SP408*, pp. 201-223 (Mar. 1975).

Reference materials in the United Kingdom, J. D. Cox, *SP408*, pp. 224-236 (Mar. 1975).

The national standard reference materials program in the U.S.A., H. T. Yolken, *SP408*, pp. 237-245 (Mar. 1975).

The SRM story at NBS, R. E. Michaelis, *SP408*, pp. 246-257 (Mar. 1975).

The role of the American National Standards Institute in national and international consensus standards programs, R. P. Trowbridge, *SP408*, pp. 258-266 (Mar. 1975).

ASTM in the U.S. measurement system, W. T. Cavanaugh, *SP408*, pp. 267-274 (Mar. 1975).

Chemical composition control problems and solutions related to metals and alloys, R. S. Cremisio, *SP408*, pp. 275-297 (Mar. 1975).

Measurement problems in physical and mechanical properties of industrial metals and the use of SRM's, J. Convey, *SP408*, pp. 298-319 (Mar. 1975).

High-purity compounds: An overview, A. J. Barnard, Jr., *SP408*, pp. 320-335 (Mar. 1975).

Industrial SRM needs and measurement problems in inorganic materials—chemical properties, V. A. Stenger, *SP408*, pp. 336-354 (Mar. 1975).

Industrial standard reference material (SRM) needs: Organic materials, J. Mitchell, Jr., *SP408*, pp. 355-365 (Mar. 1975).

"Meaningful Measurement" in clinical chemistry, J. H. Boutwell, *SP408*, pp. 366-386 (Mar. 1975).

Standard reference materials and environmental monitoring, E. W. Bretthauer, G. B. Morgan, and R. E. Jaquish, *SP408*, pp. 387-394 (Mar. 1975).

SRM needs and measurement problems in science—chemical properties, T. W. Mears, *SP408*, pp. 395-410 (Mar. 1975).

SP410. **NBS metric kit**, Nat. Bur. Stand. (U.S.), Spec. Publ. 410, envelope containing 7 items (1975) SD Catalog No. C13.10:410.

Key words: bibliography of metric information; customary units; history of measurement systems; metric chart; metric information.

This kit is a compilation of seven metric information items and is intended primarily for the teacher, student, and others seeking authentic information on the metric system.

A handy, wallet-sized card that converts customary units of measure into metric units and vice versa; a 15 centimeter (6 inch) ruler; "What About Metric," which explains in simple terms all anyone needs to know about using metric units in daily living; a brief history of measurement systems, and a colorful chart explaining base units of the metric system; a bibliography of metric information that also includes sources of metric teaching aides for educators, and an article by Dr. Richard W. Roberts, Director of the National Bureau of Standards.

SP413. **Special technical facilities at the National Bureau of Standards**, H. L. Mason and I. M. Lloyd, Nat. Bur. Stand. (U.S.), Spec. Publ. 413, 56 pages (Jan. 1975) SD Catalog No. C13.10:413.

Key words: accelerators; acoustic facilities; calorimeters; electrical measurements facilities; high pressure facilities; high temperature facilities; spectroscopy facilities.

Among the major technical facilities of the NBS laboratories in Gaithersburg, Md. and Boulder, Colo., are some which are unique and many which feature equipment that is relatively uncommon. These important resources deserve to be more widely known and used by the scientific and engineering community, including the Bureau's own staff, other Government agencies, industrial research associates, academic researchers, and postdoctoral fellows. Those facilities which are available for shared use, either occasional or extended, are briefly described in the pages of this publication.

SP415. **Biomaterials.** Proceedings of a Symposium held in conjunction with the Ninth Annual Meeting of the Association for the Advancement of Medical Instrumentation, New Orleans, April 19-20, 1974, E. Horowitz and J. L. Torgesen, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 415, 109 pages (May 1975) SD Catalog No. C13.10:415.

Key words: biocompatibility; biomaterials; blood protein; ceramic implants; implantable electrodes; metallic implants; nerve prosthesis; synthetic implants; thromboresistance.

This volume is based on papers presented at the Symposium on Biomaterials, held in conjunction with the Ninth Annual Meeting of the Association for the Advancement of Medical Instrumentation, New Orleans, LA, April 19-20, 1974. It provides a review of special topics in biomaterials research selected to focus attention on some noteworthy achievements. The topics covered include plasma-polymerized polymers and their application in biomedicine; biocompatibility of ceramic materials and their application both as inert coatings for synthetic implants and as porous materials for bone repair; the selection of metallic implant materials through engineering and medical considerations; in vitro testing of thromboresistance; adsorption of blood proteins on synthetic substrates; a prosthesis for nerve regeneration; and properties of fibrous biomaterials. *These proceedings include the following papers (indented):*

Plasma formed polymers for biomedical application. Part I. Synthesis and fundamental studies, K. G. Mayhan, A. W. Hahn, M. R. Havens, and B. W. Peace, *SP415*, pp. 1-12 (May 1975).

Key words: plasma-formed polymers; polymer films; polymerization; polymer permeability.

The deposition of polymeric coatings through Rf plasma techniques is a unique process from several points of view. By introducing monomeric gases into an inert gas Rf plasma, the monomers are converted to ultrathin continuous polymer films. These films can be made to vary in thickness from less than 1 μm to 10 μm or more. These materials are insoluble to common organic solvents and are not attacked by strong mineral acids. In addition, the monomeric materials in the reactor are distilled gases and are therefore quite pure in comparison to monomers used for ordinary linear polymerizations. As a result, the polymer coatings which are formed do not contain residual catalysts or activists and are in a highly purified state. We have utilized the plasma polymerization process to produce polymer films intended for biomedical application. Plasma coatings have been formed from a wide variety of monomers. These coatings have been applied to various nonmetallic, metallic and organic substrates. In each instance it was found that continuous adherent films could be deposited after suitable substrate preparation and reactor operation parameters were established. It has been our experience that a general cleaning procedure for all substrates cannot be dictated and that the preparative steps involved are dictated by the environment to which the final product will be subjected.

Plasma-formed polymers for biomedical applications. Part II. Biocompatibility and applications, A. W. Hahn, K. G. Mayhan, J. R. Easley, and C. W. Sanders, *SP415*, pp. 13-17 (May 1975).

Key words: biocompatibility; inflammatory response; plasma polymers; tissue reaction.

Different polymer films generated by rf plasma techniques and deposited on glasses of varying chemical composition, on implant alloys, and on formed prosthetic polymers have been implanted in New Zealand white rabbits and various canine species and have shown minimum tissue reactions after periods of time up to six months. It has further been found that the substrates upon which the plasma polymers are formed are more detrimental to cell cultures than the polymers themselves. These findings, along with other implant work, indicate that plasma-formed polymers will play a definite role as biocompatible materials in the future.

Interfacial behavior of ceramic implants, L. L. Hench, H. A. Paschall, W. C. Allen, and G. Piotrowski, *SP415*, pp. 19-36 (May 1975).

Key words: bioglass-ceramic; ceramic implants; flame spray coating; hip prosthesis; segmental bone replacement.

Recent studies of bioglass, bioglass-ceramic, and alumina implants have produced an understanding of the chemical nature of interfacial tissue reactions to bioceramics. Significant differences between hard and soft tissue reactions are due to the influence of surface chemical reactivity on the ultrastructural histology as revealed by transmission electron microscopy. Modern surface characterization of the implants correlates with the histological reactions. Applications of the results to a variety of orthopaedic prostheses show promise in animal experiments. Biomechanical analyses of interfacial bonding between bioceramic prostheses and tissues are presented.

Soft tissue response to a series of dense ceramic materials and two clinically used biomaterials, W. C. Richardson, Jr., S. F.

Hulbert, J. J. Klawitter, and B. W. Sauer, *SP415*, pp. 37-44 (May 1975).

Key words: biocompatibility; ceramic implants; histological evaluation; implant characterization.

Disc-shaped implants of spinel, alumina, mullite, zircon, a cast Co-Cr-Mo alloy, and ultra-high molecular weight polyethylene (UHMWPE) were implanted in the paraspinalis muscle of twelve adult, male, White New Zealand rabbits. Prior to implantation the implants were characterized with respect to size and shape, weight and surface roughness. After periods of 1 month, 2 months, and 4 months the rabbits were sacrificed and the tissue specimens were retrieved with the implants still intact. Histological examination of the tissues surrounding the implants along with changes in the size and shape, weight, and surface roughness of the implants were used as criteria for evaluating these materials for implant purposes.

No surface degradation of any of the materials was detected using scanning electron microscopy. Fibrous tissue seems to adhere to the UHMWPE implants more than any other material used in this study. Large amounts of fibrous tissue were also found to adhere to the cast Co-Cr-Mo alloy implants.

The histological results indicated that within the limits of this investigation, the biocompatibility of the ceramic materials used in this study compares favorably with the clinically used cast Co-Cr-Mo alloy implants and the UHMWPE implants.

Engineering and biological studies of metallic implant materials, N. D. Greene, C. Onkelinx, L. J. Richelle, and P. A. Ward, *SP415*, pp. 45-54 (May 1975).

Key words: corrosion; inflammatory response; metallic implants; systemic effects.

The aim of this investigation is the development of improved alloys for short term (0.5 to 5 years) orthopaedic implants. The program is interdisciplinary in nature—simultaneous studies of corrosion, inflammatory response, and systemic effects of iron, nickel, cobalt, titanium, and tantalum base alloys are being determined. Corrosion tests under *in vitro* and *in vivo* conditions have been performed via linear polarization and other electrochemical methods.

The inflammatory responses of various implant alloys are being determined by both *in vivo* and *in vitro* experiments. *In vitro* chemotactic assays on rabbit neutrophilic granulocytes and mononuclear cells are performed in the presence and absence of appropriate metal ion concentrations. Corrosion rate data described above are employed to select the proper concentrations.

Systemic effects of metallic corrosion products have been determined via radioisotope and analytical techniques. Radioactive metallic salts at appropriate concentrations are injected intravenously in rats of known age and sex. Following this, the concentration of metallic products is determined as a function of time in various biological samples (plasma, urine, feces, etc.). These data permit the establishment of models which can predict the distribution of individual elements released from continuously corroding metal implants.

Materials characterization of implantable porous electrodes, R. B. Beard, J. F. DeRosa, S. F. Dubin, L. Sturm, R. M. Koerner, and A. Miller, *SP415*, pp. 55-61 (May 1975).

Key words: implantable hybrid cells; pacemakers; palladium black; platinum black; polarization; porous electrodes.

Porous platinum and palladium black electrodes have been used as cathodes for reducing body oxygen in implantable hybrid cells supplying energy to pacemakers. The power-generating capabilities of a cell are greatly decreased under load, i.e., increased current density, due to polarization at the electrode interface. A greatly increased surface area of the porous electrodes, i.e., number of sites for the electrode reaction, permits a greater current density with lower overpotential or polarization. Similarly, at the pacemaker stimulating electrode and at electrodes used in making electrical impedance measurements there is polarization and a consequent loss of energy in a charge transfer at the electrode interface. Porous electrodes in these cases have also greatly reduced the overpotential. The physical electrochemical properties of the porous electrodes have been characterized by specific adsorption, i.e., BET measurements; scanning electromicrographs; galvanostatic and potentiostatic measurements; and electrical impedance measurements. Histopathological studies have been made in order to determine the biocompatibility of the tissue-electrode interface.

Properties of fibrous biomaterials with statistically dispersed orientation, E. Y. Robinson, *SP415*, pp. 63-74 (May 1975).

Key words: biomaterial properties; biomechanics; composites; fiber orientation; fibrous biomaterials.

Many factors influence the interaction between bone or soft tissue and implanted synthetic biomaterials, e.g., biocompatibility, implant configuration, functional requirements, bone and tissue structure, and relative mechanical properties. Of the many active factors, one aspect is considered here: the theoretical consequences of the fibrous-lamellar structure of bone, and of the degree of fibrous orientation present in the individual lamellae. This orientation is known to be statistically dispersed about certain preferred directions in each layer, with possible large orientation changes from layer to layer. Analysis of this type of structure is presented with graphical illustration of the effects of orientation and of statistical dispersion of orientation on conventional engineering material parameters.

New biomaterials are being evolved which combine fiber reinforcement with polymer resin matrices (e.g., graphite fibers/polyethylene matrix). Such materials may be tailored to yield certain specific properties by controlling fiber orientation and quantity. Materials of this type are of interest in implants which may be required to behave in a similar fashion to adjacent bone tissue (as in bone splints, hip prostheses, etc.). The analysis presented here provides a rapid and convenient basis for calculating the effect of controlled and dispersed fibrous orientation on material properties.

The methods described lay a base for first approximations and show certain directions which should be followed in further investigation. Graphical results include examples for both fibrous bone tissue models and synthetic types of fiber-reinforced biomaterials.

A simple *in vitro* test for screening the blood compatibility of materials, H. Kambic, T. Komai, R. J. Kiraly, and Y. Nosé, *SP415*, pp. 75-82 (May 1975).

Key words: blood coagulation; blood compatibility; blood platelet consumption; kinetic clotting test.

An *in vitro* blood compatibility test was developed to evaluate thromboresistant properties of materials. This method is called the closed-cell kinetic blood coagulation test. A closed cell system eliminates any air-blood interface. The blood is withdrawn directly from the animal into the cell, minimizing the exposure to foreign surfaces other than the one being studied and eliminating the use of anticoagulants through the process.

The technique includes the simultaneous blood filling of eight cells with the test materials, and eight cells lined with a control material. As a control material we have selected silicone rubber, which has reasonably good thromboresistant properties, is widely accepted, and commercially available. The cells are opened at different predetermined times, and the clot formation is then measured by two complimentary methods: weighing the clot and colorimetry of the unclotted blood. The two methods correlate and can differentiate between red and white thrombus.

The results are presented as clot formation curves versus time for the material under test and for the control. The variability of blood properties makes this control curve essential.

Detailed analyses of the curves will offer a new approach to the understanding of the mechanism of thrombus formation on various types of materials. Results will be presented for tests conducted on Hydron®, segmented polyurethane, purified natural rubber, as well as chemically treated tissue.

Conformation of adsorbed blood proteins, B. W. Morrissey, L. E. Smith, C. A. Fenstermaker, R. R. Stromberg, and W. H. Grant, *SP415*, pp. 83-90 (May 1975).

Key words: adsorbed protein conformation; blood protein; protein conformation.

The likelihood that surface-induced blood coagulation results from specific interactions between proteins and materials has led to a study of the conformation of adsorbed blood proteins. Infrared difference spectroscopy was used to determine the bound fraction, i.e., the fraction of carbonyl groups of an adsorbed molecule directly interacting with a silica surface, and ellipsometry was used to measure the average extension (thickness) of adsorbed protein films. *In situ* measurements were made on serum albumin, fibrinogen, and prothrombin as a function of the amount adsorbed, time of adsorption, and surface energy.

The bound fraction results obtained for serum albumin and prothrombin indicate that the internal bonding of these globular proteins is sufficient to prevent changes in conformation while adsorbed, even at low surface population. The bound fraction of fibrinogen increases with increasing adsorbance, suggesting possible interfacial aggregation. The conformation of all three proteins was found by both I.R. difference spectroscopy and ellipsometry to be independent of the time of adsorption. In addition, the ellipsometric studies show that while the adsorbance of fibrinogen and prothrombin does not vary for a number of surfaces, their extensions increase with decreasing surface energy.

Studies of cross-linked and denatured serum albumin have shown that changes in conformation concomitant with adsorption of the native protein, if they occur, are small.

A nerve implant prosthesis for facilitating peripheral nerve regeneration. Part I. Development of the prosthetic device and system of repair, W. E. Kuhn and J. L. Hall, *SP415*, pp. 91-98 (May 1975).

Key words: neurorrhaphical procedures; peripheral nerve repair; tubular prosthesis.

The design rationale and requirements of a system of sutureless nerve repair employing a special thin walled porous stainless steel tube and a vacuum technique for applying the tube and approximating the nerve ends will be outlined. A description of the tubular prosthesis, its fabrication, the surgical instruments and neurorrhaphical procedures will be presented.

A slurry dipping process has been developed for the production of uniform "green" tubes in quantity. These are sintered in a hydrogen atmosphere to impart the strength required to retain their tubular configuration under the forces imposed by the surgical procedures and the vacuum pressure. Placing the porous tube on the nerve and drawing the nerve ends into approximation is both simple and rapid.

A nerve implant prosthesis for facilitating peripheral nerve regeneration. Part II. Development of the prosthetic device and system of repair neuroanatomical aspects, J. L. Hall and W. E. Kuhn, *SP415*, pp. 99-101 (May 1975).

Key words: histological evaluation; nerve axons; surgical procedure.

The principal neuroanatomical aspects of peripheral nerve repair are the approximation of the severed ends and the minimizing of trauma during the approximation. The method of using vacuum to draw the severed ends down a porous tube seems to take these two factors into consideration. The porous tube provides a shielded environment for the regenerating nerve to grow into the approximated distal end. The porosity allows for the escape of edematous fluids, prevents the invasion of scar tissue and provides for the flow of nutritional fluids.

Histological and statistical results of the procedures are presented. In most instances the axons of the regenerating nerve grow across the gap and occupy the intact neurilema sheaths of the degenerating distal segments.

SP416. **Attacking the fire problem: A plan for action**, K. Giles and P. Powell, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 416, 37 pages (May 1975) SD Catalog No. C13.10:416.

Key words: building design; consumer protection; fire control, fire detection; fire research; fire spread; flammability.

The mission of the Center for Fire Research is to insure the development of the technical base for the standards and specifications needed in support of the National goal to reduce fire losses by 50 percent over the next generation. A systems approach to accomplish this mission is described. The Center consists of three basic programs in the area of Fire Science and five applied research programs in the area of Fire Safety Engineering. Each applied program addresses an aspect of the Fire Problem, using fundamental information supplied by the basic research function. Active participation by staff members in voluntary standards organizations is the principal means of making this technology available for codes and standards needed to reduce the Nation's fire loss.

SP417. **Directory of United States standardization activities**, S. J. Chumas, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 417, 228 pages (Nov. 1975) SD Catalog No. C13.10:417.

Key words: codes; consensus system; directory; Federal Government—standardization; industry standards activities; national standards activities; recommended practices; specifications; standardization activities; standards; states—standardization activities; test methods.

This Directory serves as a guide to standardization activities in the United States. It supersedes a Directory of the same title, issued in 1967, as National Bureau of Standards Miscellaneous Publication 288. Included in the Directory are summaries of the standardization activities of trade associations, technical and other professional societies representing industry and commerce, and state and Federal governments. For the first time this Directory covers nonengineering and nonindustry organizations. SP417 contains current descriptive summaries of more than 580 organizations.

Criteria for inclusion are that the organizations have standardization activities such as standards-writing groups, that they assist in the development of standards, or that they issue standards or disseminate standards information.

The standardization activities summaries are grouped into three sections: associations, states, and agencies of the Federal Government. In each section, the summaries are arranged alphabetically by organization. Two types of indexes are included in SP417 to assist the reader in identifying an activity: (1) a subject of index key words taken from the summaries; and (2) a listing of organizations classified into 24 subject areas. Supersedes NBS Misc. Publ. 288.

SP418. **National Bureau of Standards, Annual Report,** F. P. McGehan, M. King, and R. S. Franzen, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 418, 32 pages (Apr. 1975) SD Catalog No. C13.10:418.

Key words: annual report; computer; energy; environment; health; product safety; research; science and technology; standards.

This document describes how resources were utilized during fiscal year 1974 and highlights major achievements as a result of work performed at the National Bureau of Standards. Using the theme, "Standards for daily living," the book presents brief discussions of accomplishments within major program areas. The report serves as 1) an annual account of NBS activities and 2) promotional information about NBS. The Table of Contents includes: From the Director; Standards for Daily Living: Historical Pioneer, Catalyst for Change, Information Programs; The Year in Review: Expanding Measurement Capabilities, Toward Solving the Energy Problem, Improving Man's Environment, Striving for Safer Products, Aiding Health Care, Advancing Computer Technology; Interaction is the Key: Public Interest, Government Projects, Industry Cooperation, Information Services; Funds and Facilities; Organization; People.

SP419. **Selected topics on hydrogen fuel,** W. R. Parrish, R. O. Voth, J. G. Hust, T. M. Flynn, C. F. Sindt, N. A. Olien, and J. Hord, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 419, 212 pages (May 1975) SD Catalog No. C13.10:419.

Key words: conservation; conversion; cost; cryogenics; economics; embrittlement; energy; hydrogen; industrial; instrumentation; liquefaction; literature; materials; production; solar; storage; transmission; transportation; utilities.

The National Bureau of Standards played a vital role in developing hydrogen technology for the space age and is now engaged in efforts to adapt and improve this technology for the commercial use of hydrogen fuel. This document is a summary report on selected hydrogen-fuel topics and was prepared to identify cost and technical barriers to the commercial use of hydrogen fuel and to generate reference data for policy-planning, decision-making and design. Cryogenic hydrogen fuel technology is emphasized in the economic and systems analyses reported herein. Using the best available technical and economic data, hydrogen fuel is not currently cost competitive with alternate fuels; however, we must not reject hydrogen on the basis of current economic comparisons. Increased efficiencies of production, liquefaction, and energy conversion may drastically change these comparisons-of-today as will increased fossil fuel prices and more stringent environmental and pollution constraints. Hydrogen appears currently marketable in certain integrated utility systems, in transoceanic transport of energy produced far at sea, and is a necessary element in a wide variety of growing industrial processes and in the liquefaction of coal. This publication identifies research and development needs within selected areas of NBS competence and future research plans are outlined.

SP420. **International Bureau of Weights and Measures 1875-1975,** C. H. Page and P. Vigoureux, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 420, 257 pages (May 1975) SD Catalog No. C13.10:420.

Key words: base units; centennial volume; history of SI; International Bureau of Weights and Measures; International System of Units; measurements; SI; Treaty of the Metre.

This is the English version of the Centennial volume of the International Bureau of Weights and Measures (BIPM) translated from the French. Metrology—the science of measurement—is traced from man's earlier efforts to the world's most modern, uniform, and coherent measurement system, the International System of Units (SI). Detailed accounts are given of the 1875 Treaty of the Metre—to which 18 nations, including the United States, were signators—and the work of the International Bureau of Weights and Measures which was created by the Treaty and now the international province of 44 nations. Historical reviews are given of the development of the base and derived units of the SI, specifically mass, length, gravimetry, manobarometry, thermometry, electricity, photometry, radioactivity, x and gamma rays, and neutron measurements.

SP421. **A guide to methods and standards for the measurement of water flow,** G. Kulin and P. R. Compton, Nat. Bur. Stand. (U.S.), Spec. Publ. 421, 97 pages (May 1975) SD Catalog No. C13.10:421.

Key words: flow measurement, water; instruments, flow measurement; open channel flow measurement; pipe flow measurement; standards, flow measurement.

Selected information sources on methods and standards for making measurements of water and wastewater flow in the field are listed and described. Both closed conduit and free surface flows are treated, but emphasis is on open channel flow measurements needed in water resource engineering and in water pollution control. Instruments and methods covered include weirs, flumes, current meters (and velocity traverse methods), dilution techniques, pipe flow instruments, acoustic meters and others. In addition to summarizing the basic properties of each instrument or method and referring users to the best available sources of detailed information on performance and field application, potential sources of error are described and quantified where possible.

SP425, Volumes I and II. **Nuclear cross sections and technology.** Proceedings of a Conference held in Washington, D.C., March 3-7, 1975, R. A. Schrack and C. D. Bowman, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 425, Vol. I, 487 pages, Vol. II, 553 pages (Oct. 1975) SD Catalog No. C13.10:425.

Key words: biomedical; conference; cross section; nuclear; standards; technology.

These proceedings are the compilation of 221 papers presented at the Conference on Nuclear Cross Sections and Technology held in Washington, D.C. on March 3-7, 1975. The Conference summarized the present status of nuclear cross sections and technology and discussed future cross section needs. Special emphasis is placed on reactor technology and biomedical applications of nuclear science and the measurement of standard cross sections. *These proceedings include the following papers (indented):*

The light water reactor industry-nuclear data needs, V. O. Uotinen, J. D. Robertson, and J. S. Tulenko, *SP425*, pp. 7-13 (Oct. 1975).

Key words: lattices; nuclear data; parameter; reactivity.

Radioactive-nuclide decay data in science and technology, C. W. Reich and R. G. Helmer, *SP425*, pp. 14-20 (Oct. 1975).

Key words: applications of decay data; ENDF/B-IV decay-data file.

The scope of ENDF/B has recently been expanded to include radioactive-nuclide decay data. In this paper, the content and organization of the decay data which are included in ENDF/B are presented and discussed. The application of decay data in a wide variety of nuclear-related activities is illustrated by a number of examples. Two items pointed up by the ENDF/B decay-data compilation effort are treated: the identification of deficiencies in the data; and the importance of a radioactive-nuclide metrology effort oriented toward supplying these needs in a systematic fashion.

Radioactive decay heat analyses, R. E. Schenter and F. Schmittroth, *SP425*, pp. 21-28 (Oct. 1975).

Key words: decay heat; $\bar{E}_\beta$; $\bar{E}_\gamma$; ENDF/B-IV; fission products; half lives; yields; ^{235}U; ^{239}Pu.

Calculations of decay heat from fission products have been made using the summation method for fast and thermal reactor systems. Results of these calculations for both "burst" and long exposure times are presented and compared with previous experimental results and summation calculations. In addition, uncertainty estimate calculations are given which used both exact and approximate summation method formulas. The above calculations require as input libraries containing data for each individual fission product nuclide. Our source of data has been ENDF/B-IV, where fission yield, cross section and decay data (half lives, β and γ energies, branching, etc.) for 824 fission product nuclides are contained in the fission product and fissionable isotope files.

Sensitivity of the afterheat from ^{235}U and ^{239}Pu thermal fission to errors in fission product nuclear data, C. Devillers, B. Nimal, C. Fiche, J. P. Noël, J. Blachot, and R. de Tourreil, *SP425*, pp. 29-38 (Oct. 1975).

Key words: afterheat; decay heat; error estimates; fission products; loss of coolant accident; sensitivity.

This paper presents calculational results on the decay heat associated with the thermal fission of ^{235}U and ^{239}Pu. Calculations are based on the summation of the energies which are released by individual fission products. Two cases have been considered: the first corresponds to one instantaneous fission, the other to a 900 days irradiation time. In both cases the sensitivities of the afterheat to respectively independent yields, half-lives, average beta plus gamma energies of 512 instable fission products have been derived. This information has been used to calculate the afterheat uncertainties from experimental and evaluated nuclear data errors, when available. Results relating to the instantaneous fission of ^{235}U and ^{239}Pu are compared to calorimetric measurements between 100 and 10^5 second cooling time. Errors in the afterheat corresponding to a 900 days irradiation time have been estimated for cooling times ranging from 1 to 1000 seconds which are appropriate for Loss of Coolant Accident analyses in light water reactors. The computer programmes which have been developed can be applied to any irradiation and cooling time condition.

Significance of nuclear data on the development of the LMFBR industry, N. C. Paik, *SP425*, pp. 39-44 (Oct. 1975).

Key words: data; flux; LFMBR; neutron.

The overall interaction of nuclear data, methods and nuclear performance predictions of an LMFBR is described. Areas of successful applications of the recent Evaluated Neutron Data File (ENDF/B) to an LMFBR design are shown to be numerous. Design areas where improvements in the Evaluated Neutron Data File would have significant impact on the development of the LMFBR industry are listed. Specific cross sections where improvements in the neutron data would be beneficial to the LMFBR industry are enumerated. In order to provide insight into why these developments are required, an application of nuclear data to the determination of the intrinsic neutron source strength in an LMFBR are described in relation to the Ex-Vessel Low Level Flux Monitor system design.

Fast reactor safety, R. Avery, *SP425*, pp. 45-50 (Oct. 1975).

Key words: accidents; breeders; fast reactors; LMFBR; recriticality; safety.

The current state of knowledge with respect to the analysis of potential accident sequences in fast breeder reactors and the understanding of associated accident phenomena, as well as implications to reactor design, are reviewed.

After PHENIX, what is the importance of nuclear data programs for the FBR development?, J. Y. Barré, J. Bouchard, and J. P. Chaudat, *SP425*, pp. 51-61 (Oct. 1975).

Key words: FBR development; integral experiments; nuclear data; PHENIX.

In the fast reactor physics approach chosen in France, the integral experiments serve as a reference. The significance of differential nuclear measurements, in this philosophy, is presented.

The programs carried out on critical facilities and operating fast power reactors up to the end of this year will solve the last major problems arising from nuclear data inaccuracies for commercial plants. Results obtained on PHENIX during start-up and operation validate this approach. After the end of 1975, the nuclear data needs concern mainly safety, plant operation and fuel cycle analysis. Nonnuclear uncertainties largely dominate the effects of nuclear data uncertainties for these problems. Evaluations must be sufficient to reach the requested accuracies.

NE-213 neutron spectrometry system for measurements to 15 MeV, R. H. Johnson, B. W. Wehring, and J. J. Dorning, *SP425*, pp. 62-65 (Oct. 1975).

Key words: proton-recoil spectrometry; Pu-Be and ^{252}Cf neutron spectra; spectra unfolding.

A 5-cm by 5-cm NE-213 scintillator mounted on a 56AVP PM tube is used with a bridge utilizing two high voltage supplies and giving good linearity and good pulse shape discrimination. The cross-over timing method is used to discriminate against gamma-ray events. Measurements of a ^{252}Cf and a D-T source were used to test the linearity of the system. The ^{252}Cf measurement is in good agreement with earlier results and is fit by a Maxwellian distribution with a temperature of 1.43 MeV. A modified version of the COOLC unfolding code was used to obtain neutron spectra. This code, FORIST, optimizes the neutron energy resolution through an iterative process. A measured Pu-Be spectrum is used to demonstrate the benefits of the modified unfolding procedure. The Pu-Be spectrum is also in good agreement with earlier results. The 9.7 MeV peak of the Pu-Be neutron spectrum is resolved when the FORIST code is used, but not when the COOLC code is used with the window width data distributed with the COOLC and FERDOR code package.

Absolute calibration of neutron detectors in the 10-30 MeV energy range, J. A. Cookson, M. Hussian, C. A. Uttley, J. L. Fowler, and R. B. Schwartz, *SP425*, pp. 66-68 (Oct. 1975).

Key words: absolute efficiency of fast neutron detectors.

A central problem in fast neutron research is that of finding the absolute efficiency of neutron detectors. Using the associated particle method for this purpose, we have designed a chamber to count He particles from the $D(d,n)^3He$ or the $T(d,n)^4He$ reaction in coincidence with neutron events. The reactions take place in deuterium or tritium gas and a ΔE solid state counter at 80, 65, or 43° to the 2-10 MeV deuteron beam direction detects the He particles with 100 percent efficiency. To reduce background we allow the deuterons to pass out of the gas chamber through a Ni window and stop the beam ~ 150 cm from the counters. With the $D(d,n)^3He$ reaction we have obtained ~ 2 percent efficiency calibration of the central portion of a liquid scintillator in the 9-10 MeV energy range. With the T(d,n) reaction this calibration can be extended to ~ 27 MeV and the efficiency can be mapped out as a function of position in the scintillator.

A thick target measurement technique for determining nuclear reaction rates, N. A. Roughton, M. J. Fritts, R. J. Peterson, C. J. Hansen, and C. S. Zaidins, *SP425*, pp. 69-72 (Oct. 1975).

Key words: astrophysics; cross sections; fusion; reaction rates; thick targets.

A technique for measuring nuclear cross sections using thick targets and an empirical approximation for energy loss has been developed by our group at the Nuclear Physics Laboratory of the University of Colorado. Over the past two years we have measured thick target yields of over thirty nuclear reactions of interest in astrophysics and CTR applications. From these yields we can derive average cross sections and thermonuclear reaction rates, $N_A <\sigma v>$. We will describe the technique and data analysis methods and give some examples of our results.

A black detector for 250 keV – 1000 keV neutrons, G. P. Lamaze, M. M. Meier, and O. A. Wasson, *SP425*, pp. 73-74 (Oct. 1975).

Key words: detector; flux; Monte Carlo; neutrons; scintillators; time-of-flight.

A detector has been designed to have a greater than 95 percent efficiency in the range of 250 – 1000 keV neutron energy. The detector is modeled from a similar but larger detector by Poenitz. The efficiency calculations were made with a modified version of Carlo Black, which is a Monte Carlo calculation of multiple neutron scattering in a scintillator. The detector is a 12.6 cm × 17.78 cm cylinder of NE 110 with a 5.08 cm × 2.54 cm reentrant hole. The scintillator is mounted on an RCA 8854 photomultiplier tube which has been selected for low noise. Calculated efficiencies are presented as well as comparisons with experimental measurements.

Detector calibration with an associated particle apparatus, M. M. Meier, A. D. Carlson, and G. P. Lamaze, *SP425*, pp. 75-77 (Oct. 1975).

Key words: associated particle technique; neutron detector; neutron flux monitor; neutrons; neutron standards; $T(p,n)^3He$ reaction.

An associated particle apparatus employing the $T(p,n)^3He$ reaction is now in routine use at the NBS. The apparatus consists of two target chambers with ports at 10 and 25° which give a useful neutron energy range of 100 keV to 1 MeV for protons from the 3 MV Van de Graaff. Electrostatic deflection, fast energy discrimination and pulsed beam time of flight techniques are used to reduce background in the neutron-associated $^3He^{++}$ pulse height spectrum to less than 1 percent. Neutron fluxes in the associated cone range between 30 and 100 n/sec at the lowest and highest bombarding energies. The spatial profile of the neutron cone is broadened by coulomb scattering of the $^3He^{++}$ in the tritiated titanium target and has a width less than 12° (full width at one-tenth maximum) for neutron energies above 300 keV. The apparatus has been used to calibrate a "black" detector described by Lamaze. The results of this calibration will be compared to a Monte Carlo calculation of the efficiency.

Use of gas proportional counters for neutron flux monitors at the NBS Linac, O. A. Wasson, *SP425*, pp. 78-80 (Oct. 1975).

Key words: counter; flux; hydrogen; monitor; neutron; proportional.

The use of a hydrogen filled proportional counter as a neutron flux monitor for standard neutron reaction cross section measurements at the 200 m flight path of the NBS Linac is described. Efficiency uncertainties approaching 1 percent are obtainable.

Fission cross section measurements on short-lived alpha emitters, J. W. T. Dabbs, N. W. Hill, C. E. Bemis, and S. Raman, *SP425*, pp. 81-82 (Oct. 1975).

Key words: fast ionization chamber; fission/alpha; spherical electrodes; σ_f; ^{245}Cm.

The large difference in initial ionization can be used to limit the size of alpha pulses relative to fission pulses in an ionization chamber, if the track lengths are both short. In parallel plate chambers this condition is not well met. We have developed a spherical plate chamber in which the ratio of maximum/minimum track length is 3. In the present (small sample) version, the maximum track is 6 mm, with deposit and neutron beam diameters of 1 cm. At optimum, with pure CH_4 gas, an electron collection time of ~ 22 ns is expected across the 2 mm gap. It is expected that the worst alpha/fission current pulse ratio will not exceed 1/14. Thus fissile isotopes with alpha half lives of 30 years or more (e.g., ^{243}Cm) may be studied with 1-2 nanosecond risetime current amplifiers; in addition, very small spontaneous fission branching ratios may be better determined. Comparisons of this new chamber with a parallel plate chamber and initial results on ^{245}Cm (~ 16 μg sample) will be presented. The ORELA pulsed neutron source permits measurements below 20 eV which are inaccessible to underground explosion experiments.

Systematic discrepancy in photoneutron cross sections for medium and heavy nuclei, T. Tomimasu and S. Sugiyama, *SP425*, pp. 83-88 (Oct. 1975).

Key words: calibrations of the NBS P2 chamber; comparison of shape and magnitude of photoneutron cross sections; nuclear reactions Cu, ^{63}Cu, Pr, Pb, ^{208}Pb, $Bi(\gamma,n)$.

The shape and magnitude of the photoneutron cross sections for Cu, Pr, Pb, and Bi are compared to find out a systematic discrepancy between the cross sections obtained using the NBS P2 chamber as a bremsstrahlung beam monitor and those obtained by other experimental techniques such as the positron annihilation-in-flight. The former cross sections in general are observed to be systematically larger than the latter. The discrepancy of about 10 percent is demonstrated in the peak cross section values for medium nuclei. This may be explained in the good direction by a systematic discrepancy of 6 percent in the calibration constants of the NBS P2 chamber given at several laboratories, because the lowest values in these calibrations have been widely used to determine the photoneutron cross sections from measured neutron yield curves. The highest values can almost eliminate the 10 percent discrepancy. The definite discrepancy cannot be demonstrated for heavy nuclei because of the large discrepancies of 20 percent or more found in the cross sections obtained with γ-rays from positron annihilation-in-flight.

The 2-keV filtered beam facility at the NBS reactor, I. G. Schroder, R. B. Schwartz, and E. D. McGarry, *SP425*, pp. 89-92 (Oct. 1975).

Key words: capture gamma rays; cross sections; dosimetry; filtered beams; neutrons.

A scandium filter that views a manganese scatterer has been installed in a through tube of the National Bureau of Standards Reactor (NBSR). The use of a resonant scatterer eliminates unwanted core neutrons and core gamma rays. This produces a pure 2-keV neutron beam with only 3 percent higher energy neutron contamination and a 1 mR·hr^{-1} gamma-ray background. This should be compared with previously reported results in which the high energy contaminant was approximately 50 percent, thus severely limiting the utility of such a filter. Details of the filter construction, the use of titanium with the scandium to reduce background, the optimization of the beam for different types of experiments, and the application of 2-keV neutrons to neutron dosimetry, cross-section measurements and capture gamma-ray studies are discussed.

The Rensselaer Intense Neutron Spectrometer, R. C. Block, R. W. Hockenbury, D. S. Cramer, E. Bean, and R. E. Slovacek, *SP425*, pp. 93-96 (Oct. 1975).

Key words: measured Th fission and deduced $\overline{\Gamma}_f$ below 260 eV; measured ^{145}Nd(n,α); measured ^{238}U fission below 35 keV, deduced $\overline{\Gamma}_f$ of 6.7, 21 and 37 eV resonances.

The Rensselaer Intense Neutron Spectrometer (RINS) is obtained by driving a 75-ton lead slowing down spectrometer with the intense pulsed neutron source from the RPI 100-MeV electron linac. For the same linac beam power, RINS produces a useable neutron flux which is $10^3 \sim 10^4$ greater than that obtained with a conventional time-of-flight spectrometer. Fission measurements upon ^{238}U have shown strong subthreshold fission above 700 eV and have determined the fission widths of the 6.7, 21 and 37 eV resonances to be (10±5), (70±30) and (8±6) neV respectively. No strong subthreshold fission was observed in ^{232}Th, and an upper limit of (15±10) neV is obtained for $\overline{\Gamma}_f$ for the Th resonances below 260 eV. Measurements of ^{145}Nd (n,α) have shown that the RINS system is readily capable of measuring $\sim \mu$ eV partial widths with only several mg of sample.

A modular minicomputer multiparameter data gathering and virtual memory operating system for the NBS neutron standards program, R. A. Schrack, H. T. Heaton II, and D. Green, *SP425*, pp. 97-98 (Oct. 1975).

Key words: CAMAC; disc; minicomputer; modular; multiparameter; on-line.

The new aboveground neutron time-of-flight system has recently been completed at the National Bureau of Standards linear accelerator facility. A computer system has been developed that will permit the accumulation of multiparameter data simultaneously from several experiments, using an inexpensive minicomputer and a small moving head disc storage unit. The operating system is modular in form, allowing different experimenters to rapidly construct a software system to their requirements. Data gathering and analysis programs are interchanged between core and disc as required. Interfacing hardware has been modularized using the CAMAC system.

TUNL fast neutron cross section facility, D. W. Glasgow, F. O. Purser, J. C. Clement, G. Mack, K. Stelzer, J. R. Boyce, D. H. Epperson, H. H. Hogue, E. G. Bilpuch, H. W. Newson, and C. R. Gould, *SP425*, pp. 99-102 (Oct. 1975).

Key words: C(n,n), E=9-15 MeV, measured $\sigma(E_n,\theta)$; D(d,n)^{3}He and C(n,n) spectra; neutron TOF facility.

A fast neutron time-of-flight (TOF) facility has been constructed in order to measure neutron differential cross sections required for the CTR program. The facility combines the outstanding capabilities of the Cyclo-Graaff accelerator with those of a good energy resolution, high mechanical precision, very low background TOF spectrometer-goniometer. The facility provides the capability for measurements of scattering cross sections with magnitudes of a few mb/sr to ≈5 percent absolute accuracy in the energy range 6-15 MeV. The D(d,n)^{3}He source spectra at 0° are practically devoid of extraneous neutrons produced by deuteron reactions with the all-metal, ultraclean beam transport system.

A facility for studying neutron-induced charged particle reactions, F. P. Brady, N. S. P. King, M. W. McNaughton, J. F. Harrison, and B. E. Bonner, *SP425*, pp. 103-105 (Oct. 1975).

Key words: facility; neutron-induced reactions; ^{12}C data; 56 MeV.

Nearly monoenergetic beams of neutrons, variable in energy from below 10 to above 60 MeV are produced via intense beams of protons and deuterons from the sector focusing isochronous cyclotron at Crocker Nuclear Laboratory. The neutron production target and collimation system are connected to a scattering chamber containing detector telescopes, all in vacuum. ΔE, E and time-of-flight signals from each telescope are interfaced to a PDP15/40 computer via CAMAC and sophisticated on-line and off-line data processing can be carried out. There are a number of examples of the use of these cross sections: Neutron induced reactions on carbon have provided us with a better understanding of energy dependence of neutron detection efficiencies in plastic scintillators. Data from carbon and other tissue-resident elements are necessary for an understanding of microscopic dose distributions produced by neutrons.

After-pulse suppression for 8850 and 8854 photomultipliers, G. P. Lamaze, J. K. Whittaker, R. A. Schrack, and O. A. Wasson, *SP425*, pp. 106-107 (Oct. 1975).

Key words: after-pulse; detector; gamma-flash; photomultiplier; pulse suppression; scintillator.

Spurious pulses occurring after large light output events in a scintillator (after pulsing) have been observed in semiconducting first dynode photomultipliers (RCA 8850 series). The after-pulsing apparently has two components, an isochronous component occurring at a fixed time interval after the initial light pulse and an asynchronous component with a long duration lasting at least 40 μsec. The time interval between the isochronous bursts is related to the types of residual gases in the photomultiplier. In the RCA 8850 series tubes, the asynchronous after-pulsing consists of very low amplitude pulses and appears to be primarily due to single electron events, the number of these events being related to the main pulse amplitude. To obtain after pulse suppression, a fine stainless steel mesh was stretched tightly over the glass window of the photocathode. The mesh was then pulsed (FWHM=250 ns) during the light flash to +300 volts relative to the photocathode potential. The isochronous and asynchronous after-pulsing was completely suppressed. Further details are presented.

A secondary standard neutron detector for measuring total reaction cross sections, K. K. Sekharan, H. Laumer, and F. Gabbard, *SP425*, pp. 108-111 (Oct. 1975).

Key words: absolute efficiency determination; cross section measurements; neutron detector.

A neutron detector has been constructed and calibrated for the accurate measurement of total neutron-production cross sections. The detector consists of a polyethylene sphere of 24 in diameter in which 8-$^{10}BF_3$ counters have been installed radially. The relative efficiency of this detector has been determined for average neutron energies, from 30 keV to 1.5 MeV by counting neutrons from $^7Li(p,n)^7Be$. By adjusting the radial positions of the BF_3 counters in the polyethylene sphere the efficiency for neutron detection was made nearly constant for this energy range. Measurement of absolute efficiency for the same neutron energy range has been done by counting the neutrons from $^{51}V(p,n)^{51}Cr$ and $^{57}Fe(p,n)^{57}Co$ reactions and determining the absolute number of residual nuclei produced during the measurement of neutron yield. Details of absolute efficiency measurements and the use of the detector for measurement of total neutron yields from neutron producing reactions such as $^{23}Na(p,n)^{23}Mg$ are given.

Facilities for cross section measurements using Na-D photoneutron sources, J. C. Robertson, M. C. Davis, and J. C. Engdahl, *SP425*, pp. 112-115 (Oct. 1975).

Key words: calibration; construction; Na-D photoneutron sources; radiolysis; spectrum.

Photoneutron sources are a convenient source of neutrons in the intermediate energy range, and because of this they are often used to make absolute cross section measurements. In this paper, the construction of two sodium-deuterium sources is described. One of the sources uses deuterated polyethylene shells and the other utilizes heavy water. The methods used in the manipulation of the sources are outlined. The effects of radiolysis on the yields from the sources is discussed together with the unique features of the Michigan manganese bath system used in their calibration. The results of Monte Carlo calculations of the neutron spectra are given.

A 25-keV neutron beam facility at NBS, E. D. McGarry and I. G. Schroder, *SP425*, pp. 116-118 (Oct. 1975).

Key words: dosimetry; filtered beams; neutrons; spectroscopy.

An iron-filtered, neutron-beam facility that provides a well collimated source of 25-keV neutrons has been developed at the National Bureau of Standards (NBS) Reactor. For selected physics experiments and monoenergetic calibration of neutron dosimeters, the beam flux may be tailored to provide $5 \times 10^5 n \cdot cm^{-2} \cdot s^{-1}$ with 99 percent 25-keV neutrons. For other experiments, such as calibration of fast-neutron spectrometers, fluxes of $10^6 n \cdot cm^{-2} \cdot s^{-1}$ may be obtained with as many as 13 identifiable peaks in the energy range 25 keV to 1.5 MeV.

New experimental techniques and results in neutron spectroscopy, C. D. Bowman, *SP425*, pp. 119-128 (Oct. 1975).

Key words: neutron cross sections; new results; new techniques; review.

During the past several years there has been very little funding available for construction of new facilities for neutron measurements. The most important changes in the field have come through the development of new experimental techniques at existing facilities. These techniques and resulting measurements in the area of programmatic neutron data and neutron physics research will be discussed.

Measurement, analysis, and implications of the fission cross section of the important fissionable isotopes, M. S. Moore, *SP425*, pp. 129-138 (Oct. 1975).

Key words: calculated $<\sigma_f>$; deduced channel spectrum; E = 3-5 MeV; fission; nuclear reactions; Pu isotopes; U; $^{235}U(n,f)$.

Recent measurements on the resonance cross sections of isotopes of uranium and plutonium are reviewed, with the objective of determining average parameters suitable for calculations at higher energies. The average parameters obtained are useful in two ways: they provide the necessary input for statistical calculations of resonance cross sections in the unresolved region, and they provide a normalization point for the calculation of smooth cross sections above the unresolved region. The particular problem we address is the systematic trend of average fission cross sections from 3-5 MeV, which have been found to follow the equation $\sigma_f = -39.031 + 17.231\ Z^2/A^{3/2}$. We find that a very simple statistical model calculation, based on R-matrix parameters which adequately describe the total cross section from 20 keV to 20 MeV, can provide a qualitative understanding of this systematic behavior.

Neutron capture cross section measurement techniques, R. E. Chrien, *SP425*, pp. 139-148 (Oct. 1975).

Key words: activation; capture techniques; high resolution methods; Moxon-Rae; review; total absorption.

A review of currently-used techniques to measure neutron capture cross sections is presented. Measurements involving use of total absorption and Moxon-Rae detectors are based on low-resolution detection of the prompt γ-ray cascades following neutron captures. In certain energy ranges activation methods are convenient and useful. High resolution γ-ray measurements with germanium detectors can give information on the parameters of resonance capture states. The use of these techniques is described.

Nuclear models and data for gamma-ray production, P. G. Young, *SP425*, pp. 149-155 (Oct. 1975).

Key words: nuclear reactions ^{14}N, ^{27}Al, ^{56}Fe, Mo, ^{93}Nb, ^{181}Ta, W, ^{238}U, review selected $(n,x\gamma)$ measurements, evaluations, $\sigma(E_n)$, $\sigma(E_\gamma)$; $^{93}Nb(n,x\gamma)$, E = 14.2 MeV, calculated $\sigma(E_\gamma)$; $^{181}Ta(n,x\gamma)$, E = thermal, calculated $\sigma(E_\gamma)$.

The current Evaluated Nuclear Data File (ENDF/B, Version IV) contains information on prompt gamma-ray production from neutron-induced reactions for some 38 nuclides. In addition, there is a mass of fission product yield, capture, and radioactive decay data from which certain time-dependent gamma-ray results can be calculated. These data are needed in such applications as gamma-ray heating calculations for reactors, estimates of radiation levels near nuclear facilities and weapons, shielding design calculations, and materials damage estimates. The prompt results are comprised of production cross sections, multiplicities, angular distributions, and energy spectra for secondary gamma-rays from a variety of reactions up to an incident neutron energy of 20 MeV. These data are based in many instances on experimental measurements, but nuclear model calculations, generally of a statistical nature, are also frequently used to smooth data, to interpolate between measurements, and to calculate data in unmeasured regions. The techniques and data used in determining the ENDF/B evaluations will be reviewed in this paper, and comparisons of model-code calculations and ENDF data with recent experimental results will be given.

Techniques for the determination of neutron induced charged particle reactions, H. Liskien, *SP425*, pp. 156-160 (Oct. 1975).

Key words: application; charged particle; cross section; emission; neutron; techniques.

Several fields of practical importance are existing for neutron induced charged particle reactions despite their low position within the cross section hierarchy. A survey is given on the experimental techniques employed to obtain information on cross sections, energy and angular distribution for this class of reactions. The obtainable accuracies are discussed and compared with the accuracies requested for the practical applications. The main areas of work, presently neglected, requiring future attention can be identified: (1) Reactions on medium mass nuclei not accessible by the activation method and (2) the neutron energy region between 6 and 12 MeV where suited neutron sources are not easily available.

Integral measurements to test shielding cross sections. L. Harris, Jr., J. C. Young, N. A. Lurie, D. K. Steinman, S. J. Friesenhahn, D. E. Bryan, W. E. Gober, and L. Schänzler, *SP425*, pp. 161-164 (Oct. 1975).

Key words: concrete and steel shield; gamma-ray spectrum unfolding; integral measurements; neutron spectrum unfolding; NE-213 detector; nitrogen cross sections.

The pulsed-white-neutron-source, time-of-flight method and an NE-213 detector have been used for two integral shielding measurements. Incident-neutron-energy-dependent measurements of scattered neutrons and secondary gamma rays from small samples of Be, C, N, H_2O and Fe have been performed. Results for N, including unfolded energy spectra of scattered neutrons and secondary gamma rays at 125°, are presented. Time-dependent measurements of leakage neutrons and secondary gamma rays from a thick concrete and steel shield are described, and some data are presented.

Evaluation, uncertainty estimation and adjustment of capture cross sections for fission product nuclei. H. Gruppelaar, J. B. Dragt, A. J. Janssen, and J. W. M. Dekker, *SP425*, pp. 165-168 (Oct. 1975).

Key words: adjustment; evaluation; fission products; sensitivity analysis; σ_c; $^{101,102,104}Ru$; ^{127}I.

Part of the results of integral measurements, which have been performed in the STEK-facility for about 60 fission product nuclei, have been analysed and used for adjustment of capture cross sections needed for fast breeders. This paper gives an outline of the method used to obtain these adjusted cross sections as well as some conclusions for σ_c of $^{101,102,104}Ru$, ^{127}I.

Integral test of cross sections using neutron leakage spectra from spheres of iron, niobium, beryllium, and polyethylene. R. H. Johnson, J. J. Dorning, and B. W. Wehring, *SP425*, pp. 169-172 (Oct. 1975).

Key words: beryllium; carbon; integral cross section tests; iron; niobium.

Measurements of neutron leakage spectra in the energy range 1 to 15 MeV from homogeneous spherical assemblies have been made using an NE-213 spectrometry system. These benchmark-type measured spectra will be compared with detailed computed spectra as an integral test of evaluated nuclear data. Preliminary ANISN calculations using cross section sets based on ENDF/B-III are presented and compared with the measurements. Measurements on a 22-cm diam beryllium sphere, a 25-cm diam niobium sphere, and a 46-cm diam polyethylene (CH_2) sphere, each with a ^{252}Cf source at the sphere center, have been made. The niobium calculation slightly underpredicts the leakage spectrum below 9 MeV. The beryllium and polyethylene calculations are in general agreement with the measurements, though discrepancies are seen for small energy ranges. Measurements have also been made for a 76-cm diam iron sphere with a 14-MeV source at the sphere center. The preliminary iron calculation (ENDF/B-III) greatly underpredicts the leakage spectrum from 1 to 8 MeV.

Uncertainties and correlations in evaluated data sets induced by use of standard cross sections. R. W. Peelle, *SP425*, pp. 173-176 (Oct. 1975).

Key words: correlation; covariance; ENDF/B; standard cross section; uncertainty file.

A file of cross-section uncertainty information for use in reactor performance uncertainty analysis should take into account the propagated effects of uncertainties in the standard cross sections used. This problem has been analyzed using first-order error theory in terms of the uncertainties in the standard cross sections and the energy-dependent weight given to each underlying experimental result in obtaining an evaluated cross section. Three cases occur depending on whether the energy dependence of the standard was utilized, and if so whether the absolute magnitude or only the shape of the standard cross section was used in an underlying experiment. The analysis yields the uncertainties in and correlations among the evaluated cross sections. The resulting uncertainty files need not refer explicitly to the uncertainties in standards and can use the same set of formats employed for other uncertainty data.

Shielding benchmark experiments and sensitivity studies in progress at some European laboratories. G. Hehn, M. Mattes, W. Matthes, R. Nicks, and H. Rief, *SP425*, pp. 177-183 (Oct. 1975).

Key words: benchmark; cross sections; graphite; neutron; sodium; water.

A 100 group standard library based on ENDF/B3 has been prepared by IKE and JRC. This library is used for the analysis of the current European and Japanese iron benchmark experiments. Further measurements are planned for checking the data sets for graphite, sodium, and water.

In a cooperation between the IKE and JRC groups coupled neutron-photon cross section sets will be produced.

Point data are processed at IKE by the modular program system RSYST (CDC 6600) for elaborating the ENDFB data, whereas the JRC group, apart from using standard codes such as SUPERTOG 3, GAMLEG, etc., has developed a series of auxiliary programs (IBM 360) for handling the DLC 2D and POPOP libraries and for producing the combined neutron-plus gamma library EL4 (119 groups). Sensitivity studies (in progress at IKE) make possible improvements in methods and optimization of calculation efforts for establishing group data. A tentative sensitivity study for a 3-dimensional MC approach is in progress at Ispra. As for nuclear data evaluation, the JRC group is calculating barium cross sections and their associated gamma spectra.

Assessment of neutron group constants for iron and stainless steel through measurements and analyses of energy and space distributions of neutrons in test assemblies. I. Kimura, K. Kobayashi, S. A. Hayashi, S. Yamamoto, H. Nishihara, M. Ando, S. Kanazawa, and M. Nakagawa, *SP425*, pp. 184-188 (Oct. 1975).

Key words: activation method; group constants; iron; neutron spectrum; one-dimensional transport calculation; stainless steel; time-of-flight.

In order to assess group constants (JAERI-FAST, ABBN, DLC-2D, etc.) for iron and stainless steel, neutron

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energy spectra from 1 keV to a few MeV in iron and stainless steel assemblies were measured by the linac-time-of-flight method. Neutron spatial distributions measured by the activation method ($^{58}Ni(n,p)^{58}Co$ and $^{197}Au(n,\gamma)^{198}Au$) showed a spherical symmetry around the photoneutron source, and enabled us to use one-dimensional transport codes (ANISN, DTF-IV, etc.). The measured neutron spectra agree with the predicted by ANISN code with DLC-2D for both materials. However, C/E agreement is poorer below the 25 keV resonance when JAERI-FAST constants for iron are used in calculation. This disagreement was considerably reduced by using a modified set of constants. General shape of fast-neutron spatial distributions agrees with the theoretically predicted for all cases.

ENDF/B dosimetry cross section file benchmark neutron flux-spectral uncertainties, W. N. McElroy, *SP425*, pp. 189-192 (Oct. 1975).

Key words: cross sections; flux; neutrons; reaction rates; spectra.

An ENDF/B file of evaluated energy dependent cross sections for dosimetry applications has been established. The fission and most reliable nonfission reaction cross sections on this file are used with current recommended sets of evaluated measured reaction rates for several benchmark spectra to establish multiple foil derived flux-spectra with Monte Carlo uncertainties for comparison with spectrometry and calculated spectra. It is concluded that integral data testing of cross sections on the ENDF/B-IV file is presently limited to the ± 5 to 10 percent (1σ) range because of uncertainties in the benchmark flux-spectra.

Fission-product gamma-ray and photoneutron spectra, M. G. Stamatelatos and T. R. England, *SP425*, pp. 193-198 (Oct. 1975).

Key words: fission products; gamma spectra; photoneutron spectra; reactors; ^{2}H; ^{9}Be.

Fission-product gamma-ray and photoneutron spectra from thermal and fast fission of ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu have been calculated at 27 time intervals between 1 and 1000 hours following reactor shutdown. The gamma spectral calculations were made using CINDER, a depletion and fission-product code, which has been revised, extended, and variably dimensioned for applications to many problems involving irradiated materials. ENDF/B-IV yield and decay data for all fission products with half-lives ≥ 15 minutes and gamma energies above $^{9}Be(\gamma,n)^{8}Be$ threshold were used. An interesting general feature of the spectra is that they harden with time. The photoneutron spectra were calculated with PHONEX, a program general enough to operate on arbitrary gamma spectra incident on specific materials, e.g., ^{9}Be and ^{2}H. Time-dependent distributions of photons and photoneutrons/fission were calculated in 66 energy groups (50 keV grids). The constancy of these source strengths between ~ 10 and 200 hours following reactor shutdown indicates the possibility of sourceless start-ups.

Safeguards against theft or diversion of nuclear materials, T. B. Taylor, *SP425*, pp. 199-201 (Oct. 1975).

Key words: nuclear enterprises; nuclear materials; plutonium; safeguard; uranium.

An overview of the risks and safeguards relevant to the possible theft or national diversion of special nuclear materials from peaceful nuclear enterprises is presented.

Fission theory and actinide fission data, A. Michaudon, *SP425*, pp. 202-213 (Oct. 1975).

Key words: actinide; cross sections; fission.

The understanding of the fission process has made great progress recently, as a result of the calculation of fission barriers, using the Strutinsky prescription. Double-humped shapes were obtained for nuclei in the actinide region. Such shapes could explain, in a coherent manner, many different phenomena: fission isomers, structure in near-threshold fission cross sections, intermediate structure in subthreshold fission cross sections and anisotropy in the emission of the fission fragments. A brief review of fission barrier calculations and relevant experimental data is presented. Calculations of fission cross sections, using double-humped barrier shapes and fission channel properties, as obtained from the data discussed previously, are given for some U and Pu isotopes.

The fission channel theory of A. Bohr has greatly influenced the study of low-energy fission. However, recent investigation of the yields of prompt neutrons and γ-rays emitted in the resonances of ^{235}U and ^{239}Pu, together with the spin determination for many resonances of these two nuclei cannot be explained purely in terms of the Bohr theory. Variation in the prompt neutron and γ-ray yields from resonance to resonance does not seem to be due to such fission channels, as was thought previously, but to the effect of the $(n,\gamma f)$ reaction.

The number of prompt fission neutrons and the kinetic energy of the fission fragments are affected by the energy balance and damping or viscosity effects in the last stage of the fission process, from saddle point to scission. These effects are discussed for some nuclei, especially for ^{240}Pu.

Nuclear data for actinide recycle, E. J. Hennelly, *SP425*, pp. 214-217 (Oct. 1975).

Key words: actinide burnup; cross section sets; neutron spectrum; transplutonium; waste management; yield.

Large quantities of heavy actinides will be byproducts of burning plutonium and uranium fuel in nuclear power reactors. Chemical recovery and subsequent recycle in reactors will be for the production of ^{238}Pu and ^{244}Cm as heat sources and ^{252}Cf as a unique source of neutrons or for the ultimate conversion of heavy actinides to shorter-lived fission products to reduce long-term waste storage problems. Test measurements and production yields have provided data for developing a consistent set of multigroup cross sections which give excellent predictions of actinide concentrations in a variety of reactor environments and exposures. These multigroup cross sections are compatible with advanced reactor theory calculational codes.

(n,f) cross sections for exotic actinides, J. B. Wilhelmy, H. C. Britt, A. Gavron, E. Konecny, and J. Weber, *SP425*, pp. 218-221 (Oct. 1975).

Key words: deduced σ_{nf}; nuclear reactions measured P_f $^{230\text{-}233}Pa$, $^{231,232}U$, $^{233\text{-}239}Np$, $^{237,238}Pu$, $^{239\text{-}243}Am$, $^{241\text{-}244}Cm$, $^{248,249}Bk$ using $(^{3}He,df)$, $(^{3}He,tf)$, E= threshold $- \sim 12$ MeV.

Neutron induced fission cross sections have been obtained for 26 actinide nuclei using $(^{3}He,df)$ and $(^{3}He,tf)$ reactions to determine fission probabilities and then multiplying these values by calculated compound nuclear neutron reaction cross sections. Comparison with existing (n,f) data shows this to be a feasible approach for obtaining reliable estimates for (n,f) cross sections where direct measurements are not possible. Theoretical developments in interpreting fission probability measurements are discussed.

A study of the ^{233}U-^{232}Th reactor as a burner for actinide wastes, S. Raman, C. W. Nestor, Jr., and J. W. T. Dabbs, *SP425*, pp. 222-223 (Oct. 1975).

Key words: actinide fuel, fertile material, and wastes; recycle concept; transuranium element production; waste recycling in a ^{233}U-^{232}Th reactor.

A plausible method for reducing the storage problems and hazards now associated with long-lived actinide wastes might be to recycle and convert these to fission products. Several reactor types can be envisaged for this purpose. We note that in a ^{233}U-^{232}Th reactor, the production of ^{237}Np, Pu and transplutonium isotopes is greatly reduced compared to a ^{235}U-^{238}U reactor because several additional neutron captures are required to reach the same mass. Hence, the ^{233}U-^{232}Th reactor can be employed to effectively reduce Np, Pu, Am, and Cm wastes to fission-product wastes which entail shorter (≈ 1000 yr) storage times.

A consistent set of transplutonium multigroup cross sections, R. W. Benjamin, V. D. Vandervelde, T. C. Gorrell, and F. J. McCrosson, *SP425*, pp. 224-228 (Oct. 1975).

Key words: heavy actinide burnup; multigroup cross sections; neutron reactions, heavy actinides; reactor production experiments.

A consistent set of multigroup neutron cross sections was developed for nuclides in the chain from ^{242}Pu to ^{253}Es. Evaluated multigroup cross section data were combined with experimental test measurements and production yields from long-term reactor irradiations in flux spectra of varying hardness. Thus 37- and 84-group data were derived in part from ENDF/B and existing Savannah River Laboratory evaluated libraries. Where differential data were lacking, resonance-region model calculations and integral cross section values were combined to form the multigroup data. The data were tested with the JOSHUA system to calculate the reactor environment as a function of time and to predict the concentration of actinide nuclides in the chain. Cross section data were modified within experimental uncertainties until predicted nuclide concentrations matched experimental results within reasonable limits over the range of neutron flux spectra.

Measurement of the neutron capture cross sections of the actinides, L. W. Weston and J. H. Todd, *SP425*, pp. 229-231 (Oct. 1975).

Key words: actinide management; neutron capture cross sections; Pu isotopes, ^{241}Am.

The capture cross sections of the isotopes heavier than ^{239}Pu are of great importance for the core physics, fuel recycle, and waste management for power reactors. Since total cross sections are not sufficient, a program for the measurement of these needed capture cross sections is being carried out at ORNL. Measurements have been almost completed on ^{240}Pu, ^{241}Pu, and ^{241}Am and have been planned for ^{242}Pu and possible ^{237}Np and ^{243}Am. The capture gamma-ray detector used is the "total energy detector" which is a modification of the Moxon-Rae detector. Fission, when present, is detected with fast neutron counters. Results obtained on ^{240}Pu, ^{241}Pu, and ^{241}Am will extend continuously from thermal neutron energies to 350 keV. The cross sections are normalized at thermal neutron energies and the neutron flux is measured relative to the $^{10}B(n,\alpha)$ cross section up to 2 keV and $^{6}Li(n,\alpha)$ at higher neutron energies. The accuracy of the techniques used varies with the sample but is about 8 percent. With such cross sections the long range management of the actinides produced in power reactors can be planned on a more systematic basis.

Measurements of the ^{6}Li and ^{10}B partial cross sections from 1 to 1500 keV, S. J. Friesenhahn, V. J. Orphan, A. D. Carlson, M. P. Fricke, and W. M. Lopez, *SP425*, pp. 232-235 (Oct. 1975).

Key words: neutron cross section; standard; ^{10}B; ^{6}Li.

The $^{10}B(n,\alpha_0+\alpha_1)^7Li$, $^{10}B(n,\alpha_1)^7Li^*$ and $^{6}Li(n,\alpha)T$ cross sections have been measured between 1- and 1500-keV neutron energy. The neutron spectrum was measured using proton scattering as observed in a methane-filled proportional counter. Gamma rays from the $^{10}B(n,\alpha_1)^7Li^*$ reaction were observed with a high-resolution Ge(Li) spectrometer, and the reaction products from the $^{10}B(n,\alpha_0+\alpha_1)^7Li$ and $^{6}Li(n,\alpha)T$ reactions were observed in a large ion chamber. In an auxiliary measurement, the ratio of the $^{10}B(n,\alpha_0+\alpha_1)^7Li$ cross section to the hydrogen scattering cross section was obtained between 200 and 1000 keV by observation of interactions in a specially constructed $^{10}BF_3$ proportional counter containing a methane additive.

An absolute measurement of the $^{6}Li(n,\alpha)$ cross section at 964 keV, W. P. Stephany and G. F. Knoll, *SP425*, pp. 236-239 (Oct. 1975).

Key words: absolute cross section measurements; manganese bath; neutron cross sections; photoneutron sources; surface barrier detectors; $^{6}Li(n,\alpha)$.

A value of 356 mb ± 12 percent was obtained for the $^{6}Li(n,\alpha)$ cross section at 964 keV. Neutrons were produced using a spherical Na-Be photoneutron source, calibrated relative to NBS-II using The University of Michigan manganese bath. Thin ^{6}LiF targets enriched to 95 atom percent ^{6}Li were vapor deposited onto the electrode surfaces of a 42 micron thick, fully depleted Si surface barrier detector. A summary of the data, corrections, and error analysis is presented.

Angular anisotropy in the $^{6}Li(n,\alpha)^3H$ reaction at 25 keV, I. G. Schroder, E. D. McGarry, G. de Leeuw-Gierts, and S. de Leeuw, *SP245*, pp. 240-243 (Oct. 1975).

Key words: cross sections; fast-neutron reactions; lithium; nuclear reactions; (n,α) cross sections.

The angular anisotropy in the $^{6}Li(n,\alpha)^3H$ reaction at 25 keV has been measured in two sets of experiments performed at an iron-filtered beam facility (99% of the flux at 25 keV) at the NBS Reactor. First, a surface-barrier detector coated with 80 $\mu g \cdot cm^{-2}$ of ^{6}LiF (front face) was used as a 2π detector. This detector was placed in four different angular positions with respect to the neutron beam: front face at 90 and 45° to the beam; back face at 90 and 45° to the beam. The pulse-height distributions of both the ^3H and ^4He were recorded for these four positions yielding a forward-to-backward asymmetry of 1.59 ± 0.11 in the center-of-mass system. A second detector was placed coaxially with the first (at 90° to the beam) and in such a way as to substend a 45° cone. Coincidence measurements, that simultaneously recorded the distributions in both detectors, yielded an asymmetry in the back-to-forward 45° cone of 1.80 ± 0.06 in the center-of-mass system. The existence of such a large anisotropy at this low energy and the possibility of similar behavior at still lower energies (i.e., 1–2 keV) should result from s-p wave interference. This would give rise to a constant anisotropy that is experimentally masked by the 1/v behavior of the isotropic s-s interference terms at lower energies.

Neutron total cross section of ^{6}Li from 10 eV to 10 MeV, J. A. Harvey and N. W. Hill, *SP425*, pp. 244-245 (Oct. 1975).

Key words: nuclear reactions: ^{6}Li, σ_{nT}, En = 10 eV to 10 MeV.

Transmission measurements have been made at ORELA upon two metal samples of ^{6}Li(98.72%) with inverse sample thicknesses of ^{6}Li of 11.99 and 2.987 b/atom. The measurements at low energies (from 10 eV to 300 keV) were made using a ^{6}Li glass scintillation detector at 17.878 m and 78.203 m and at high energies (from 50 keV to ~ 10 MeV) using an NE-110 scintillation detector at 78.203 m. The total cross section data from both samples and detectors are in good agreement and are believed to be accurate to 1 to 2 percent below 1 MeV. Total cross section data obtained from both samples at ~ 25 discrete energies up to 1 MeV using an iron-filtered beam are in good agreement with the continuous spectra data.

Observation and analysis of elastic neutron scattering from ^{12}C, R. J. Holt, A. B. Smith, and J. F. Whalen, *SP425*, pp. 246-249 (Oct. 1975).

Key words: measured $\sigma_T(E)$, E= 1.5-5.0 MeV,$\sigma(\theta,E)$, E= 1.8-4.0 MeV, θ_{lab}= 20 to 160°; nuclear reaction $^{12}C(n,n)^{12}C$; R-function analysis.

Angular distributions of neutrons elastically scattered from ^{12}C were measured from 1.8-4.0 MeV at intervals of ≥ 20 scattering angles distributed between 20-160 deg. Incident neutron energy resolutions were 20-50 keV. All differential cross sections were determined relative to those of the H(n,n) reaction. In addition, total neutron cross sections were deduced from monoenergetic ($\Delta E \simeq 2$ keV) neutron transmissions in the energy range 1.5-5.0 MeV. The experimental results were interpreted in terms of a multilevel R-matrix analysis including considerations of previously reported cross sections and polarizations. The resulting R-matrix parameters are compared with the Yale values deduced from observed scattered neutron polarizations. The measured values and analysis suggest physically consistent standard carbon total and scattering cross sections readily referenced in measurement applications.

Fission spectrum neutrons for cross section validation and neutron flux transfer, J. A. Grundl and C. M. Eisenhauer, *SP425*, pp. 250-253 (Oct. 1975).

Key words: cross sections; dosimetry; evaluation; fission spectrum; neutron flux; neutrons.

A variety of measurement methods over more than two decades provides a base for proper evaluation of the fission spectrum shape. The evaluation presented recommends a Maxwellian reference description for ^{252}Cf (spontaneous fission) and ^{235}U (thermal-neutron-induced fission) with average energy parameters of 2.13 MeV and 1.97 MeV respectively over the energy range 0.25 to 8 MeV. A further multigroup summary of the experimental data presents the final evaluation as an empirical adjustment of Maxwellian segments and includes an estimate of credible departures from the true spectrum shape. The reference Maxwellian shapes differ from the final evaluated shape by < 2 percent over the above energy range. A few basic integral quantities, fission neutron age in water and the fission-spectrum-averaged fission cross section for ^{238}U, ^{235}U, and ^{237}Np, are reviewed briefly, based on the results of the evaluation. Two features of fission neutrons make them a useful reference for certain measurement problems in nuclear technology: the fission spectrum shape is preserved above ~ 1 MeV in important reactor-associated neutron environments, and small, intense sources of pure ^{252}Cf fission neutrons are now available. A restricted class of related applications using fission neutron sources is discussed.

Fundamental integral cross section ratio measurements in the thermal-neutron-induced uranium-235 fission neutron spectrum, A. Fabry, J. A. Grundl, and C. Eisenhauer, *SP425*, pp. 254-257 (Oct. 1975).

Key words: dosimetry; fission cross sections; neutron standards; uranium-235 cavity fission spectrum.

High-accuracy integral cross section ratio measurements have been performed in the thermal-neutron-induced uranium-235 fission neutron spectrum. This involves the basic fission reactions $^{235}U(n,f)$, $^{239}Pu(n,f)$, $^{238}U(n,f)$ and $^{237}Np(n,f)$; and the gold capture and $^{115}In(n,n')^{115m}In$ dosimetry reactions. The uranium-235 fission neutron spectrum is generated at the center of a one meter diameter spherical cavity within a graphite thermal column. Simple and variable geometrical arrangements were used and evaluated for neutron field purity. The fission rates were determined with the NBS double fission chamber as well as with others of different size and design. All fission detectors were validated within a parallel program of interlaboratory comparisons in the MOL-ΣΣ Standard Neutron Field. The activation rates have been measured with calibrated gamma-ray spectrometers. The resulting integral cross section ratios relative to the $^{238}U(n,f)$ reaction are, for $^{235}U(n,f)$: 3.94 ± 0.08; $^{239}Pu(n,f)$: 5.93 ± 0.13; $^{237}Np(n,f)$: 4.35 ± 0.13; $^{115}In(n,n')^{115m}In$: 0.620 ± 0.019; and $^{197}Au(n,\gamma)^{198}Au$: 0.287 ± 0.014.

Interlaboratory comparison of absolute fission rate and uranium-238 capture rate measurements in the Mol-ΣΣ secondary intermediate-energy standard neutron field, M. Pinter, W. Scholtyssek, P. Fehsenfeld, H. A. J. van der Kamp, W. H. J. Quaadvliet, A. Fabry, G. De Leeuw, S. De Leeuw, F. Cops, J. A. Grundl, D. Gilliam, and C. Eisenhauer, *SP425*, pp. 258-261 (Oct. 1975).

Key words: fast reactors; fission chambers; fission rates; mass assay; MOL-ΣΣ facility; uranium-238 capture rates.

Interlaboratory comparisons have been made during the past two years, of techniques that are currently applied for the measurement of fission rates and uranium-238 capture rates in a number of zero-power fast assemblies related to the LMFBR program. This effort has involved the exposure of absolute fission chambers and of activation foils, to the Mol-ΣΣ central neutron field. Long term flux level monitoring accuracy of better than ±0.5 percent in Mol-ΣΣ has been achieved. The perturbation of the neutron field by the access hole has been studied extensively. Uncertainties in measured reaction rates estimated by each laboratory relative to flux monitors are between ±1.5 percent and ±3.5 percent. Interlaboratory agreement for ^{235}U, ^{238}U, and ^{239}Pu fission rates is in the range ±0.5 to ±1.3 percent. Poor agreement is obtained for the ^{238}U capture rate measurements and further interlaboratory efforts are recommended including complementary experimental techniques. A set of ΣΣ preferred values of central fission rate ratios and uncertainties is presented.

Manganese bath systematic effects in measurements of nu-bar and eta, J. R. Smith, *SP425*, pp. 262-265 (Oct. 1975).

Key words: eta; fissile nuclei; manganese bath; nu-bar; ^{252}Cf.

Measurements using the manganese bath technique are central to the discrepancy that has existed between measured values of $\bar{\nu}$ for ^{252}Cf. Manganese bath measurements of $\bar{\nu}$ belong to the lower group of values, while the η measurements are consistent with the higher ν values. A three-part study was performed to see if the discrepancy could be explained by differences in manganese bath techniques: (1) A ^{252}Cf source previously calibrated by De Volpi was calibrated in the MTR manganese bath; (2) The recommendations made by De Volpi for altering the MTR eta values were carefully considered; and (3) The results of the Monte Carlo calculations of the MTR experiment, carried out at Bettis Atomic Power Laboratory, were examined in detail. The study produced insignificant changes in the η values.

Absolute ^{235}U fission cross section for ^{252}Cf spontaneous fission neutrons, H. T. Heaton II, J. A. Grundl, V. Spiegel, Jr., D. M. Gilliam, and C. Eisenhauer, *SP425*, pp. 266-269 (Oct. 1975).

Key words: fission spectrum; spectrum averaged cross section; ^{235}U(n,f); ^{252}Cf.

A measurement of the absolute ^{235}U fission cross section for ^{252}Cf spontaneous fission neutrons has been performed with two double fission chambers in compensated beam geometry. The fission chambers are mounted 10 cm apart on opposite sides of a small volume, single encapsulated ^{252}Cf source (4×10^{9} n/sec, 0.34 cm^3 capsule vol: ~ 2 g steel and aluminum). In this geometry the effect of source position errors is small. The ^{252}Cf neutron source strength was determined with a Manganous Sulfate Bath relative to the internationally compared Ra-Be photoneutron standard neutron source, NBS-I, presently known to ± 1.1 percent. Uncertainty in the Manganous Bath comparison of NBS-I and the Cf source was ± 0.4 percent; the ^{235}U fissionable deposit masses have been ascertained to ± 1.3 percent. Five scattering corrections were applied to the data: source capsule (0.6 ± 0.8) percent, fission chamber (1.1 ± 0.4) percent, support structure (0.6 ± 0.5) percent, platinum deposit backing (1.3 ± 0.8) percent and total room return (0.5 ± 0.2) percent. The observed ^{235}U fission cross section is 1204 ± 29 mb. A computed value of 1245 mb is obtained using an evaluated ^{252}Cf fission neutron spectrum and ENDF/B-IV for the ^{235}U(n,f) cross section.

Fission cross section ratios in the ^{252}Cf neutron spectrum (^{235}U: ^{238}U: ^{239}Pu: ^{237}Np), D. M. Gilliam, C. Eisenhauer, H. T. Heaton II, and J. A. Grundl, *SP425*, pp. 270-272 (Oct. 1975).

Key words: fission cross section; fission spectrum; ^{252}Cf; ^{235}U; ^{238}U; ^{239}Pu; ^{237}Np.

In a ^{252}Cf neutron field, ratios of spectrum-averaged fission cross sections have been measured by back-to-back counting in a double fission ionization chamber with interchangeable deposits of ^{235}U, ^{238}U, ^{239}Pu, and ^{237}Np. These ratio measurements provide integral tests for evaluated cross section data. The dominant error in the ratio measurements was the ± 1.4 percent to ± 2.1 percent uncertainty in the fissionable deposit masses. Redundant mass assay methods were employed for all deposit nuclides. Corrections of up to (1.4 ± 7) percent were necessary for inelastic scattering effects on the neutron energy distribution in the cases of ^{238}U and ^{237}Np. For ^{235}U and ^{239}Pu fission rates, a correction of (0.45 ± 0.20) percent was made for the contribution of neutrons moderated and back-scattered by laboratory structures. The cross section ratios observed in the present measurements were as follows: 1.000: 0.266 ± 1.7 percent: 1.500 ± 1.6 percent: 1.105 ± 2.2 percent for ^{235}U: ^{238}U: ^{239}Pu: ^{237}Np, respectively. In comparison to the observed integral cross section ratios, the corresponding values derived from ENDF/B-IV data were 2.3 to 6.0 percent lower.

Measurement of cross sections for threshold reactions induced by californium-252 spontaneous fission neutrons, W. G. Alberts, J. Bortfeldt, E. Günther, K. Knauf, M. Matzke, G. Rassl, V. Siegel, and K. F. Walz, *SP425*, pp. 273-276 (Oct. 1975).

Key words: activity measurement; cross sections; fission spectrum; neutron source; scattering corrections; threshold detectors.

An open-air experiment for measuring cross sections averaged over the californium-252 spontaneous fission neutron spectrum is described. In a low-scattering arrangement the ^{252}Cf source was enclosed by the sample materials for irradiation. From the source strength (3×10^{9} s^{-1} as of Jan. 1973) and the activities of the generated nuclides, average cross sections for the reactions ^{27}Al(n,α)^{24}Na, ^{54}Fe(n,p)^{54}Mn, ^{56}Fe(n,p)^{56}Mn, and ^{46}Ti(n,p)^{46}Sc were derived. The influence of neutron scattering in the source and samples has been taken into account by means of Monte Carlo calculations; in addition this influence in the samples was studied experimentally by activating samples of various thicknesses.

Absolute neutron flux determination in fast neutron spectra, I. Schouky, S. Cierjacks, P. Brotz, D. Gröschel, and B. Leugers, *SP425*, pp. 277-280 (Oct. 1975).

Key words: gas scintillation transmission counters; neutron flux determination: $1 \leq E_n \leq 30$ MeV.

A flux detector system was developed in order to determine the fast neutron flux between 1-30 MeV obtained with the Karlsruhe isochronous cyclotron. The counter system represents a telescope-like proton recoil device using solid radiators and gas scintillation transmission counters. Flux determination is accomplished separately between about 1-6 MeV and $\sim$ 5-30 MeV, with a small energy interval of overlap. Below 6 MeV, recoil protons are detected in a single gas scintillation chamber viewed by three photomultipliers requiring a fast coincidence. Above this range, high energy recoil protons are identified by coincidences in three adjacent chambers and by their specific energy losses. Since the transmission of the entire flux counter system is better than 99 percent, it can be used for simultaneous flux measurements in partial cross section determination. The accuracy for the determination of the neutron flux is about 5 percent.

Thermal parameters of the fissile isotopes, B. R. Leonard, Jr., *SP425*, pp. 281-285 (Oct. 1975).

Key words: evaluation; nuclear reactions ^{233}U, ^{235}U, ^{239}Pu, ^{241}Pu(n,F) (n,γ) (n,n) ν, E = 0-1 eV.

Evaluations have continued to better define the 2200 m/s nuclear data for the fissile isotopes. The author has been participating in such evaluations with both the International Atomic Energy Agency (IAEA) and the USAEC National Neutron Cross Section Center (NNCSC). Each study is faced with the same dilemma: the measured values of a given parameter form a set which is reasonably self-consistent, yet the average values of the interrelated parameters constitute a set which is significantly inconsistent. The obvious discrepancy is between the values of alpha deduced with high accuracy from irradiation experiments with the values which result from the ensemble of values of the other parameters which by themselves form a reasonably self-consistent set. However, the inconsistency could result from error assignments which are too small for two or more parameters, e.g., fission and eta. In order to expedite ENDF/B-IV, the NNCSC evaluation fixed certain input parameters including the thermal shapes which are in good agreement with differential data. As a result the least-squares-compromise adjusted absorption, fission, and nubar values by several tenths percent. In the IAEA evaluation, the primary adjustments of the LSQ fit were in nubar and g_γ values which implicitly infer significant systematic errors in the directly measured capture shapes. The Electric Power

Research Institute has initiated studies to attempt to resolve this dilemma which is crucial to analyses of fission power reactors. These are: (1) A simultaneous LSQ fit to energy-dependent differential partial and total data; (2) A reevaluation of the accuracy assignment of absolute fission cross section values; and (3) A reexamination of irradiation alpha experiments with sophisticated analytical methods. Further experiments which would improve the knowledge of the thermal parameters include: (1) Confirmatory measurements of capture shapes extended to lower neutron energies; (2) Confirmatory measurements relative to the monoenergetic eta experiments; (3) Accurate coherent scattering amplitude measurements in the thermal region for all isotopes; (4) Measurement of the total cross section of ^{233}U from thermal to several tenths eV; (5) Improved thermal fission critical experiments and analysis for ^{239}Pu; and (6) Confirmatory high accuracy absolute fission cross-section experiments.

The third IAEA evaluation of the 2200 m/s and 20 °C Maxwellian neutron data for U-233, U-235, Pu-239, and Pu-241, H. D. Lemmel, *SP425*, pp. 286-292 (Oct. 1975).

Key words: Cf-252 spontaneous fission neutron yield; E= 0.0253 eV and 20 °C Maxwellian; fission-neutron yields; half-lives of U-233, U-234, Pu-239; mean energy of fission neutron spectrum; neutron cross-sections; neutron data evaluation; U-233, U-235, Pu-239, Pu-241; Westcott g-factors.

The paper presents a new consistent set of best values of 2200 m/s and 20 °C Maxwellian neutron cross-sections, fission-neutron yields, and Westcott g-factors for U-233, U-235, Pu-239, and Pu-241, and of related reference values such as the spontaneous fission-neutron yield of Cf-252, the mean fission-neutron spectrum energies of the five nuclides named, the α-decay half-lives of U-233, U-234, and Pu-239 and others.

This consistent set of values is derived from a multiparameter least-squares fit of all available experimental data, after reviewing and, where feasible, reassessing the authors' quoted values and errors usually after consultation with the authors.

The new best set of values is significantly different from that of the Second IAEA Review of 1969. The major changes are due to new lower experimental values of $\overline{\nu}$ (Cf-252) and of half-lives. Also discussed are some disturbing unresolved discrepancies among experimental data, which leave the accuracies of some parameters, for example the uranium fission cross-sections, still unsatisfactory.

Neutron cross section standards and flux determinations above thermal energies, A. D. Carlson, *SP425*, pp. 293-301 (Oct. 1975).

Key words: Au(n,γ); C(n,n); H(n,n); neutron flux determination; standard cross sections; ^{3}He(n,p); ^{6}Li(n,α); ^{10}B(n,α); ^{235}U(n,f); ^{237}Np(n,f).

The recent worldwide advances in nuclear technology, particularly fast fission and fusion reactors, have revealed the need for accurate neutron reaction cross sections for the design of these systems. The accuracies of these cross sections are generally limited by the standard cross sections relative to which they are measured. With the exception of the hydrogen scattering cross section, there have been serious problems with each of the standards in the energy region where it is being used as a standard. New measurements of many of these standards have been recently completed which will have a strong impact on the quality of these cross sections. A review will be presented of the status of the neutron cross section standards presently employed for measurements of neutron cross sections. Light element, capture and fission standards will be included. Special emphasis will be placed on the techniques which have been used to obtain the neutron flux for measurements of neutron cross section standards.

R-matrix analysis of the light element standards, G. M. Hale, *SP425*, pp. 302-308 (Oct. 1975).

Key words: cross sections; light elements; R-matrix; standards; ^{6}Li; ^{10}B.

The application of multilevel, multichannel R-matrix theory to the analysis of reactions in light nuclear systems is outlined. The discussion then specializes to describe analyses of reactions in the ^{7}Li and ^{11}B systems, which contain (n,α) cross sections widely used as neutron standards. Comprehensive R-matrix analyses which were incorporated in Version IV of the Evaluated Nuclear Data File (ENDF/B-IV) for neutron reactions from ^{6}Li and ^{10}B are described, giving the reactions and data analyzed, the resulting parameters, and predicted cross sections. The effects of new experimental information on the ENDF/B-IV results are discussed for both lithium and boron. Particular attention is given to the perplexing question of determining the ^{6}Li(n,α) cross section in the region of the 240 keV resonance. Suggestions for further experimental work are given.

Computer-readable "Nuclear Data Sheets," W. B. Ewbank, *SP425*, pp. 309-312 (Oct. 1975).

Key words: computers; data; decay; ENSDF; evaluation; files; formats; levels; nuclear structure; radiations; reactions; tables; γ-rays.

The evaluated nuclear structure data contained in "Nuclear Data Sheets" are available in computer-readable form. Experimentally established properties of nuclear levels are included as well as radiations from nuclear reactions and radioactive decay. Portions of the data can be selected for distribution in several formats on magnetic tape or computer cards. A variety of different listing and drawing formats are also available.

Recent evaluation for the German nuclear data library KEDAK-3, B. Goel, H. Küsters, and F. Weller, *SP425*, pp. 313-316 (Oct. 1975).

Key words: evaluation; nuclear data; plutonium; uranium.

For the design and optimization of reactors a precise knowledge of the microscopic neutron data is needed. For this purpose new evaluations for a number of important fast reactor materials have been performed at this laboratory. In the paper we discuss reevaluations of U^{238} and Pu^{239}. To check the quality of the presently evaluated data in reactor physics calculations, their effect on k_{eff} for a large variety of critical assemblies is studied. Calculation shows that with the evaluated data for U^{235}, U^{238}, Pu^{239}, Pu^{240}, Pu^{241}, and Pu^{242} the value of k_{eff} for a large number of critical assemblies can be reasonably well reproduced without any adjustment of the data.

Description of the ENDF/B-IV silicon evaluation energy distributions of outgoing particles, D. Larson, *SP425*, pp. 317-319 (Oct. 1975).

Key words: cross sections; energy distributions; photon; tertiary; theoretical.

Calculations are presented for the energy distributions of secondary particles resulting from neutron-induced binary and tertiary reactions on ^{28}Si.

Evaluation of fission product nuclear data for 28 important nuclides, S. Igarasi, S. Iijima, M. Kawai, T. Nakagawa, Y. Kikuchi, K. Maki, and H. Matsunobu, *SP425*, pp.320-323 (Oct. 1975).

Key words: capture cross section; elastic and inelastic scattering cross sections; evaluation; fission product; optical model; resonance cross section; statistical model; total cross section.

Evaluation of 28 fission product nuclear data for fast reactors is performed for total, capture, elastic scattering and inelastic scattering cross sections up to 15.0 MeV. Resonance parameters as well as the data of resonance integrals are surveyed. The cross sections reproduced with these parameters are adjusted so as to fit the thermal values and are connected smoothly with the cross sections obtained by the statistical model calculations. For some nuclides whose resonance parameters are not experimentally obtained yet, the statistical model calculations are carried out down to fairly low energy point. The cross section values thus obtained are used as the expectation values of averaged cross sections in the resonance region. Numerical data obtained are stored on the magnetic tape in the ENDF/B format.

Evaluated decay-scheme data for the ILRR program, R. G. Helmer and R. C. Greenwood, *SP425*, pp. 324-327 (Oct. 1975).

Key words: evaluated half-lives; evaluated γ-ray intensities; ILRR program.

The half-lives and γ-ray intensities associated with radioactive decay have been evaluated for nuclides of interest to the Interlaboratory LMFBR Reaction Rate program. The results indicate that for most of the isotopes the decay parameters are known sufficiently well to meet the ILRR goals of 2 1/2 or 5 percent accuracy in reaction rate measurements.

Development of a two-step Hauser-Feshbach code with precompound decays and gamma-ray cascades—a theoretical tool for cross section evaluations, C. Y. Fu, *SP425*, pp. 328-331 (Oct. 1975).

Key words: fluorine; iron; photon; reaction; tertiary.

The code is used to calculate neutron-induced binary reaction, tertiary reaction and associated gamma-ray-production cross sections of ^{19}F, ^{40}Ca and ^{56}Fe. Comparisons with experimental data show much improved agreements over those previously possible.

Neutron cross sections and their uncertainties obtained from nuclear systematics, S. Pearlstein, *SP425*, pp. 332-334 (Oct. 1975).

Key words: cross section; neutrons; nuclear model.

Previously, neutron cross sections in the MeV range for nuclei ranging in Z from 21 through 41 were calculated using a hybrid empirical-statistical model code THRESH. The formalism includes level density, Coulomb barrier, and competing reaction effects and has been useful in the prediction of unmeasured cross sections or normalized to point measurements to generate complete excitation curves. Reaction data up to 20 MeV in the Z range 21 through 83 are used to refine the model and extend its range of validity. A least squares fitting technique optimizes the choice of parameters with the resulting matrix used to determine parameter uncertainties and correlations. Fitted cross sections and their calculated uncertainties are compared with measurements and quoted errors. A range of uncertainty is assigned to predicted cross sections.

Level density calculation for deformed nuclei, J. P. Felvinci, D. Cacuci, and E. Melkonian, *SP425*, pp. 335-337 (Oct. 1975).

Key words: level densities and positions of K-bands in rare earth and actinide nuclei.

Level densities for the rare earth and actinide nuclei have been calculated using a modified version of the Ericson formalism. The assumption was made, that K (the projection of J on the symmetry axis of the nucleus) is a good quantum number in the compound nucleus. Individual level densities for the different (K,J) values of the compound nucleus formed by low energy neutron interactions were calculated. The results show good agreement with the interpretation of recent results obtained on U-235 in this laboratory. Using the above calculations it is also possible to infer from the measured level densities the locations of the band heads of different K bands in the compound nucleus. The results also indicate that the K bands responsible for the level densities exclude the ground state rotational band. Levels built on the higher lying β and γ vibrational bands and their composites are sufficient in number to explain the observed level densities.

Odd-even fluctuations in neutron strength functions, G. J. Kirouac, *SP425*, pp. 338-341 (Oct. 1975).

Key words: doorway states, optical model; neutron strength function.

Systematic fluctuations are reported for the s-wave neutron strength functions of adjacent mass target nuclei with odd and even neutron number. Within the 3S and 4S single-particle resonances, the fluctuations appear to be related to odd-even variations in the doorway state density which are correlated with the excitation energy. A simple model calculation successfully reproduces the strength function fluctuations in the first peak of the split 4S resonance ($143 \leq A \leq 160$). An examination of all available even-Z strength function data suggests a general trend; S-odd > S-even near single-particle resonances and S-even > S-odd between resonances. This result is discussed in terms of the optical model spreading width W and other fundamental nuclear properties.

Statistical estimation of physical quantities in thermal- and fast-neutron-induced fission, T. Yamamoto and K. Sugiyama, *SP425*, pp. 342-345 (Oct. 1975).

Key words: actinide nuclide; fast-neutron-induced fission; fission; fission fragment; fission product; kinetic energy; mass yield; prompt neutron; scission point; statistical theory.

Making use of a model based on the statistical theory in which the scission-point distance is treated as an adjustable parameter, calculations were performed to obtain the mass yields of fission products, the kinetic energies of fission fragments and the numbers of prompt neutrons from neutron-induced fission of ^{232}Th, ^{231}Pa, ^{233}U, ^{235}U, ^{238}U, ^{237}Np, ^{239}Pu, and ^{241}Pu for incident-neutron energies ranging from thermal to 14.7 MeV. Calculated results reproduced experimental values well. The proposed method could be used in the estimation of unknown physical quantities in fission.

Theoretical estimates of (n,γ) cross sections for 6-15 MeV neutrons, G. Longo and F. Saporetti, *SP425*, pp. 346-349 (Oct. 1975).

Key words: calculations; complex interaction; semi-direct model; volume form; (n,γ) cross sections.

The knowledge of the correct values of (n,γ) cross sections for high energy neutrons is of great interest for studies into nuclear reaction mechanism as well as for reactor shielding purposes and in particular fusion-reactor design. The use of theoretical estimates is therefore required to fill the gaps in the available experimental data. For this purpose the semi-direct capture model has been refined (a) by replacing the previous surface form factors of the interaction by volume form factors, (b) by including quadrupole terms in addition to the dipole ones. Calculations, based on the refined model, agree satisfactorily with experimental data.

Reaction mechanism in the high energy tail of the 14 MeV ^{56}Fe(n,n')-process, H. Jahn, C. H. M. Broeders, and I. Broeders, *SP425*, pp. 350-353 (Oct. 1975).

Key words: angular distribution; inelastic scattering; proton emission; scattered neutron.

Measured cross-sections of 14 MeV-neutrons scattered inelastically on ^{56}Fe are analyzed to carry out investigations about the reaction mechanism. It is shown that a considerable part of direct inelastic scattering has to be added to the evaporation and pre-equilibrium processes in order to reproduce the data, especially the angular distribution, for energies of the scattered neutron above 7 MeV.

Calculations of (n,α) rates for iron-group materials, F. M. Mann and Z. E. Switkowski, *SP425*, pp. 354-356 (Oct. 1975).

Key words: calculated σ(E), (α,n), (n,α), Hauser-Feshbach; nuclear reactions Fe group.

The Hauser-Feshbach statistical model is used to calculate (α,n) and (n,α) cross sections for Fe-group elements to provide information on helium production within fusion reactors. A parametrization of the cross sections is discussed.

Parametric fit of the total cross section of ^{45}Sc, B. A. Magurno and S. F. Mughabghab, *SP425*, pp. 357-359 (Oct. 1975).

Key words: bound level parameters; spin assignments; thermal cross sections.

A parametric fit to the total cross section of Sc-45 based on the Breit-Wigner multilevel formalism was carried out. To reproduce the minimum in the total cross section at 2.0 keV and to get an acceptable fit for the low energy resonances, the spins of the bound level, the 3.24, and 4.27 keV resonances are 4,3,4 respectively. At higher energies the spins adopted for the resonances at 6.5, 7.9, 8.9, and 11.7 keV were 3,4,3,4. The parameters of the bound level are $E_0=-270$ eV, $\Gamma_n^\circ=2.05$ eV (J=4) and $\Gamma_\gamma=0.38$ eV.

Neutron capture mechanism in light and closed shell nuclides, B. J. Allen, J. W. Boldeman, M. J. Kenny, A. R. deL. Musgrove, H. Pe, and R. L. Macklin, *SP425*, pp. 360-362 (Oct. 1975).

Key words: nuclear reactions: Al, Si, ^{40}Ca, ^{52}Cr, ^{90}Zr, ^{138}Ba(n,γ), $E_n > 2.5$ keV, measured σ(n,γ), ^{6}Li monitor, enriched targets, deduced resonance parameters, correlation coefficient, valence component.

High resolution neutron capture cross section measurements have been made at the Oak Ridge Electron Linear Accelerator on Al, Si, ^{40}Ca, ^{52}Cr, ^{90}Zr, and ^{138}Ba for the energy range above 2.5 keV. These data have been analysed at Lucas Heights where capture measurements with Ge(Li) and Moxon-Rae detectors have provided complementary information. While valence model calculations are important for these nuclides in explaining the shape of the γ-ray spectra and the observed correlation between reduced neutron and radiative widths, the valence component cannot adequately account for the observed radiative widths and a substantial single particle component, uncorrelated with neutron widths, is required.

Radiation Shielding Information Center data activities, R. W. Roussin, B. F. Maskewitz, and D. K. Trubey, *SP425*, pp. 363-366 (Oct. 1975).

Key words: analysis; cross sections; evaluation; information; processing; radiation; shielding.

Activities developed at the Radiation Shielding Information Center (RSIC) play an important role in the utilization of nuclear cross sections in various radiation transport applications and help improve the general utility of the national ENDF/B effort. The activities involving processed and evaluated data libraries on behalf of RSIC's various sponsoring agencies are described.

Evaluation of the resonance parameters and capture cross section for chromium up to 600 keV, D. Abramson, J. C. Bluet, and P. Fardeau, *SP425*, pp. 367-370 (Oct. 1975).

Key words: capture; chromium; cross section; evaluation; neutron; resonance.

Experimental results are examined. An extensive comparison of recent sets of results allows a point-wise evaluation of the capture cross section versus energy. Moreover a set of resonance parameters has been chosen. The curve calculated with these parameters and a smoothly varying background agrees pretty well with the point-wise evaluation.

Representation of the neutron cross sections in the unresolved resonance region, G. de Saussure and R. B. Perez, *SP425*, pp. 371-379 (Oct. 1975).

Key words: cross sections; ENDF/B; neutrons; reactors; resonances; unresolved.

We discuss some limitations of the statistical approach to the representation of cross sections in the unresolved region and suggest that the actual Doppler-broadened cross sections should be used instead.

Helium production in reactor materials, E. P. Lippincott, W. N. McElroy, and H. Farrar, *SP425*, pp. 375-377 (Oct. 1975).

Key words: benchmark; cross sections; helium; neutron.

Comparisons of integral helium production measurements with predictions based on ENDF/B Version IV cross sections have been made. It is concluded that an ENDF/B helium production cross section file should be established in order to ensure a complete and consistent cross section evaluation to meet accuracies required for LMFBR, CTR, and LWR applications.

Fast reactor fission yields for ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, and recommendations for the determination of burnup on FBR mixed oxide fuels, W. J. Maeck, *SP425*, pp. 378-384 (Oct. 1975).

Key words: burnup monitors; capture-to-fission; dilution mass spectrometry; fast fission yields; yields vs. energy; ^{233}U, ^{235}U, ^{238}U, ^{239}Pu.

Absolute fast reactor fission yields are presented for over 40 stable and long-lived isotopes of Kr, Rb, Sr, Zr, Mo, Ru, Sb, Xe, Cs, Ba, La, Ce, Nd, and Sm for ^{233}U, ^{235}U, ^{238}U, and ^{239}Pu irradiated in EBR-II. A method for ordering fission yields as a function of neutron energy is given. Recommendations for the determination of burnup on mixed-oxide fuels irradiated in a fast reactor are given.

Effects of nuclear data uncertainties upon LMFBR fuel cycle

characteristics, R. D. McKnight, L. G. LeSage, and J. M. Christenson, *SP425*, pp. 385-388 (Oct. 1975).

Key words: breeding ratio; cross section uncertainties; equilibrium cycle; fuel cycle; reactivity swing; sensitivity study.

Fuel cycle sensitivity calculations have been performed to determine the effect which nuclear data uncertainties have upon the long term properties of a typical LMFBR. These effects are assessed by direct comparison of a series of fuel cycle calculations which evaluate the approach to equilibrium conditions. The effects of uniform cross section adjustments (for the fission and capture cross sections for ^{238}U, ^{238}Pu, ^{240}Pu, and ^{241}Pu) upon the fuel cycle characteristics, including breeding ratio, doubling time, power distribution, fissile loading, fissile mass discharge rates, control requirements and reactivity swing are presented for the initial burn cycle and the equilibrium cycle. ENDF/B-3 data are used for a data reference. Several of the cross section modifications produced significant uncertainties in LMFBR design parameters. The effects of these changes upon the fuel cycle characteristics propagate from cycle to cycle but, in general, do not increase with time. The most significant effects were produced by uncertainties in σ_f for ^{239}Pu and ^{241}Pu, and σ_c for ^{238}U. Uncertainties in these cross sections produce large changes in control requirements, breeding potential, and reactivity swing.

The sensitivity of k_{eff} of metallic assemblies to the parametric representation of the fission and the inelastic scattering spectra, H. Nissimov and J. J. Wagschal, *SP425*, pp. 389-391 (Oct. 1975).

Key words: critical assemblies; ENDF/B-IV; fission spectrum; inelastic scattering; sensitivity; ^{239}Pu.

The fission spectrum and the inelastic scattering spectrum of ENDF/B-IV ^{239}Pu data were modified. The variations of k_{eff} and of the leakage spectrum induced by these modifications were calculated for a bare ^{239}Pu critical sphere, as a typical metallic assembly. In certain cases these modifications lead to substantial variations in k_{eff}. Guides for reasonable changes in the representation of the spectra were obtained. The variations in k_{eff} and in the leakage spectrum caused by these reasonable changes were found to be within their experimental errors.

Comparison of Doppler broadening methods, D. E. Cullen, C. R. Weisbin, R. Q. Wright, and J. E. White, *SP425*, pp. 392-397 (Oct. 1975).

Key words: calculation; comparison; Doppler broadening; line shape.

Burnup calculations for the KWO reactor, D. C. Lutz, *SP425*, pp. 398-400 (Oct. 1975).

Key words: burnup calculation; burnup model; critical boron concentration; fission products; KWO; RSYST.

An effort was made to reproduce the measured shape of the critical boron concentration for the KWO reactor (PWR) during the first cycle starting from basic nuclear data (ENDF/BII). The overall results are quite satisfactory but there are some local differences up to 80 ppm.

Fission product nuclear data obtained by use of on-line mass spectrometer, P. L. Reeder, J. F. Wright, and R. A. Anderl, *SP425*, pp. 401-404 (Oct. 1975).

Key words: cumulative yields; delayed-neutrons; fission products; half-lives; independent yields; mass spectrometry.

A Spectrometer for On-Line Analysis of Radionuclides (SOLAR) has been installed at a 1 MW TRIGA reactor at Washington State University. Fission product ions from a combination target/ion source located within the thermal column are brought out to a 60° magnetic sector mass spectrometer. Surface ionization provides copious beams of Rb^+ and Cs^+ ions and less intense beams of Br^- and I^- ions with negligible contamination by other elements. About 40 fission product nuclides can thus be chemically and physically separated in times of less than 1 second. Past results on independent and cumulative fission yields along with measurements of half-lives of some very neutron-rich nuclides will be presented. Current work on delayed-neutron emission probabilities and energy spectra of delayed neutrons from individual nuclides will be described.

Differential cross sections and integral data: The ENDF/B-4 library and "clean" criticals, J. J. Wagschal, A. Ya'ari, and Y. Yeivin, *SP425*, pp. 405-408 (Oct. 1975).

Key words: adjustment; critical assemblies; cross sections; evaluation; integral data; sensitivities; uncertainties.

The ENDF/B-4 cross sections of the principal isotopes of U and Pu are adjusted by critical-mass data on 15 metallic assemblies. Only very minor cross-section modifications are needed in order for neutronic calculations to reproduce the integral data well within their experimental errors. The nature of the adjustments and the quality of the input integral data are discussed.

Neutron attenuation in normal and ilmenite concretes, R. J. Adams and K. H. Lokan, *SP425*, pp. 409-414 (Oct. 1975).

Key words: ilmenite concrete; Monte Carlo; neutron attenuation; time of flight.

Energy distributions of neutrons transmitted through slabs of normal (density = 147 lb/ft^3) and ilmenite loaded (240 lb/ft^3) concretes have been obtained using time of flight methods, for concrete thicknesses increasing in 3 inch steps from 0 to 18 inches. The incident spectrum was a photoneutron continuum from aluminium irradiated with 35 MeV bremsstrahling, and was generally similar to a fission neutron spectrum.

The measured distributions are compared with the results of a Monte Carlo calculation, and agree well within the experimental errors. Results from the calculations are used to extrapolate to greater thicknesses and other ilmenite concrete densities.

Analysis of the BNL ThO_2-^{233}U exponential experiments, D. Dabby, *SP425*, pp. 415-418 (Oct. 1975).

Key words: cross sections; ThO_2 resonance integral; ^{232}Th; ^{233}U.

The BNL ThO_2-3 w/o ^{233}U light-water-moderated exponential experiments were analyzed to evaluate (1) cross section library sets for ^{233}U and ^{232}Th, and (2) correlations with measured ThO_2 resonance integral data. A total of six cross section library sets were evaluated, including ENDF/B-2 and ENDF/B-3 libraries for ^{232}Th, ENDF/B-2 library for ^{233}U, and ThO_2 resonance integral correlations based on data by Weitman and Pettus, Hardy and Palowitch, and corrections to the latter data by Steen. A modified version of the LEOPARD code was used throughout this analysis. The principal results of this work are as follows: (1) The library set containing ENDF/B-2 data for ^{233}U and ENDF/B-3 data for ^{232}Th, together with ThO_2 resonance integral correlation based on Steen's corrections to the Hardy and Palowitch data, yields the best agreement with measurements, giving an average k_{eff} of 0.9975 with a standard deviation of 0.0067 for the 21 analyzed configurations. (2) With respect to this "best" set, the ENDF/B-2 ^{232}Th data is less reactive than the corresponding ENDF/B-3 data by ~0.1%Δk. (3) The ThO_2 resonance integral correlation based on data by Weitman and Pettus yields resonance integrals that are consistently higher than those produced by the correlation with Steen's values, even though the latter is normalized to an infinitely dilute resonance integral of 85.9 barns (0.5 eV cutoff), while the former is normalized to a corresponding value of 80 barns. Thus, with respect to the "best" set, the ThO_2 resonance integral correlation based on the Weitman and Pettus data is less reactive by ~0.75%Δk.

Tabular cross section file generation and utilization techniques, D. E. Cullen, O. Ozer, and C. R. Weisbin, *SP425*, pp. 419-421 (Oct. 1975).

Key words: cross sections; linearization; paging; preprocessing; relative error; thinning.

Criteria of importance to the generation of linear cross section tabulations are presented. Algorithms for reducing or thinning such tables within a desired accuracy criterion and the implementation of paging techniques for efficient utilization of large data tables are reviewed.

Neutron energy spectrum controlled blanket for fast breeder reactor, L. H. Tang, *SP425*, pp. 422-425 (Oct. 1975).

Key words: high plutonium productivity; moderation-jacket in blanket; thermal boosts.

It is shown that the productivity of a blanket can be substantially improved by introducing a "moderation-jacket" around the inner blanket facing the fast core. The operational procedure and the expected significance of the jacket are investigated. For a flux level similar to that of EBR-II, it is shown that one can shorten the plutonium production time by 34.5 percent for 0.7 percent plutonium density buildup and 15.4 percent for 1.5 percent plutonium density buildup. The overall time saving is about 100 days per recycling from density buildup of 0.7 to 2.0 percent.

Use of Monte Carlo method in the estimation of fast neutrons leaked through a concrete-paraffin shielding, L. S. Chuang and K. C. Wong, *SP425*, pp. 426-430 (Oct. 1975).

Key words: application of nuclear cross section; Monte Carlo method; 14 MeV neutron shielding.

A neutron generator shielding house, in which a 14 MeV neutron generator with a 4π yield of 1×10^{11} neutron per second is installed, was built with labyrinth geometry and made of ordinary concrete and paraffin block. Rough estimation for fast neutron flux in a location directly above the neutron generator target, but outside the shielding layers, is 7.7×10^{-3} n/cm²-s which was resulted from the approximation that for 14 MeV neutron, the flux is reduced by a factor of 10 for each 15 inches of solid concrete, or for each 8.2 inches of paraffin wax, disregarding the effect of scattering from the surrounding shielding materials. In order to take the geometrical effect of the shielding into consideration, a computer program, FORTRAN IV, was devised for calculating the neutron flux at the same location, using the Monte Carlo technique in a simplified 1-dimensional diffusion of neutron through the shielding layers. The result of this calculation was about 10^{-1} n/cm²-s; in good agreement with the result of measurement using a BF_3 counter.

A comparison of air-over-ground transport calculations using different cross sections, J. C. Saccenti and W. A. Woolson, *SP425*, pp. 431-435 (Oct. 1975).

Key words: cross section sensitivity; gamma ray; neutron; transport calculations.

Time dependent neutron and secondary gamma-ray transport calculations for 14 MeV and fission sources were performed in air-over-ground geometry utilizing cross sections from the DNA working cross section library. These calculations were compared with earlier calculations which have been widely used in weapon effects studies. Several significant differences were found attributed to the different cross sections used in the calculations.

The sensitivity of neutron air transport to nitrogen cross section uncertainties, A. Niiler, W. B. Beverly, and N. E. Banks, *SP425*, pp. 436-439 (Oct. 1975).

Key words: air transport; cross sections; neutrons; nitrogen; sensitivity calculation.

The sensitivity of the transport of 14-MeV neutrons in sea level air to uncertainties in the ENDF/B-III values of the various nitrogen cross sections has been calculated using the correlated sampling Monte Carlo neutron transport code SAMCEP. The source consisted of a 14.0- to 14.9-MeV band of isotropic neutrons and the fluences (0.5-15.0 MeV) were calculated at radii from 50 to 1500 metres. The maximum perturbations, assigned to the ENDF/B-III or base cross section set in the 6.0- to 14.5-MeV energy range were: (1) 2 percent to the total, (2) 10 percent to the total elastic, (3) 40 percent to the inelastic and absorption and (4) 20 percent to the first Legendre coefficient and 10 percent to the second Legendre coefficient of the elastic angular distributions. Transport calculations were carried out using various physically realistic sets of perturbed cross sections, bounded by evaluator-assigned uncertainties, as well as the base set. Results show that in some energy intervals at 1500 metres, the differential fluence level with a perturbed set differed by almost a factor of two from the differential fluence level with the base set.

Monte Carlo studies of the effect of cross section characteristics on fast neutron penetration in iron, L. P. Ku and H. Goldstein, *SP425*, pp. 440-443 (Oct. 1975).

Key words: cross section; fission neutrons; inelastic scattering; iron; minima; Monte Carlo.

Using Monte Carlo Method, we are able to study the mechanisms of neutron transport in natural iron and their relations to the cross section properties. Fission neutrons in 15 MeV to 10 keV range are discussed. It is concluded that the low energy spectrum exiting from a small bare sphere is particularly sensitive to inelastic cross sections near the threshold. For larger, and for reflected spheres, inelastic scattering plays a much less important role. At distances of practical significance ($\lesssim$ 1 meter) it is found that transport in the regions of cross section minima, while significant, does not provide dominant channels in determining the penetrating neutron spectra.

Neutron-coupled gamma-ray cross-section requirements for gas-cooled fast breeder reactors, M. Nagel and R. J. Cerbone, *SP425*, pp. 444-446 (Oct. 1975).

Key words: gas-cooled fast breeder reactor; neutron-coupled gamma-ray cross sections.

The generation, application, and testing of neutron-coupled gamma-ray cross sections required for Gas-Cooled Fast Breeder Reactor shield analysis are described.

Cross section preparation for the continuous-energy Monte Carlo code VIM, R. E. Prael, *SP425*, pp. 447-450 (Oct. 1975).

Key words: cross section; interpolation; Monte Carlo; probability; resonance; thinning; unresolved.

Improvements in the methods used to represent cross sections in the data library for the Monte Carlo code VIM are discussed. The degree to which observed difficulties have been eliminated and the reliability of the current VIM library based on ENDF/B Version 3 data are illustrated by comparison of broad-group cross section calculations made by VIM and by ETOE-2/MC^2-2.

A comparison of VIM and MC^2-2—Two detailed solutions of the neutron slowing-down problem, R. E. Prael and H. Henryson II, *SP425*, pp. 451-454 (Oct. 1975).

Key words: benchmark; cross section; eigenvalue; Monte Carlo; multigroup; reactor; resonance; slowing-down; stochastic; transport.

A comparison of solutions by the Monte Carlo code VIM and by ETOE-2/MC^2-2 of a zero-dimensional slowing-down problem in the homogeneous ZPR-6 Assembly 7 core composition demonstrates the ability of either code to provide a reliable computational benchmark capability for such calculations.

Decay heat analysis for an LMFBR fuel assembly using ENDF/B-IV data, G. W. Morrison, C. R. Weisbin, and C. W. Kee, *SP425*, pp. 455-458 (Oct. 1975).

Key words: CRBR; decay heat; ENDF/B-IV fission product; LMFBR; ORIGEN.

Recently evaluated ENDF/B-IV fission product data have been used in decay heat calculations for typical LMFBR fuel assemblies exposed to 100,000 MWd/MT burnup. The decay heat and radioactivity of the fuel assemblies have been calculated as a function of time from discharge. Important contributors to the decay have been identified.

A two dimensional cross section sensitivity analysis of iron in a concrete shield, T. E. Albert and G. L. Simmons, *SP425*, pp. 459-463 (Oct. 1975).

Key words: cross section; sensitivity; shield; two dimensional.

A cross section sensitivity analysis of iron in a family of concrete shields is performed to illustrate the dependence of the cross section sensitivity to the spatial distribution of reinforcing steel. The results of this study demonstrate that one dimensional sensitivity methods can be inadequate for multidimensional problems.

GCFR benchmarks: Experiments and analysis, S. Seth, W. Heer, M. Jermann, C. McCombie, E. Ottewitte, R. Richmond, and P. Wydler, *SP425*, pp. 464-468 (Oct. 1975).

Key words: benchmarks; data testing; GCFR; integral measurements.

Measurements of reaction rate ratios and neutron spectra in GCFR benchmark lattices are described. An important feature of the lattices is that rod fuel elements are used. Several data sets have been tested against the experiments and deficiencies indicated.

Biomedical application of shortlived positron emitting isotopes, P. Meyer, E. Behrin, R. Frank, R. Holub, and C. E. McJilton, *SP425*, pp. 469-471 (Oct. 1975).

Key words: Anger positron camera, lung function; radioactive tracers.

Radioactive nitrogen, oxygen and ozone have been used for dynamic lung-function studies on live dogs with an Anger positron camera. In particular an attempt was made to determine the feasibility of this method to study early functional changes caused by ozone.

Energy-dependent pion mean free path length for star formation, C. Werntz and C. W. Lucas, Jr., *SP425*, pp. 472-475 (Oct. 1975).

Key words: cross sections; pion; star formation.

Through the use of a simple model in which true absorption of a pion in flight by a nucleus is treated analogously to collisional broadening in optics, the energy dependent mean free path for star formation in water is calculated. Besides the absorption cross section, the cross sections for elastic and inelastic scattering are presented.

Spectrum and shielding measurements and calculations of neutrons produced by 800 MeV protons, L. R. Veeser, G. J. Russell, E. D. Arthur, P. A. Seeger, W. F. Sommer, D. M. Drake, R. G. Fluharty, and R. F. Bentley, *SP425*, pp. 476-479 (Oct. 1975).

Key words: analysis by Monte Carlo; angular dependence; deep penetration of neutrons in Fe + H shield; measured neutron spectra; shielding, $^{238}U(p,xn)$, $E_p = 800$ MeV.

Measurements were made to check: (a) calculation of the neutron flux produced by 800-MeV protons on a cylinder of depleted uranium, and (b) computations of the energy-dependent neutron flux as a function of thickness for a rectangular shield surrounding the target. A proton recoil spectrometer was used to measure neutron fluxes from the shield between 300 keV and 7 MeV. Agreement has been obtained between the proton recoil data and Monte Carlo calculations for shields composed of steel and gypsum for thicknesses between 0.48 and 1.37 m. Agreement is good at most angles for energies above 1 MeV.

Nuclear data for assessment of activation of scintillator materials during spaceflight, C. S. Dyer, J. I. Trombka, and S. M. Seltzer, *SP425*, pp. 480-483 (Oct. 1975).

Key words: activation; Apollo; background; computation, decay-schemes; cross-sections; scintillators; spacecraft, gamma-rays; spallation.

A calculation is outlined which predicts energy-loss spectra observed in detector materials due to the decay of radioactive nuclides which are produced by particle irradiation in spaceflight. The input decay schemes and cross-section requirements are described. Examples are given from the Apollo gamma-ray spectrometer experiments.

Proton scattering for analysis of atmospheric particulate matter, K. R. Akselsson, J. W. Nelson, and J. W. Winchester, *SP425*, pp. 484-487 (Oct. 1975).

Key words: air particulate matter; proton scattering; quantitative analysis.

Proton scattering has been applied to the problem of elemental quantitative analysis of air particulate matter. Elements up through chlorine may be resolved using 16 MeV protons incident upon targets up to about 1 mg/cm^2 in thickness. Using the FSU Super FN Tandem Accelerator and a large area solid state proton detector, an analysis can be performed in several minutes. Combination of this technique with proton induced x-ray emission analysis provides a means of quantitative analysis for all elements. These accelerator based methods are being applied to studies of the composition of air particulate matter in diverse locations such as St. Louis, Mo.; Los Angeles, Ca.; several cities in Florida; and Bermuda.

Use of elastic scattering cross section anomalies for depth profiling helium and hydrogen isotopes in solids, R. S. Blewer, *SP425*, pp. 488-491 (Oct. 1975).

Key words: depth; deuterium; diffusion; elastic; helium; migration; oxide; proton; range; scattering.

A proton elastic scattering technique is described which makes possible direct accurate depth profile measurements of light element isotopes (deuterium, tritium, helium, etc.) in metal or insulator hosts. Several examples of the application of this technique to current problems are given in the fields of energy research and neutron generator target evaluation.

Spallation cross sections and the LAMPF medical radioisotope program, B. R. Erdal, P. M. Grant, V. R. Casella, A. E. Ogard, and H. A. O'Brien, Jr., *SP425*, pp. 492-495 (Oct. 1975).

Key words: E=800 MeV; isotope production; La,Mo,V(p,spallation); measured σ; nuclear medicine; nuclear reactions.

The intense beam of medium-energy protons (600 to 800 MeV) from the LAMPF accelerator will be used to prepare multi-curie quantities of radioisotopes of value in diagnostic and therapeutic nuclear medicine. Thin-target cross section measurements of spallation-induced reactions represent a significant segment of the LASL Medical Radioisotope Research Program, as these data provide a basis for calculating specific radioisotope yields in thick targets, evaluating potential isotopic interferences, and monitoring hot-cell operations. Recent measurements include the cross sections (cumulative yields) of ^{123}I, ^{127}Xe, ^{82}Sr, and ^{43}K formed in the interaction of 800-MeV protons with La, Mo, and V targets; they are reported to be 51 ± 3 mb, 51 ± 7 mb, 24.5 ± 0.8 mb, and 5.4 ± 0.3 mb, respectively. Comparison with previous results at 590 MeV are made, and quantity and product quality estimates are presented for biomedical isotopes under the irradiation conditions expected to prevail at LAMPF.

Feasibility of neutron-gamma techniques for field analysis of fresh concrete, M. C. Taylor, J. R. Rhodes, and D. L. Bernard, *SP425*, pp. 496-499 (Oct. 1975).

Key words: analysis; application; concrete; feasibility; gamma rays; neutrons.

A technique has been developed which employs two neutron sources (^{252}Cf and ^{238}Pu-Be) and three NaI(Tl) detectors to determine the H, Ca, Si and C content of calcareous aggregate concrete in its plastic state. These elements are indicative of the water, cement, fine aggregate and coarse aggregate components which along with air entrainment are key factors in strength determination. Results are presented which demonstrate the feasibility of the technique for analysis of typical samples in a total time of the order of 10 minutes.

Cross section requirements for industrial gauging applications, B. Y. Cho and T. P. Sheahen, *SP425*, pp. 500-503 (Oct. 1975).

Key words: industrial gauging; isotopes; Monte Carlo calculations; multiple scattering.

We use nuclear isotopes for gauging and control of industrial products. The use of recycled materials have made paper, steel, plastic, etc., into ever-changing composite media, forcing us to update calibrations empirically. This paper lists those areas of research that would benefit our work. Specifically, we need: differential cross sections for electrons scattered from most common elements, as a function of energy below 3.6 MeV; Monte Carlo calculations that simulate isotopic sources (Kr-85, Sr-90/Y-90) interacting with common materials; phenomenological models or empirical expressions that coalesce scattering formulas and Monte Carlo results into forms usable for gauge design.

Li, Be and B production in proton-induced reactions: Implications for astrophysics and space radiation effects, C. T. Roche, R. G. Clark, G. J. Methews, and V. E. Viola, Jr., *SP425*, pp. 504-508 (Oct. 1975).

Key words: astrophysical production of Li, Be and B; E= 45 − 100 MeV; L = Li, Be, B; measured σ(E) for A=6, 7, 9, 10, 11; nuclear reactions ^{12}C(p,L).

Cross sections for the production of mass 6 to 11 isobars from proton spallation of carbon targets have been measured at bombarding energies of 45, 55, 60, 65, 75 and 100 MeV. The results of these measurements and similar studies by other groups are used to test theories of Li, Be and B nucleosynthesis. The measured abundance ratios for ^{7}Li/^{6}Li, ^{11}B/^{10}B, Li/Be and B/Li can be reproduced using measured cross sections and models which propose interstellar proton fluxes ϕ(E) of the form $(m_p C^2 + E)^{-2.6}$, $E^{-\gamma}$ ($\gamma \approx 1.5 - 2.0$) or E^{-3} for $E > 30$ MeV, if a substantial amount of ^{7}Li is synthesized via some other source. The cross sections for formation of Li, Be and B are also of importance because of possible high LET effects in biological material exposed to cosmic radiation. Our measurements are compared with calculated cross sections that have been used to estimate LET effects.

Long lived isotope production cross sections from proton bombardment of rhenium, A. J. Armini and S. N. Bunker, *SP425*, pp. 509-511 (Oct. 1975).

Key words: cross sections; excitation function; proton; rhenium.

The production cross reaction of long lived isotopes produced by proton bombardment of rhenium has been measured between 15 and 160 MeV. A set of stacked graphite disks impregnated with rhenium was used as a target. The data have been used to calibrate a high temperature graphite thickness gauge.

A need for (p,n) cross sections for selected targets at lower energies, H. S. Ahluwalia, *SP425*, pp. 512-515 (Oct. 1975).

Key words: acceleration mechanisms; neutrons; nuclear reactions; protons; solar flares.

We have argued elsewhere that protons of energy $\lesssim 10$ MeV are probably accelerated, in the active regions on the sun, for several days, following a solar flare. These protons must undergo nuclear interactions with the constituents of the solar atmosphere producing, among other things, neutrons. Being electrically neutral the neutrons are not affected by the solar or interplanetary magnetic fields. So they should be observable when the active regions lie on the earth-sun line. No solar neutrons have been detected so far. We think that the reason for this null-result is that the energy response of most of the detectors used, peaks at too high an energy (~ 100 MeV). Recent discovery of solar deuterons indicates that the solar neutrons probably have lower energies. They are probably produced in (p,n) reactions involving C,N,O,Ne,Mg,Si,S,Ca,Fe, etc. The available cross sections, in the energy range 3.4 MeV to 30 MeV, certainly bear out this expectation for Fe. The cross sections for some other elements are as yet unknown. Our conclusions are presented and the urgent need for the determination of the (p,n) cross sections for other elements is discussed.

The measurement of thermal neutron constants of the soil; application to the calibration of neutron moisture gauges and to the pedological study of soil. P. Couchat, C. Carre, J. Marcesse, and J. Le Ho, *SP425*, pp. 516-519 (Oct. 1975).

Key words: calibration; neutron moisture gauge; pedology; soil; thermal neutron constants.

The neutronic method for measuring the water content of soils is more and more used by agronomists, hydrogeologists and pedologists. On the other hand the studies on the phenomena of slowing down and diffusion process have shown a narrow relation between the thermal absorption (Σ_a) and diffusion (Σ_d) constants and the thermal flux developed in the soil around a fast neutron source like Am-Be. Then, the authors present two original applications of the direct measurement of Σ_a and Σ_d.

The method described consists in the measurement, in a cube of graphite with an Am-Be source in the middle, on one side of the perturbation of the thermal flux, obtained by the introduction of 300 g of soil, and on the other side of the transmitted thermal flux measured through the same sample of soil, on a side of the cube.

After calibrating the device, these two parameters give Σ_a and Σ_d which are easily introduced in the calibration equation of neutron moisture gauge. Also these two values are useful for the pedologists because Σ_d is connected to clay content in the soil and Σ_a is connected to the type of clay by the way of rare earth contents.

Medical uses of nuclear data. R. S. Tilbury, R. E. Bigler, L. Zeitz, and J. S. Laughlin, *SP425*, pp. 520-526 (Oct. 1975).

Key words: activation cross-section; bone mineral; *in vivo* neutron-activation analysis; therapy.

Nuclear data is used in modern medicine in a myriad of ways. Activation cross sections are used in the calculation of radioisotope production rates for both neutron and charged particle activation. The radioisotopes so produced are used in diagnostic nuclear medicine for the early detection of disease and for therapy either by external radiation or by internal radiation. The calculation of radiation dose from internally administered radioisotopes involves a knowledge of the decay scheme, mode and energy of decay, internal conversion coefficients, x-ray fluorescent and Auger electron yields. The decay scheme of radioisotopes including parent-daughter equilibria is essential knowledge for their accurate assay and for the understanding of radioisotope generators. Range-energy relationships for neutrons of various energies, charged particles, gamma-rays and electrons are also necessary for therapy and dose considerations. Applications to *in vivo* neutron activation analysis and photon absorptiometry for bone mineral measurement are also considered. An attempt is made to briefly describe these applications and to point out where more basic nuclear data measurements would be helpful.

Medical use of fast neutrons in radiotherapy and radiography, D. K. Bewley, *SP425*, pp. 527-532 (Oct. 1975).

Key words: dosemeter; radiography; radiotherapy; tissue.

Over 400 patients have been treated with fast neutrons from a cyclotron at Hammersmith Hospital, London, using 16 MeV deuterons on beryllium. A large variety of malignant disease is included in this trial. A randomized trial of fast neutron therapy for cancer of the mouth and throat is in progress and preliminary results will be given. Fast neutron radiographs are often taken to check the positions of the fields used on the patients. These show no contrast from bone, but demonstrate only the presence of gas-filled cavities. As a diagnostic method, fast neutron radiography suffers from a number of disadvantages, the main ones being lack of sensitivity of the image-forming system and the hazard to the patient due to a large Quality Factor. Estimation of the absorbed dose given to different types of tissue is an important factor in the medical use of fast neutrons. More data are needed on the processes whereby fast neutrons impart energy to matter, particularly for neutrons above 15 MeV.

Biomedical radiation transport calculations as an application of nuclear data. R. G. Alsmiller, Jr., *SP425*, pp. 533-539 (Oct. 1975).

Key words: absorbed dose; cell survival; heavy particles; OER; radiotherapy.

The extent to which transport calculations of biomedical interest for negatively charged pions, neutrons, protons, alpha particles, and heavier ions can presently be performed is reviewed.

Geochemical mapping of the moon by orbital gamma-ray spectroscopy. R. C. Reedy, *SP425*, pp. 540-545 (Oct. 1975).

Key words: cosmic-ray reactions; lunar chemistry; lunar γ-rays; neutron capture; nonelastic scattering.

Chemical compositions of the surfaces of the moon and certain planetary bodies can be determined by orbital γ-ray spectroscopy. The major sources of γ-ray lines (and of radionuclides) in the moon are the decay of the primordial radioelements (U, Th, and ^{40}K) and nuclear reactions induced by the bombardment of the moon by cosmic-ray particles. The major cosmogenic γ-ray lines are produced by neutron nonelastic scattering and neutron capture reactions. The fluxes of γ-ray lines expected from the moon for each major source have been calculated. Gamma-rays from the moon were measured by γ-ray spectrometers during the Apollo 15 and 16 missions. The preliminary analysis of the data show that O and Si vary little over the moon's surface, that Mg, Fe, and Ti have higher concentrations in the maria than in the lunar highlands, and that the radioelements are significantly more abundant in and near the western near-side maria than in the rest of the moon.

A measurement of the fission cross section of ^{235}U from 1 keV to 1 MeV. J. B. Czirr and G. S. Sidhu, *SP425*, pp. 546-548 (Oct. 1975).

Key words: fission; measurement; ratio; ^{235}U.

We have measured the ratio of the ^{235}U fission cross section to the ^{6}Li (n,α) reaction for neutron energies from thermal to 1 MeV. This experiment is the third in a series which is designed to measure the relative fission cross section of ^{235}U from thermal to 20 MeV. The first two experiments covered the energy range from 0.8- to 20-MeV, and used the n,p scattering reaction to measure the energy dependence of incident flux.

The average number of prompt neutrons, $\bar{\nu}_p$, from neutron induced fission of ^{235}U between 0.2 and 1.4 MeV. F. Käppeler and R. E. Bandl, *SP425*, pp. 549-552 (Oct. 1975).

Key words: $E_n = 0.2$-1.4 MeV; fast time-of-flight technique; number of prompt fission neutrons; ^{235}U.

For the clarification of existing discrepancies in the energy dependence of $\bar{\nu}_p$ for ^{235}U an experiment was performed which was based on a method independent of current techniques. A considerable reduction of background and correction problems was achieved by renouncing on an absolute measurement. Thus the resulting systematic uncertainty was 0.6 percent. In the energy range between 0.2 and 1.4 MeV the shape of $\bar{\nu}_p$ was measured at 22 points in steps of 50 keV with an average energy resolution of 3.3 percent. Repetition of several runs with modified experimental conditions ensured the consistent reproduction of the results. It was found that $\bar{\nu}_p$ of ^{235}U shows distinct deviations of up to 2 percent from a linear energy dependence.

Monte Carlo analysis of direct measurements of the thermal eta (0.025 eV) for U^{233} and U^{235}, J. J. Ullo and M. Goldsmith, *SP425*, pp. 553-556 (Oct. 1975).

Key words: E=0.25 eV; eta; fission neutrons per absorption; nuclear reactions; U^{233}; U^{235}.

In support of the LWBR program, the manganese bath measurements of eta of U^{233} and U^{235} at 0.025 eV were analyzed using Monte Carlo methods. The calculated values of eta, including statistical, cross section, and experimental uncertainties, are $\eta^{233}=2.2993\pm0.0082$ and $\eta^{235}=2.0777\pm0.0064$. The systematic corrections to the experiments were also studied in detail.

Monte Carlo analysis of manganese bath measurement of eta of ^{233}U and ^{235}U using thermalized neutrons, M. Goldsmith and J. J. Ullo, *SP425*, pp. 557-559 (Oct. 1975).

Key words: E=0.0253 eV; eta; fission neutrons per absorption; nuclear reactions; ^{233}U; ^{235}U.

Monte Carlo analysis of the ORNL manganese bath measurements of eta of ^{233}U and ^{235}U at 2200 m/sec yields: $\eta_{2200}{}^{233}=2.3019\pm0.0086$, and $\eta_{2200}{}^{235}=2.0746\pm0.0078$. The analysis was confirmed by calculating measured quantities used by the experimentalists in their determinations of η_{2200}.

Parameters of the subthreshold fission structure in ^{240}Pu, G. F. Auchampaugh and L. W. Weston, *SP425*, pp. 560-563 (Oct. 1975).

Key words: $\Gamma_{f\lambda'}$, $\Gamma_{f\lambda''}{}^{II}$, $\langle H_{\lambda'\lambda''}{}^2\rangle$; ^{240}Pu(n,f); 500 to 10 000 eV.

The neutron subthreshold fission cross section of ^{240}Pu has been measured from 500 eV to 10 000 eV using the Oak Ridge Electron Linear Accelerator neutron facility. A total of 82 fission widths were obtained from area and shape analysis of those resonances which define the class II states at ≅782 eV, ≅1406 eV, ≅1936 eV, and ≅2700 eV. The average square of the coupling matrix element for the first three class II states is 4.08 ± 1.63 eV^2. The average class II fission width is 2.47 ± 0.96 eV. Approximately 22 clusters of class I resonances were observed below 10 keV, which results in a value of 450 ± 50 eV for the average class II level spacing. Assuming parabolic inner and outer barriers, the following barrier parameters were obtained: $V_A - B_n/\hbar\omega_A=0.59\pm0.06$ and $V_B - B_n/\hbar\omega_B=0.54\pm0.006$.

Measurement of the ^{239}Pu fission cross-section and its ratio to the ^{235}U fission cross-section in the energy range from 1 keV to 1 MeV, D. B. Gayther, *SP425*, pp. 564-567 (Oct. 1975).

Key words: cross-sections; fission; measured; neutrons; 1 keV – 1 MeV; ^{239}Pu; ^{235}U.

The cross-section for the ^{239}Pu(n,f) reaction has been measured on the Harwell 45 MeV linac using the time-of-flight method. Fission events were recorded by detecting the prompt neutrons and the incident neutron flux spectrum was measured with a detector which was calibrated against two standard detectors. The cross-section was normalized in the 10 to 30 keV energy interval to agree with the recent evaluation of Sowerby et al. Comparison with this evaluation shows agreement to within 5 percent at energies above a few keV. The agreement with the ENDF/B-IV evaluation is generally within 4 percent throughout the complete energy range. A similar comparison is made for the ratio of the ^{239}Pu and ^{235}U fission cross-sections, obtained from the present measurement, and a previously published measurement of the ^{235}U(n,f) cross-section made with the same equipment.

A measurement of the ^{238}U/^{235}U fission cross-section ratio, M. S. Coates, D. B. Gayther, and N. J. Pattenden, *SP425*, pp. 568-571 (Oct. 1975).

Key words: cross-sections; fission; measured; neutrons; ratio; ^{238}U; ^{235}U; 600 keV-22 MeV.

The ratio of the neutron induced fission cross-sections of ^{238}U and ^{235}U have been measured in the energy range from 600 keV to 22 MeV using the time-of-flight method on the Harwell synchrocyclotron, at a nominal resolution of 0.5 ns/m. Fission fragments were detected in a gas scintillation chamber containing foils of each material mounted back-to-back and perpendicular to the incident beam. The measured cross-section ratio was normalized at 14 MeV to the ratio evaluated by Sowerby et al. The estimated standard deviation error in the ratio measurements is ±2 1/2 percent. Comparison with other recent data shows reasonable agreement throughout most of the energy range.

Precision measurement of prompt fission neutron spectra of ^{235}U, ^{238}U and ^{239}Pu, P. I. Johansson, B. Holmqvist, T. Wiedling, and L. Jéki, *SP425*, pp. 572-575 (Oct. 1975).

Key words: fast fission neutron spectra; TOF-technique; ^{235}U; ^{238}U; ^{239}Pu.

Prompt neutron spectra from fission of ^{235}U, and ^{239}Pu have been measured at incident neutron energies of 0.10, 0.18, 0.53 and 2.07 MeV. A major effort was made to obtain an accurate experimental determination of the efficiency and energy response function of the time-of-flight neutron detector in the energy range 0.15 to 15 MeV. The spectra have been analytically described by the so called Watt distribution, as well as with a Maxwell distribution. It is shown that the Watt relation gives a somewhat better description of the spectra than the Maxwell formula. The angular correlation between incident-neutrons and fission-neutrons was measured for ^{235}U and ^{238}U at an incident neutron energy of 2.07 MeV. The data indicate some slight anisotropies, being rather small or even negligible for ^{235}U and somewhat more pronounced for ^{238}U. The results show that the shape of the neutron energy distribution is independent of the angle of observation.

Spin determination of resonances in ^{235}U, G. A. Keyworth, C. E. Olsen, J. D. Moses, J. W. T. Dabbs, and N. W. Hill, *SP425*, pp. 576-579 (Oct. 1975).

Key words: fission channels; J; multilevel fits; polarized neutrons; polarized target; ^{235}U(n,f).

A polarized beam of neutrons and a polarized ^{235}U target have been used to determine the spins of resonances below 150 eV. Most spins are assigned by inspection of the data; others by comparison with multilevel or single-level fits. Previously published data on fission fragment angular distributions, in conjunction with our spin assignments, indicate that two or more fission channels are available to each spin state. The ratio of symmetric to asymmetric fission appears to be uncorrelated with the resonance spin.

Quantum numbers of low lying neutron resonances in U-235, J. P. Felvinci, E. Melkonian, and W. W. Havens, Jr., *SP425*, pp. 580-583 (Oct. 1975).

Key words: spins of ^{235}U resonances.

Experiments were performed at ORELA to measure the low energy fission cross section of U-235. Times of flight of the neutrons causing fission and the fission fragment energy detected by a solid state detector were recorded event-by-event. Analysis of the data showed marked pulse height variation among resonances. Several of the large resonances were shown to be composites and the level density obtained is much higher than previously determined. The results were interpreted by the hypothesis that K is a good quantum number in the compound nucleus. This assumption and the systematic variation of the fission fragment energies among resonances enabled us to assign J and K quantum numbers to many levels. Three families of fission resonances were seen, $J=4^-$; $K=2$, $J=4^-$; $K=1$, and $J=3^-$; $K=1$. Our results have implications as to the accuracy of fission cross section measurements and to the calculation of cross sections in the unresolved energy region.

keV capture cross section of ^{242}Pu, R. W. Hockenbury, A. J. Sanislo, and N. N. Kaushal, *SP425*, pp. 584-586 (Oct. 1975).

Key words: capture; normalization; strength functions.

The neutron capture cross section of ^{242}Pu has been measured from 5 to 70 keV. The high-low bias method was used to distinguish between capture and fission events. Transmission experiments were also made in the resonance region. A normalization method was developed using the absorption and transmission data from six resonances. Using an average s-wave radiation width of 22 MeV, an s-wave strength function of 1.16×10^{-4} and our measured capture cross section, we have determined p-wave contributions to the ^{242}Pu capture cross section below 70 keV.

Spontaneous fission decay constant of plutonium-238, R. Gay and R. Sher, *SP425*, pp. 587-590 (Oct. 1975).

Key words: coincidence counting; decay constant; plutonium-238; safeguards data; spontaneous fission; track recorders.

The spontaneous fission decay constant of plutonium-238 was measured by two methods: fission-track counting in mica and coincidence counting of the fission fragments in solid-state detectors. The efficiency of the mica track detector was determined by thermal column irradiation of the plutonium source-mica detector assembly and subsequent counting of tracks arising from plutonium-239 fission. The coincidence counting result was combined with a determination of the Pu^{238} alpha emission rate of the sample to obtain the spontaneous fission decay constant. The results of the two methods were $\lambda_{sf}=(4.75\pm0.12)\times10^{-19}$ sec^{-1} and $(4.9 \pm 0.4) \times 10^{-19}$ sec^{-1}, respectively.

Neutron-induced fission cross sections of ^{233}U, ^{234}U, ^{236}U, and ^{238}U with respect to ^{235}U, J. W. Behrens, G. W. Carlson, and R. W. Bauer, *SP425*, pp. 591-596 (Oct. 1975).

Key words: fission cross section ratios; linear accelerator; time-of-flight technique; uranium isotopes—^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U; 0.001 to 30 MeV.

Ratios of the neutron-induced fission cross sections of ^{233}U, ^{234}U, ^{236}U, and ^{238}U relative to ^{235}U and of ^{238}U relative to ^{233}U were measured with fission ionization chambers at the LLL 100-MeV electron linear accelerator. The time-of-flight technique was used to measure the cross section ratios as a function of neutron energy from 0.1 to 30 MeV, except for the ^{233}U:^{235}U and ^{238}U:^{233}U ratios, which were measured from 0.001 to 30 MeV, and 1 to 30 MeV, respectively. The continuous energy spectrum of the neutron source allowed us to cover the entire energy range of each ratio in one measurement. The threshold cross section method was used to normalize the ratios independent of other cross section measurements. Typical energy resolutions of the data are 5 percent at 20 MeV and 1.5 percent at 1 MeV. Most of the data have counting uncertainties smaller than 4 percent. Systematic errors are discussed, and current results are compared with previous measurements.

On sub-barrier fission in ^{238}U, J. A. Wartena, H. Weigmann, and E. Migneco, *SP425*, pp. 597-598 (Oct. 1975).

Sub-barrier fission in ^{238}U has first been observed by R. Block et al., using ionization chambers for fission fragment detection. In the present measurements a liquid scintillator was used to detect prompt fission neutrons. Thereby, with a sample of 250 g of ^{238}U, neutron time-of-flight measurements could be performed at a 30 m flightpath with a nominal resolution of 1.3 nsec/m. The result of the present investigation is a full confirmation of the findings of Block et al. This includes a confirmation, by high resolution data, of the fact that the resonance at 721.0 eV and 1210.7 eV contribute most strongly to the observed fission in the two sub-barrier structures at low neutron energies. Their fission widths are found to be (0.85 ± 0.13) MeV and (0.25 ± 0.05) MeV, respectively (assuming $\Gamma_\gamma=23$ MeV). For most of the other resonances in these two structures only upper limits for the fission widths are obtained.

Capture-to-fission ratio of ^{235}U from the measurement of low-energy γ-rays, F. Corvi and P. Giacobbe, *SP425*, pp. 599-602 (Oct. 1975).

Key words: E=86 eV – 31.6 keV; enriched target; measured capture-to-fission ratio; nuclear reactions ^{235}U(n,f) and ^{235}U(n,γ).

A new technique of α-determination is presented, consisting of measuring with a Ge(Li)-detector low-energy γ-ray spectra following neutron absorption in ^{235}U, as a function of neutron energy. A relative value of α can then be deduced assuming that the intensity of a given capture (fission) γ-ray is proportional to the average capture (fission) cross-section. Such an assumption is thoroughly discussed in the text. More specifically, α was taken proportional to the ratio between the intensity of the 642 keV capture transition and those of the fission γ-rays at 352 keV and 1280 keV. Average α-values with statistical errors less or equal to ±5 percent were determined for 20 intervals in the range 86 eV – 31.6 keV.

Intermediate structure in the keV fission cross section of ^{235}U, E. Migneco, P. Bonsignore, G. Lanzanò, J. A. Wartena, and H. Weigmann, *SP425*, pp. 607-610 (Oct. 1975).

The relative fission cross section of ^{235}U has been measured up to 200 keV with a nominal resolution of 1.0 ns/m, using a thin foil plastic scintillator detector. The data have been analyzed in order to detect nonstatistical effects due to intermediate structure. Statistical tests which have been applied to this fission and similar total cross section data include calculations of the auto-correlation function and Wald-Wolfowitz tests on the cross-section and on the autocorrelograms. The comparison of the results indicates the presence of intermediate structure effects in fission cross-section which may be interpreted on the basis of the double-humped deformation potential.

The ^{241}Pu neutron induced fission cross section from 0.01 eV to 50 eV and its normalization, C. Wagemans and A. J. Deruytter, *SP425*, pp. 603-606 (Oct. 1975).

Key words: normalization; Westcott g_f-factor; ^{241}Pu fission cross-section.

The neutron induced fission cross-section of ^{241}Pu has been measured at an 8 m flightpath of the CBNM Linac (from 50 eV to below thermal energy) with respect to the $^{10}B(n,\alpha)^{7}Li$ cross-section. Several fission integrals were calculated as well as the 20.44 °C Westcott factor $g_f = 1.046 \pm 0.006$. Special attention is given to normalization problems.

Energy spectrum of delayed neutrons from photo-fission of ^{238}U, S. Iwasaki, K. Yana, S. Sato, K. Sano, M. Hagiwara, and K. Sugiyama, *SP425*, pp. 611-614 (Oct. 1975).

Key words: delayed neutron; energy spectrum, β — n time-of-flight; fission; group 2; $^{238}U(\gamma,f)$.

Energy spectrum of the second group delayed neutrons ($T_{1/2}=22$ sec.) from photo-fissions of ^{238}U has been obtained using a time-of-flight technique between beta-particles and neutrons. Experimental results show a fine structure in the spectrum. The six prominent peaks of energies; 200-, 240-, 280-, 380-, 540- and 750-keV are observed.

^{235}U fission cross section measurements relative to neutron-proton scattering, G. S. Sidhu and J. B. Czirr, *SP425*, pp. 615-619 (Oct. 1975).

Key words: linac source; neutron energy 0.8 to 20 MeV; relative to n-p scattering; U235 fission cross section.

Energy dependence of the fission cross section of ^{235}U with respect to the n-p scattering reaction was measured for neutron energies from 0.8 to 20 MeV. The LLL linac target was used as the pulsed neutron source; neutron energies were measured by time-of-flight technique. A ^{235}U ion chamber was designed and operated to make the fission detection efficiency independent of the angular distribution of fission fragments. The neutron flux monitor consisted of an annular polyethylene radiator with a shielded proton recoil detector. Data in the energy range from 3 to 20 MeV were obtained with a 3.3 mg/cm^2 radiator; a 0.31 mg/cm^2 radiator was used for the range from 0.8 to 4 MeV. Both sets of data were normalized to yield the average fission cross section value of 1.198 b in the overlapping region from 3 to 4 MeV. Total error in the relative $^{235}U(n,f)$ cross section is ± 1 percent below 7 MeV, ± 2 percent at 14 MeV, and ± 6 percent at 20 MeV.

Measurement of the ^{238}U capture cross section shape in the neutron energy region 20 to 550 keV, R. R. Spencer and F. Käppeler, *SP425*, pp. 620-622 (Oct. 1975).

Key words: $E_n = 20$-550 keV; $\sigma_\gamma(^{238}U)$ shape.

The Karlsruhe 800 l liquid scintillator detector and 3 MV pulsed Van de Graaff were used to measure the shape vs. neutron energy of the ^{238}U capture yield relative to a gold capture sample and relative to ^{235}U fission. The resulting cross section shape computed from the gold capture cross section is consistent with that computed from a recent evaluation of the ^{235}U fission cross section. Below 100 keV a significant intermediate structure is observed which corresponds to that in recent ORNL data.

Intermediate structure in the ^{238}U neutron capture cross section, R. B. Perez and G. de Saussure, *SP425*, pp. 623-626 (Oct. 1975).

Key words: doorway states; intermediate structure; ^{238}U capture cross section.

Recent measurements of the ^{238}U neutron capture cross section show large fluctuations in the unresolved resonance region. To test whether or not the observed long-range fluctuations of the neutron capture represent departures from the compound nuclear model, the Wald-Wolfowitz runs and correlation tests were applied to the ^{238}U neutron capture data obtained at ORELA. The Wald-Wolfowitz runs test deals with the statistic, R, which is the number of unbroken sequences of data points above or below a given reference line. This statistic is to be compared with the expected value of runs $E(R) \pm \sigma(R)$ arising from randomly distributed data. In the correlation test we have computed the first serial correlation coefficient of the data as well as its expected value and variance for a set of random data. In both tests one computes the probability, P, for the given statistical entity to depart from its expected value by more than ϵ standard deviations. Both tests confirm the presence of intermediate structure between 5 and 100 keV. The range of the structure far exceeds the width of the experimental resolution and level widths.

A direct comparison of different experimental techniques for measuring neutron capture and fission cross sections for ^{239}Pu, R. Gwin, L. W. Weston, J. H. Todd, R. W. Ingle, and H. Weaver, *SP425*, pp. 627-630 (Oct. 1975).

Key words: comparison; cross sections; fission, absorption; measurement; ^{239}Pu.

A comparison of the results of two different experimental methods of measuring the neutron absorption and fission cross sections for ^{239}Pu is made. These measurements were normalized at thermal energy and extend to 200 keV. The ratio of the neutron capture to fission cross section for ^{239}Pu derived in these two experiments is shown to be in good agreement.

Fast neutron fission spectrum measurement of ^{235}U at 0.52 MeV incident neutron energy, P. I. Johansson and J. M. Adams, *SP425*, pp. 631-634 (Oct. 1975).

Key words: fast neutron fission; prompt fission neutron spectrum; T-O-F technique; U-235.

There exists a large number of measurements of the prompt fission neutron spectrum of ^{235}U. The discrepancies in the results, however, indicate systematic errors which might be attributable to the different experimental equipment and facilities used at the various laboratories. This measurement is a collaboration between the Harwell Nuclear Physics Division and the Neutron Physics Laboratory in Studsvik. The purpose was to repeat measurements on ^{235}U at Studsvik and Harwell. The experiments were performed on IBIS, the Harwell neutron time-of-flight facility and the experimental parameters of importance were chosen to be identical, viz the same incident neutron energy, detector angle, sample size and composition etc., and also the highly critical parameters, viz the neutron detector response function and the energy calibration of the neutron time-of-flight spectrometer, were obtained by using the same experimental technique and nuclear reactions.

The fission cross section of ^{235}U for Na-Be photoneutrons, D. M. Gilliam and G. F. Knoll, *SP425*, pp. 635-636 (Oct. 1975).

Key words: fission cross section; manganese bath; NBS-II; track-etch detector; ^{235}U; ^{24}Na; $^{9}Be(\gamma,n)$.

The fission cross section of ^{235}U for Na-Be photoneutrons has been measured with absolute flux determination. The neutron flux was determined absolutely (i.e., without significant dependence on other cross section data) by using a manganese bath to compare the photoneutron source with the standard source NBS-II. Fission counts were accumulated with the source positioned symmetrically between two identical detectors, all suspended in a low-albedo laboratory. Fission fragments passing through limited solid angle apertures were recorded on polyester track-etch films. Use of a projection microscope counting system allowed rapid measurement of track diameters, so that the smallest tracks could be distinguished reliably from background pits that were not much smaller in diameter. The masses of the U_3O_8 deposits (7 mg each) were determined by microbalance weighings. After making a small correction for the calculated energy distribution of the source neutrons, a value for the fission cross section at 964 keV of 1.21 barns ± 2.1 percent (1.8% systematic and 1.0% random) is derived from the present measurement.

The total cross section and the fission cross section of ^{241}Am in the resonance region, resonance parameters, H. Derrien and B. Lucas, *SP425*, pp. 637-641 (Oct. 1975).

Key words: neutron; resonance parameters; total cross section; ^{241}Am.

The ^{241}Am total and fission cross sections have been measured in the resonance region, using the 60 MeV Saclay linac as a pulsed neutron source. The resonance parameters obtained by a single level shape analysis of the transmission data are given for 189 levels up to 150 eV neutron energy. The mean level spacing, corrected for 18 percent of missed resonances in the 0 to 50 eV energy range, is (0.55 ± 0.05) eV. The s-wave neutron strength function value, in the 0 to 150 eV energy range, is equal to $(0.94 \pm 0.09)10^{-4}$. The average radiation width obtained from 43 resonances is (43.77 ± 0.72) meV. Only preliminary results of the fission experiment are available now; 38 fission widths are given up to 32 eV neutron energy, with the average value $\langle \Gamma_f \rangle \simeq 0.23$ meV; the statistical distribution of these fission widths corresponds to a X^2 law with 4 degrees of freedom. An area analysis of the Los Alamos fission data has also been done, from which we obtain 36 Γ_f values in the 20 to 50 eV energy range; the corresponding average value is: $\langle \Gamma_f \rangle$ 0.52 meV. the statistical distribution obeys to a X^2 law with 15 degrees of freedom, in disagreement with the Saclay results.

Structures in ^{232}Th(n,f) and ^{238}U(n,f) cross sections, J. Blons, C. Mazur, and D. Paya, *SP425*, pp. 642-645 (Oct. 1975).

Key words: cross sections; structures; ^{232}Th(n,f); ^{238}U(n,f).

The ^{232}Th(n,f) and ^{238}U(n,f) cross sections have been measured relative to that of ^{235}U up to 6 MeV. The best energy resolution was 3 keV at 1.6 MeV. Below the fission threshold of ^{238}U, intermediate structures are observed. In the ^{232}Th(n,f) cross section, the broad vibrational resonances located above 1 MeV are resolved into sharp structures which are interpreted as rotational states. The angular anisotropy of fission fragments has been also measured in the same energy range. Thereby, values of K and J have been determined for each structure. The moment of inertia of ^{233}Th in shape isomeric deformation has been deduced.

Nuclear data needs for fusion reactor design, D. Steiner, *SP425*, pp. 646-650 (Oct. 1975).

Key words: fusion reactor design; nuclear data for fusion.

The nuclear data needs associated with the development of fusion as an energy source will be discussed in terms of seven areas of design application including: fusion fuel cycles, tritium breeding performance (for concepts based on the D-T fuel cycle), nuclear heating, radiation damage effects, induced activity, radiation shielding, and hybrid concepts. Dosimetry applications will also be considered. The areas of application described above will be related to specific types of nuclear data and to the programmatic requirements of the Controlled Thermonuclear Research effort. The paper concludes with a summary of recent activities relevant to CTR nuclear data needs.

Model calculations as one means of satisfying the neutron cross section requirements of the CTR program, D. G. Gardner, *SP425*, pp. 651-658 (Oct. 1975).

Key words: applications to CTR; cross-section calculations; fast neutron reactions; gamma-ray production; isomers; radiation widths; statistical model codes.

A large amount of cross-section and spectral information for neutron-induced reactions will be required for the CTR design program. To undertake to provide the required data through a purely experimental measurement program alone may not be the most efficient way of attacking the problem. It is suggested that a preliminary theoretical calculation be made of all relevant reactions on the dozen or so elements that now seem to comprise the inventory of possible construction materials to find out which are actually important, and over what energy ranges they are important. A number of computer codes for calculating cross sections for neutron induced reactions have been evaluated and extended. These will be described and examples will be given of various types of calculations of interest to the CTR program.

Energy from charged particle reactions among light nuclei, T. A. Tombrello, *SP425*, pp. 659-663 (Oct. 1975).

Key words: CTR energy production; nuclear reactions.

The copious production of neutrons in the "standard" CTR fuels has led to a renewed interest in proposals that various "exotic" fusion fuels be investigated. These fuels invariably involve reactions on lithium, beryllium, or boron isotopes in which most of the energy is liberated in the form of charged particles. Obtaining reaction cross sections at the appropriate energies or extrapolating the yield into inaccessible energy regions is, however, not always a straightforward procedure; and each reaction may require the development of new techniques. By means of selections from among such "exotic" fuel reactions, I shall show examples of experimental techniques for charged particle cross-section measurements at low energies and some techniques for extrapolation to still lower energies.

A survey of fast-neutron induced reaction cross-section data, S. M. Qaim, *SP425*, pp. 664-673 (Oct. 1975).

Key words: cross-section data and systematics; cross-section measurement; excitation functions; fast neutrons; nonelastic interactions; nuclear reactions; sources and spectra.

Sources of fast-neutrons and their spectra are discussed briefly. A critical survey of experimental techniques employed in studies of nuclear reactions (excluding fission) at $E_n \geqslant 14$ MeV is presented. The recent experimental cross-section data are described concisely. Special attention is paid to the case of low-yield reactions, such as processes with trinucleon emission. A review of recently discussed cross-section systematics together with an outline of some of the theoretical implications is given.

A quantitative assessment of CTR cross section needs, S. A. W. Gerstl, D. J. Dudziak, and D. W. Muir, *SP425*, pp. 674-679 (Oct. 1975).

Key words: cross sections; fusion reactors; perturbation; sensitivity; uncertainties.

A computational method to quantitatively determine cross section requirements is described and applied to a particular CTR design project. In order to provide a rational basis for the priorities assigned to new cross section measurements or evaluations, this method includes a quantitative assessment of the uncertainty of currently available

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data, the sensitivity of important nuclear design parameters to selected cross sections, and the accuracy desired in predicting nuclear design parameters. Perturbation theory is used to combine estimated cross section uncertainties with calculated sensitivities to determine the variance of any nuclear design parameter of interest. Selected computational results are presented for a model of the Tokamak Fusion Test Reactor.

A sensitivity study of data deficiencies weighting functions, and 14 MeV neutron source spectrum effects in a ^{238}U fueled fusion-fission hybrid blanket, B. R. Leonard, Jr., U. P. Jenquin, D. L. Lessor, D. F. Newman, and K. B. Stewart, *SP425*, pp. 680-682 (Oct. 1975).

Key words: fusion blanket neutronics; nuclear reactions; ^{238}U.

Neutronic calculations have been made for a hybrid DT fusion reactor blanket in which the initial region is fueled with depleted uranium followed by lithium and graphite. The important parameters of the blanket are the tritium production, fissions, ^{238}U captures, and thermal flux in the graphite. The sensitivity of these integral parameters was studied as a function of ^{238}U region thickness and the ^{238}U microscopic data used. In particular the effect of modifying some improbable secondary neutron energy distributions of ^{238}U on both versions III and IV of ENDF/B was calculated. Calculations were made for multigroup data obtained by collapsing over constant and E^{-1} weighting functions below the fusion peak. Results were also obtained for a narrow DT fusion neutron peak and for neutron source distribution resulting from an essentially exact calculation of a mirror plasma driven by 100 keV neutral ^{2}H and ^{3}H.

Advanced fuels for nuclear fusion reactors, J. R. McNally, Jr., *SP425*, pp. 683-687 (Oct. 1975).

Key words: advanced-fuels; DD; D^{6}Li; fusion-dynamics; I-layer; reactivity-coefficients.

Should magnetic confinement of hot plasma prove satisfactory at high beta ($\Sigma 8\pi nkT/B^2 > 0.2$), nuclear fusion fuels other than DT will be important in future fusion reactors. The prospect of the advanced fusion fuels DD and ^{6}LiD in such fusion reactors appears very promising provided the system is large, well reflected and has a sufficiently high density and temperature (high beta). Steady state burning of DD can ensue in a 60 kG field, 5m radius reactor for $\beta \gtrsim 0.1$ and wall reflectivity $R_\mu = 0.9$. The first generation thermonuclear reactions between D and D or ^{6}Li produce the very active, energy-rich fuels t and ^{3}He which exhibit a high burnup probability in very hot plasmas. Steady state burning of ^{6}LiD has also been demonstrated theoretically for low concentrations of ^{6}Li; however, important features of the ^{6}Lid system still need to be incorporated in the calculation. In particular, there is a need for new and improved nuclear cross section data on over 80 reaction possibilities.

A study of the ^{6}Li(n,α)t reaction between 2-10 MeV, C. M. Bartle, *SP425*, pp. 688-691 (Oct. 1975).

Key words: angular distribution; 2-10 MeV; ^{6}Li(n,α)t.

Absolute ^{6}Li(n,α)t cross section measurements are reported between 2.16 and 9.66 MeV. The results agree with the Pendlebury evaluation. The possibility of unfolding angular distributions from the pulse-height distributions in ^{6}LiI(Eu) is investigated.

Absolute cross sections for neutrons from ^{6}Li + d reactions at energies between 0.2 and 0.9 MeV, A. J. Elwyn, R. E. Holland, F. J. Lynch, J. E. Monahan, and F. P. Mooring, *SP425*, pp. 692-696 (Oct. 1975).

Key words: $E_d = 0.2$-0.9 MeV; measured $(d^2\sigma)/(dE_n d\Omega)$ $(\theta; E_d)$, $\sigma_t(E_d)$ for ^{7}Be breakup reaction; measured $\sigma(\theta; E_d)$, $\sigma_t(E_d)$ for ^{6}Li(d,n)^{7}Be reactions.

Absolute differential and total cross sections in reactions of deuterons with ^{6}Li have been measured for neutrons corresponding to the formation of ^{7}Be in both its ground and its first excited state, and for the continuum neutrons involved in the breakup of ^{7}Be at deuteron energies between 0.2 and 0.9 MeV. Discussion of the experimental procedure is presented. The results indicate that the breakup neutrons are a substantial portion of the total neutron production cross section in this reaction. The reaction rates of the various neutron production reactions are presented.

Cross section measurements for charged particle induced reactions on ^{6}Li, C. R. Gould, J. M. Joyce, and J. R. Boyce, *SP425*, pp. 697-700 (Oct. 1975).

Key words: deduced σ $\alpha\nu\delta$ $\langle\sigma v\rangle$; measured $\sigma(\theta)$; nuclear reactions; ^{6}Li(p,p); ^{6}Li(p,^{3}He); ^{6}Li(^{3}He,p); ^{6}Li(d,p); ^{6}Li(d,α).

Investigations of proton, deuteron and helium induced reactions on ^{6}Li are of importance in connection with the advantages of fusion reactor cycles involving only charged particles. The cross section data for many of these reactions are incomplete and poorly known. We report measurements of the absolute cross sections of the reactions ^{6}Li(p,p), ^{6}Li(p,^{3}He) at $E_p = 3$-12 MeV, ^{6}Li(d,p), ^{6}Li(d,α) at $E_d = 2.25$-6 MeV and ^{6}Li(^{3}He,p) at E = 3-6 MeV. Our data are combined with available information in the literature to determine reaction rate parameters as a function of the temperature of the reacting nuclei.

Phase shift analysis of nD, nT, DD, DT, TT, αD and αT cross sections, C. Abulaffio and A. Peres, *SP425*, pp. 701-703 (Oct. 1975).

Key words: alpha particles; cross sections; deuterons; neutrons; phase shifts; tritons.

Explicit formulas are given for the elastic and inelastic cross sections of neutrons, deuterons, tritons and alpha particles. These formulas, obtained by a phase shift analysis, are the best fit to currently available experimental data, for all angles and energies up to 14 MeV.

^{238}U pulsed sphere measurements and CTR fusion-fission blanket calculations, C. Wong, J. D. Anderson, R. C. Haight, L. F. Hansen, and T. Komoto, *SP425*, pp. 704-707 (Oct. 1975).

Key words: implications for fusion-fission blanket calculations; spectra from 10 keV to 15 MeV compared with calculations; ^{238}U pulsed sphere measurements.

The neutron emission spectra from ^{238}U spheres pulsed with 14-MeV neutrons have been measured from the source energy down to 10 keV and have been compared with calculations employing ENDF/B-IV and ENDL cross sections. The low energy spectra (10 keV to 1 MeV) are best described using ENDF/B-IV cross sections while the high energy spectra (2 MeV to 15 MeV) are best described using ENDL cross sections. It is concluded that use of ENDL cross sections should yield the best estimate of tritium breeding and ENDF/B-IV that of Pu breeding in a CTR fusion-fission blanket.

The ^{94}Nb(n,γ)^{95}Nb, ^{95m}Nb reaction for the CTR reactor technology program, P. J. Persiani, E. M. Pennington, Y. D. Harker, and R. L. Heath, *SP425*, pp. 708-711 (Oct. 1975).

Key words: afterheat; blanket; cross-section; experiment; fusion; radioactivity; resonance-levels.

Depending on the assumptions made of the neutron cross section behavior in the high-energy region, the captures in ^{94}Nb have been found to be the major components influencing the afterheat and radioactivity in fusion reactor design problems. Preliminary blanket designs indicate that about 60 percent of the capture rates in ^{94}Nb occur above 1 keV and 90 percent occur above 100 eV. Therefore an important and timely cross section need is an estimate and measurement of the ^{94}Nb(n,γ)^{95}Nb, ^{95m}Nb reaction in the keV-MeV energy region. Nuclear level systematic studies using the two known positive energy resonances, the thermal cross section, the resonance integral and the apparent high-density of the low-lying levels in niobium, have suggested postulating the existence of negative energy levels or level. These considerations involved the postulated negative energy resonances, and assumptions about positive energy resonances above 50 eV and average unresolved parameters based on nuclear systematics. The experimental technique to obtain a measured integrated cross-section in the fast fission spectrum of the Coupled Fast Reactivity Measurements Facility (CFRMF) and the Argonne Fast Source Reactor (AFSR) is investigated with foils of ^{93}Nb containing 4.1 percent ^{94}Nb utilizing Ge(Li) spectrometry.

Production cross sections of some micro and millisecond isomers with 14.8 MeV neutrons, G. N. Salaita and P. K. Eapen, *SP425*, pp. 712-715 (Oct. 1975).

Key words: cylic activation; formation cross sections measurements; isomeric states.

The formation cross sections for the isomeric states in Mg, Al, Y, In, Hf, Tl, Pb, and Bi by the (n,p), (n,α), and (n,2n) reactions have been measured using the cyclic activation technique and a Ge(Li) detector. The half-lives of the induced isomeric activities were determined using a wide range time-to-pulse height converter and a multichannel analyzer.

Reactivities for two-component fusion calculations, G. H. Miley and H. H. Towner, *SP425*, pp. 716-721 (Oct. 1975).

Key words: advanced fusion fuels; Doppler effect; fusion cross sections; fusion energy multiplication; fusion reactivities; Two-Component Torus (TCT).

Tables and graphs of fusion reactivities ($\langle \sigma v \rangle$) are readily available for fusion in thermalized (Maxwellian) plasma using common fuels. However, plans to construct the Two-Component Torus (TCT) have created a need for reactivities to characterize fusion via high-energy beams interacting with low-temperature target plasmas. Such reactivities are derived in the present paper for a variety of fuels including D$\rightarrow$T, D$\rightarrow$^{3}He, D$\rightarrow$D, T$\rightarrow$T, T$\rightarrow$^{3}He, and p$\rightarrow$^{11}B. Some examples of the use of these reactivities in two-component calculations are also described.

Application of Bondarenko formalism to fusion reactors, P. D. Soran and D. J. Dudziak, *SP425*, pp. 722-728 (Oct. 1975).

Key words: Bondarenko; f-factors; fusion reactors; niobium; Reference Theta-Pinch Reactor; tritium breeding.

The Bondarenko formalism used to account for resonance self-shielding effects (temperature and composition) in a Reference Theta-Pinch Reactor is reviewed. A material of interest in the RTPR blanket is ^{93}Nb, which exhibits a large number of capture resonances in the energy region below 800 keV. Although Nb constitutes a small volume fraction of the blanket, its presence significantly affects the nucleonic properties of the RTPR blanket. The effects of self-shielding in ^{93}Nb on blanket parameters such as breeding ratio, total afterheat, radioactivity magnet-coil heating and total energy depositions have been studied. Resonance selfshielding of 93Nb, as compared to unshielded cross sections, will increase tritium breeding by ~ 7 percent in the RTPR blanket, and will decrease blanket radioactivity, total recoverable energy, and magnet-coil heating. Temperature effects change these parameters by less than 2 percent. The method is not restricted to the RTPR, as a single set of Bondarenko f-factors is suitable for application to a variety of fusion reactor designs.

Neutron cross-section measurements on ^{236}U, L. Mewissen, F. Poortmans, G. Rohr, J. Theobald, H. Weigmann, and G. Vanpraet, *SP425*, pp. 729-732 (Oct. 1975).

Key words: enriched target; measured $\sigma_{n,T}$, $\sigma_{n,\gamma}$, $\sigma_{n,n}$; nuclear reactions ^{236}U(n,n), ^{236}U(n,γ), E = 30-1800 eV; ^{237}U resonances deduced Γ_n, Γ_γ.

Capture, scattering and total cross-section measurements have been performed on ^{236}U, over an energy range from 30 eV up to 1.8 keV. The neutron width Γ_n could be determined for 97 levels and the capture width Γ_γ for 57 among them. The average radiative width is: $\Gamma_\gamma = [23.0 \pm 0.3$ (stat.) ± 1.5(syst.)$]$ meV. For the s-wave strength function we find: $S_o = (1.05 \pm 0.14)10^{-4}$.

p-wave assignment of ^{238}U neutron resonances, F. Corvi, G. Rohr, and H. Weigmann, *SP425*, pp. 733-737 (Oct. 1975).

Key words: enriched targets; measured σ(E, E$_\gamma$) and $\sigma_{n\gamma}$ ^{238}U deduced resonances, π, gΓ_n; nuclear reactions ^{238}U(n, γ), E = 10-1600 eV.

A method of p-wave assignment of ^{238}U resonances is presented, consisting of measuring the fraction of capture γ-rays above 4.3 MeV for neutron resonances in the range 10-1600 eV. In this way, 57 resonances showing an enhancement of the high energy γ-ray yield, were identified as p-waves. In addition, a capture cross-section measurement was performed on a $6.32 \cdot 10^{-3}$ at/barn thick sample in order to obtain the gΓ_n values of such small resonances. The derived final estimates of the p-wave strength functions S_1 and of the s-wave level spacing D_o are: $S_1 = (2.3^{+0.5}_{-0.4}) \cdot 10^{-4}$; $D_o = (22.4 \pm 1.0)$eV.

Neutron resonance parameters of ^{238}U, Y. Nakajima, A. Asami, M. Mizumoto, T. Fuketa, and H. Takekoshi, *SP425*, pp. 738-741 (Oct. 1975).

Key words: background; JAERI linac; natural U; resonance parameters $\Gamma_n{}^o$ up to 5 keV; three thicknesses; transmission measurements; 190-m flight path.

Neutron transmission measurements on natural U samples were performed in the energy region from 20 eV up to 30 keV on a 190-m flight path of the JAERI 120-MeV linac neutron time-of-flight spectrometer. Samples were all metallic slabs with three thicknesses of 0.00725, 0.0144 and 0.0236 atoms/barn, respectively. One of them was cooled down to 77 K to reduce Doppler broadening. The best nominal resolution of the measurements was 0.3 nsec/m. A special attention has been paid to determine the background, because the shape of the background was found to depend on the thickness of the sample in the beam. Resonance parameters $\Gamma_n{}^o$ are obtained in the energy region up to about 5 keV with the Atta-Harvey area-analysis program. Results are compared with currently available experimental data.

Evidence for structure in the sequence of s-wave levels in ^{238}U,

E. Melkonian, J. P. Felvinci, and W. W. Havens, Jr., *SP425*, pp. 742-743 (Oct. 1975).

Key words: collective motion; correlations; level densities; resonance levels; ^{238}U; $\Gamma_n°$; $\Gamma_\gamma°$.

The levels in ^{238}U show unusual clusterings of large and small levels as evidenced by runs statistics and sequential correlation of values of $\Gamma_n°$. Also, $\Gamma_n°$ is found to show significant correlation with Γ_γ. These effects are interpreted in terms of a model which assumes that excitation states are built upon persistent states of collective vibration and that an entering neutron seeks to form those states involving minimum change of particle motion.

Total neutron cross section measurements on gross fission products, H. G. Priesmeyer and U. Harz, *SP425*, pp. 744-747 (Oct. 1975).

Key words: gross fission products; neutron cross section; time-of-flight; 1-240 eV.

Fast-chopper time-of-flight transmission measurements have been made using gross fission product samples of different irradiation and cooling histories, in order to find isotopic identifications and parameters of fission product resonances. The covered energy range was from 1 eV to 240 eV with resolutions of 47 ns/m and 94 ns/m. Some prominent fission product resonances have been found and can partly be identified. From the transmission analysis the U 235 content and burnup can be calculated within ≤ 5 percent.

High resolution total neutron cross-section in ^{54}Fe and ^{56}Fe, M. S. Pandey, J. B. Garg, J. A. Harvey, and W. M. Good, *SP425*, pp. 748-753 (Oct. 1975).

Key words: high resolution; total neutron cross section; ^{54}Fe; ^{56}Fe.

High resolution neutron total cross-section measurements on ^{54}Fe and ^{56}Fe have been made using the ORELA facility and resonance parameters are reported up to an energy of 500 keV. The total cross-section data were analyzed by R-matrix multi-level code for broad, interfering s-wave resonances. For narrow and noninterfering s-wave resonances and $l > 0$-wave resonances transmission data were analyzed using Harvey-Atta code of area analysis. From these values of resonance parameters, the values of level density $\langle D \rangle$ and strength function for s- and p-wave neutron scattering have been determined. Statistical distributions of spacing and reduced neutron widths are presented. A large number of p-wave resonances are observed which have not been reported before.

Thick sample transmission measurement and resonance analysis of the total neutron cross section of iron, S. Cierjacks, G. Schmalz, R. Töpke, R. R. Spencer, and F. Voss, *SP425*, pp. 754-757 (Oct. 1975).

Key words: Fe(n), $E_n = 0.5$-30 MeV; measured $\sigma_{nt}(E)$; multilevel R-matrix resonance analysis.

New transmission measurements on natural iron samples were performed at the 190 m flight path of the Karlsruhe fast neutron time-of-flight spectrometer, allowing for an improved resolution of 0.015 ns/m. The measurements were carried out in the energy range from 0.5-30 MeV using two largely different sample thicknesses. The thick sample results indicate, that the deep s-wave minima are now fully explored in the energy range below the inelastic scattering threshold at about 850 keV. From the highly resolved transmission data resonance parameters were determined by multilevel R-matrix analysis. The results of the thick sample measurements between 0.5-30 MeV and the resonance parameters determined in the range between 500-800 keV are presented.

Gamma-ray production measurements due to interactions of neutrons with elements required for nuclear power applications and design, G. T. Chapman, J. K. Dickens, T. A. Love, G. L. Morgan, and E. Newman, *SP425*, pp. 758-761 (Oct. 1975).

Key words: cross sections; $(n,x\gamma)$; photon energy.

For the past three years neutron-induced gamma-ray production cross sections have been made for a variety of elements at the Oak Ridge Electron Linear Accelerator. A large, well shielded, NaI spectrometer was used as the gamma-ray detector and ORELA as the neutron source. The facility provides a consistent data set for neutron energies from 0.7 to 20 MeV and photon energies from 0.3 to 10.5 MeV. Typically the samples are flat plates of the element of ≈ 0.02 atoms/barn thickness, although several elements studied required samples in compound form. The data are accumulated in a two-parameter array, gamma-ray pulse height versus neutron time-of-flight. Data reduction was accomplished by binning in desired neutron-energy groups and in fixed photon-energy groups. For each neutron-energy group the data were unfolded using FERD unfolding routine, and the results are in the form of absolute differential cross sections, $d^2\sigma/d\omega dE$, for each photon-energy bin. So far data have been obtained for 20 elements (Li, C, N, O, F, Mg, Al, Si, Ca, Fe, Ni, Cu, Zn, Nb, Ag, Sn, Ta, W, Au, and Pb).

Cross sections for the production of low energy photons by neutron interactions with fluorine and tantalum, J. K. Dickens, G. L. Morgan, and F. G. Perey, *SP425*, pp. 762-765 (Oct. 1975).

Key words: cross sections; fluorine; neutron-induced low-energy photons; tantalum.

Differential cross sections for the production of low energy photons (< 240 keV) by neutron interactions in fluorine and tantalum have been measured for neutron energies between 0.1 and 20 MeV. Photons were detected at 92° using an intrinsic germanium detector. Incident neutron energies were determined by time-of-flight techniques for a white source spectrum.

Spectral gamma-ray production cross-section measurements from threshold to 20 MeV, V. C. Rogers, V. J. Orphan, C. G. Hoot, V. V. Verbinski, D. G. Costello, and S. J. Friesenhahn, *SP425*, pp. 766-769 (Oct. 1975).

Key words: E_n to 21 MeV; E_γ to 10 MeV; $\sigma(n,x\gamma)$ measurements.

The gamma-ray production cross-section measurement program at IRT is described. Neutrons from epithermal energies to 21 MeV were produced with the IRT Linac, and gamma rays resulting from neutron interactions were detected with a Ge(Li) spectrometer system. Representative results are presented for C, N, Al, Si, and Fe.

Fourteen-MeV, neutron-induced gamma-ray production cross sections for several elements, E. D. Arthur, D. M. Drake, M. G. Silbert, and P. G. Young, *SP425*, pp. 770-773 (Oct. 1975).

Key words: $E_n = 14.2$ MeV; measured $d^2\sigma/d\Omega dE$; nuclear reaction $(n,n'\gamma)$.

A pulsed 14.2 MeV neutron source and a NaI(Tl) gamma-ray spectrometer were used to measure gamma-ray production cross sections for several elements in the range $A = 12$ to 239. Angular distributions for some of the more prominent gamma ray groups were obtained. Complete gamma-ray production cross sections were measured for all the sample materials, including those in which no clearly separable gamma ray groups appeared.

The low energy total cross section of ^{36}Ar. S. F. Mughabghab and B. A. Magurno, *SP425*, pp. 774-775 (Oct. 1975).

Key words: parameters of bound level of Ar-36.

To compare the predictions of the valence model with measured partial radiative widths of Ar-36 an accurate knowledge of the bound-level parameters is required. This is achieved by carrying out a Breti-Wigner parameter fit to the total cross section of Ar-36 measured by Chrien et al. and renormalized to the recommended values of the thermal capture and scattering cross sections. The result is as follows:

$$E_o = -10 \text{ keV}, \Gamma_n^o = 92.3 \text{ eV}, \Gamma_\gamma = 1.26 \text{ eV}.$$

Neutron cross sections of Ni-59, G. J. Kirouac and H. M. Eiland, *SP425*, pp. 776-779 (Oct. 1975).

Key words: nickel-59; resonance integral; resonance parameters; thermal cross section.

The thermal cross section and resonance integral for Ni-59 have been measured in integral measurements using the pile oscillator technique. The results are σ_o (2200 m/sec) = 92 ± 4 barns and RI = 125 ± 8 barns. Separate differential measurements of the neutron total cross section from 0.5 eV to above 2 keV were performed at the RPI linear accelerator. A resonance was observed at 203 eV and analyzed by shape and area methods. Parameters for the resonance have been determined. The integral and differential results were compared and found to be in reasonable agreement.

Neutron resonance spectroscopy at Nevis laboratories, G. Hacken, H. I. Liou, J. Rainwater, and U. N. Singh, *SP425*, pp. 780-783 (Oct. 1975).

Key words: measured $\sigma_t(E)$: (n,n), (n,γ), E = 1 eV-few keV; nuclear reactions; summary of deduced E_o, $g\Gamma_n$, Γ_γ, S_o, $\langle D_o \rangle$; various statistical tests.

A review of the results of high resolution, high intensity neutron time of flight spectroscopy with the Columbia University Nevis Synchrocyclotron is presented. The review includes a brief description of the experimental facilities and a summary of resonance parameter results.

Threshold photoneutron spectroscopy of nuclei near A = 140, R. J. Holt and H. E. Jackson, *SP425*, pp. 784-787 (Oct. 1975).

Key words: deduced $\Sigma\Gamma_{\gamma 0}$ (M1) and $\Sigma\Gamma_{\gamma 0}$ (E1); $E_x \approx 9$ MeV; measured $\sigma(E_n,\theta)$; nuclear reactions ^{138}Ba(γ,n), ^{140}Ce(γ,n).

The E1 and M1 radiative strength functions have been measured for nuclei with atomic mass number near A = 140 and at an excitation energy of approximately 9 MeV using the threshold photoneutron technique. A method was developed for extracting the dipole strength even though the first excited state of the daughter nucleus is near the ground state. The photoneutron spectra were measured at laboratory angles of 90° and 135° and with high resolution (0.5 ns/m) using the time-of-flight spectrometer associated with the Argonne high-current linac. In particular the dipole strengths found in ^{138}Ba and ^{140}Ce are discussed. These results are compared with theoretical estimates and with the radiative strengths of nuclei in the mass range 50 < A < 250.

Analyzing powers of the ^{6}Li($\vec{n}$, t)^{4}He reaction, M. Karim and J. C. Overley, *SP425*, pp. 788-791 (Oct. 1975).

Key words: deduced analyzing powers A(Θ); measured yield asymmetries; nuclear reactions: ^{6}Li($\vec{n}$, t)^{4}He, E = 0.2-1.4 MeV.

We have measured analyzing powers for the ^{6}Li($\vec{n}$, t)^{4}He reaction for neutron energies between 0.2 and 1.4 MeV. An energy continuum of neutrons was produced by bombarding a thick lithium metal target with a 3.5-MeV, nanosecond-pulsed proton beam. The partially polarized neutrons emitted at 50° were incident on an evaporated ^{6}Li metal target. A silicon surface barrier detector was used to measure triton and α-particle yields as a function of particle energy. Tritons were distinguished from α particles with time-of-flight techniques. Yield asymmetries were determined at laboratory angles of 35, 60 and 80° with angular resolutions of ± 5°. The α-particle yield asymmetries were converted to backward angle triton asymmetries, providing data at six angles. Analyzing powers as a function of angle were deduced. Although results are tentative, analyzing powers near 90° and 250 keV are negative (~ − 0.3) while above 700 keV they are large and positive (~ −+ 0.9) and vary slowly with neutron energy.

Neutron-absorption cross section of sodium-22, R. Rundberg, M. F. Elgart, H. L. Finston, E. T. Williams, and A. H. Bond, Jr., *SP425*, pp. 792-794 (Oct. 1975).

Key words: cross section; neutron; resonance; sodium-22; thermal; Westcott.

We describe a simple method for determining the neutron-absorption cross sections for radionuclides produced and consumed in a reactor-neutron flux. Data were obtained for ^{22}Na which through application of Westcott's procedure, yielded the following: σ_o = 51.1 ± 3.1 Kbarns, s_o = 2.3 ± 0.1, and Σ' = 100 ± 10 Kbarns.

Evidence for valence neutron capture in s-wave neutron capture in ^{36}Ar and ^{54}Fe, S. F. Mughabghab, *SP425*, pp. 795-798 (Oct. 1975).

Key words: thermal capture spectra; valence capture in ^{36}Ar and ^{54}Fe.

The valence and channel neutron model of Lane and Lynn remarkably account for partial radiative widths of neutron resonances in the 3p-giant resonance. In this investigation, evidence is presented for valence neutron capture at and in the neighborhood of the 3s- giant resonance in target nuclei Ar-36 and Fe-54. In addition, the variation of the correlation coefficient $\rho(\Gamma_{\gamma ij}, E_\gamma^{-n}, (2J+1)\, S_{dp})$ with the reduction power factor n of the γ ray energy is studied.

Neutron resonance spectroscopy, **^{209}Bi**, U. N. Singh, J. Rainwater, H. I. Liou, G. Hacken, and J. B. Garg, *SP425*, pp. 799-801 (Oct. 1975).

Key words: deduced E_o, l, J, $g\Gamma_n$, S_o, S_1; measured $\sigma_t(E)$; nuclear reactions ^{209}Bi (n,n), (n,γ), E = 500 eV-75 keV.

Neutron time of flight transmission measurements were made on several samples of ^{209}Bi using the Nevis Synchrocyclotron of Columbia University. The resonance parameters are given for 29 levels to 75 keV. Out of the 29 observed levels 10 were $l = 0$ and 19 were $l = 1$ levels. The implied s and p-strength functions are $10^4 S_o = (0.60\, _{-0.21}^{+0.39})$ and $10^4 S_1 = (0.19_{-0.05}^{+0.08})$.

Measurement of neutron capture cross section near 24 keV, N. Yamamuro, T. Doi, T. Hayase, Y. Fujita, K. Kobayashi, and R. C. Block, *SP425*, pp. 802-805 (Oct. 1975).

Key words: C_6F_6 detector; Fe-filtered beam; neutron capture cross section; pulse-height weighting; time-of-flight method: ^{93}Nb, Ag, ^{127}I, ^{165}Ho, ^{197}Au and ^{238}U.

Neutron capture cross sections of ^{93}Nb, Ag, ^{127}I, ^{165}Ho, ^{197}Au and ^{238}U were measured near 24 keV using the Fe-filtered-beam method. A 15-cm thick Fe filter was placed in the neutron time-of-flight beam produced by the KUR 46-MeV electron Linac. Capture γ-rays were detected by two C_6F_6 total energy detectors located on a 12-m flight path. Pulse-height weighting was used to determine the relative capture efficiency. The neutron flux was determined with the detector via the ^{10}B (n;$\alpha_1\gamma$) reaction and saturated resonance capture in Ag at 5.2 eV. Multiple scattering corrections were applied to the data, resulting in 24 keV capture cross sections of 0.33, 1.10, 0.76, 1.26, 0.68 and 0.50 barns for ^{93}Nb, Ag, ^{127}I, ^{165}Ho, ^{197}Au and ^{238}U, respectively. Total errors are 5 to 7 percent, with an estimated systematic error of 4 percent.

Fluctuations in the neutron strength function, C. M. Newstead, *SP425*, pp. 806-809 (Oct. 1975).

Key words: fluctuations; neutron strength functions; optical potential; quasi-particles.

Strength function fluctuations are interpreted in terms of variation of the quasi-particle state density. The anomalous behaviour of the neodymium isotopes is described and an account of the fluctuations of S_0 in the 3S and 4S size resonances is given. Fluctuations of the local strength fluctuations with energy are discussed.

Measurements of thermal neutron cross sections for helium production in ^{59}Ni, J. McDonald and N. G. Sjöstrand, *SP425*, pp. 810-812 (Oct. 1975).

Key words: alpha particles; cross section; helium; nickel; neutron; spectrum.

The cross section for the reaction ^{59}Ni (n,α)^{56}Fe was measured at three neutron energies from 0.029 to 0.042 eV. The alpha particles were recorded using a Si surface barrier detector. The measurements were made relative to Li-6. Within experimental errors the cross section ratio remained constant for the three energies. Assuming that the 1/v law applies the ^{59}Ni (n,α) cross section at 0.0253 eV is found to be 22.2 ± 1.7 barn.

Differential cross sections for the 0.847-MeV gamma ray from iron for incident neutrons of 8.5, 10.0, 12.2, and 14.2 MeV, D. M. Drake, L. R. Veeser, M. Drosg, and G. Jensen, *SP425*, pp. 813-815 (Oct. 1975).

Key words: $E_n = 8.5$, 10.0, 12.2, 14.2 MeV; Fe(n,xγ); measured $\sigma(\theta)$ for $E_\gamma = 0.847$ MeV; nuclear reactions: $\theta = 90°$, 75°, 55°, 35°.

Neutron-induced differential gamma-ray production cross sections for the 0.847-MeV gamma ray from iron have been measured using a pulsed ^{3}H(p,n)^{3}He neutron source and a NaI spectrometer. Background caused by break-up neutrons and Compton-scattered gamma rays was suppressed by placing the sample about one meter from the neutron source and using time-of-flight to select only pulses caused by the monoenergetic ^{3}H(p,n)^{3}He neutrons.

High energy γ-ray transitions of ^{56}Fe resonances in the energy range 7-70 keV, H. Beer, R. R. Spencer, and F. Käppeler, *SP425*, pp. 816-818 (Oct. 1975).

Key words: $E_n = 7$-70 keV; natural iron target; nuclear reaction ^{56}Fe (n,γ); relative partial radiation widths; γ-transitions in ^{57}Fe of ^{56}Fe resonances.

High energy γ-ray transitions to low lying states in ^{57}Fe following neutron capture in ^{56}Fe were investigated for individual resonances in the energy region 7-70 keV at the Karlsruhe 3 MV pulsed Van-de-Graaff-accelerator by means of a 50 cc Ge(Li)-detector. As a result relative partial radiation widths for 5 transitions of 4 resonances were determined.

Excitation functions of the (n,2n) reactions on ^{12}C and ^{238}U, A. Ackermann, B. Anders, M. Bormann, and W. Scobel, *SP425*, pp. 819-822 (Oct. 1975).

Key words: measured σ(E); nuclear reactions ^{12}C(n,2n), E= 23-34 MeV; statistical model calculations: ^{238}U(n,2n), E= 13-18 MeV.

The excitation functions of the reaction ^{12}C(n,2n)^{11}C for incident neutron energies from 23 to 34 MeV and of ^{238}U(n,2n)^{237}U from 13 to 18 MeV have been measured with activation techniques. The results are compared with existing data and interpreted with the statistical model approach. The calculations performed for ^{238}U include fission competition and preequilibrium contributions to account for an enhanced (n,2n) yield at projectile energies above 15 MeV.

Incoherent neutron scattering cross-sections as determined by diffuse neutron scattering techniques, W. Schmatz, G. Bauer, and M. Löwenhaupt, *SP425*, pp. 823-824 (Oct. 1975).

Key words: diffuse neutron scattering; incoherent neutron scattering; point defects.

A discussion is given of the way in which small incoherent scattering cross-sections can be obtained as a by-product of point defect scattering studies. A table with σ_{inc}-values for ten elements is given.

Cross section and method uncertainties: The application of sensitivity analysis to study their relationship in calculational benchmark problems, C. R. Weisbin, E. M. Oblow, J. Ching, J. E. White, R. Q. Wright, and J. Drischler, *SP425*, pp. 825-833 (Oct. 1975).

Key words: air transport; benchmark; profiles; sensitivity; uncertainties.

Sensitivity analysis is applied to the study of an air transport benchmark calculation to quantify and distinguish between cross-section and method uncertainties. The boundary detector response was converged with respect to spatial and angular mesh size, P_l expansion of the scattering kernel, and the number and location of energy grid boundaries. The uncertainty in the detector response due to uncertainties in nuclear data is 17.0 percent (one standard deviation, not including uncertainties in energy and angular distribution) based upon the ENDF/B-IV "error files" including correlations in energy and reaction type. Differences of approximately 6 percent can be attributed exclusively to differences in processing multigroup transfer matrices.

Benchmark experiments for nuclear data, E. M. Bohn, R. J. LaBauve, R. E. Maerker, B. A. Magurno, F. J. McCrosson, and R. E. Schenter, *SP425*, pp. 834-841 (Oct. 1975).

Key words: benchmark experiments; dosimetry; fast reader testing; fission products; shielding; thermal reactor testing.

Benchmark experiments offer the most direct method for validation of nuclear data. Benchmark experiments for several areas of application of nuclear data have been specified by CSEWG. These experiments are surveyed and tests of recent versions of ENDF/B are presented.

Estimated uncertainties in nuclear data – An approach, F. G. Perey, *SP425*, pp. 842-847 (Oct. 1975).

Key words: correlations; covariances; data adequacy; estimated uncertainties; evaluations; neutron transport.

The need to communicate estimated uncertainties in evaluated nuclear data to be used in the assessment of their adequacy in applications has been recognized in the ENDF/B system. Starting with ENDF/B-IV, the data files contain formatted data describing the estimated covariances of some of the microscopic cross sections in such a form that they can be processed by computer codes to generate covariance matrices of quantities used in solving neutron transport problems such as group cross sections. The basic concepts behind the representation of such quantities will be described and the work done so far in the representation and manipulation of such quantities will be discussed. Problem areas not yet addressed in ENDF/B-IV but under study will be discussed.

A survey of computer codes which produce multigroup data from ENDF/B-IV, N. M. Greene, *SP425*, pp. 848-854 (Oct. 1975).

Key words: computer codes; multi-group data; survey.

The features of three code systems that produce multigroup neutron data are contrasted. This includes the ETOE-2/MC^2-2/SDX, MINX/SPHINX and AMPX code packages. These systems all contain a fairly extensive set of processing capabilities with the current evaluated nuclear data files – ENDF/B. They were designed with different goals and applications in mind. This paper discusses some of their differences and the implications for particular situations.

Measurement of (n,2n) and (n,3n) cross-sections for incident energies between 6 and 15 MeV, J. Fréhaut and G. Mosinski, *SP425*, pp. 855-858 (Oct. 1975).

Key words: E_n = 8-15 MeV; measured σ(En); nuclear reactions ^{56}Fe, ^{59}Co, ^{76,78,80,82}Se, ^{89}Y, ^{93}Nb, ^{103}Rh, ^{169}Tm, ^{175}Lu, ^{181}Ta, W, Pt, ^{197}Au, ^{209}Bi, ^{238}U(n,2n); ^{238}U(n,3n).

Cross sections for the (n,2n) and (n,3n) reactions have been measured for several nuclides between 6 and 15 MeV using a large liquid scintillator to count the neutrons directly. Measurements were made relative to fission cross section of ^{238}U for ^{56}Fe, ^{59}Co, ^{76}Se, ^{78}Se, ^{80}Se, ^{82}Se, ^{89}Y, ^{93}Nb, ^{103}Rh, ^{169}Tm, ^{175}Lu, ^{181}Ta, ^{197}Au, ^{209}Bi, ^{238}U, and for the natural elements Pt and W. The relative accuracy was generally in the range 5 to 10 percent. The present results are compared with previous measurements.

Excitation curve for the production of ^{115}In^m by neutron inelastic scattering, D. C. Santry and J. P. Butler, *SP425*, pp. 859-861 (Oct. 1975).

Key words: excitation curve; neutron elastic scattering; ^{115}In^m; 0.335-14.7 MeV.

Cross sections for the reaction ^{115}In(n,n′)^{115}In^m have been measured by the activation method from a threshold energy of 0.335 MeV to 14.74 MeV. Cross sections at energies below 5.3 MeV were based on neutron flux measurements determined with a calibrated neutron long counter, while at higher energies measurements were made relative to the known cross section for the ^{32}S(n,p)^{32}P reaction. An effective cross section for a ^{235}U fission neutron spectrum calculated from the measured excitation curve is 173 ± 9 mb.

Inelastic neutron excitation of the ground state rotational band of ^{238}U, P. Guenther and A. Smith, *SP425*, pp. 862-865 (Oct. 1975).

Key words: E = 0.3-3.0 MeV; nuclear reaction ^{238}U(n,n) and ^{238}U(n,n′); $\sigma(\Theta,E)$; Θ_{lab} = 20 to 160°.

Cross sections for the neutron excitation of the 2+(45 keV), 4+(148 keV) and 6+(308 keV) states in ^{238}U were measured to incident energies of ≈ 3.0 MeV. The experimental resolution was sufficient to resolve these components throughout the measured energy range. Particular attention was given to energies near threshold and in the few MeV range where direct reaction contributions were appreciable. The experimental results were compared with theoretical estimates based upon statistical and coupled-channel models deduced from comprehensive studies of neutron scattering from heavy-rotational-deformed nuclei. An evaluated inelastic scattering data set was derived from the present experimental and calculational results and previously reported experimental values and compared with respective values from the ENDF-IV file.

Differential elastic and inelastic scattering of 9-15 MeV neutrons from carbon, F. O. Purser, D. W. Glasgow, H. H. Hogue, J. C. Clement, G. Mack, K. Stelzer, J. R. Boyce, D. H. Epperson, S. G. Buccino, P. W. Lisowski, S. G. Glendinning, E. G. Bilpuch, H. W. Newson, and C. R. Gould, *SP425*, pp. 866-870 (Oct. 1975).

Key words: measured $\sigma(E)_n,\theta)$; nuclear reactions C(n,n), C(n,n′), E = 9-15 MeV.

Measurements have been made of the differential elastic and inelastic scattering cross sections, at 28 angles each, for 9, 9.21, 9.6, 10, 10.25, 10.74, 11, 11.22, 11.79, 12, 13, 14, 14.5, and 15 MeV neutrons incident upon natural carbon. The measurements were made with the TUNL FN tandem accelerator and a high-precision goniometer time-of-flight spectrometer. Monte Carlo simulation has been used to correct the differential cross sections for multiple scattering. Absolute uncertainties are typically 5 percent. These data partially fill the 9-15 MeV gap in the C elastic and inelastic scattering data set required for the CTR program.

Neutron inelastic scattering cross sections in the energy range 2 to 4.5 MeV, M. A. Etemad, *SP425*, pp. 871-874 (Oct. 1975).

Key words: Hauser-Feshbach; inelastic-scattering; measurements; MeV range 2 to 4.5; neutrons; time-of-flight.

Fast neutron inelastic scattering cross sections have been measured for the elements Al, Ti, V, Mn, Fe, Ni, Nb, Pb and Bi by the time-of-flight technique. The measurements were made in the energy range of 2 to 4.5 MeV in steps of 0.25 MeV and at a scattering angle of 125°. The experimental results are compared to the excitation functions calculated on the basis of the Hauser-Feshbach formalism and corrected for the effects of the level width fluctuations.

The absolute polarization of fast neutrons elastically scattered from light nuclei, F. W. K. Firk, J. E. Bond, G. T. Hickey, R. J. Holt, R. Nath, and H. L. Schultz, *SP425*, pp. 875-878 (Oct. 1975).

Key words: E = 2 to 5 MeV; measured $\overrightarrow{p}(E,\theta)$ absolutely for ^{12}C$(n,\overrightarrow{n})$ reaction then determined $\overrightarrow{A}(E,\theta)$ for other reactions; nuclear reactions ^{4}He$(\overrightarrow{n},n)$; ^{6}Li$(\overrightarrow{n},n)$; ^{9}Be$(\overrightarrow{n},n)$; ^{12}C$(\overrightarrow{n},n)$ and ^{16}O$(\overrightarrow{n},n)$; R-function and phase-shift analyses; θ_{lab} = 20 to 150°.

Photoneutrons from the target of the Yale LINAC were polarized by elastic scattering from a cylinder of graphite.

The polarized neutrons were observed at angles of 50 and 130° and their energies determined with a time-of-flight resolution of 0.75 ns·m^{-1}. The *absolute* polarization of the neutrons was measured in a true double-scattering experiment; this polarized source then was used to measure the analyzing powers of the reactions $\vec{n}$-^{4}He, $\vec{n}$-^{6}Li, $\vec{n}$-^{9}Be, and $\vec{n}$-^{16}O over wide ranges of energy and angle. These reactions are of interest from three viewpoints i) the design of fission and fusion power reactors ii) absolute neutron standards and iii) fundamental theory. General, multi-level R-function analyses and phase-shift analyses of the observed analyzing powers were made in all cases. Differential and total cross sections were predicted and compared with currently available measurements.

Inelastic scattering of fast neutrons from ^{103}Rh, D. Reitmann, E. Barnard, D. T. L. Jones, and J. G. Malan, *SP425*, pp. 879-882 (Oct. 1975).

Key words: fast neutrons; inelastic scattering; isomeric state; level scheme; optical model; rhodium-103.

Cross sections for elastic and inelastic scattering of fast neutrons from ^{103}Rh were measured at energies up to 1500 keV. Additional information about the level scheme followed from (n,n'γ) measurements. The effective cross section for excitation of the isomeric state at 40 keV was derived from these results and compared with activation measurements and theoretical results.

ORNL neutron scattering cross section measurements from 4 to 8.5 MeV: A summary, W. E. Kinney and F. G. Perey, *SP425*, pp. 883-885 (Oct. 1975).

Key words: cross section; differential; elastic; inelastic; neutron; scattering.

The ORNL program to measure neutron elastic and inelastic scattering cross sections for 26 nuclides from C to ^{238}U in the 4-8.5 MeV energy range is summarized. Data acquisition and reduction techniques are reviewed and typical results given. The nuclides investigated are tabulated.

Differential elastic scattering cross sections of sulphur for 14.8 MeV neutrons by surface of revolution technique, A. M. Ghose, A. Chatterjee, and S. Nath, *SP425*, pp. 886-888 (Oct. 1975).

Key words: differential elastic scattering cross section; fast neutrons; scattering geometry; uniform sensitivity neutron counter.

A new technique has been developed for the absolute measurements of differential elastic scattering cross sections of nuclei for fast neutrons. The method is based on constant angle scatterers shaped in the form of a surface of revolution around the source to detector line as axis. Inelastically scattered neutrons have been discriminated by the multiple bias technique applied to recoil proton plastic detectors. The results obtained for sulphur for 14.8 MeV neutrons will be presented.

Differential cross sections for carbon neutron elastic and inelastic scattering from 8.0 to 14.5 MeV, G. Haouat, J. Lachkar, Y. Patin, J. Sigaud, and F. Coçu, *SP425*, pp. 889-892 (Oct. 1975).

Key words: angular distributions; carbon-neutron elastic and inelastic scattering; $E_n = 8.0$-14.5 MeV; excitation functions.

Differential elastic and inelastic cross sections for fast neutrons scattered by carbon have been measured between 8.0 and 14.5 MeV. No other results on ^{12}C seem to have been reported, at this time, between 9 and 14 MeV. A complete and consistent set of data for carbon, including total, elastic and inelastic, (n,α) and (n,n'3α) cross sections, is now available for energies below 14.5 MeV.

Level and decay schemes of even-A Se and Ge isotopes from (n,n'γ) reaction studies, J. Sigaud, Y. Patin, M. T. McEllistrem, G. Haouat, and J. Lachkar, *SP425*, pp. 893-896 (Oct. 1975).

Key words: E_γ; $E_n = 2.0$-4.1 MeV; level schemes; (n,n'γ) reaction; $\sigma(E_\gamma,\Theta)$; ^{76,78,80,82}Se, ^{76}Ge.

The energy levels and the decay schemes of ^{76}Se, ^{78}Se, ^{80}Se and ^{76}Ge have been studied through the measurements of (n,n'γ) differential cross sections. Gamma-ray excitation functions have been measured between 2.0- and 4.1-MeV incident neutron energy, and angular distributions have been observed for all of these isotopes.

Symmetry effects in neutron scattering from isotopically enriched Se isotopes, J. Lachkar, G. Haouat, M. T. McEllistrem, Y. Patin, J. Sigaud, F. Coçu, *SP425*, pp. 897-900 (Oct. 1975).

Key words: deduced optical-model parameters; enriched targets; measured $\sigma(\theta)$; nuclear reactions ^{76,78,80,82}Se(n,n), (n,n'), E = 6-10 MeV.

Differential cross sections for neutron elastic and inelastic scattering from ^{76}Se, ^{78}Se, ^{80}Se and ^{82}Se, have been measured at 8-MeV incident neutron energy and from ^{76}Se and ^{82}Se at 6- and 10-MeV incident energies. The differences observed in the elastic scattering cross sections are interpretable as the effects of isospin term in the scattering potentials. A full analysis of the elastic scattering data are presented.

Fast neutron capture and activation cross sections, W. P. Poenitz, *SP425*, pp. 901-904 (Oct. 1975).

Key words: fast neutron capture; Co, Ni, Cu, Zn, Nb, Ho, Ta, Au, ^{238}U; theory and experiment.

Fast neutron capture cross sections were measured in the energy interval from 0.02 to 0.7 MeV using white source neutron time-of-flight techniques and from 0.3 to 3.0 MeV using monoenergetic neutrons. Target materials were Co, Ni, Zn, Cu, Nb, Ho, Ta, Au and ^{238}U. A 1300 l liquid scintillator was used as a capture γ-ray detector. Flat efficiency neutron detectors and/or the standard capture cross section of Au were used for the neutron flux determination. Fast neutron capture and activation cross sections were calculated in terms of the statistical model. The Hauser-Feshbach formalism and a gamma cascade model previously described were used.

Fission product capture cross sections in the keV region, R. W. Hockenbury, H. R. Knox, and N. N. Kaushal, *SP425*, pp. 905-907 (Oct. 1975).

Key words: average Γ_γ, D, S^0 and S^1; capture cross sections.

Capture cross section measurements have been made on ^{105}Pd, ^{151,153}Eu and ^{103}Rh from 20 eV to 200 keV. Capture data in the resolved resonance region are combined with our own transmission data to obtain a consistent capture normalization. For these experiments, the statistical uncertainty of the normalization is ±4 percent for ^{151}Eu, ^{153}Eu and ^{105}Pd, and ±8 percent for ^{103}Rh. The statistical uncertainty of the keV capture cross section point data is about ±4 percent. The information derived from these measurements is the measured keV capture cross section and the average s and p wave parameters $\bar{\Gamma}_\gamma$, S^0 and S^1.

Integral capture cross-section measurements in the CFRMF for LMFBR control materials, R. A. Anderl, Y. D. Harker, E.

H. Turk, R. G. Nisle, and J. R. Berreth, *SP425*, pp. 908-911 (Oct. 1975).

Key words: boron carbides; capture cross sections; CFRMF reactor; control materials; europium oxides; fast reactors; neutron reactions; tantalum.

Integral capture-cross sections for separated isotopes of Eu and Ta are reported for measurements in the Coupled Fast Reactivity Measurements Facility (CFRMF). These cross sections along with that measured in the CFRMF for $^{10}B(n,\alpha)$ provide an absolute standard for evaluating the relative reactivity worth of Eu_2O_3, B_4C and Ta in neutron fields typical of an LMFBR core. Based on these measurements and for neutron fields characterized by the ^{235}U:^{238}U reaction rate spectral index ranging from 23 to 50, the infinitely dilute relative worth of Eu_2O_3 has been estimated to be 25 to 40 percent higher than that for B_4C and 80 to 100 percent higher than that for Ta.

Radiative capture of neutrons in the keV region, R. C. Greenwood, R. E. Chrien, and K. Rimawi, *SP425*, pp. 912-915 (Oct. 1975).

Key words: iron filter; $Mn(n,\gamma)$; neutron capture gamma-rays; ^6Li filter; $^{154}Gd(n,\gamma)$; $^{156}Gd(n,\gamma)$.

Essentially monoenergetic neutrons with keV energies can be obtained from a reactor by using suitable filters. To date, prompt γ-ray spectra have been measured using 24-, 2-, and 1-keV neutrons, obtained through Fe + Al + S, Sc + Ti and ^6Li filters, respectively. Two features of these data are of note to reactor shielding. First, the radiative capture spectra from higher Z nuclei usually result from an average over many resonance states. Hence statistical fluctuations in the primary γ-ray intensities, to which the corresponding thermal neutron capture spectra are subject, are averaged out. Second, such data provide information on the dependence of radiative capture spectra on neutron energy. The data shows that at 24 keV there is a significant p-wave contribution to these spectra, even for those mass regions where the ratio of the p-to-s wave strength function is close to a minima. This occurs because the smallness of the relative penetrability at 24 keV, $0.04 < (kR)^2 < 0.08$ for $100 < A < 240$, is compensated for by the branching ratio $\Gamma\gamma/\Gamma$ which is now much larger for p-wave than for s-wave resonances.

Measurement of the γ-ray production cross sections from inelastic neutron scattering in some chromium and nickel isotopes between 0.5 and 10 MeV, F. Voss, S. Cierjacks, D. Erbe, and G. Schmalz, *SP425*, pp. 916-919 (Oct. 1975).

Key words: $E_n = 0.5\text{-}10$ MeV; ^{52}Cr, ^{58}Ni, ^{60}Ni (n,n',γ) experimental results of γ-ray production cross sections.

At the Karlsruhe fast neutron time-of-flight spectrometer the investigation of γ-ray production cross sections of technologically important materials has been continued with the elements Cr and Ni. The excitation functions for the γ-ray production cross sections in inelastic neutron scattering have been measured at 125° from threshold to 10 MeV. The Karlsruhe cyclotron was used to produce a pulsed beam of neutrons having a continuous energy spectrum between ~ 0.5 and 30 MeV. The incident neutron energy was determined by the time of flight technique. The energy resolution ranged from 2.2 keV at 1 MeV to 70 keV at 10 MeV. Neutron flux determination was accomplished by use of a calibrated proton recoil detector. Preliminary results are shown for the γ-ray energies 1434 keV in ^{52}Cr, 1454 keV in ^{58}Ni and 1333 keV in ^{60}Ni and compared with the results of other authors.

Measurement of 24.3 keV activation cross sections with the iron filter technique, K. Rimawi and R. E. Chrien, *SP425*, pp. 920-922 (Oct. 1975).

Key words: relative ^{10}B standard; 24.3 keV neutron activation cross sections.

Using high-resolution detection techniques, intensities of specific activation lines from $^{197}Au(n,\gamma)$$^{238}U(n,\gamma)$,$^{127}I(n,\gamma)$, and $^{115}In(n,\gamma)$ {54 min + 2.2 sec} were recorded, using the BNL HFBR iron-filtered neutron beam. From a comparison with the reaction $^{10}B(n,\alpha\gamma)$, cross sections at 24.3 keV were determined.

Radiative capture gamma rays from the reaction $^{208}Pb(n,\gamma)^{209}Pb$ for 11-MeV incident neutrons, D. M. Drake, E. D. Arthur, I. Bergqvist, D. K. McDaniels, and P. Varghese, *SP425*, pp. 923-925 (Oct. 1975).

Key words: measured capture gamma rays resolution approximately 80 keV; nuclear reactions $^{208}Pb(n,\gamma)^{209}Pb$ $E_n = 11.2$ MeV.

The spectrum of gamma rays emitted by ^{209}Pb from 11-MeV neutron capture has been measured with a Ge(Li) detector. Although the statistical quality of the data is poor it seems apparent that two-particle, one-hole states, as well as single-particle states, play a prominent role in fast neutron capture in ^{208}Pb.

γ-ray spectra from $l = 1$ neutron capture near 24 keV, K. Rimawi and R. E. Chrien, *SP425*, pp. 926-928 (Oct. 1975).

Key words: $E_n = 24.3$ keV; neutron capture γ-rays; width correlations.

The characteristics of neutron capture γ-ray spectra near $E_n = 24.3$ keV are discussed. The E-1 transitions following the capture of p-wave neutrons show a marked preference for populating low-lying states with and s or d single-particle character. This preference introduces a significant correlation between partial (n,γ) cross sections and the neutron reduced widths for final states as measured in the (d,p) reaction.

Shape analysis and width correlation studies based on neutron capture data for ^{56}Fe, ^{58}Ni, ^{60}Ni and ^{61}Ni, F. H. Fröhner, *SP425*, pp. 929-933 (Oct. 1975).

Key words: nuclear reactions ^{56}Fe, $^{58,60,61}Ni(n,\gamma)$, $E = 6\text{-}150$ keV, deduced $\Gamma\gamma$, width correlations; shape analysis.

Previously reported neutron capture data were analyzed up to 150 keV for ^{56}Fe, ^{58}Ni and ^{60}Ni, and up to 30 keV for ^{61}Ni with a newly developed multilevel shape analysis code with the aim to improve and extend older area analysis results, to check whether the reported correlations between neutron and radiation widths are not produced e.g. by neglect of multilevel effects in the older self-shielding and multiple-scattering calculations and to search for channel effects such as asymmetric peak shapes.

γ-ray production cross sections for neutron inelastic scattering from Cr, Ni, ^{92}Zr, and ^{94}Zr from 3 to 6 MeV, G. Tessler and S. S. Glickstein, *SP425*, pp. 934-937 (Oct. 1975).

Key words: Cr, Ni, Zr; $E_n = 3\text{-}6$ MeV; $(n,n'\gamma)$; nuclear reactions; γ-production.

Cross sections for γ-ray production by neutron inelastic scattering from Cr, Ni, ^{92}Zr, and ^{94}Zr have been measured for incident neutrons in the energy range 3-6 MeV. The γ rays were detected with a 55 cm³ coaxial Ge(Li) anti-Compton spectrometer located at 55° to the incident neutron direction. Background associated with neutrons scattering from the samples into the Ge(Li) detector was suppressed by the pulsed beam time-of-flight technique. Assignment of γ rays to transitions from specific energy levels of the isotopes of Cr, Ni, and Zr has been made using γ-ray energies determined from this work and energies and level schemes reported in the literature. Many of the observed γ rays could not be assigned to known levels.

Scattering of neutrons by nitrogen and oxygen from 5.0 to 9.3 MeV, D. L. Bernard and M. C. Taylor, *SP425*, pp. 938-941 (Oct. 1975).

Key words: angular distributions; differential cross sections; neutron cross sections; neutron time-of-flight spectroscopy.

Angular distributions of neutrons scattered elastically and inelastically from nitrogen-14 and oxygen-16 have been measured at neutron energies of 5.04, 6.25 and 9.29 MeV. Neutron flux attenuation and multiple scattering corrections were made using a modified version of an existing computer code. Special consideration was given in the modification of the code to developing an angular resolution function to treat the effects on multiple scattering corrections due to the solid angle subtended by the scattering sample at the neutron producing target. Graphs and tabulated results are presented as center of mass differential scattering cross sections versus the cosine of the center of mass scattering angle.

Deformation effects in neutron scattering from the Sm isotopes, M. T. McEllistrem, J. Lachkar, G. Haouat, C. Lagrange, Y. Patin, R. E. Shamu, J. Sigaud, and F. Coçu, *SP425*, pp. 942-945 (Oct. 1975).

Key words: calculated $\sigma(\theta)$; measured $\sigma(\theta)$; nuclear reactions ^{146}Nd(n,n), (n,n′), ^{148,150}Sm(n,n), (n,n′), ^{152,154}Sm(n,n+n′), E = 7.0 MeV.

Deformation effects in neutron scattering from isotopically enriched Sm_2O_3 samples have been studied at an incident neutron energy of 7 MeV where a maximum of the deformation effects was observed in total cross section measurements on the same isotopes.

Differential cross sections for elastic scattering and inelastic scattering (first 2^+ state) were measured for ^{148}Sm and ^{150}Sm and for ^{146}Nd, which was included in this study to aid in separating isospin effects from deformation effects. Cross sections for the sum of elastic and inelastic scattering (first 2^+ state) were determined for ^{152}Sm and ^{154}Sm.

Experimental cross sections are compared to the results of nonspherical optical-potential coupled-channel calculations.

Small-angle scattering of fast neutrons, W. Bucher, C. E. Hollandsworth, and J. E. Youngblood, *SP425*, pp. 946-949 (Oct. 1975).

Key words: fast neutrons; Pb; scattering; small angles; U.

By the application of a new technique, absolute cross sections for the small-angle elastic scattering of neutrons by U have been accurately determined at various energies in the range 7-14-MeV. The data show less strong forward-peaking at small angles than previously reported results. In addition, measurements of the small-angle scattering by Pb were also carried out over the same energy range; and the results, while in conflict with some previous reported measurements, are, apart from normalization, in excellent agreement with optical model calculations based on the energy independent, nonlocal potential of Perey and Buck.

Elastic and inelastic differential neutron scattering cross sections for ^{238}U from 0.9-2.7 MeV, J. J. Egan, G. H. R. Kegel, G. P. Couchell, A. Mittler, B. K. Barnes, W. A. Schier, D. J. Pullen, P. Harihar, T. V. Marcella, N. B. Sullivan, E. Sheldon, and A. Prince, *SP425*, pp. 950-952 (Oct. 1975).

Key words: compared with calculated excitation functions; measured $\sigma(E_n, 90°)$ for ground, 45, 148 keV states; nuclear reactions ^{238}U(n,n), (n,n′), E = 0.9-2.7 MeV; time-of-flight.

Differential cross sections have been measured via the time-of-flight method for neutrons scattered at 90° from the ground and first two excited states, at 45 and 148 keV, of ^{238}U in the bombarding energy range 0.9 to 2.7 MeV. The ^{7}Li(p,n)^{7}Be reaction was the neutron source. The LTI 5.5 MeV Van de Graaff accelerator in conjunction with a Mobley bunching system generated proton pulses with durations as short as 320 picoseconds (fwhm). The excellent timing characteristics of this system enabled the three states in ^{238}U to be resolved up to 2.7 MeV. Above 1.5 MeV the present results for the 2^+ state at 45 keV are 2 to 2.5 times larger than the ENDF/IV cross sections. However, the present results are in good agreement with theoretical calculations which incorporate both direct interaction and compound nucleus contributions to the cross sections.

Absolute measurements of neutron radiative capture cross sections for Na^{23}, Cr, Mn^{55}, Fe, Ni, Rh^{103}, Ta, U^{238} in the keV energy range, C. Le Rigoleur, A. Arnaud, and J. Taste, *SP425*, pp. 953-956 (Oct. 1975).

Key words: absolute radiative capture cross sections; keV energy range – Na^{23}, Cr, Mn^{55}, Fe, Ni, Rh^{103}, Ta, U^{238}.

The absolute measurements of several neutron radiative capture cross sections in the keV energy range are presented. The total energy weighting technique was used. Absolute neutron flux were done. Special care was given to the correction arising from the neutron sensitivity of the gamma detector.

Capture cross section of ^{197}Au between 10 keV and 500 keV, E. Fort and C. Le Rigoleur, *SP425*, pp. 957-960 (Oct. 1975).

Key words: absolute values; fluctuations; Monte Carlo calculations for corrections; total energy weighting technique; $4\pi\beta\gamma$ detector.

This reference capture cross-section has been measured by two different absolute methods: prompts γ measurements, activation method. The results obtained are in good agreement between themselves and with Poenitz's recommendation.

Self shielding factor measurements for natural iron and Na^{23} between 24 keV and 160 keV at 300 K, A. Arnaud, C. Le Rigoleur, and J. P. Marquette, *SP425*, pp. 961-963 (Oct. 1975).

Key words: Fe; multigroup capture cross section; Na^{23}; self shielding factor; 24 keV; 160 keV.

We present experimental values of the multigroup capture cross section and self shielding factor for natural iron and Na^{23} between 24 keV and 160 keV. The capture rate is measured with a shielded neutron flux $\phi = \phi_0 \exp(-n\sigma_T X)$ after transmission through a sample of iron or Na^{23}, at room temperature. The self shielding factors at the non zero dilution are obtained by analytical calculation.

SP427. **Secondary ion mass spectrometry.** Proceedings of a Workshop on Secondary Ion Mass Spectrometry and Ion Microprobe Mass Analysis, held at the National Bureau of Standards, Gaithersburg, Md., September 16-18, 1974, K. F. J. Heinrich and D. E. Newbury, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 427, 230 pages (Oct. 1975) SD Catalog No. C13.10:427.

Key words: Auger electron spectroscopy; elemental depth profiling; ion microprobe mass analysis; ion optics; local thermal equilibrium (LTE); mineral analysis; secondary ion mass spectrometry (SIMS); surface analysis.

This book is the formal report of the Workshop on Secondary Ion Mass Spectrometry (SIMS) and Ion Microprobe Mass Analysis held at the National Bureau of Standards in September 1974. Invited and contributed papers cover a range of topics in the SIMS field: design of SIMS instrumentation; factors affecting secondary ion collection; techniques of reducing secondary ion mass spectra to yield quantitative compositional information; comparisons of SIMS with Auger electron spectroscopy (AES); techniques of obtaining elemental depth profiles and the instrumental and physical factors affecting such profiles; and applications of SIMS to the study of geological samples. The papers include both tutorial reviews and detailed reports on current research in SIMS. The volume should be of interest to all workers in the SIMS and surface analysis fields. *These proceedings include the following papers (indented):*

The ion microprobe—Instrumentation and techniques, H. Liebl, *SP427*, pp. 1-31 (Oct. 1975).

Looking at the collection efficiency problem through the ion microscope optics, G. Slodzian, *SP427*, pp. 33-61 (Oct. 1975).

High mass resolution secondary ion mass spectrometry, P. Williams and C. A. Evans, Jr., *SP427*, pp. 63-68 (Oct. 1975).

A comparison of mass spectra from three ion probes, J. G. Bradley, D. Y. Jerome, and C. A. Evans, Jr., *SP427*, pp. 69-77 (Oct. 1975).

A critical discussion of the local thermal equilibrium model for the quantitative correction of sputtered ion intensities, C. A. Andersen, *SP427*, pp. 79-119 (Oct. 1975).

An outline of secondary ion emission models, J. M. Schroeer, *SP427*, pp. 121-127 (Oct. 1975).

Empirical quantitation procedures in SIMS, J. A. McHugh, *SP427*, pp. 129-134 (Oct. 1975).

Application of SIMS microanalysis techniques to trace element and isotopic studies in geochemistry and cosmochemistry, J. F. Lovering, *SP427*, pp. 135-178 (Oct. 1975).

Factors that influence an elemental depth concentration profile, J. A. McHugh, *SP427*, pp. 179-189 (Oct. 1975).

A comparison of Auger electron spectroscopy (AES) and secondary ion mass spectrometry (SIMS), J. M. Morabito, *SP427*, pp. 191-224 (Oct. 1975).

SP429. **Proceedings of the 7th Annual Conference of the National Conference of States on Building Codes and Standards**, S. A. Berry, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 429, 129 pages (Sept. 1975) SD Catalog No. C13.10:429.

Key words: ASHRAE 90-P; building codes; mobile homes; NCSBCS.

The National Conference of States on Building Codes and Standards had its formal beginning in Wisconsin in 1967. Its formation represented a response by the States to recommendations for intergovernmental reforms in the area of building codes, prepared by the Advisory Commission on Intergovernmental Relations. The formative meeting held in Wisconsin was a direct outgrowth of an earlier exploratory meeting, involving several States, called by the National Bureau of Standards. At this meeting, the States represented discussed the idea of a national organization of the States similar to the National Conference of Weights and Measures, assisted by the National Bureau of Standards, leading to a cooperative solution regarding the multiple problems in the entire building regulatory system.

The Governor of Wisconsin issued an invitation to the States to gather in Wisconsin to address the problem, to develop an organization which could effectively respond to this national need, and to consider the offer of assistance of the National Bureau of Standards. Sixteen States attended this meeting and unanimously agreed to the formation of the NCSBCS and to accept the secretariat role of the National Bureau of Standards.

The Conference is structured to develop many technical and general recommendations in the field of comprehensive building code administration and its programs explore the entire system of this important segment of governmental regulatory service.

The secretariat of the National Conference of States on Building Codes and Standards located in the Office of Building Standards and Codes Services, Center for Building Technology, National Bureau of Standards, Washington, D.C. 20234.

SP430. **Household weights and measures**, Nat. Bur. Stand. (U.S.), Spec. Publ. 430, 2 pages (Sept. 1975) SD Catalog No. C13.10:430.

Key words: consumer metric information; International System of Units; kitchen measurement units; metric system; weights and measures.

This card presents weights and measures tables most useful for household (kitchen) purposes. It also introduces metric information for consumer use.

SP436. **Detection, diagnosis, and prognosis.** Proceedings of the 22d meeting of the Mechanical Failures Prevention Group, held at Anaheim, Calif., Apr. 23-25, 1975, T. R. Shives and W. A. Willard, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 436, 366 pages (Dec. 1975) SD Catalog No. C13.10:436.

Key words: diagnostic case histories; diagnostic systems; failure detection; failure diagnosis; failure prevention; failure prognosis.

These Proceedings consist of a group of nineteen submitted papers and discussions from the 22nd meeting of the Mechanical Failures Prevention Group which was held at the Grand Hotel in Anaheim, California on April 23-25, 1975. Failure detection, diagnosis, and prognosis represent the central theme of the Proceedings. Technology and techniques, ongoing diagnostic programs, and coming requirements in the field of DD&P are discussed. In addition, several case histories are presented. *These proceedings include the following papers (indented):*

Signal analysis techniques for vibration diagnostics, D. R. Houser, *SP436*, pp. 3-15 (Dec. 1975).

A new technology for bearing performance monitoring, G. J. Philips, *SP436*, pp. 18-28 (Dec. 1975).

Bearing contact resistance as a diagnostic aid, R. L. Smith, *SP436*, pp. 31-41 (Dec. 1975).

Nondestructive tire inspection, M. J. Lourenco and L. H. Emery, *SP436*, pp. 43-75 (Dec. 1975).

Measurement of spectra in internal combustion engine cylinders, J. M. Marrs, *SP436*, pp. 78-82 (Dec. 1975).

Sonic analyzer—Case history, J. L. Frarey, *SP436*, pp. 97-102 (Dec. 1975).

Oil analysis in perspective, R. S. Miller (presented by M. Hoobchaak), *SP436*, pp. 104-112 (Dec. 1975).

Instrumentation for predictive maintenance monitoring, R. James, B. Reber, B. Baird, and W. Neal, *SP436*, pp. 114-122 (Dec. 1975).

Gas turbine engine diagnostic test results utilizing a thermodynamic analysis technique, R. L. Stenberg, *SP436*, pp. 137-149 (Dec. 1975).

Problem areas encountered in establishing a data baseline and evaluating the A-7E inflight engine condition monitoring system, A. J. Hess, *SP436*, pp. 151-161 (Dec. 1975).

Tri service oil analysis research and development program, P. B. Senholzi, *SP436*, pp. 165-181 (Dec. 1975).

Development of inspection and diagnostic equipment for motor vehicle equipment for motor vehicle inspection, G. L. Parker (presented by L. H. Emery), *SP436*, pp. 185-192 (Dec. 1975).

On vehicle mobility measurement and recording system, F. K. Chin and R. Watts, *SP436*, pp. 195-219 (Dec. 1975).

VIDEC ship propulsion system performance monitor, R. P. Wallace and W. L. McCarthy, *SP436*, pp. 221-256 (Dec. 1975).

An overview of current efforts to detect and prevent steel wheel failures, G. L. Leadley, *SP436*, pp. 261-287 (Dec. 1975).

Diagnostics for refrigerator car diesel generating sets, R. F. McKee, *SP436*, pp. 289-302 (Dec. 1975).

Using acoustic emission technology to predict structural failure, H. L. Dunegan, *SP436*, pp. 304-319 (Dec. 1975).

Applications of the shock pulse technique to helicopter diagnostics, J. A. George, T. C. Mayer, and E. F. Covill, *SP436*, pp. 321-340 (Dec. 1975).

LST 1179 diesel diagnostic system feasibility study, M. B. Peterson, J. Frarey, D. Dominy, H. Hegner, and H. C. Burnett, *SP436*, pp. 342-354 (Dec. 1975).

SP437. **National Bureau of Standards Annual Report FY 1975**, P. A. Powell and S. A. Washburn, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 437, 32 pages (Dec. 1975) SD Catalog No. C13.10:437.

Key words: annual report; computer; energy; environment; measurement; product safety; research; science; standards; technology.

This publication highlights the major achievements of the National Bureau of Standards during FY75 and describes how resources were utilized during this period. In addition, the report will contain sections featuring the Bureau's interaction with the public and private sectors and emphasizing the historical perspective in relation to the Bureau's 75th anniversary and the nation's bicentennial. This publication will serve as (1) an annual accounting of major NBS activities and (2) promotional information on NBS services and capabilities.

Sections of the report feature: increasing measurement competence, sharing measurement techniques, exploring our energy options, expanding computer utilization, preserving environmental quality, promoting better materials use, improving product safety, providing information as a resource, organization, funds and facilities, people.

3.8. APPLIED MATHEMATICS SERIES

Mathematical tables, manuals, and studies of special interest to physicists, engineers, chemists, biologists, mathematicians, computer programmers, and others engaged in scientific and technical work.

No publications issued in this series during this period.

3.9. NATIONAL STANDARD REFERENCE DATA SERIES

Provides quantitative data on the physical and chemical properties of materials, compiled from the world's literature and critically evaluated. Developed under a worldwide program coordinated by NBS. Program under the authority of National Standard Data Act (Public Law 90-396).

NSRDS-NBS3, Section 5. **Selected tables of atomic spectra. A: Atomic energy levels—Second edition. B: Multiplet tables.** N I, N II, N III, C. E. Moore, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 3, Sec. 5, 67 pages (May 1975) SD Catalog No. 13.48:3/Sec.5.

Key words: atomic energy levels, N I, N II, N III; multiplet tables, N I, N II, N III; nitrogen spectra, N I, N II, N III; spectra, N I, N II, N III; wavelengths, nitrogen spectra N I, N II, N III.

The present publication is the fifth Section of a series being prepared in response to the persistent need for a current revision of two sets of tables containing data on atomic spectra as derived from analyses of optical spectra. As in the previous sections, Part A contains the atomic energy levels and Part B the multiplet tables. The first three spectra of nitrogen, N I, N II and N III are included. The form of presentation is described in detail in the text of Section 1.

NSRDS-NBS43, Supplement. **Selected specific rates of reactions of transients from water in aqueous solution. Hydrated electron, supplemental data,** A. B. Ross, Nat. Stand. Ref. Data. Ser., Nat. Bur. Stand. (U.S.), 43, Suppl., 43 pages (June 1975) SD Catalog No. C13.48:43, Suppl.

Key words: aqueous solution; chemical kinetics; data compilation; hydrated electron; radiation chemistry; rates.

A compilation of rates of reactions of hydrated electrons with other transients and with organic and inorganic solutes in aqueous solution appeared in NSRDS-NBS43, and covered the literature up to early 1971. This supplement includes additional rates which have been published through July 1973.

NSRDS-NBS51. **Selected specific rates of reactions of transients from water in aqueous solution, II. hydrogen atom,** M. Anbar, Farhataziz, and A. B. Ross, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 51, 56 pages (May 1975) SD Catalog No. C13.48:51.

Key words: aqueous solution; chemical kinetics; data compilation; hydrogen atom; radiation chemistry; rates.

Rates of reactions of hydrogen atoms (from radiolysis of water and other sources) with organic and inorganic molecules, ions, and transients in aqueous solution have been tabulated. Directly measured rates obtained by kinetic spectroscopy or conductimetric methods, and relative rates determined by competition kinetics are included.

NSRDS-NBS53. **Crystal structure transformations in inorganic nitrites, nitrates, and carbonates,** C. N. R. Rao, B. Prakash, and M. Natarajan, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 53, 54 pages (May 1975) SD Catalog No. C13.48:53.

Key words: carbonates; crystal structure transformation; nitrates; nitrites; phase transformation; x-ray diffraction data.

A critical survey of the data describing crystal structure transformations in inorganic nitrites, nitrates, and carbonates is compiled. Data on crystallographic, thermodynamic, spectroscopic, electrical, dielectric, and other properties are given for each solid. Experimental techniques used to obtain the data are given and comments on the data are included in the tables. The literature is surveyed up to June 1973. References have been selected on the basis of their pertinence to the data cited.

NSRDS-NBS54. **The radiolysis of methanol: product yields, rate constants, and spectroscopic parameters of intermediates,** J. H. Baxendale and P. Wardman, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 54, 26 pages (Apr. 1975) SD Catalog No. C13.48:54.

Key words: chemical kinetics; data compilation; methanol; radiation chemistry; rates; review.

Product yields and primary yields in the radiolysis of methanol in the solid, liquid and vapor phase have been compiled and reviewed. Preferred values for *G* of the major products in the vapor and liquid states are listed. Rates of reactions of solvated and trapped electrons and other transient ions and radicals, and optical absorption and esr parameters for e_s^-, e_t^-, $\dot{C}H_2OH$ and $CH_3O\cdot$ are also included.

NSRDS-NBS55. **Property index to NSRDS data compilations, 1964-1972,** D. R. Lide, Jr., G. B. Sherwood, C. H. Douglass, Jr., and H. M. Weisman, Nat. Stand. Ref. Data. Ser., Nat. Bur. Stand. (U.S.), 55, 15 pages (June 1975) SD Catalog No. C13.48:55.

Key words: cumulative property index; data compilations; National Standard Reference Data System.

A property index to data contained in publications of the National Standard Reference Data System during the period 1964-1972 is presented. Data compilations published in the NSRDS-NBS series, other publication series of the National Bureau of Standards, scientific journals, and books of commercial publishers are included. When used with the cumulative property index published annually since 1972 in the *Journal of Physical and Chemical Reference Data*, this index serves as an entry to the complete output of the NSRDS program.

NSRDS-NBS56. **Crystal structure transformations in inorganic sulfates, phosphates, perchlorates, and chromates,** C. N. R. Rao and B. Prakash, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 56, 38 pages (Nov. 1975) SD Catalog No. C13.48:56.

Key words: chromates; crystal structure; crystal structure transformations; perchlorates; phase transformations; phosphates; sulfates; thermodynamic data; x-ray diffraction data.

Literature dealing with crystal structure transformations of simple inorganic sulfates, phosphates, perchlorates and chromates has been critically reviewed. Data on thermodynamic, crystallographic, spectroscopic, dielectric and other properties are given. Experimental techniques employed to obtain the data are indicated and comments on the data are made wherever necessary. All pertinent references to the published literature (up to 1974) are listed.

3.10. BUILDING SCIENCE SERIES

Disseminates technical information developed at the Bureau on building materials, components, systems, and whole structures. The series presents research results, test methods, and performance criteria related to the structural and environmental functions and the durability and safety characteristics of building elements and systems.

BSS57. **Comparison of measured and computer-predicted thermal performance of a four bedroom wood-frame townhouse,** B. A. Peavy, D. M. Burch, F. J. Powell, and C. M. Hunt, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 57, 62 pages (Apr. 1975) SD Catalog No. C13.29/2:57.

Key words: air leakage measurement; building heat transfer; computer programs; dynamic thermal performance; heat flow analysis; heating and cooling loads; temperature predictions; thermal analysis; thermostat setback; transient heat flows.

Measurements of the dynamic heat transfer in a four bedroom townhouse were made under controlled conditions in a large environmental chamber to explore the validity of a computer program developed at NBS, labelled NBSLD, for predicting heating and cooling loads and inside air temperatures. This study was supported jointly by the Department of Housing and Urban Development and the National Bureau of Standards, and is a part of a broader research program supported by both agencies to improve performance test procedures and criteria for housing.

The test house was a factory-produced four bedroom townhouse of modular design and of lightweight (wood) construction. Tests were performed with simulated outside summer, winter and fall diurnal temperature cycles. The inside temperature was maintained at about 75 °F. Also during the tests, the activities of a six-member family were simulated.

The time-varying energy requirements were measured, and these values were compared with computer predicted values. For example, the disparity between predicted and measured daily heating energy requirements averaged 3.1 percent with a maximum departure of 4.9 percent for five tests. The computer program NBSLD was experimentally validated for predicting the peak heating and cooling loads and the energy requirements for the test house.

The air leakage of the house was measured by a tracer gas technique over a range of outdoor conditions, and algorithms were developed to account for its effect on heating loads and energy requirements.

Separate tests were also performed to investigate the energy savings achieved by night temperature setback. An 8-h 9 °F setback from 75 °F produced an 11 percent diurnal savings in energy for an average nighttime temperature of 20 °F and a 9 percent savings in energy was achieved for the same setback when the average nighttime temperature was 2 °F.

BSS60. **Hydraulic performance of a full-scale townhouse drain-waste- vent system with reduced-size vents,** M. J. Orloski and R. S. Wyly, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 60, 43 pages (Aug. 1975) SD Catalog No. C13.29/2:60.

Key words: DWV; performance testing; reduced-size vents; trap-seal retention; venting; venting criteria; vents, reduced-size.

This report describes the experimental findings of tests on a full-scale two-story plumbing system with reduced-size vents under a range of operating conditions including tests with the earlier work on full-scale systems of substantially different geometry, criteria for sizing reduced-size vents are given for general application to conventional 1-2 story housing units. In addition to the practical evidence in terms of acceptable trap performance, the current study provided fundamental evidence of the excessive present design criteria. For the first time measurements were obtained which relate traditional design criteria (air flow and vent pressure) to presently recommended performance criteria (trap-seal retention) under dynamic conditions. These findings indicate that the vents can be sized on the basis of 1.5 in water gage (equals 372 pascals) suction in the vent rather than the 1.0 in W.G. (equals 248.8 Pa) presently specified in the plumbing codes. Also air demands measured were significantly less than assumed in current practice for short stacks and for systems with vent networks.

BSS61. **Natural hazards evaluation of existing buildings,** C. G. Culver, H. S. Lew, G. C. Hart, and C. W. Pinkham, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 61, 958 pages (Jan. 1975) SD Catalog No. C13.29/2:61.

Key words: buildings; damage; disaster; dynamic analysis; earthquakes; hurricanes; natural hazards; structural engineering; tornadoes; wind.

A methodology is presented for survey and evaluation of existing buildings to determine the risk to life safety under natural hazard conditions and estimate the amount of expected damage. Damage to both structural and nonstructural building components resulting from the extreme natural environments encountered in earthquakes, hurricanes, and tornadoes is considered. The methodology has the capability of treating a large class of structural types including braced and unbraced steel frames, concrete frames with and without shear walls, bearing wall structures, and long-span roof structures. Three independent but related sets of procedures for estimating damage for each of the natural hazards are included in the methodology. The first set of procedures provides a means for qualitatively determining the damage level on the basis of data collected in field surveys of the building. The second set utilizes a structural analysis of the building to determine the damage level as a function of the behavior of critical elements. The third set is based on a computer analysis of the entire structure. All three sets of procedures are based on the current state of the art. The procedures are presented in a format which allows updating and refining. Numerical examples illustrating application of the procedures are included.

BSS63. **Analysis of current technology on electrical connections in residential branch circuit wiring,** W. J. Meese and R. L. Cilimberg, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 63, 23 pages (Mar. 1975) SD Catalog No. C13.29/2:63.

Key words: contact resistance; electrical codes; electrical connections; fire safety; house wiring; materials properties; performance testing.

In the Operation BREAKTHROUGH research and demonstration program the U.S. Department of Housing and Urban Development became concerned with the inability to properly evaluate innovative electrical connections. Long life requirements, fire safety considerations, the lack of adequate technical information, and long established conventional practices and evaluation procedures have led to slow-changing regulations concerning electrical connections used in branch circuit wiring in housing. This report discusses the present methods of evaluating electrical connections, the technical parameters involved, and innovative electrical connection developments. Innovations involving electrical connections may lead to significant advancements in housing construction if it could be demonstrated that functional and safety requirements over the expected life of the electrical connections were adequately satisfied. Research is needed to enable prediction of long term performance of electrical connections based on the results of accelerated performance tests.

BSS65. **Nonmetallic coatings for concrete reinforcing bars,** J. R. Clifton, H. F. Beeghly, and R. G. Mathey, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 65, 41 pages (Aug. 1975) SD Catalog No. C13.29/2:65.

Key words: bridge decks; chloride ions; concrete; corrosion; deicing salts; epoxy coatings; organic coatings; polyvinyl chloride coatings; steel reinforcing bars.

This work was undertaken to ascertain the feasibility of using organic coatings, especially epoxies, to protect the steel reinforcing bars embedded in concrete of bridge decks from rapid corrosion. This corrosion is caused by the chloride ions from the most commonly applied deicing salts, sodium chloride and calcium chloride. Altogether, 47 different coating materials were evaluated to some extent, consisting of 21 liquid and 15 powder epoxies; 5 polyvinyl chlorides; 3 polyurethanes; 1 polypropylene; 1 phenolic nitrile; and one zinc rich coating. The chemical and physical durabilities, chloride permeabilities, and protective qualities of coatings were assessed. The bonds between coated and uncoated bars and concrete were measured by both pullout and creep tests.

The results indicate that both epoxy and polyvinyl chloride coatings, if properly applied, should adequately protect steel reinforcing bars from corrosion. However, only the epoxy coated bars had acceptable bond and creep characteristics when embedded in concrete. The powder epoxy coatings overall performed better than the liquid epoxies, and four powder epoxy coatings have been identified as promising materials to be used on reinforcing bars embedded in concrete decks of experimental bridges.

BSS66. **Underground heat and chilled water distribution systems,** T. Kusuda, Ed., Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 66, 146 pages (May 1975) SD Catalog No. C13.29/2:66.

Key words: corrosion of underground pipes; district heating; hot and chilled water systems; insulation of underground pipes; specifications for underground systems.

This publication contains the keynote address and all the technical papers presented during the Symposium on Underground Heat and Chilled Water Distribution Systems, which was held on November 26 and 27, 1973 in Washington, D.C.

The Symposium was sponsored jointly by the National Bureau of Standards, the National Capital Chapter of the American Society of Heating, Refrigerating and Air-Conditioning Engineers, the Building Research Institute and the Association of Physical Plant Administrators.

The subject matter covered in the papers includes energy, economics, design criteria, heat transfer, corrosion protection, specification, operation, and maintenance related to underground pipes. *These proceedings include the following papers (indented):*

The energy situation and central plant, T. R. Casberg, *BSS66*, pp. 5-8 (May 1975).

Key words: central plant system; coal gasification; heat pump system; heat recovery and conservation system; nuclear fuel; on-site power generation system; petroleum problems.

Several optimistic myths regarding the energy situation in the United States are clarified by using factual data leading to an inevitable conclusion that there exists a real, rough and long lasting energy shortage.

The author stresses that the energy crisis demands engineers to forget yesterdays' data on building design practices and fuel cost, and to play an entirely new ball game that requires new thinking, a fresh approach, and a daring attitude. Several innovative approaches pertaining to central plant concept, such as on-site power generation, solar energy utilization, large scale heat pumps and energy storage are discussed.

Economic advantages of central heating and cooling systems, J. E. Mesko, *BSS66*, pp. 9-17 (May 1975).

Key words: central heating and cooling plants; cost analysis; cost comparison; economics; future trend; local building heating/cooling plants, Southeast Federal Area, Washington, D.C.

Economic comparisons between central and local building heating and cooling plants have been prepared and analyzed. Inherent and basic economic advantages in the distribution of heat and cooling from a single central district plant, over those practically attainable from individual local building plants, are analyzed and presented graphically. Factors contributing to the economic advantages of central plants are described.

The cost comparison performed for a 30-year future time period for the Southeast Federal Area of Washington, D.C., indicates that by year 2000 it will cost 15 to 20 percent less annually to own and operate a properly selected and phased central plant system than the optimum cost local plant systems.

Heat transfer studies of underground chilled water and heat distribution systems, T. Kusuda, *BSS66*, pp. 18-41 (May 1975).

Key words: chilled water pipe; earth temperature; heat transfer; multiple pipe system; underground pipe.

Heat transfer theory of underground pipe systems which include systems of more than one pipe at different temperatures buried in the same trench is summarized in this paper. Experimental observation made on a two-pipe chilled water system connecting the Pentagon and another Federal Office Building (FOB2) in Washington, D.C., was used to verify the theoretical analysis. In addition, the paper presents a concept of using integrated 10 ft average temperatures I10ET of selected earth temperature stations in the United States for design calculations.

The I10ET's could be used for selecting the pipe insulation in lieu of the ground water temperatures on certain average temperatures, which are currently being used.

Design criteria of underground heat and chilled water distribution systems for corrosion protection, J. H. Fitzgerald, III, and K. J. Moody, *BSS66*, pp. 42-51 (May 1975).

Key words: anodes; cathodic protection; coatings; corrosion; deterioration; inhibitors; materials selection; nonmetallics; rectifiers; water treatment.

Corrosion failures occur in all types of heat and chilled water distribution systems unless precautions are taken. Failures are expensive and cause shutdowns, hazardous conditions, occasional catastrophies and inconvenience to involved personnel and the general public. Corrosion leaks cause wetting of thermal insulation, resulting in thermal losses. For new construction, a corrosion survey should be made to determine best course of action, materials to use and the precautions needed to achieve the desired life of the piping. Cathodic protection is necessary for steel conduit or direct burial piping. Protection is also needed for steel pipe in insulative backfills. Mini-tunnels need to be kept dry or protection used. Internal corrosion is controlled with inhibitors. Nonmetallic materials and various means of construction should be considered to establish the best long-term approach. For existing systems, a survey should be made to determine if protection, repairs or replacement is the best course. Several case histories illustrate typical corrosion problems.

Available types of underground heat distribution systems, H. A. Borger, *BSS66*, pp. 52-59 (May 1975).

Key words: heat distribution; heating; high temperature water; hot water; insulation; piping; steam; underground piping.

This paper briefly discusses the main features and characteristics of various types of currently-available underground heat distribution system, including concrete trenches, clay tile conduits, pressure testable steel conduits, sectionalized conduits, insulating envelopes, and sealed insulation systems.

Design criteria for auxiliary equipment for underground heating and cooling distribution systems, R. O. Couch, *BSS66*, pp. 60-72 (May 1975).

Key words: accesses; ball joints; concrete manholes; expansion joints; expansion loops; o-ring gaskets; prefabricated manholes; restrained piping.

Manholes are an important and necessary part of any distribution system. They may be made of concrete or prefabricated steel. Design considerations must be given to sizing, accesses, ventilation, sumps, and miscellaneous equipment. Expansion provisions must also be provided for piping in distribution systems by using natural piping flexibility, expansion joints, ball joints, or gasketed couplings on the pipe.

Federal agency specification for underground heat distribution systems, L. V. Irvin, Jr., *BSS66*, pp. 73-77 (May 1975).

Key words: ASTM; criteria; Federal Construction Council; interagency; prequalification; system performance; tri-service; underground heat distribution.

Past and present efforts of the Federal Construction Council (FCC) Task Group on Underground Heat Distribution Systems are reviewed. It is pointed out that the present FCC criteria, properly implemented by Inter-Agency performance specifications, have been very successful in reducing the number of system failures. It is also noted that these criteria are too inflexible, and have resulted in the use of unnecessarily expensive systems in some areas and prevented the acceptance of promising new concepts. The FCC criteria are now being updated and are expected to be made available in early 1974. General provisions of the proposed criteria, activities in other areas such as ASTM, which will affect Agency Specifications, and plans for revising the present specifications are discussed.

Specifications for an underground heated and chilled water system for private sector contracts, G. S. Campbell, *BSS66*, pp. 78-87 (May 1975).

Key words: cascade heater; insulated underground piping; insulation; limitation of liability; "or equal" specifications; performance specifications; schematic diagrams; specifications; specification writer.

Based on 30 years experience in Consulting Engineering, an over-view is given of the technical specifications required (1) to show the designers' intent, (2) to set out clearly the material and equipment required under the proposed contract, and (3) to establish the construction methods which will be required for certain operations. The necessary capabilities of a specification writer are suggested. The true scope of a complete specification is outlined and a workable format is given. The impossibility of following the "3 names and catalogue numbers" approach is shown. A comment as to the practicality of the performance specification is given. Certain design considerations underlying an underground heated and chilled water system are enumerated. The need for accurate site utility information is emphasized. The need for accurate delineation of contract limits in the Contract Documents is shown. The typical equipment in the Central Energy Plant serving an underground system is enumerated. The various types of piping materials and their applications are discussed. Particular attention is given: cascade heaters, pumps, and insulated underground piping. The problems of protecting insulation are explored. Several thoughts on unexpected design and installation problems are given. The need for Limitation of Designer Liability is explained. Finally, a method is suggested to obtain maximum competition at minimum contract cost.

Fiberglass reinforced plastic pipe in underground condensate return service, H. O. Andersen, *BSS66*, pp. 88–101 (May 1975).

Key words: condensate return; epoxy; fiberglass reinforced plastic; filament-wound; insulated; molded; morpholine; prefabricated steel conduit; Qualified Products List; tieline.

In 1967 approximately 3,700 lineal feet of uninsulated fiberglass reinforced plastic (FRP) pipe was installed for condensate return service in a steel conduit with an insulated steam line at the Naval Weapons Center, China Lake, California. The FRP fittings failed. Factors contributing to the failures were: (1) improper supports for the FRP line which prevented free movement; and, (2) the FRP elbows installed had a lower pressure rating than specified. The testing procedure followed to evaluate the product of another FRP pipe manufacturer and measures taken to provide a successful condensate return system are discussed.

Inter-building heat energy distribution systems: growth, operation and maintenance experience, W. L. Viar, *BSS66*, pp. 102–115 (May 1975).

Key words: anchor; controls; corrosion; gorwth; metering; modern; museum; primary; reliability; renovation; secondary; system; variable.

District heating concepts are used in heat energy supply to the vast majority of buildings at the University of Virginia. Building ages and construction methods range from 1825 to the present. A number of buildings are too distant from the central heating plant, and are heated by their respective small fired-furnace circulating water systems. Services distributed underground from the central plant include multi-pressure steam lines, medium temperature hot water and domestic hot water. Demands have increased severely on all systems, particularly since 1952. During the period 1965–75 University building space will have been increased by about 112 percent; not all new loads will be placed on central heating facilities. Growth, renovation and upgrading effects on operation and maintenance of heat generating and distributing equipment and personnel have been encumbering at times. Proper planning, scheduling, design and construction followed by satisfactory performance of equipment, systems and personnel have been combined to achieve adequate winter conditioning for this institution, with continuity. Summer air conditioning is relatively new here. Refrigeration units are scattered, vary from one-half to 1,000 tons capacity, have been added in less than systematic fashion, to be generous. There is no inter-building distribution of chilled liquids to date. It is envisioned that central heating and central cooling concepts will ultimately be blended here for most efficient utilization and rejection of heat energy in the pursuit of controlled environment.

Cathodic protection can be an effective means for preventing corrosion on underground metallic structures, R. C. Young, *BSS66*, pp. 116–119 (May 1975).

Key words: cathodic protection; insulating joints; nonconducting coating; sacrificial anodes; soil resistivity.

Cathodic protection can effectively prevent electrochemical corrosion on underground metallic piping and other structures for as long as the use of the piping is required. However, the system must be designed to suit the soil environment, and physical makeup of the structure by someone fully experienced in such work. Thorough inspection must be maintained during installation to assure that the system is properly installed as verified by a completion check by a knowledgeable person. Included in the final report should be a maintenance program to monitor the cathodic protection system preferably one that can be made by regular maintenance personnel. The maintenance program should be carried out fully, and any failures that occur should be remedied promptly otherwise early failure of the structure may be experienced.

Operation and maintenance of steel conduit systems, R. J. Ruschell, *BSS66*, pp. 120–121 (May 1975).

Key words: design specification; guide and installation procedures; steel conduit system.

Thousands of manhours have been devoted to preparing a "Guide Specification for Military Construction, Heat Distribution Systems Outside of Buildings". This specification has been in mandatory use since 1965 by the Department of Defense and other Federal and State agencies. The system design and installation procedures have incorporated the knowledge and experience of many of the most able mechanical engineers from government and private industry. Only minor changes have been made to the Guide Specification during the past twelve years. No guide or procedure has been issued in regard to maintaining these underground systems. Additional years of useful, economic life could be realized from a program of inspection and prompt repair procedures where indicated.

Experience with central heat distribution systems in cold regions, W. Tobiasson, *BSS66*, pp. 122–135 (May 1975).

Key words: air leakage; Arctic; central heat distribution systems; construction materials; drainage; insulation; permafrost; seasonal frost; snow drifting; utilidors; ventilation.

Buried, on-grade and elevated central heat distribution systems have been built in the cold regions of the Northern Hemisphere. Heating lines are frequently routed along with water lines, sewers and other utilities in conduits known as utilidors. In areas where the ground is permanently frozen, systems are generally designed to prevent thaw and subsidence of the supporting soil as well as prevent freezing liquids in the lines. One approach is to support the utilidor on piles. Such utilidors are often elevated several feet above the surface to minimize snow drifting problems. Elevated utilidors can be obstructions to the movement of individuals and vehicles in a community. Elevated utilidors subjected to differential heave and settlement have developed gaps through which cold air infiltrated and caused freezeups.

The bulb of thaw created around a buried conduit containing warm utilities can be a collecting point for ground water, especially in the spring. Flooding can result unless the conduit is watertight or provisions are made to redirect the ground water. Many large buried utilidors in Siberia are ventilated in the winter to annually refreeze the surrounding soil.

Provisions for winter maintenance are important features of all central heat distribution systems in cold regions.

To illustrate the above points, design and performance data are presented in this paper for several central heat distribution systems in Alaska, Canada, Greenland and Siberia.

BSS68. **Review of standards and other information on thermoplastic piping in residential plumbing,** R. S. Wyly, W. J. Parker, D. E. Rorrer, J. R. Shaver, G. C. Sherlin, and M. Tryon, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 68, 65 pages (May 1975) SD Catalog No. C13.29:2/68.

Key words: fire performance of piping; functional performance of piping; performance characteristics for piping; thermal/structural performance of piping; thermoplastic piping in plumbing.

The paper is a review of existing information on the physical characteristics of thermoplastic piping that are of particular interest in considering its potential for use in residential, aboveground plumbing. The presentation is oriented to considerations of adequacy of functional performance of plumbing systems from the user's/owner's viewpoint in contrast with the typical product-specifications oriented format reflected in current standards.

Not only are the physical characteristics emphasized that relate most directly to the determination of functional performance of installed systems, but the importance of design and installation detail in the context is discussed.

In conclusion, this review indicates the need for better use of existing knowledge as well as for some research and test development work particularly in the areas of thermal properties, response to building fires, and resistance to water hammer.

BSS70. **Windows and people: A literature survey. Psychological reaction to environments with and without windows,** B. L. Col-

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lins, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 70, 92 pages (June 1975) SD Catalog No. C13.29/2:70.

Key words: daylight; fenestration; psychological; solar glass; spaciousness; sunshine; view; windowless; windows.

An understanding of human requirements for windows in buildings can be developed through a survey of the literature on the reaction to environments with and without windows. Evaluation of the response to a variety of windowless situations reveals that although the attitudes toward a windowless space are often somewhat unfavorable, the most adverse reaction occurs in a small, restricted and essentially static environment. This suggests that one function performed by a window is the addition of a dynamic, active quality to an interior environment. Consideration of the response to the actual presence of windows indicates that another essential function of a window is the provision of a view of the external world. Although almost any view is acceptable, there is some evidence that views with a high information content are preferable. In addition, windows admit illumination, in the form of daylight and sunshine which furnish a dynamic, changing character to a room. Yet, the functions of windows extend beyond view and illumination to an enhancement of the basic character of a room, such that the mere presence of a window may cause a room to appear more spacious. Finally, the optimum size and shape of a window for fulfilling these various functions is discussed.

BSS71. **A proposed concept for determining the need for air conditioning for buildings based on building thermal response and human comfort**, J. E. Hill, T. Kusuda, S. T. Liu, and F. J. Powell, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 71, 155 pages (Aug. 1975) SD Catalog No. C13.29/2:71.

Key words: air conditioning criteria; building thermal response; comfort indices; human comfort; predicted indoor habitability index.

Determining the need for air conditioning can be based on a wide variety of factors. To date, the only criteria that have been written and can be referenced are those of several federal organizations and many are not really criteria in the true sense of the word. They are guidelines to be used in the determination of fund allocation; in other words, provisions are made to air condition federal facilities in specific geographical locations if pertinent weather characteristics of that locality meet certain requirements. This paper presents the concept that a true criteria can be established based both on weather characteristics of the locality as well as characteristics of the building or structure under consideration.

The paper gives the details of a study showing the feasibility of such a scheme. A simulation was made of two proposed residences in several geographical localities. For the simulation, actual hour-by-hour weather data was used in conjunction with a sophisticated computer program. The results revealed for the non air-conditioned spaces, the extent and duration of undesirable indoor conditions based upon generally accepted comfort indices. The concept of a new "comfort" or "discomfort" index called Predicted Indoor Habitability Index (PIHI) is introduced. The authors indicate the way in which a criterion could be established that would be in the form of tables, indicating for a given specified building and geographical locality, whether mechanical cooling should or should not be installed.

BSS72. **Fire endurance of gypsum board walls and chases containing plastic and metallic drain, waste and vent plumbing systems**, W. J. Parker, M. Paabo, J. T. Scott, D. Gross and I. A. Benjamin, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 72, 114 pages (Sept. 1975) SD Catalog No. C13.29/2:72.

Key words: ABS; DWV; fire endurance; fire spread; fire test; gases; plastic pipe plumbing; PVC; smoke.

The use of plastic pipe in plumbing systems of multiple-occupancy buildings has raised considerations regarding fire safety. To provide needed data, ten full-scale fire endurance tests were performed involving a total of 39 plumbing chase and wall assemblies containing plastic and metal drain, waste, and vent (DWV) systems typical of installations serving one or two story buildings. Two tests were conducted using plumbing chase configurations simulating kitchen sink drain systems. The PVC DWV piping in these installations did not contribute to spread of fire from one side of the construction to the other. Six fire endurance tests were conducted in which the performance of ABS, PVC, copper and iron was compared directly in kitchen sink drain systems as installed in wood-stud and gypsum-board walls. The stacks ranged from 2 inch to 4 inch in diameter and laterals from 2-1/2 inch to 4 inches. In these tests it was noted that the plumbing configuration and wall construction details, particularly the sealing of plumbing penetrations, seriously affected the fire endurance of the barrier. Satisfactory performance was achieved when certain conditions were met. In the two tests involving nominal 2 by 4 steel-stud-and-gypsum-board walls it was determined that the one-hour fire resistance rating of the wall was reduced considerably when ABS or PVC DWV was installed within it using the construction details described in this report. These details included back to back 1-1/2-in diameter laterals feeding directly into 2-in diameter stacks.

BSS74. **The buffeting of tall structures by strong winds**, E. Simiu and D. W. Lozier, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 74, 90 pages (Oct. 1975) SD Catalog No. C13.29/2:74.

Key words: accelerations; buffeting; building codes; buildings; deflections; dynamic response; gust factors; structural engineering; wind engineering; wind loads.

Certain shortcomings of current procedures for computing alongwind structural response have been shown to result in unrealistic estimates of tall building behavior under the action of strong winds. Differences between predictions of fluctuating response based on various such procedures may be as high as 200 percent. In recent years, advances in the state of the art have been made which provide a basis for significantly improved alongwind response predictions. The purpose of the present work is to present a procedure for calculating alongwind response which incorporates and utilizes these advances. The basic structural, meteorological and aerodynamic models employed are described, and expressions for the alongwind deflections and accelerations, consistent with those models, are derived. A computer program is presented for calculating the alongwind response of structures with unusual modal shapes or for which the contribution of the higher modes to the response is significant. For more common situations, a simple procedure is presented which makes use of graphs and on the basis of which rapid manual calculations of the alongwind deflections and accelerations can be performed. Numerical examples are given to illustrate the use of the computer program and of the graphs. Results of numerical calculations are used to discuss some of the approximations and errors inherent in the models employed.

BSS77. **Acoustical and thermal performance of exterior residential walls, doors and windows**, H. J. Sabine, M. B. Lacher, D. R. Flynn, and T. L. Quindry, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 77, 170 pages (Nov. 1975) SD Catalog No. C13.29/2:77.

Key words: acoustics; air infiltration; air leakage; architectural acoustics; building acoustics; doors; energy conservation; heat loss from buildings; heat transfer; sound transmission loss; thermal resistance; thermal transmittance; windows.

Laboratory tests of sound transmission loss, thermal transmittance, and rate of air leakage were conducted on full scale (9 feet high × 14 feet wide; 2.7 × 4.3 meters) specimens of typical residential exterior wall constructions, either unbroken or penetrated by a door or window. The walls were of wood frame construction with gypsum board drywall interior finish and exterior finishes of wood siding, stucco, or brick veneer. Additional acoustical tests were run on a number of individual doors and windows. A total of 109 acoustical tests and 48 thermal tests are reported. The resultant data are compared with literature data on similar constructions. Correlations developed among the several quantities measured will assist more rational design where both energy conservation and noise isolation must be considered.

BSS78. **Pre-design analysis of energy conservation options for a multi-story demonstration office building**, T. Kusuda, J. E. Hill, S. T. Liu, J. P. Barnett, and J. W. Bean, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 78, 64 pages (Nov. 1975) SD Catalog No. C13.29/2:78.

Key words: building design; building energy analysis; energy conservation options; energy design optimization; heating and cooling load calculation.

The design phase of the GSA-Manchester Building included extensive analysis of the building design and operation to determine the potential for energy conservation. Described in this report are highlights and a summary of the calculations performed during the design phase. The analysis included a study of the exterior shell, ventilation rate, lighting and occupancy levels, room temperature controls, and nighttime flushing of the building using outdoor air, on the predicted yearly energy consumption of the building.

BSS79. **Energy conservation potential of modular gas-fired boiler systems**, G. E. Kelly and D. A. Didion, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 79, 54 pages (Dec. 1975) SD Catalog No. C13.29/2:79.

Key words: boiler oversizing; efficiency vs. heating load; modular boilers; modular concept; seasonal efficiency.

The modular concept of boiler operation was examined in a laboratory test of five gas-fired, cast iron, hydronic boilers. Four of the boilers, each having an input rating of 85,000 Btu per hour, were arranged so that they could either be operated like a single boiler (i.e., all of the boilers either on or off) or as a modular installation in which the boilers are sequentially fired to match the number in operation with the heating load. The fifth boiler had an input rating of 300,000 Btu per hour and was operated as a single boiler installation. Efficiency vs. heating load curves were obtained for the single boiler installation, the four small boilers run like a single boiler and the modular installation operated with and without water flowing through the "idle" modules. These efficiency curves were then used to theoretically predict the effect of the modular concept and boiler oversizing on the seasonal efficiency of gas-fired heating plants. It was found that under certain conditions the use of a gas-fired modular boiler installation instead of a single large boiler could result in considerable energy savings.

3.11. FEDERAL INFORMATION PROCESSING STANDARDS

Publications in this series collectively constitute the Federal Information Processing Standards Register. Register serves as the official source of information in the Federal Government regarding standards issued by NBS pursuant to the Federal Property and Administrative Services Act of 1949 as amended, Public Law 89-306 (79 Stat. 1127), and as implemented by Executive Order 11717 (38 FR 12315, dated May 11, 1973) and Part 6 of Title 15 CFR (Code of Federal Regulations).

FIPS PUB 21-1. **COBOL**, M. V. Vickers, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 21-1, 5 pages (Dec. 1, 1975) SD Catalog No. C13.52:21-1.

Key words: COBOL; data processing; Federal Information Processing Standard; information interchange; information processing; programming language; software; standards conformance.

This FIPS PUB announces the adoption of the American National Standard COBOL (X3.23-1974) as the Federal Standard COBOL. This revision supersedes FIPS PUB 21 and reflects major changes and improvements to the COBOL specifications. The American National Standard defines the elements of the COBOL Programming Language and the rules for their use. The standard is used by implementors as the reference authority in developing compilers and by users for writing programs in COBOL. The primary purpose of the standard is to promote a high degree of interchangeability of programs for use on a variety of automatic data processing systems.

The COBOL language is intended for use in computer applications that emphasize the manipulation of characters, records, and files.

FIPS PUB 34. **Guide for the use of International System of Units (SI)**, R. R. Roundtree, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 34, 4 pages (1975) SD Catalog No. C13.52:34.

Key words: ADP standards; computers; data processing, Federal Information Processing Standards; metric conversion; SI units; standards.

The use of SI (International System of Units) within the United States is increasing. The Secretary of Commerce has established the policy that publications of the Department will provide dual-dimensions to the extent practicable.

The Federal Information Processing Standards (FIPS) Program in response to Public Law 89-306 (the Brooks Act) strives to improve the utilization of ADP equipment, goods and services within the Federal Government through the establishment of uniform Federal automatic data processing standards. These standards and guidelines which are published by the National Bureau of Standards as FIPS contain specifications which should be expressed as dual-dimensions. Accordingly, this guideline will be used in the preparation of all new FIPS PUBS and existing FIPS PUBS when revised.

FIPS PUB 35. **Code extension techniques in 7 or 8 bits**, J. L. Little, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 35, 4 pages (1975) SD Catalog No. C13.52:35.

Key words: American Standard Code for Information Interchange; ASCII, coded character subsets; codes; data communication, data interchange, data processing; Federal Information Processing Standards; graphic character subsets; graphic subsets; information interchange; information processing; standards; subsets.

This FIPS PUB announces the adoption of the American National Standard X3.41-1974, Code Extension Techniques for Use with the 7-Bit Coded Character Set of ASCII. This standard specifies methods of extending the 7-bit code of ASCII (FIPS 1), remaining in a 7-bit environment or increasing to an 8-bit environment, building upon the structure of ASCII to describe various means of extending the control and graphic sets of the code. It also describes techniques for constructing codes related to ASCII so as to allow application dependent usage without preventing the interchangeability of their data and describes 8-bit codes for general information interchange in which ASCII is a subset.

FIPS PUB 36. **Graphic representation of the control characters of ASCII (FIPS 1)**, J. L. Little, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 36, 4 pages (1975) SD Catalog No. C13.52:36.

Key words: American Standard Code for Information Interchange; ASCII, coded character subsets; codes; data communication, data interchange, data processing; Federal Information Processing Standards; graphic character subsets; graphic subsets; information interchange; information processing; standards; subsets.

This FIPS PUB announces the adoption of the American National Standard X3.32-1973, Graphic Representation of the Control Characters of American National Standard Code for Information Interchange. This standard specifies graphical representations for the 34 characters of ASCII (FIPS 1) for which a graphic representation is not indicated in FIPS 1. Graphical representations are given for the 32 control functions of columns 0 and 1 as well as the characters "Space" and "Delete." Two forms of graphical representations for each of the 34 characters are provided: a pictorial symbol, and a 2-letter alphanumeric code.

FIPS PUB 37. **Synchronous high speed data signaling rates between data terminal equipment and data communications equipment**, G. E. Clark, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 37, 4 pages (1975) SD Catalog No. C13.52:37.

Key words: data communication equipment; data processing terminal equipment; data transmission (high speed); Federal Information Processing Standards; synchronous signaling rates; teleprocessing; wide band.

This FIPS PUB announces the adoption of the American National Standard X3.36-1975, Synchronous High Speed Data Signaling Rates Between Data Terminal Equipment and Data Communication Equipment, and is the same as Federal Standard Number 1001. This standard specifies a series of signaling speeds for synchronous high speed serial data transfer.

FIPS PUB 41. **Computer security guidelines for implementing The Privacy Act of 1974**, T. C. Lowe, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 41, 20 pages (1975) SD Catalog No. C13.52:41.

Key words: access controls; ADP security; computer security; Federal Information Processing Standards; information management; personal data; physical security; privacy risk assessment.

This publication provides guidelines for use by Federal ADP organizations in implementing the computer security safeguards necessary for compliance with Public Law 93-579, the Privacy Act of 1974. A wide variety of technical and related procedural safeguards are described. These fall into three broad categories: Physical security, information management practices, and computer system/network security controls. As each organization processing personal data has unique characteristics, specific organizations should draw upon the material provided in order to select a well-balanced combination of safeguards which meets their particular requirements.

FIPS PUB 42. **Guidelines for benchmarking ADP systems in the competitive procurement environment,** J. F. Wood, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 42, 8 pages (Dec. 1975) SD Catalog No. C13.52:42.

Key words: benchmarking; benchmark mix demonstration; computer selection; Federal Information Processing Standard; workload representation.

This publication provides general guidelines to be used by Federal agencies as best practices of benchmark mix demonstrations for validating hardware and software performance in context with processing the users' expected actual workload. It treats selection of the benchmark mix, sanitation of the benchmark mix, planning for the benchmark mix demonstration, and conducting the benchmark mix demonstration.

FIPS PUB 43. **Aids for COBOL program conversion (FIPS PUB 21 to FIPS PUB 21-1),** M. V. Vickers, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 43, 54 pages (1975) SD Catalog No. C13.52:43.

Key words: COBOL; Federal Standard COBOL; program conversion; programming aids; programming languages.

Since COBOL is a "living" language, in the sense that it is under constant development and clarification, the Federal community which relies heavily on COBOL to satisfy their programming needs has a large degree of assurance that COBOL will continue to meet their data processing needs as future generation systems are introduced. However, along with the advantage of having more sophisticated and better COBOL tools to interact with new systems requirements, there is a short term disadvantage. As clarifications and new facilities are added, they must interact with the language specifications already standardized, and this interaction sometimes requires changes in source programs. An analysis, in the form of narrative descriptions and syntax comparisons, is provided to aid in the transitioning of COBOL programs for use with compilers developed in accordance with the 1968 COBOL Standard (FIPS PUB 21) to compilers developed in accordance with the 1974 COBOL Standard (FIPS PUB 21-1).

3.12. PRODUCT STANDARDS

Developed under procedures published by the Department of Commerce in Part 10, Title 15, of the Code of Federal Regulations. The purpose of the standards is to establish nationally recognized requirements for products, and to provide all concerned interests with a basis for common understanding of the characteristics of the products. The National Bureau of Standards administers the Voluntary Product Standards program as a supplement to the activities of the private sector standardizing organizations.

PS1-74. **Construction and industrial plywood.** *(ANS A199.1-1974)*, K. G. Newell, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 1-74, 34 pages (Mar. 1975) SD Catalog No. C13.20/2:1-74.

Key words: construction and industrial plywood; industrial plywood; plywood, construction, and industrial.

This Voluntary Product Standard covers requirements and methods of test for the wood species, veneer grading, glue bonds, panel construction and workmanship, dimensional tolerances, marking, moisture content, and packing of plywood intended for construction and industrial uses.

Also included are a glossary of trade terms and a quality certification program. Information regarding generally available sizes, methods of orderings, and reinspecting practices, is provided in the appendix.

PS61-74. **Plastic containers (jerry-cans) for petroleum products.** *(ANS MH 17.1-1974)*, K. G. Newell, Jr., Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 61-74, 6 pages (May 1975) SD Catalog No. C13.20/2:61-74.

Key words: containers for petroleum products; jerry-cans; petroleum products, containers for; plastic containers for petroleum products.

This Voluntary Product Standard covers requirements and methods of test for the material, design, and properties of plastic containers (jerry-cans) intended for use with petroleum products. Methods of identifying containers that conform to the requirements of the standard are included.

PS62-74. **Grading of diamond powder in sub-sieve sizes.** *(ANS Z300.1-1974)*, C. W. Devereux, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 62-74, 5 pages (Jan. 1975) SD Catalog No. C13.20/2:62-74.

Key words: diamond powder, grading; grading of diamond powder; powder, diamond; sizes, sub-sieve of diamond powder.

This Voluntary Product Standard covers the quality requirements of sub-sieve sizes of diamond powder and establishes the standard particle size ranges for micron sizes. It establishes size designations of the size ranges and the grading limits that are acceptable in each size range. It also gives a method of inspection to determine compliance with this standard and directions for the labeling of powder to indicate such compliance.

PS63-75. **Latex foam mattresses for hospitals.** *(ANS Z 255.1-1975)*, G. S. Chaconas, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 63-75, 8 pages (Apr. 1975) SD Catalog No. C13.20/2:63-75.

Key words: foam mattresses; hospital mattresses; latex; latex foam mattresses; latex foam for hospitals; mattresses.

The purpose of this Voluntary Product Standard is to establish nationally recognized dimensional and quality requirements for latex foam mattresses intended for use in hospitals, and to provide producers, distributors, and users with a basis for common understanding of the characteristics of this product.

3.13. TECHNICAL NOTES

Studies or reports which are complete in themselves but restrictive in their treatment of a subject. Analogous to monographs but not so comprehensive in scope or definitive in treatment of the subject area. Often serve as a vehicle for final reports of work performed at NBS under the sponsorship of other Government agencies.

TN594-10. **Optical radiation measurements: The NBS 20-, 60-, and 85-degree specular gloss scales,** J. J. Hsia, Nat. Bur. Stand. (U.S.), Tech. Note 594-10, 32 pages (July 1975) SD Catalog No. C13.46:594-10.

Key words: accuracy; appearance; error analysis; gloss; photometry; reflectance; scattering; spectrophotometry; specular gloss.

The 20-, 60-, and 85-degree specular gloss scales are established at NBS with an accuracy of about one half gloss unit. This is one of many programs of the spectrophotometry group of the Optical Radiation Section of NBS directed toward improving the accuracy and assurance of spectrophotometric measurements made throughout the scientific and industrial community.

The specular gloss scales are established through a unique technique employing polarized light flux both parallel and perpendicular to the plane of incidence. General calibration equations are derived. NBS instrumentation and measurement procedures are described. Instrument calibration and error analyses are performed. Some of the analyses can also be applied to reflectance measurements in general.

TN658. **Development of electric and magnetic near-field probes,** F. M. Greene, Nat. Bur. Stand. (U.S.), Tech. Note 658, 53 pages (Jan. 1975) SD Catalog No. C13.46:658.

Key words: electric near-field probe; electromagnetic-field hazard; field-strength measurements; magnetic near-field probe; near-field measurements; r-f hazard measurements; semiconducting transmission line.

This publication describes the development and design of small electric and magnetic near-field probes for measuring hazard-level fields up to 20,000 V/m and 100 A/m, respectively. They were originally designed to be used over the frequency range from 10 to 30 MHz, and consist of short dipole antennas and small, single-turn balanced, loop antennas to measure the electric- and magnetic-field components, respectively. The probes are intended for use by various researchers in their electromagnetic, radiation-exposure programs for determining the effects of hazard-level, nonionizing, EM fields on living tissue, electroexplosive devices, and volatile fuels.

In order to later extend the use of the probes to frequencies above 30 MHz, a detailed analysis was made of several types of measurement errors likely to be encountered. The principal errors result from a variation with frequency in: the effective length and impedance of the dipoles; and the electric-dipole response and partial resonance of the loops. Corresponding corrections are given for each type of error as a function of the operating frequency from 10 to 1000 MHz, and as a function of the physical and electrical sizes of the probes.

As a result of the analysis, the dipoles can now be used for measurements at frequencies up to 750 MHz and the loops to 75 MHz with an estimated uncertainty of 0.5 dB. Applying recommended corrections will provide a substantial further increase in the usable frequency range.

TN659. **An earth-based coordinate clock network,** N. Ashby, Nat. Bur. Stand. (U.S.), Tech. Note 659, 35 pages (Apr. 1975) SD Catalog No. C13.46:659.

Key words: clocks; coordinate time; general relativity; time.

This paper investigates some of the possible operational procedures for synchronizing clocks at fixed sites spread around on the earth's surface, to within a 1 nanosecond level of accuracy. Since a common synchronization procedure is by transport of standard clocks in commercial jet airline flights, and most of the effects we shall discuss are fractional corrections to the elapsed time, as a criterion of whether an effect is significant at the 1 nanosecond level we take for comparison purposes an elapsed time $T_c = 10$ hours. This is a typical time for an intercontinental airplane flight. Analysis of a number of effects which might affect clock synchronization is carried out within the framework of general relativity. These effects include the gravitational fields of the earth, sun, and moon, and orbital motion, rotation, and flattening of the earth. It is shown that the only significant effects are due to the gravitational field and rotation of the earth, and motion of the transported clocks. Operational procedures for construction of a synchronized coordinate clock network using light signals and transported standard clocks are discussed and compared.

TN660. **Molecular beam tube frequency biases due to distributed cavity phase variations,** S. Jarvis, Jr., Nat. Bur. Stand. (U.S.), Tech. Note 660, 43 pages (Jan. 1975) SD Catalog No. C13.46:660.

Key words: accuracy evaluation; atomic beam frequency standards; cavity phase shift.

For atomic beam frequency standards, an analysis is described for estimating the frequency bias due to distributed cavity phase difference over finite beam widths, and for estimating the resulting inaccuracy in power shift and beam reversal experiments. Calculated atomic trajectories and simplified rf-field distributions are used, as well as certain assumptions about beam tube alignment. The results are applied to one of the present NBS primary time and frequency standards and a shorter tube geometry.

One conclusion is that beam reversal experiments are not necessarily much more accurate than power shift experiments and that the use of both methods (plus the use of pulse techniques) is desirable.

TN662. **A review of precision oscillators,** H. Hellwig, Nat. Bur. Stand. (U.S.), Tech. Note 662, 24 pages (Feb. 1975) SD Catalog No. C13.46:662.

Key words: accuracy; atomic clocks; clocks; crystal oscillator; frequency standards; stability; survey of clocks.

Precision oscillators used in PTTI applications include quartz crystal, rubidium gas cell, cesium beam, and hydrogen maser oscillators. A general characterization and comparison of these devices is given including accuracy, stability, environmental sensitivity, size, weight, power consumption, availability and cost. Areas of special concern in practical applications are identified and a projection of future performance specifications is given. An attempt is made to predict physical and performance characteristics of new designs potentially available in the near future.

TN663. **Characterization of a high frequency probe assembly for integrated circuit measurements,** R. L. Jesch and C. A. Hoer, Nat. Bur. Stand. (U.S.), Tech. Note 663, 55 pages (Apr. 1975) SD Catalog No. C13.46:663.

Key words: high frequency probe assembly; integrated circuit transistors; parasitic element; S-parameters.

A detailed, applications-oriented description of a measurement technique that characterizes a high-frequency probe assembly for integrated circuit measurements is given along with the procedure that extracts the parasitic effects of the probe assembly from measurements made at the input connectors of the probe assembly. The scattering parameters of an integrated-circuit device or transistor can now be extracted and accurately determined up to 2 GHz at the wafer stage of assembly. This represents a significant advance over conventional techniques that enable only dc parameters to be measured. Measurement results using this technique are given along with the precision of values obtained as well as the nature of the measurement bias introduced by the probe assembly.

TN664. **Hydrogen-future fuel—A bibliography (with emphasis on cryogenic technology),** N. A. Olien and S. A. Schiffmacher, Nat. Bur. Stand. (U.S.), Tech. Note 664, 131 pages (Feb. 1975) SD Catalog No. C13.46:664.

Key words: cryogenic technology; data; energy fuel; hydrogen; hydrogen properties; LNG/SNG; production; safety; storage.

This NBS Technical Note is a compilation of references dealing directly and indirectly with the possible future use of hydrogen as a fuel. The references were selected using an automated information system operated by the Cryogenic Data Center. This bibliography of references emphasizes the use of cryogenic technology in the hydrogen field. Articles are indexed under 40 subject headings and an author index is included. Over 1600 references are included in this bibliography.

TN665. **A pyroelectric power meter for the measurement of low level laser radiation,** C. A. Hamilton and G. W. Day, Nat. Bur. Stand. (U.S.), Tech. Note 665, 41 pages (Feb. 1975) SD Catalog No. C13.46:665.

Key words: laser; power; pyroelectric.

A 1 cm^2 plastic (PVF_2) pyroelectric detector, developed in this laboratory, has been applied to measure low level laser power. The result is a compact instrument which has a low noise equivalent power (10^{-8} $W/Hz^{1/2}$), and fast response (1 s averaging time), and which is precise ($\sigma \sim \pm 1\%$), uniform ($\sim \pm 1\%$), and inherently free from short term drift. This note describes the fabrication of the detector, the design of the instrument, and the results of an extensive evaluation of three such instruments.

TN666. **Efflux of gaseous hydrogen or methane fuels from the interior of an automobile,** J. M. Arvidson, J. Hord, and D. B. Mann, Nat. Bur. Stand. (U.S.), Tech. Note 666, 56 pages (Mar. 1975) SD Catalog No. C13.46:666.

Key words: automobile; detection; dispersion; explosion; fire; hydrogen; leakage; methane; safety; vents.

Gasoline-powered automobiles are being converted to operate on gaseous fuels such as H_2 or CH_4. These fuels are commonly stored in containers located in the trunk of the car. Potential leakage of these gaseous fuels into the passenger compartment of the vehicle constitutes a safety threat. Definitive experiments were performed to identify the explosion hazards, establish venting criteria and obviate general safeguards for H_2 or CH_4 fueled passenger vehicles. Appropriately designed ventilation systems significantly reduce the safety hazards associated with accumulated combustible gases. Vents are recommended for all autos *converted* to burn H_2 or CH_4 and may possibly be eliminated in new cars that are *designed* for gaseous fuel operation. Combustible gas warning systems are recommended, at least in the interim, for all (converted and new-design) gaseous fueled vehicles. H_2 and CH_4 gases appear equally safe as vehicular fuels if used in properly designed vehicles.

TN667. **Upper-bound errors in far-field antenna parameters determined from planar near-field measurements. Part I: Analysis,** A. D. Yaghjian, Nat. Bur. Stand. (U.S.), Tech. Note 667, 120 pages (Oct. 1975) SD Catalog No. C13.46:667.

Key words: antennas; error analysis; far-field pattern; near-field measurements; planar scanning; plane-wave spectrum.

General expressions are derived for estimating the errors in the sum or difference far-field pattern of electrically large aperture antennas which are measured by the planar near-field scanning technique. Upper bounds are determined for the far-field errors produced by (1) the nonzero fields outside the finite scan area, (2) the inaccuracies in the positioning of the probe, (3) the distortion and nonlinearities of the instrumentation which measures the amplitude and phase of the probe output, and (4) the multiple reflections. Computational errors, uncertainties in the receiving characteristics of the probe, and errors involved with measuring the input power to the test antenna are briefly discussed.

TN668. **The use of National Bureau of Standards high frequency broadcasts for time and frequency calibrations,** N. Hironaka and C. Trembath, Nat. Bur. Stand. (U.S.), Tech. Note 668, 47 pages (May 1975) SD Catalog No. C13.46:668.

Key words: dissemination; frequency; high frequency broadcasts; standard; time.

Methods to determine time or frequency by reception of NBS high frequency radio broadcasts are discussed. Results are shown for calibration of time signals to within ± 100 microseconds and calibration of frequency offset with a resolution of better than 1 part in 10^9. These results are achieved by using a systematic approach and refined measurement technique.

TN669. **The measurement of frequency and frequency stability of precision oscillators,** D. W. Allan, Nat. Bur. Stand. (U.S.), Tech. Note 669, 31 pages (May 1975) SD Catalog No. C13.46:669.

Key words: accurate frequency measurement; accurate time measurement; frequency; frequency stability; frequency stability analysis; models of frequency stability; picosecond time difference measurements.

The specification and performance of precision oscillators is a very important topic to the owners and users of these oscillators. This paper presents at the tutorial level some convenient methods of measuring the frequencies and/or the frequency stabilities of precision oscillators—giving advantages and disadvantages of these methods.

Conducting such measurements, of course, gives additional understanding into the performance of the given pair of oscillators involved. Further it is shown that by processing the data from the frequency measurements in certain ways, one may be able to state more general characteristics of the oscillators being measured. The goal in this regard is to allow the comparisons of different manufacturers' specifications and more importantly to help assess whether these oscillators will meet the standard of performance the user may have in a particular application.

The methods employed for measuring frequency are designed for state-of-the-art oscillators, and an effort has been made to allow for fairly simple, inexpensive, and/or commonly available components to be used in the measurement systems. The method for measuring frequency stability is basically that recommended by the IEEE subcommittee on Frequency Stability of the Technical Commitee on Frequency and Time of the IEEE Group on Instrumentation & Measurement.

TN672. **Time domain automatic network analyzer for measurement of RF and microwave components,** W. L. Gans and J. R. Andrews, Nat. Bur. Stand. (U.S.), Tech. Note 672, 176 pages (Sept. 1975) SD Catalog No. C13.46:672.

Key words: attenuation; discrete Fourier transform; fast Fourier transform; insertion loss; jitter; microwave measurement; mismatch; network analyzer; noise; pulse generator; pulse measurement; sampling oscilloscope; scattering parameters; spectral analysis; time domain analysis.

This technical note describes in detail a new NBS instrument for the measurement of the scattering parameters (S_{ij}) of RF and microwave components. The instrument is the Time Domain Automatic Network Analyzer (TDANA). It utilizes time domain pulse measurements to obtain frequency domain parameters. The frequency range is dc to 18 GHz with a lower upper limit for large values of attenuation. The instrument consists of three major components: an ultra-fast pulse generator, a broadband sampling oscilloscope, and a digital minicomputer.

TN673. **Using six-port and eight-port junctions to measure active and passive circuit parameters,** C. A. Hoer, Nat. Bur. Stand. (U.S.), Tech. Note 673, 29 pages (Sept. 1975) SD Catalog No. C13.46:673.

Key words: admittance; automated precision measurements; correlator; current; impedance; microwave circuit parameters; microwave measurements; phase angle; power; ratio; reflection coefficient; reflectometer; self-calibration; six-ports; vector voltmeter; voltage.

This review paper brings together a number of old and new methods for measuring voltage, current, power, impedance, and phase angle using only amplitude type detectors. Vector voltmeters and reflectometers can be constructed to measure all of these quantities in terms of four amplitude measurements made on four arms of a six-port junction. Whereas previous uses of this type of instrument depended on precision components for accuracy, new equations switch this dependence primarily to detector linearity and only secondarily on the properties of the measuring device itself.

TN674. **Report on the 1975 survey of users of the services of Radio Stations WWV and WWVH,** J. A. Barnes and R. E. Beehler, Nat. Bur. Stand. (U.S.), Tech. Note 674, 91 pages (Oct. 1975) SD Catalog No. C13.46:674.

Key words: frequency; questionnaire; standard frequency and time broadcasts; time.

The users of the National Bureau of Standards (NBS) radio stations WWV and WWVH were surveyed by means of a questionnaire. The questionnaire was distributed to the station mailing list, published in some periodicals, and its availability was announced on the stations themselves and publicized in other periodicals. More than 12,000 completed questionnaires were returned, which revealed, among other things, that the 5, 10, and 15 MHz transmissions were the most used frequencies; 25 MHz was the least used. Of the information contained on the broadcasts, the voice time-of-day announcement was the most important, and the DUTl values the least important. In general the returns were very supportive of the services, with only two of the more than 12,000 responses advocating a complete shutdown of the broadcasts.

TN789-1. **Emergency workshop on energy conservation in buildings,** S. A. Berry, Nat. Bur. Stand. (U.S.), Tech. Note 789-1, 31 pages (July 1975) SD Catalog No. C13.46:789-1.

Key words: building codes; buildings; energy conservation; standards.

This report contains the non-technical presentations given at the National Conference of States on Building Codes and Standards/National Bureau of Standards Joint Emergency Workshop on Energy Conservation in Buildings.

Presentations included in this document are those of other Federal Agencies, States, technical societies and industry organizations.

This document is a companion document to NBS Technical Note 789, "Technical Options for Energy Conservation in Buildings."

TN850. **Gasoline and gasoline container fire incidents,** E. A. Tyrrell, Nat. Bur. Stand. (U.S.), Tech. Note 850, 34 pages (Jan. 1975) SD Catalog No. C13.46:850.

Key words: accidents; FFACTS; gasoline; gasoline containers; gasoline incidents; gasoline-related fires; ignition-causing activities; ignition sources; volatile flammable liquids; volatile flammable liquids incidents.

Gasoline was involved in 72 percent of the 645 volatile flammable liquids fire incidents found in the NBS Flammable Fabrics Accident Case and Testing System as of December 1973. These gasoline incidents, particularly those that were container-related, were studied in detail. Male victims out-numbered females approximately 5 to 1. Both males and females, ages 6-20, were injured more frequently than would have been expected if the incidents for each sex had been distributed uniformly over all age groups. Starting or tending an open fire caused ignitions most frequently and involved primarily males ages 13-45. Children were injured most from knocking over or dropping a container of gasoline close to an ignition source and playing with gasoline and an ignition source. Matches were the most frequent ignition source. Containers ranged from large gasoline cans to kitchen measuring cups, although gasoline cans were reported most often. The youngest children were involved most with some of the largest containers. The remaining victims were involved primarily with smaller, more easily managed containers. There was no indication that the gasoline containers, by themselves, contributed substantially to these incidents. The problem was one of human error—misuse or abuse of the gasoline, the container, or both.

TN854. **A system of Fortran IV computer programs for crystal structure computations,** L. W. Finger and E. Prince, Nat. Bur. Stand. (U.S.), Tech. Note 854, 133 pages (Feb. 1975) SD Catalog No. C13.46:854.

Key words: computer programs; contour plotting; constrained refinement; crystallographic calculations; Fourier section; Fourier synthesis; least squares.

This report gives detailed descriptions and instructions for use of a system of programs for crystallographic calculations, including least-squares refinement with generalized systems of constraints, calculation of bond distances and angles with errors, Fourier synthesis, plotting of contours in Fourier maps, and preparation of structure factor tables for publication.

TN855. **An experimental technique for the evaluation of thermal transient effects on piezoelectric accelerometers,** C. F. Vezzetti and P. S. Lederer, Nat. Bur. Stand. (U.S.), Tech. Note 855, 48 pages (Jan. 1975) SD Catalog No. C13.46:855.

Key words: accelerometer; performance characteristics; piezoelectric; test method; thermal radiation; thermal transient; zero shift.

A simple, inexpensive method was developed for determining the effects of thermal transients on the zero output and sensitivity of piezoelectric accelerometers. Thermal transient stimuli are generated by an incandescent lamp and can be made to heat the top or side of the test accelerometer. Fourteen commercial accelerometers were tested using this technique. Zero shifts with magnitudes as high as 640 g_n* were observed. Zero shifts up to 2 percent of full-scale resulted from one-second duration transients, and up to 7 percent of full-scale from fifteen-second transients. These results were obtained at a radiation power density of 1.8 W/cm^2. No changes of accelerometer sensitivity exceeding experimental uncertainties were noted as a result of the thermal transients used.

TN856. **Note on a vibratory phenomenon arising in transducer calibration,** R. Kraft, Nat. Bur. Stand. (U.S.), Tech. Note 856, 13 pages (Feb. 1975) SD Catalog No. C13.46:856.

Key words: boundary initial problems; measurement; pressure transducer; transducer calibration; vibration.

By making appropriate physical approximations and idealizations a theoretical explanation is found for a vibratory phenomenon observed in calibrating pressure transducers inside thin liquid filled cylinders. The theoretical explanation requires proving the equivalence of two boundary initial problems which define the vibratory phenomenon. A short, general and complete proof of this equivalence is given.

TN857. **Real-time acquisition and processing of fluorimetry data,** P. S. Shoenfeld, Nat. Bur. Stand. (U.S.), Tech. Note 857, 45 pages (June 1975) SD Catalog No. C13.46:857.

Key words: analytical chemistry; computers; data acquisition; data processing; fluorimetry; laboratory automation; real-time.

The National Bureau of Standards Analytical Chemistry Division uses a centralized computer system to automate a number of experiments. Computer software for a fluorimetry application is described in this report. The file and program structure used is quite general and can be applied to other experiments as well.

TN858. **A program for survey of fire loads and live loads in office buildings,** C. Culver and J. Kushner, Nat. Bur. Stand. (U.S.), Tech. Note 858, 229 pages (May 1975) SD Catalog No. 13.46:858.

Key words: buildings; fire loads; occupancy live loads; load surveys; structural engineering; survey techniques.

The development of a survey program for determining the fire loads and live loads in office buildings is described. Considerations involved in planning the program which is directed toward establishing the factors affecting the loads in buildings are presented. The type of data to be collected and a data collection technique which utilizes visually observed information on the characteristics of building content items to determine weight are discussed. Procedures employed to select buildings to be included in a nation-wide office building load survey being conducted by the National Bureau of Standards and a sampling plan for selecting rooms to be surveyed in these buildings are also discussed.

TN859. **Literature search: Law enforcement facilities—planning, design, construction,** R. Kapsch and J. Stroik, Eds., Nat. Bur. Stand. (U.S.), Tech. Note 859, 221 pages (Nov. 1975) SD Catalog No. C13.46:859.

Key words: architecture; bibliography; building; construction; design; law enforcement facilities.

Citations and abstracts are provided on literature concerning the planning, design, and construction of law enforcement facilities in the United States and in foreign countries. In addition, plans of 21 select law enforcement facilities are included.

TN860. **NBS reactor: Summary of activities July 1973 to June 1974,** R. S. Carter, Nat. Bur. Stand. (U.S.), Tech. Note 860, 143 pages (Apr. 1975) SD Catalog No. C13.46:860.

Key words: activation analysis; crystal structure; diffraction; isotopes; molecular dynamics; neutron; nuclear reactor; radiation; radiography.

This report summarizes all those programs which depend on the NBS reactor. It covers the period from July 1973 through June 1974. The programs range from the use of neutron beams to study the structure and dynamics of materials through nuclear physics, and neutron standards and neutron radiography to sample irradiations for activation analysis, isotope production and radiation effects studies.

TN861. **A survey for the collection of professional opinion on selected fire protection engineering topics,** G. A. Harrison and J. L. Houser, Nat. Bur. Stand. (U.S.), Tech. Note 861, 30 pages (Mar. 1975) SD Catalog No. C13.46:861.

Key words: building construction; detectors; flame spread; furnishings; interior finishes; noncombustible; smoke development; sprinklers; survey.

A questionnaire survey on selected fire protection engineering topics was sent to 422 persons from every state and major city in the United States and, also, parts of Canada. The surveyed included architects, engineers, insurance and government representatives, academics, and fire services personnel. One hundred and eighty-six questionnaires were returned, a 46.2 percent return rate. This return rate is more than double the National average on survey returns. The questionnaire covered topics such as the adequacy of the term "noncombustible" as contained in the National Fire Protection Association's National Fire Code, hazards of fire loading concepts, code regulation and enforcement, furnishings, sprinkler systems and smoke detectors. In addition to the questionnaire data, many of the surveyed took the time to write in various unsolicited comments.

Although this survey does not represent a statistical study approach, it is the best effort to date to gather and document the current professional thinking on fire protection matters. When the data permitted, obvious and significant group thought ideas and patterns are documented. The objective of this survey is to collect and document professional opinions on selected fire protection engineering topics for the purpose of determining current professional thinking, and indications of future trends of thought.

TN862. **Application of ion beam milling to the characterization of cracks in metals,** L. K. Ives, A. Harper, and A. W. Ruff, Nat. Bur. Stand. (U.S.), Tech. Note 862, 29 pages (Apr. 1975) SD Catalog No. C13.46:862.

Key words: cracks; flaws; ion beam milling; metals; microscopy; surfaces.

The technique of ion beam milling coupled with subsequent optical and scanning electron microscopy has been applied as a means of detecting and characterizing small surface intersecting cracks. Two types of cracked specimens involving different metals were studied. Various orientations of the crack plane, crack direction, and ion beam were explored. The technique is capable of increasing the sensitivity for detection of small cracks and also removing distorted surface layers and revealing the crack more accurately.

TN863. **Fatigue tests of bituminous membrane roofing specimens,** G. F. Sushinsky and R. G. Mathey, Nat. Bur. Stand. (U.S.), Tech. Note 863, 32 pages (Apr. 1975) SD Catalog No. C13.46:863.

Key words: bituminous roof membranes; fatigue testing; flexural fatigue; performance criteria; roofing; temperature effects; tensile fatigue; test methods.

Tensile and flexural fatigue tests were performed on built-up roof membrane specimens (ASTM Designation: D2523-70) fabricated from four different material systems. The tensile fatigue tests were run under cyclic load control conditions while specimens tested in flexural fatigue were run under cyclic midspan displacement control. Tests were run at ambient laboratory conditions, generally 70 ± 2 °F (21 ± 1 °C), and at 0 ± 2 °F (-18 ± 1 °C). Curves based on the experimental results are plotted relating the peak load or displacement to the median fatigue lifetimes for specimens fabricated from each material. Performance criteria for roof membranes subject to fatigue loading are recommended.

TN864. **Cost recovery in pricing and capacity decisions for automated information systems,** J. A. Dei Rossi, Nat. Bur. Stand. (U.S.), Tech. Note 864, 60 pages (Apr. 1975) SD Catalog No. C13.46:864.

Key words: automated information retrieval; cost benefit; public good; scientific and technical information; semi-public good; subsidization; total cost recovery; user charges.

This paper examines the cost-benefit implications of alternative pricing and capacity investment decisions for automated scientific and technical information retrieval systems. Two typical systems are examined and numerical examples presented. In the first system, search requests are entered on-site. The numerical examples show how setting price to maximize net social benefit precludes total cost recovery and implies subsidization. In the second hypothetical system, search requests are entered from remote access terminals. Allowance is made for random arrival rates, and distinction is made between system charges to users and other user incurred costs. With these refinements, the numerical examples show how, for certain ranges of output, total cost recovery is consistent with the maximization of net social benefit. The paper then examines the "public good" attributes of scientific and technical information retrieval systems and concludes that such systems can be viewed as "semi-public goods," since the information stored has the characteristics of a public good while access to this information has the characteristic of a private good. Based on the public good considerations and the numerical examples, the paper concludes that subsidization for the fixed costs is warranted to the extent that all reasonable alternatives which maximize net social benefit preclude total cost recovery.

TN865. **Critical electrical measurement needs and standards for modern electronic instrumentation,** P. Richman, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 865, 74 pages (May 1975) SD Catalog No. C13.46:865.

Key words: data conversion; dynamic measurements; electrical measurements; electronic instrumentation; signal conditioning; systems; time domain.

Recognizing the proliferation of sophisticated modern electronic instrumentation in the field of electrical measurements, the Electricity Division of the National Bureau of Standards recently initiated a new program in the general area of dynamic measurements and standards in support of such instrumentation. Recognizing further that the vastness and complexity of the field would require, at the earliest stages of the program, identification of the most critical problem areas, the Electricity Division held a workshop on 23 and 24 September, 1974, at the Bureau's Gaithersburg site, to assist it in ascertaining just what these areas in fact were. The basic idea of the Workshop was to bring together a broadly representative group of some twenty-five leading manufacturers and prime users, working in a free and open atmosphere, in order to have them delineate the present and future critical support needs in the field of dynamic electrical measurements for modern electronic instrumentation, with emphasis on physical standards, standardized measurement methods, new calibration and measurement assurance services, relevant data, and most important, new measurement methodologies. The overall objectives of the Workshop were generally met, and a number of significant specific programs and projects consistent with the mission of the Electricity Division were identified.

TN866. **Chemical kinetic and photochemical data for modelling atmospheric chemistry,** R. F. Hampson, Jr., and D. Garvin, Eds., Nat. Bur. Stand. (U.S.), Tech. Note 866, 118 pages (June 1975) SD Catalog No. C13.46:866.

Key words: atmospheric chemistry; chemical kinetics; data evaluation; gas phase; photoabsorption cross section; photochemistry; quantum yield; rate constant.

A table of data for gas phase chemical reactions and photochemistry of neutral species is presented. Specifically, it gives preferred values for reaction rate constants, photoabsorption cross sections, and quantum yields of primary photochemical processes and also cites recent experimental work. It is intended to provide the basic physical chemical data needed as input data for calculations modelling atmospheric chemistry. An auxiliary table of thermochemical data for the pertinent chemical species is given in the appendix.

TN867. **Relationship of garment characteristics and other variables to fire injury severity,** L. B. Buchbinder, Nat. Bur. Stand. (U.S.), Tech. Note 867, 41 pages (June 1975) SD Catalog No. C13.46:867.

Key words: accident patterns; apparel; apparel fires; burn injury; FFACTS; fire; flammable fabrics; flammable liquids; garment fires; garment parameters; injury severity; victim's activity; victim's reactions.

This final report on an in-depth study of apparel fire accident variables focuses on the physical parameters of fabrics and garments involved in apparel fires and the relationship between these parameters and injury severity. Interactions between accident variables are summarized and recommendations for remedial action and further research are included. Garments involved in apparel fire accidents were classified by degree of fit and amount of the body covered. Fires in which the garment configurations involved covered over half the body (the dress/shift and pants/top configurations) were shown to be associated with more extensive burn injuries than fires involving configurations covering smaller areas (loose tops, fitted pants, and loose pants). Degree of fit could not be shown to be directly related to injury severity. Within garment configuration classifications, age was shown to be a major determinant of injury severity, with victims over 65 years of age receiving a significantly higher percentage of severe burns than those in the 21-65 age group. In accidents involving loose tops, fitted pants, and loose pants the presence of flammable liquids in the accident sequence appeared to be the dominant factor in determining injury level. In addition, when accidents involved flammable liquids, (1) the fabrics involved tended to be heavier, (2) the fit of the garment at point of ignition was closer, and (3) the proportion of cellulosic/synthetic blend and 100 percent synthetic fabrics was higher than in accidents which did not involve flammable liquids. Because of the many human and physical variables shown to be associated with an apparel fire accident, the author suggests a broad fire prevention program which includes both product regulation and public education.

TN868. **Statistical analysis of extreme winds,** E. Simiu and J. J. Filliben, Nat. Bur. Stand. (U.S.), Tech. Note 868, 52 pages (June 1975) SD Catalog No. C13.46:868.

Key words: building codes; extreme value distributions; hurricanes; probability distribution functions; reliability; risk; statistical analysis; storms; structural engineering; wind loads; wind speeds.

With a view to assessing the validity of current probabilistic approaches to the definition of design wind speeds, a study was undertaken of extreme wind speeds based on records taken at 21 U.S. weather stations. For the purpose of analyzing extreme value data, a computer program was developed, which is described herein. The following results were obtained: (1) the assumption that a single probability distribution is universally applicable to all extreme wind data sets in a given type of climate was not confirmed, and (2) predictions of 100-year wind speeds based on overlapping 20-year sets of data taken at the same station differed between themselves by as much as 100 percent. Similar predictions for 1000-year winds differed by as much as a few hundred percent. Since wind pressures are proportional to the square of the wind speeds, errors of such magnitude are unacceptably high for structural design purposes. It is therefore suggested that while, in principle, probabilistic methods provide the most rational approach to specifying design wind speeds, it is of the utmost importance that the possible errors inherent in this approach be carefully taken into account.

TN869. **Temperature section activity summary, 1974,** J. F. Schooley, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 869, 28 pages (June 1975) SD Catalog No. C13.46:869.

Key words: annual report; calibrations; progress report; standards; temperature scale; thermometry.

This report summarizes the progress in calendar 1974 of the technical program of the temperature section of the Heat Division, Institute for Basic Standards. Separate sections of the report are devoted to the various projects, to highlights of the year's activities, and to other agency interactions.

TN870. **Sampling techniques for electric power measurement,** R. S. Turgel, Nat. Bur. Stand. (U.S.), Tech. Note 870, 35 pages (June 1975) SD Catalog No. C13.46:870.

Key words: analog-to-digital conversion; digital; electricity; electric power; measurement; sampling; simulation; wattmeter.

A system is described that determines average electric power by periodically sampling current and voltage waveforms and calculating the result from digitized values of measured instantaneous currents and voltages. System performance is modeled on a digital computer to investigate the effects of noise, harmonics and sampling time errors on the result of a simulated power measurement. With 15 bit analog-to-digital conversion and 512 measured sample points an accuracy of 0.01 percent can theoretically be obtained from dc up to 5 kHz.

TN871. **Geometrical calibration of the NBS electron scattering apparatus,** S. Penner, S. P. Fivozinsky, J. W. Lightbody, Jr., L. S. Cardman, and W. P. Trower, Nat. Bur. Stand. (U.S.), Tech. Note 871, 79 pages (June 1975) SD Catalog No. C13.46:871.

Key words: absolute cross section; beam profile; electron scattering; scattering angle; solid angle; spectrometer.

A comprehensive calibration of the geometry of the NBS electron scattering apparatus is described. A complete set of measured parameters is tabulated in this report. Combining these parameters with observed values of certain variables as described herein permits the accurate determination of the solid angle, scattering angle, and target angle for each cross section measurement made with the apparatus. The uncertainty in a cross section measurement due to the imprecision of the geometry calibrations is less than one part in 10^3.

TN872. **Computer program package for metric conversion: Reference manual,** R. K. Anderson and J. O. Harrison, Jr., Nat. Bur. Stand. (U.S.), Tech. Note 872, 145 pages (July 1975) SD Catalog No. C13.46:872.

Key words: Caterpillar Tractor Co.; computer program; documentation; engineering drawing; General Motors Corporation; metric conversion; rounding; test problem; tolerance.

The programs in this package are designed to convert dimensions and other quantities appearing on engineering drawings from metric to U.S. customary units and vice versa. They were developed by Caterpillar Tractor Co. and General Motors Corporation. In addition to the programs themselves, the package contains documentation explaining how to get the programs running on different computers and how to use them, and test problems to permit users to verify that the programs run correctly on their own computers. The Caterpillar program converts 31 different metric units to their U.S. customary equivalents. In contrast, the General Motors programs convert in both directions but work with millimetres and inches only. The General Motors programs also use rounding conventions differing somewhat from those employed in the Caterpillar program. Both the Caterpillar and the General Motors programs are written in American National Standard FORTRAN and are suitable for use on a wide range of computers with little or no modification. The Caterpillar program is operated in batch mode while the General Motors programs are interactive.

TN873. **Electro-optical deflection measuring device,** R. A. Crist, R. D. Marshall, and H. I. Laursen, Nat. Bur. Stand. (U.S.), Tech. Note 873, 24 pages (Dec. 1975) SD Catalog No. C13.46:873.

Key words: buildings; deflections; instrumentation; structural response; wind loads.

The development and testing of an electro-optical device for the direct measurement of lateral deflections of tall structures are described. The device utilizes a tracking telescope mounted on a fixed reference and a light source attached to the structure of the level for which lateral deflections are to be measured. Operating characteristics of the system are based on the results of tests carried out over a period of several months in one of the elevator shafts of a 12-story building.

TN874. **Software testing for network services,** R. B. Stillman and B. Leong-Hong, Nat. Bur. Stand. (U.S.), Tech. Note 874, 40 pages (July 1975) SD Catalog No. C13.46:874.

Key words: dynamic analysis; NBS analyzer; NBS FORTRAN test routines; networking; systematic testing; testing tools.

This report is a first step toward indentifying effective software test and measurement tools, and developing a guide for their usage network-wide. The utility of two tools, the NBS FORTRAN Test Routines and the NBS Analyzer, is studied experimentally, and indications of their role in systematic testing in a networking environment are given.

TN875. **Interlaboratory intercomparisons of radioactivity measurements using National Bureau of Standards mixed radionuclide test solutions,** B. M. Coursey, J. R. Noyce, and J.

M. R. Hutchinson, Nat. Bur. Stand. (U.S.), Tech. Note 875, 20 pages (Aug. 1975) SD Catalog No. C13.46:875.

Key words: environment; intercalibration; intercomparison; radioactivity; radionuclide; radiostrontium.

In 1973 the National Bureau of Standards (NBS) distributed three calibrated test solutions to interested laboratories. Two of these solutions each contained nine gamma-ray-emitting radionuclides that the participants were asked to identify and quantify. The third solution contained ^{89}Sr and ^{90}Sr-^{90}Y, and participants were asked to perform a quantitative radioactivity analysis of the mixture. The results reported by all of the participating laboratories are given here. Most of the activity values reported for the mixed gamma-ray-emitting solutions were within ± 20 percent of the corresponding NBS values, but less than half of the laboratories reported ^{89}Sr and ^{90}Sr-^{90}Y activity values both of which were within ± 20 percent of the NBS values.

TN876. **Exploring privacy and data security costs—A summary of a workshop,** J. L. Berg, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 876, 35 pages (Aug. 1975) SD Catalog No. C13.46:876.

Key words: computer security; data security; privacy; privacy costs; security costs.

On February 20, 1975, the ICST hosted a one-day round-table discussion on the economic aspects of privacy and data security costs. The workshop was chaired by Gary Bearden, U.S. Civil Service Commission. The participants were Walter L. Anderson, General Accounting Office; Richard A. Eberhart, Office of the Secretary, Department of Commerce; Earl P. Bassett, Jr., Vice President, 3M Company; Robert Caravella, Federal Trade Commission; Theodore Clemence, Bureau of Census; Richard L. Nolan, Harvard Business School; Stan Halper, Coopers and Lybrand; and Larry Simonette, Peat, Marwick, Mitchell and Company. The group discussed the benefits EDP managers or data base administrators might gain from the privacy requirements, the processes for identifying direct or hidden costs, and processes for allocating costs.

TN877. **A basis for standardization of user-terminal protocols for computer network access,** A. J. Neumann, Nat. Bur. Stand. (U.S.), Tech. Note 877, 29 pages (July 1975) SD Catalog No. C13.46:877.

Key words: command languages; computers; man-machine systems; networks; system commands; user protocols.

A user-terminal protocol is defined which enables a user at a terminal to access computerized information systems. The basic functions such as identification, authorization, and validation are outlined and various signals and messages making up the protocol are identified. The purpose of the paper is to establish a basis for standardization and development of a unified user protocol.

TN878. **The M40 fingerprint matcher,** J. H. Wegstein, Nat. Bur. Stand. (U.S.), Tech. Note 878, 14 pages (July 1975) SD Catalog No. C13.46:878.

Key words: computerized fingerprint identification; fingerprint; pattern recognition.

A procedure is described for automatically determining whether two fingerprint impressions were made by the same finger. The procedure uses the x and y coordinates and the individual directions of the minutiae (ridge endings and bifurcations). The identity of the two impressions is established by computing the density of clusters of points in Δx, Δy space where Δx and Δy are the differences in coordinates that are found in going from one of the fingerprint impressions to the other.

TN879. **Fire buildup in a room and the role of interior finish materials,** J. B. Fang, Nat. Bur. Stand. (U.S.), Tech. Note 879, 49 pages (June 1975) SD Catalog No. C13.46:879.

Key words: buildings; fire growth; flame spread; heat release; interior linings; material ignitability; performance criteria; room fires; smoke; wood crib.

A variety of wall and ceiling panels in a full-scale room corner have been exposed to a fire from a standardized wood crib, simulating the environment produced by the burning of a single item of furniture, to evaluate their contribution to room fire growth. A total of twenty room corner tests were performed using selected combinations of eight wood-base and gypsum board-base interior finish materials on the walls and ceiling. Gas temperatures and velocities, surface temperatures, heat fluxes, smoke densities, and concentrations of oxygen, carbon dioxide and carbon monoxide were measured. Ignition times of newsprint, cotton fabric and plywood in the lower part of the room were also recorded. The results of these full-scale tests were compared with laboratory tests of the ease of ignition, surface flame spread, heat release rate and smoke generation on the same materials. The maximum upper room gas temperature has been found to agree with the ignition of such indicators as newsprint and plywood, and to represent a measure of fire hazard in terms of potential involvement of all combustible contents or room flashover. A temperature range of 450 to 650 °C appears to be the boundary between limited and full involvement.

TN880. **The service concept applied to computer networks,** M. D. Abrams and I. W. Cotton, Nat. Bur. Stand. (U.S.), Tech. Note 880, 38 pages (Aug. 1975) SD Catalog No. C13.46:880.

Key words: computer networks; interactive computing; man-machine interaction; performance measurement; time-sharing.

The Network Measurement System (NMS) represents the implementation of a new approach to the performance measurement and evaluation of computer network systems and services. By focusing on the service delivered to network customers at their terminals, rather than on the internal mechanics of network operation, measurements can be obtained which are directly relevant to user needs and management concerns. Furthermore, the type of measurement necessary to implement this approach can be made directly, without perturbing the network system under test.

This technical note introduces the service concept and other background information necessary to understand the need for and use of the NMS. The fundamental distinction between service and internal efficiency is clarified, both in general and in the environment of computer networks. A number of different measures of service are then discussed, followed by the presentation of several models of interactive use of networks. Then, the practical aspects of gathering data and applying this information to service measurement are reviewed, leading to a presentation of the NMS as it is implemented. The note ends with a discussion of applications for the NMS.

TN881. **Critical evaluation of data in the physical sciences—A status report on the National Standard Reference Data System, April 1975,** S. A. Rossmassler, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 881, 53 pages (Sept. 1975) SD Catalog No. C13.46:881.

Key words: atomic and molecular data; chemical kinetics; colloid and surface properties; mechanical properties; nuclear data; solid state data; standard reference data; thermodynamic data, transport properties.

This is a report on the status of the National Standard Reference Data System as of April 1975. Current activities and functions of the Office of Standard Reference Data are summarized. A complete list of data evaluation projects supported by the Office of Standard Reference Data during Fiscal Year 1975 is included; this list also includes projects which received financial support during the previous fiscal year, and which are still actively involved in some aspect of data compilation and evaluation. The list of projects includes continuing data centers in the United States whose activities fall within the scope of the system, but which are not formally affiliated with it. A list of publications resulting from the Standard Reference Data program is provided.

TN882. **Criteria for the performance evaluation of data communications services for computer networks,** D. S. Grubb and I. W. Cotton, Nat. Bur. Stand. (U.S.), Tech. Note 882, 36 pages (Sept. 1975).

Key words: computer communications; computer networking; data communications; networks; performance requirements; telecommunications.

In general, when telecommunications services are used as a means of interchanging information between information processing systems, or between terminals and systems, a number of parameters determine how well that interchange is performed. This report examines the following characteristics of telecommunications services: 1. Transfer Rate; 2. Availability; 3. Reliability; 4. Accuracy; 5. Channel Establishment Time; 6. Network Delay; 7. Line Turnaround Delay; 8. Transparency; 9. Security.

These terms are all defined and their significance discussed. The effects of these factors on data communication networks are illustrated.

TN883. **Waterproofing materials for masonry,** E. J. Clark, P. G. Campbell, and G. Frohnsdorff, Nat. Bur. Stand. (U.S.), Tech. Note 883, 86 pages (Oct. 1975) SD Catalog No. C13.46:883.

Key words: accelerated weathering; durability of waterproofing materials; masonry; performance criteria; waterproofing materials; water repellent materials.

The initial effectiveness and durability characteristics of fifty-five clear masonry waterproofing materials were evaluated using laboratory tests. This report contains the results of initial performance tests including water absorption, water vapor transmission, resistance to efflorescence and change in appearance. Durability tests, including periodic measurement of water absorption after exposures to accelerated weathering and outdoor exposures, were also conducted. Based on test results, performance criteria for clear waterproofing materials were developed. In addition, recommendations for the application of waterproofing materials were formulated. Finally, the report contains a summary of a survey concerning field experiences with waterproofing and a brief theoretical discussion of water flow.

TN884. **Calibration of unrecorded low and medium density type magnetic disk pack surfaces,** N. P. Goumas, Nat. Bur. Stand. (U.S.), Tech. Note 884, 23 pages (Oct. 1975) SD Catalog No. C13.46:884.

Key words: calibration factor; computer amplitude reference; computer storage media; disk calibration; disk pack; magnetic disk; Standard Reference Surface; unrecorded disk surface.

This publication describes the design requirements and the operation of the NBS test bed that is used for calibrating unrecorded magnetic disk pack surfaces for low and medium density use. The signal level calibration is made with respect to a reference level that is derived from the NBS Standard Amplitude and Data Reference Surfaces that are held in repository at NBS. The techniques for calibrating the measurement system with the NBS repository Reference Surfaces and the calibration of candidate reference disks are described in detail.

TN885. **A technical review of the Nicaraguan building regulatory system,** R. N. Wright and I. A. Lamana, Nat. Bur. Stand. (U.S.), Tech. Note 885, 85 pages (Oct. 1975) SD Catalog No. C13.46:885.

Key words: architecture; building; building codes; building design; disaster mitigation; earthquakes; engineering; environmental hazards; housing; inspection and testing; safety.

This report on the Nicaraguan Building Regulatory System has been prepared under the auspices of the Organization of American States and the United States Agency for International Development. It presents an overview of the building regulatory system in Nicaragua; its activities in review of designs, issuance of building permits, inspection of construction, control of quality of materials, and issuance of occupancy permits. The technical bases for these activities are the building code and standards, the laboratory facilities for control of the quality of building materials, and the processes for development and application of codes and standards. Recommendations address the status and development of this system and its technical bases.

The losses in the December 23, 1972, Managua Earthquake provided dramtic evidence of the need for effective implementation of good building standards. Repetitions of these tragic losses elsewhere in Nicaragua and in a reconstructed Managua are certain unless a good building code is developed and adopted, its use and design by architects and engineers enforced by careful review of designs, and the implementation of these designs by the builders assured by inspection of construction and testing of building materials. A summary and critical review of U.S. building regulatory practices for areas with severe natural hazards is presented in Appendix B for guidance in building regulatory system planning and development. A survey of housing performance in Managua is presented in Appendix C to illustrate that earthquake resistant construction is feasible and economical for Nicaragua and other nations with comparable resources.

TN886. **Modification of fluorescent luminaires for energy conservation,** R. W. Beausoliel, W. J. Meese, and G. Yonemura, Nat. Bur. Stand. (U.S.), Tech. Note 886, 15 pages (Oct. 1975) SD Catalog No. C13.46:886.

Key words: capacitors; energy conservation; fluorescent lamp; fluorescent luminaire; lighting efficiency; power factor.

Reducing energy consumption in existing buildings by reducing the number of lamps presents technical problems when more than one fluorescent lamp operates from a single ballast. A preliminary investigation was made whereby capacitors were substituted for one fluorescent lamp in a two-lamp luminaire which operated with a single ballast. Under optimum conditions, lighting efficiency (foot-candles per watt) was nearly as high at reduced power input as it was with two lamps operating normally. No failures in lighting equipment or capacitors occurred and no fire hazards, other safety hazards or other unsatisfactory occurrences were observed. A more thorough investigation involving a number of parameters is needed to ascertain the feasibility of this modification.

TN887. **Six data base management systems: Feature analysis and user experiences,** E. Fong, J. Collica, and B. Marron, Nat. Bur. Stand. (U.S.), Tech. Note 887, 84 pages (Nov. 1975) SD Catalog No. C13.46:887.

Key words: data base applications; data base management systems; selection criteria; software features; system evaluation; system features; user experiences.

This report presents an objective overview of features of six selected data base management systems (DBMS) and Federal user experiences with these systems. Application criteria were developed in order to aid in the evaluation and selection of DBMS.

The advantages of generalized DBMS over traditional methods of software system development are discussed. The criteria for choice of the six systems' features are presented. The data reported were gathered from two sources: vendors and users. Vendor information consisted of side-by-side presentation of features of the six DBMS. User experiences reported are summarized under appropriate headings. This information is used to derive application criteria for assessing the usability and operational suitability of DBMS to a variety of data processing requirements.

The six systems reviewed are: ADABAS, IMS/VS, INQUIRE, MODEL 204, SYSTEM 2000, and TOTAL.

TN888. **Nuclear Science Education Day,** F. J. Shorten, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 888, 95 pages (Nov. 1975) SD Catalog No. C13.46:888.

Key words: biology; career; ecological; electricity; energy; environment; fusion; medicine; nuclear; power; radiation; reactor; research; utilities.

These proceedings are a collection of invited papers given at the Nuclear Science Education Day Conference held on November 29, 1973 at the National Bureau of Standards, Gaithersburg, Md. The program was sponsored jointly by the ANS (Washington Chapter) and the NBS for secondary school science teachers and outstanding science students in the Washington area. Four main topics are covered: research and development in nuclear energy applications; man, environment, and nuclear energy; nuclear science frontiers; and career opportunities in nuclear science. *These proceedings include the following papers (indented):*

Nuclear power: Everyone's involved, J. L. Liverman, *TN888,* pp. 1-12 (Nov. 1975).

Energy research and the Electric Power Research Institute, R. L. Loftness, *TN888,* pp. 13-33 (Nov. 1975).

The role of the public in the evaluation process, G. Charnoff, *TN888,* pp. 34-37 (Nov. 1975).

Assessing environmental effects, the risk and benefit concept, B. E. Leonard, *TN888,* pp. 38-45 (Nov. 1975).

Ecological monitoring techniques, B. Jensen, *TN888,* pp. 46-49 (Nov. 1975).

Radiation utilization in medicine and biology, V. P. Bond, *TN888,* pp. 50-61 (Nov. 1975).

Advanced concepts in applied nuclear science, G. A. Graves, *TN888,* pp. 62-76 (Nov. 1975).

Projected national and regional manpower needs for environmental and nuclear scientists, R. L. Murray, *TN888,* pp. 77-80 (Nov. 1975).

Educational opportunities at institutions of higher learning, D. Duffy, *TN888,* pp. 81-84 (Nov. 1975).

TN890. **Productivity measurement in R&D: Productivity measurement experiment (PROMEX) in selected research and development programs at the National Bureau of Standards,** J. T. Hall and R. A. Dixon, Nat. Bur. Stand. (U.S.), Tech. Note 890, 52 pages (Dec. 1975) SD Catalog No. C13.46:890.

Key words: impact; objectives, output; performance measurement; production indices; production measurement.

This report describes an experiment in productivity measurement conducted at the National Bureau of Standards. The experiment concludes that no matter how sophisticated the analysis and synthesis processes become, statistical counts of output media (e.g., publications, citations, invited talks) will not serve as reliable measures of R&D productivity.

The conduct of the experiment included a work sampling study, a communications study, an output analysis, a value analysis approach to developing criteria for selection and evaluation of programs, construct of a rating system for evaluation of programs, and construction of a model of the R&D process.

TN892. **Retrofitting a residence for solar heating and cooling: The design and construction of the system,** J. E. Hill and T. E. Richtmyer, Nat. Bur. Stand. (U.S.), Tech. Note 892, 99 pages (Nov. 1975) SD Catalog No. C13.46:892.

Key words: retrofitted solar residence; solar collector; solar heating and cooling system; solar-powered absorption refrigeration.

During 1972 and 1973, the National Bureau of Standards conducted controlled laboratory tests on a factory-built four-bedroom house having a floor area of 110 m^2 (1200 ft^2) equipped with a conventional gas furnace and central electric air conditioner incorporated into a forced air distribution system. During 1974, the house was moved onto the NBS grounds and a solar heating and cooling system was designed to be added to the house. Calculations have been made to show that more than 75 percent of the yearly energy needs for heating, cooling, and supplying domestic hot water could be obtained from the sun.

This report deals with the design and construction of the retrofitted system. It consists of 45 m^2 (485 ft^2) of double-glazed, flat-plate solar collector, 5.7 m^3 (1500 gallons) of water storage, and a 10,000 W (3 ton) lithium bromide absorption air cooling unit.

3.14. CONSUMER INFORMATION SERIES

Practical information, based on NBS research and experience, covering areas of interest to the consumer. Easily understandable language and illustrations provide useful background knowledge for shopping in today's technological marketplace.

CIS6. **Color in our daily lives**, D. B. Judd, Nat. Bur. Stand. (U.S.), Consum. Inf. Ser. 6, 32 pages (Mar. 1975) SD Catalog No. C13.53:6.

Key words: color; environment; experimenting with; harmony; hues; illumination; light; personal uses; relationships; uses.

If you are like most consumers, color is at once a delight, a challenge, and a problem. Color is a delight because it can convert an otherwise drab costume, scene, or room into a thing of beauty. It is a challenge because it brings out our creative ability and enables us to brighten and enliven our surroundings at a comparatively cheap cost. It is a problem because, improperly used, it can fail in its purpose, and if we are unsure of the ways in which colors go together, the choice of a tie, a lipstick, a drapery fabric, or a wall paint to match furniture and carpet can become an unpleasant chore.

Because of the importance of color in our daily lives, and the widespread lack of knowledge about the relationship of colors, we are pleased to bring you this extraordinary booklet as a part of our Consumer Information Series. It has been written in simple language, but in its scientific accuracy, and in the precise selection and printing of illustrative colors, it meets the exacting standards of a scientific treatise. Although it was designed to be of practical value to you in solving everyday color problems, we believe Color in Our Daily Lives will also become a treasured possession.

CIS8. **Making the most of your energy dollars in home heating and cooling**, M. Jacobs and S. Petersen, Nat. Bur. Stand. (U.S.), Consum. Inf. Ser. 8, 20 pages (June 1975) SD Catalog No. C13.53:8.

Key words: building economics; consumer information; energy conservation; home economics; home improvements; insulation.

This booklet is a consumer-oriented adoption of BSS64 (Retrofitting Existing Housing for Energy Conservation: An Economic Analysis) which provides basic energy conservation information of an economic nature to homeowners. It is concerned primarily with energy conservation improvements which will decrease heating and cooling costs in houses. Investment in insulation, storm windows and doors, and weatherstripping/caulking is examined with regards to different climates and different energy prices in order to determine the combination of these improvements which will provide the greatest long-run economies in space heating and cooling to the homeowner. Information of a general nature on the proper use of such improvements is outlined and further references are listed.

3.15. NBS INTERAGENCY REPORTS

A special series of interim or final reports on work performed by NBS for outside sponsors (both government and non-government). In general, initial distribution is handled by the sponsor; public distribution by the National Technical Information Service (NTIS), Springfield, Va. 22161, in paper copy or microfiche form unless otherwise stated. When ordering this series from NITS you must order it by the "COM, PB, AD, or N" number listed at the end of each entry.

NBSIR 73-145. **Study of relationships between activity, reaction, garment parameter patterns and injury severity for fire incidents involving apparel,** L. B. Buchbinder, 33 pages (Apr. 1973). Order from NTIS as COM 75-10541.

Key words: accident patterns; apparel; apparel fires; burn injury; FFACTS; fire; flammable fabrics; garment fires; garment parameters; injury severity; victim's activity; victim's reactions.

Fire accidents result from the interaction of a number of environmental, human, and physical factors, all of which may effect the severity of the burn injury. Using information gathered from case histories in the Flammable Fabrics Accident Case and Testing System, this study seeks to identify patterns in the apparel fire accident variables: (1) activity preceding the accident, (2) parameters of fabrics and garments involved, (3) reaction of victim, and (4) severity of the burn injury. It will also attempt to define the extent and nature of the relationships between these accident variables.

This interim report gives a detailed description of the methodology employed in the development and completion of the study, with emphasis on accident pattern identification and classification for apparel fire incidents. Preliminary results of the study are included which identify certain recurring patterns of activity leading to burn injuries.

NBSIR 73-177. **Comparison of the fire performance of neoprene and flame retardant polyurethane mattresses,** W. J. Parker, 46 pages (Apr. 1973). Order from NTIS as COM 75-10336.

Key words: fire retardant; fire test; heat release ignition; mattress; smoke; toxic gases.

Full scale fire tests of a neoprene and two different types of flame-retardant polyurethane mattresses were performed in a room-sized compartment at the National Bureau of Standards. The mattresses were tested in two orientations, horizontal and vertical and with two types of coverings, a fire retardant treated cotton and a high temperature nylon ticking, in addition to the bare mattress insert. In addition to the visual observations, the burning rates, ceiling temperatures, optical density of the smoke, and the toxic gas concentrations were measured. This series of tests were repeated on small mattress sections to examine the relevance of small scale tests as a means of predicting full scale behavior. The flame spread index was measured with the radiant panel (ASTM E162); and the smoke and toxic gas concentrations were measured in the NBS smoke density chamber. Measurements were also performed in the heat release rate calorimeter and the ease of ignition test apparatus.

NBSIR 73-256. **Development of reference materials for atmospheric analysis of the occupational environment: Filter samples containing toxic metals,** R. Mavrodineanu, J. R. Baldwin, and J. K. Taylor, 16 pages (Oct. 1973). Order from NTIS as COM 75-11443.

Key words: analysis of toxic materials; atmospheric analysis; industrial hygiene; reference materials.

Techniques are described that may be used to prepare filters on which are deposited prescribed amounts of heavy metals, for use as reference materials in industrial atmospheric analysis. Working solutions, prepared from pure metals and highly purified acids and water, are pipetted onto the filters held in jigs to facilitate their application. The techniques were used to prepare three sets of reference materials containing the following metals: Set 1 – Pb, Cd, Zn, Sn; Set 2 – Pb, Zn, Mn; Set 3 – Be. The amounts of each metal deposited on the filters correspond to those expected when collecting personal samples, in atmospheres when the concentrations are both below and above the TLV levels.

NBSIR 73-257. **A system for producing test atmospheres containing hydrogen cyanide,** E. P. Scheide, E. E. Hughes, and J. K. Taylor, 12 pages (Oct. 1973). Order from NTIS as COM 75-11444.

Key words: gas blending system; hydrogen cyanide; ion selective electrode; occupational safety.

A system capable of producing well-defined test atmospheres of HCN in air (or any other desired diluent) and an analytical system for the analysis of these gas mixtures is described. This system provides a means of calibration of the various analytical systems for HCN now in use. The analytical unit of the system can also be used for the determination of hydrogen cyanide in industrial atmospheres. By collecting the HCN in a sodium hydroxide solution, and measuring the cyanide content by the use of a cyanide-ion selective electrode, concentrations of HCN in air between 5 and 500 ppm were measured. This method is rapid and convenient and can easily be performed by a technician or adapted to automation.

NBSIR 73-258. **A gas dilution system for acrolein,** E. P. Scheide, E. E. Hughes, and J. K. Taylor, 11 pages (Oct. 1973). Order from NTIS as COM 75-11445.

Key words: acrolein; gas chromatography analysis; gas dilution system; occupational safety.

A system capable of producing well-defined test atmospheres of acrolein in air (or any other desired diluent) and an analytical system for the analysis of these gas mixtures is described. Using a bulk mixture of 9.0 ppm acrolein in nitrogen, and accurately blending this with a stream of clean, dry air, concentrations between 0.05 and 0.50 ppm can be produced. This system provides a means of calibration of the various analytical systems for acrolein now in use.

NBSIR 73-259. **A gas dilution system for methyl bromide,** E. P. Scheide, E. E. Hughes, and J. K. Taylor, 11 pages (Oct. 1973). Order from NTIS as COM 75-11446.

Key words: gas chromatography analysis; gas dilution system, methyl bromide; occupational safety.

A system capable of producing well-defined test atmospheres of methyl bromide in air (or any other desired diluent) and an analytical system for the analysis of these gas mixtures is described. Using a bulk mixture of 1000 ppm methyl bromide in nitrogen, and accurately blending this with a stream of clean, dry air, concentrations between 5 and 100 ppm can be produced.

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This system provides a means of calibration of the various analytical systems for methyl bromide now in use.

NBSIR 73-260. **A gas dilution system for arsine-air mixtures,** P. A. Pella, E. E. Hughes, and J. K. Taylor, 14 pages (Oct. 1973). Order from NTIS as COM 75-11440.

Key words: arsine; gas-blending; Gutzeit method; spectrophotometry.

A gas-blending system originally designed for chlorine-air mixtures was modified for producing arsine-air mixtures in the concentration range from 0.02 to 0.25 ppm. This system has been tested in order to provide accurately known concentrations of arsine-in-air for calibration of analytical monitoring devices. An analytical method has been developed for checking the concentration of arsine in the working standard and consists of the spectrophotometric measurement of an arsine-diethyldithiocarbamate complex in solution.

NBSIR 73-261. **A gas dilution system for hydrogen fluoride-air-mixtures,** P. A. Pella, E. E. Hughes, and J. K. Taylor, 23 pages (Oct. 1973). Order from NTIS as COM 75-11441.

Key words: fluoride analysis; gas-blending; HF-air mixtures; ion-specific electrode.

A gas-blending system was constructed for producing hydrogen fluoride-air mixtures in the concentration range from 1 to 20 ppm for the purpose of calibrating analytical monitoring devices. The system has been tested by measuring these HF concentrations using a fluoride ion-specific electrode.

NBSIR 73-262. **Some cutting experiments on human skin and synthetic materials,** J. R. Sorrells and R. E. Berger, 70 pages (Oct. 1973). Order from NTIS as COM 75-10370.

Key words: cut; edges, hazardous; experimental studies; human tolerances; injury; injury thresholds; inspection of edges; laceration; safety; simulation; skin; skin, cutting; synthetic materials, cutting; toys.

Human skin specimens were cut in vitro with edges of varying geometry over a normal force range of 0 to 89 newtons. Generally, at a given force, the smaller the included angle and tip radius of an edge, the deeper the resulting cut. For a given edge and skin specimen, empirical curves fitted to the data indicate that the depth of cut increases with force, and that this rate of increase diminishes exponentially. Based on the experimental data, a convention was proposed for labelling the edges as safe or hazardous.

Synthetic materials were sought which, when applied in a specific manner to the test edges, would be completely penetrated by only those edges labelled hazardous. Then such materials could be used in an inspection procedure for unknown edges. Tests were conducted on many synthetics, but only a few showed possibilities in this regard.

NBSIR 73-343. **Calibration of impulse noise generators,** G. R. Reeve, 77 pages (Oct. 1973). Order from NTIS as COM 75-10282.

Key words: impulse; impulse generator calibration; impulse noise; impulse noise generator.

This report covers work performed by the Electromagnetics Division, Institute for Basic Standards, National Bureau of Standards, on a Signal Corps contract to develop a calibration system for impulse noise generators. Various technical approaches are discussed with their respective problems. A prototype system which was constructed is presented along with some measurements of its capability. Finally another approach is suggested utilizing newer techniques and instrumentation which should come closer to achieving the desired level of performance.

NBSIR 73-415. **Noble metal constitution diagrams: Part II,** R. M. Waterstrat and R. C. Manuszewski, 170 pages (Aug. 1975). Order from NTIS as COM 75-11448.

Key words: alloy phases; constitution diagrams; noble metals; phase diagrams; phase equilibria; platinum group metals.

Six binary constitution diagrams involving the noble metals are presented. These diagrams include the V-Ru, V-Rh, Nb-Os, Nb-Pd, Nb-Pt and Ta-Pd alloy systems.

Experimental alloys were prepared from starting materials having a nominal purity of at least 99.9 percent and precautions were taken to insure that no significant contamination was introduced during alloy preparation and heat-treatment. Temperatures were measured to an accuracy within ± 20 °C.

NBSIR 74-355. **Carbon thin film thermometry,** R. S. Collier, L. L. Sparks, and T. R. Strobridge, 65 pages (Oct. 1973). Order from NTIS as N74-30195.

Key words: calibration; carbon films; low temperature; thermometry; vacuum deposition.

This is a summary of work done on NASA(Marshall Space Flight Center) purchase order H-92167A concerning Carbon Thin Film Thermometry. Optimum film deposition parameters were sought on an empirical basis for maximum stability of the films. One hundred films were fabricated for use at the Marshall Space Flight Center; 10 of these films were given a precise quasi-continuous calibration of temperature vs. resistance with 22 intervals between 5 and 80 K using primary platinum and germanium thermometers. Sensitivity curves were established and the remaining 90 films were given a three point calibration and fitted to the established sensitivity curves. Hydrogen gas-liquid discrimination set points are given for each film.

NBSIR 74-372. **Cryogenic refrigerators for shipboard forward looking infrared applications,** R. O. Voth, 75 pages (June 1974). Order from NTIS as AD-A006037.

Key words: cryogenics; infrared detector; low capacity; reliability; shipboard; 77 K refrigerator.

The Naval Ordnance Laboratory (NOL) has asked the Cryogenics Division of the National Bureau of Standards to investigate and evaluate 1) commercially available refrigerators, 2) refrigerators under development, and 3) new or novel ideas applicable to a refrigerator to cool infrared detectors in a shipboard Forward Looking Infrared (FLIR) system. Although a refrigerator has been selected for two prototype FLIR units, the study was initiated to select the most appropriate refrigerator for additional purchases of FLIR units. The FLIR requires a refrigerator capacity of approximately 2 watts at 77 K and a physical configuration allowing for an interface to the FLIR unit. Information was collected by interviewing FLIR manufacturers, surveying refrigerator manufacturers and by contacting users of similar systems. Correlation of this information with the NOL requirements is presented herein. The primary difference between airborne spaceborne refrigerators and a shipborne refrigerator is the accessibility for minor repairs on-board ship although major repairs may be deferred for extended periods of time. It is anticipated that the shipboard units will operate away from major maintenance facilities, for periods as long as 6 months, with the refrigerator operating at least half of this time. Thus, reliability and ease of maintenance are emphasized when evaluating the various systems.

NBSIR 74-379. **Completion of the program to evaluate/improve instrumentation and test methods for electroexplosive device safety qualification,** P. A. Hudson, D. G. Melquist, A. R. Ondrejka, and P. E. Werner, 37 pages (June 1974). Order from NTIS as PB247658.

Key words: electroexplosive device safety; electromagnetic compatibility; electromagnetic interference; stray energy sensor.

Qualification of weapon and missile systems for electroexplosive device (EED) safety has been a continuing problem in the military services. Quantitative measurement of stray energy in EED's has been hampered by limitations of existing sensors. This report describes a new video diode detector instrumented EED (VIDEED) which responds to both the normal pin-to-pin energy (which would heat an EED bridgewire) and to the pin-to-case voltage (which might cause EED ignition due to arcing).

Also described in this report are the amplifiers, cables, adapters and recorders which make up the rest of the measuring system. Mention is also made of the test procedures used in testing the VIDEED system.

NBSIR 74-381. **Electromagnetic attenuation properties of clay and gravel soils,** D. A. Ellerbruch, 24 pages (Aug. 1974). Order from NTIS as COM 75-10522.

Key words: attenuation; clay; gravel; measurements; microwave; skin depth.

The objective of this work was to establish the feasibility of using active microwave techniques to differentiate between the different subsurface layers in a pavement system. The electromagnetic attenuation properties of clay and gravel soils were measured as a function of moisture content and frequency. Measurements were done at frequencies in the 0.5-4.5 GHz range. Soil samples were compounded in the laboratory at approximately 10, 50 and 90 percent saturation. Sample thickness was in the range 2.5-20.3 cm. Each homogeneous sample was sealed in a polyethylene container to retain the total moisture and to maintain a constant moisture content with depth.

NBSIR 74-391. **Electromagnetic noise in Lucky Friday Mine,** W. W. Scott, J. W. Adams, W. D. Bensema, and H. Dobroski, 139 pages (Oct. 1974). Order from NTIS as COM 74-10258.

Key words: amplitude probability distribution; digital data; electromagnetic interference; electromagnetic noise; emergency communications; Fast Fourier transform; Gaussian distribution; impulsive noise; magnetic field strength; measurement instrumentation; mine noise; spectral density; time-dependent spectral density.

Measurements of the absolute value of electromagnetic noise and attenuation along a hoist rope were made in an operating hard-rock mine, Lucky Friday Mine, located near Wallace, Idaho. Spectra of electromagnetic noise generated by various pieces of equipment, spectra of specific noise signals at various depths, and noise and attenuation on the 4250 foot (1295 meter) hoist, were measured. Three techniques were used to make the measurements. First, noise was measured over the entire electromagnetic spectrum of interest for brief time periods. Data were recorded using broadband analog magnetic tape for later transformation to spectral plots. Second, noise amplitudes were recorded at several discrete frequencies for a sufficient amount of time to provide data for amplitude probability distributions. A third technique gave attenuation data through the direct measurement of field strength at various depths.

The specific measured results are given in a number of spectral plots, amplitude probability distribution plots and amplitude curves as a function of depth.

NBSIR 74-393. **Semi-annual report on materials research in support of superconducting machinery,** R. P. Reed, R. L. Durcholz, F. R. Fickett, P. J. Giarratano, J. G. Hust, M. B. Kasen, H. M. Ledbetter, R. P. Mikesell, E. R. Naimon, R. E. Schramm, L. L. Sparks, R. L. Tobler, and W. F. Weston, 283 pages (Oct. 1974). Order from NTIS as COM 75-10768.

Key words: composites; elastic properties; fracture; liquid helium; mechanical properties; structural materials; superconducting machinery; thermal conductivity.

Results of six months of study on Materials Research in Support of Superconducting Machinery (April through September, 1974) are reported to the sponsor, the Advanced Research Projects Agency of the U.S. Department of Defense. The report is divided into five sections: thermal conductivity, magnetothermal conductivity, fatigue and fracture-toughness properties, properties of advanced composites, and elastic properties. The temperature range 4 to 300 K is covered by the study. Materials studied are either being used or are candidates for use in superconducting machinery and include: aluminum alloys, composites,inconels, OFHC copper, stainless steels, and titanium alloys.

Special results of the study include: fracture-toughness and fatigue-crack growth-rate data for AISI 310, Ti-5 Al-2.5 Sn, A286 stainless steel, and Inconel 750 at 4, 76, and 300 K; initial reports of tensile testing of composites at 4 K; a second review paper on advanced-composite low-temperature behavior; magnetothermal conductivity measurements on OFHC copper and Inconel 718 indicate that, in a magnetic field, the thermal conductivity may change by 100 percent; anomalous low-temperature elastic behavior of AISI 300 series stainless-steel alloys; and thermal conductivity data for OFHC copper, Inconel 750, and Inco Low-Expansion-Alloy. These data provide considerable insight into material characteristics at extremely low temperatures, assisting in material selection and efficient design.

NBSIR 74-394. **A rack-mounted precision waveguide-below-cutoff attenuator with an absolute electronic readout,** C. C. Cook, 45 pages (Nov. 1974). Order from NTIS as COM 75-10126.

Key words: absolute (unambiguous) readout; piston; precision attenuator; sensor; waveguide-below-cutoff.

A coaxial precision waveguide-below-cutoff attenuator is described which utilizes an absolute (unambiguous) electronic digital readout of displacement in inches in addition to the usual gear-driven mechanical counter/dial readout in decibels. The attenuator is rack-mountable and has the input and output rf connectors in a fixed position. The attenuation rate for 55, 50, and 30 MHz operation is given along with a discussion of sources of errors. In addition, information is included to aid the user in making adjustments on the attenuator should it be damaged or disassembled for any reason.

NBSIR 74-395. **Bibliography of the Electromagnetics Division, June 30, 1973 to June 30, 1974,** M. L. Woolley, 26 pages (Nov. 1974). Order from NTIS as COM 75-10161.

Key words: antenna parameters; attenuation; automated measurements; EM Metrology; field strength; impedance; noise; phase; power; pulsed quantities; squids; transmission lines; waveform analysis; waveguides.

This bibliography lists the publications of the NBS Electromagnetics Division between June 30, 1973 and June 30, 1974.

NBSIR 74-398. **Provisional values for the thermodynamic functions of ethane,** R. D. Goodwin, 342 pages (June 1, 1974). Order from NTIS as COM 75-10130.

Key words: densities; enthalpies, entropies; equation of state; internal energies; isobars; isochores; isotherms; Joule-Thomson inversion; latent heats of vaporization; melting line; orthobaric densities; specific heats; speeds of sound; vapor pressures.

Thermophysical properties are tabulated at uniform temperatures over the entire range of fluid states from 90 to 600 K along isobars to 700 bar. A new, rational equation of state is employed for the first time. Thermodynamic functions in the compressed liquid at $T < T_c$ are obtained by use of specific heats $C_p(T)$ along a high pressure isobar.

NBSIR 74-449. **Fire endurance tests on walls and plumbing chases containing either metallic or nonmetallic drain waste and vent systems,** W. J. Parker, 83 pages (Nov. 1973). Order from NTIS as COM 75-10049.

Key words: ABS; cast iron; copper; drain; fire endurance; fire spread; fire test; Operation BREAKTHROUGH; plastic pipe; PVC; smoke; toxic gases; vent; waste.

Two full scale non-load bearing ASTM E-119 fire endurance tests were performed on plumbing chase and wall assemblies containing polyvinyl chloride (PVC) drain, waste, and vent (DWV) systems typical of installations serving two or more stories. For the systems tested which were typical of kitchen sink drain systems constructed and installed according to typical plans, the PVC piping did not contribute to the spread of fire through the plumbing chase to the adjoining dwelling during the test which lasted 50 minutes. A test failure not associated with the plastic piping aborted the test but there was no indication that there would have been a failure due to the piping if the test had continued for one hour.

Three full scale non-load bearing ASTM E-119 fire endurance tests were also run on walls with enclosed DWV systems of acrylonitrile butadiene styrene (ABS), PVC, copper, and iron.

Neither PVC nor ABS piping contributed to fire spread in a plumbing system consisting of 2-inch stacks and 1½-inch back-to-back laterals in a 2×3 fir-stud-and-gypsum-board wall. In one test in which the stacks and laterals were 4 inches in diameter and in another test in which the distance between wall surfaces was decreased by using 2×4 studs, the effective fire endurance rating of the wall assembly was reduced by the installation of the plastic plumbing.

This progress report on the fire endurance evaluation of five plumbing chase and wall assemblies is limited to construction assemblies in which the openings around the laterals were carefully sealed with plaster spackling. Additional tests are in progress to examine the effect of leaving the openings unsealed.

NBSIR 74-461. **The calibration of small volumetric laboratory glassware,** J. Lembeck, 34 pages (Dec. 1974). Order from NTIS as PB246623.

Key words: burets; capacity; flasks; meniscus; pipets; volumetric calibration.

This report describes a procedure for testing small volumetric apparatus. The procedure is based upon a determination of the volume of water either contained or delivered by the vessel. There are techniques described for cleaning, reading the meniscus, filling, draining and weighing the contained or delivered volume.

NBSIR 74-482. **An automated system for precision calibration of accelerometers,** B. F. Payne, 196 pages (Apr. 1974). Order from NTIS as COM 75-10147.

Key words: acceleration; automation; calibration; measurements; minicomputer; shakers; standards; transducers; vibration; vibration exciters; vibration pickups.

The report describes an automated system for accelerometer calibration under realtime control by a small, dedicated digital computer. The hardware components of the system and the software programs are given. The software automatically regulates the rate and amount of data collected based on analysis of input data. Printout of the frequency response of test accelerometers is on a teletypewriter and also can be stored on a magnetic tape. Manual operation of the system is also described.

NBSIR 74-488. **Measurements of railroad noise-line operations, yard boundaries, and retarders,** J. M. Fath, D. S. Blomquist, J. M. Heinen, and M. Tarica, 108 pages (Dec. 1974). Order from NTIS as COM 75-10088.

Key words: acoustics; noise measurement; noise (sound); railroad yard; trains.

A field investigation of noise emission from railroad operations was conducted. The objectives of the study were the establishment of a data base on the noise levels associated with railroad operations, both line (trains in transit) and yard, and the development of measurement procedures that could be utilized in regulations applicable to the noise from rail carrier equipment and facilities. For trains in transit, measurements were made as a function of horizontal distance from the tracks [five locations at 25, 50, 100, 200 and 400 feet] and as a function of microphone height [three different heights at the 25 and 50 foot microphone locations]. Train passby data are presented as the maximum A-weighted sound level observed during the passby and as Single Event Noise Exposure Levels (both A-weighted and one-third octave band levels). A-weighted sound level measurements were made at the boundary of the railyard, at 0.1 second intervals, for periods of time ranging from 1 to 23 hours over several days. These data are presented as the energy equivalent sound level and the level exceeded ten percent of the time. The directionality of retarder noise was also investigated. Measurements were made of the noise emitted in various directions during retarder operation.

NBSIR 74-501. **Development of specifications for archival record materials,** W. K. Wilson, 17 pages (May 23, 1974). Order from NTIS as COM 75-10131.

Key words: aging of paper; archival materials; natural aging; old paper; paper, aging of; paper, stability of; paper testing; stability of paper.

Effort on a long range program on the Development of Specifications for Archival Record Materials has included: (1) Reappraisal of research needs; (2) a study of 18 papers made in 1937, tested before and after dry accelerated aging in 1937, and tested again in 1973; (3) evaluation of 19 commercial papers, evaluated before and after moist accelerated aging in 1963, and tested again in 1973; and (4) development of specifications for copies from office copying machines.

A review of the literature on stability of paper and data obtained in this laboratory over the past several years indicate that a fresh approach is needed to a study of the stability of paper. The following tasks are suggested: (1) Continue to use handsheets of known composition; (2) study old papers to determine changes that probably have occurred during natural aging; (3) confine testing to methods that give some clues concerning what happens during aging such as zero span tensile, wet strength, peroxide formation, functional group content, and molecular chain length distribution; and (4) study the effect of cycling of relative humidity on the properties of paper.

NBSIR 74-514. **1973 international activities, Center for Building Technology,** C. C. Raley, 54 pages (July 1974). Order from NTIS as COM 75-10102.

Key words: cooperative programs; foreign visitors; information exchange; international building technology; international organization memberships; professional interaction.

This report summarizes the Center for Building Technology's 1973 international activities including formal cooperative programs, exchange programs, special projects, international organization memberships, foreign guests at CBT, and CBT foreign travel.

NBSIR 74-521. **HATCH—A model for fish hatchery analysis,** F. C. Johnson, 73 pages (July 8, 1974). Order from NTIS as COM 75-10187.

Key words: benefit/cost; fish hatchery analysis; fish hatchery management; fish hatchery operation; mathematical model.

The HATCH model is an automated system for analyzing the physical, biological and economic factors of fish hatchery operation and for computing optimal hatchery management policies.

NBSIR 74-522. **First interim report on salmon fishery modelling,** F. C. Johnson, 21 pages (July 8, 1974). Order from NTIS as COM 75-10080.

Key words: analysis of biological processes; economic performance; fisheries management; fisheries regulation; mathematical models; salmon fisheries model.

The salmon fishery modelling project is a joint State-Federal program for the development of improved techniques for analyzing the economic and biological effects of changes in the Pacific Coast salmon fishery regulatory parameters. This interim report covers the initial program design phase of the project.

NBSIR 74-523. **Preparations for gage block comparison measurements,** C. D. Tucker, 14 pages (July 9, 1974). Order from NTIS as COM 75-11126.

Key words: deburring; gage blocks, gage block comparator; linear variable differential transformer.

The methods described here for the cleaning and deburring of gage blocks can be useful to those individuals who have not established formal laboratory procedures for these operations. Many individuals may employ valid methods that vary somewhat from those employed at the National Bureau of Standards.

Many of the gage block comparators that are in use have not been periodically evaluated by the user. It is the intent of this report to set forth guidelines and procedures that may be used conveniently by metrologists to aid in obtaining more meaningful comparisons of gage blocks by the use of probe-type transducers.

NBSIR 74-526. **Analysis of non-reinforced masonry building response to abnormal loading and resistance to progressive collapse,** W. McGuire and E. V. Leyendecker, 67 pages (Nov. 1974). Order from NTIS as COM 75-10087.

Key words: abnormal loading; building; gas explosion; load-bearing masonry; load-bearing walls; masonry; masonry research; progressive collapse.

Five case studies of susceptibility to progressive collapse were made of non-reinforced masonry bearing wall buildings. All were assumed to comply with governing building codes. Based on the assumed failure mechanisms, analysis indicated that two of the structures had excellent resistance to progressive collapse, one was marginal, and two had little resistance to progressive collapse. Analytical approaches used are illustrated and areas of needed research are identified.

NBSIR 74-530. **Preparation of charcoal sampling tubes containing known quantities of adsorbed solvents,** B. C. Cadoff, E. E. Hughes, R. Alvarez, and J. K. Taylor, 36 pages (July 1974). Order from NTIS as COM 75-10041.

Key words: activated carbon; air sampling; gas standards; industrial hygiene.

The method in widespread use for the determination of the concentration of organic solvents in the work atmosphere consists in collection of the solvent by adsorption on activated charcoal followed by desorption with carbon disulfide and measurement by gas chromatography. This report describes techniques developed to produce reference standards for this determination and modifications in the analytical procedure to improve its precision and accuracy.

NBSIR 74-541. **An evaluation of potentially useful separator materials for nickel-cadmium (Ni-Cd) satellite batteries,** H. A. Baker, S. D. Toner, and W. F. Cuthrell, 37 pages (Oct. 1974). Order from NTIS as COM 75-10618.

Key words: battery separators; nickel-cadmium batteries; satellite batteries; separator materials.

An evaluation intended to determine the potential suitability and probable efficacy of a group of separator materials for use in nickel-cadmium (Ni-Cd) satellite batteries was carried out. These results were obtained using test procedures established in an earlier evaluation of other separator materials, some of which had also been used in experimental battery cells subjected to simulated use conditions.

The properties that appear to be most important are: high electrolyte absorptivity, good electrolyte retention, low specific resistivity, rapid wettability and low resistance to air permeation. Wicking characteristics and wet-out time seem to be more important with respect to the initial filling of the battery with the electrolyte.

While the properties of some of these materials indicate that they would be satisfactory, no specific conclusions can be drawn as to their actual effectiveness without further testing after they have been subjected to simulated use conditions in experimental cells.

NBSIR 74-542. **Economics of protection against progressive collapse,** R. E. Chapman and P. F. Colwell, 34 pages (Sept. 1974). Order from NTIS as COM 75-10081.

Key words: benefit-cost analysis; building safety; economics; progressive collapse; standards.

Public and government concern about the progressive collapse of buildings caused by abnormal loading has resulted in the development of draft standards to provide protection against progressive collapse. From society's viewpoint, standards for protection against progressive collapse should result in a level of protection which is more efficient (i.e., the net social benefits from protection should be increased). An economic model utilizing the principles of benefit-cost analysis is developed which establishes a methodology for determining the efficiency of various levels of protection against progressive collapse. An application of the model to a partial evaluation of a specific standard demonstrates some of the capabilities of the model. Recommendations are made for a complete evaluation of this standard and for the further refinement of the model.

NBSIR 74-553. **Preparation and calibration of phosphor standards,** M. L. Greenough and H. K. Hammond, III, 70 pages (Oct. 1974). Order from NTIS as COM 75-10058.

Key words: fluorescence measurement; instrumentation, luminescence measuring; luminescence measurement; phosphorescence measurement.

This project involved two activities, 1) the fabrication and calibration of phosphor standards for use in the Postal Service Model 4A8 Phosphormeter and 2) the construction of an instrument to perform the calibration function. Both of these relate to the standardization of the phosphorescent and fluorescent activity of the luminescent coatings applied to postage stamps by the Bureau of Engraving and Printing. The purpose of the luminescent coatings is to facilitate detecting the orientation of envelopes in facer-canceler machines during mail processing.

Work on the project entailed the fabrication of approximately 60 phosphor standards, which are hand-sized aluminum blocks into which stamp-sized wafers of luminescent materials are mounted. Fabrication was carried out following the specific procedures supplied by the Postal Service, with however, authority to verify or alter the process as necessary. On the other major project effort, an instrument was designed and constructed following in general the basic design of an earlier breadboard device developed under a prior project. Quantitatively in the system, evaluations are ultimately referred to calibrations at NBS of the relative irradiance of a lamp in the ultraviolet and visible regions of the spectrum.

This report, one of two covering the project activities, describes the preparation of luminescent wafers, their assembly into phosphor standards and the test procedures on completed standards. It includes a tabulation of the calibrated values of the new standards.

NBSIR 74-557. **Non-metallic antenna-support materials,** N. Halsey, D. E. Marlowe, and L. Mordfin, 45 pages (June 1974). Order from NTIS as COM 75-11439.

Key words: composite materials; fiber-reinforced-plastic rod; glass-reinforced-polyester rod; guys, antenna; processing parameters, pultrusion; pultrusion; reinforced plastic rod; stress rupture of FRP rod; test methods, FRP rod; weatherability, FRP rod.

Thirteen samples of pultruded, glass fiber-reinforced-polyester rod material were manufactured using a different combination of the manufacturing process parameters for each. These samples were tested to evaluate the effects of nine different process parameters on the properties and characteristics of the rods. Elevated-temperature stress-rupture tests under saturated humidity were used as an accelerated measure of long-term weatherability. The test results were somewhat inconsistent, but it appears that certain process parameters, such as collimation and ultrasonic agitation of the rovings during pultrusion, were beneficial to both tensile strength and weatherability. Other parameters, such as pretensioning of the rovings, were beneficial to weatherability but detrimental to tensile strength. Additives to the resin system were generally detrimental.

A high speed tension test method was developed and it was found that the strength of the rod is substantially greater under high loading rates.

An approximate relationship was observed between transverse tensile strength and electrical breakdown voltage. However, neither of these characteristics, nor surface hardness, correlated with axial tensile strength or weatherability.

NBSIR 74-580. **Spectral characteristics of additional Bar Code Readers. II,** J. Cohen, 12 pages (Sept. 1974). Order from NTIS as PB248465.

Key words: bar code reader; filters; optical wedge; photodetector; relative spectral output; wavelength.

The spectral characteristics of two bar code readers (submitted by the U.S. Postal Service under Task No. 1, Agreement No. 74-02934 [Mod. No. 1]) have been measured as a function of wavelength in the approximate interval of 450 to 1200 nm.

NBSIR 74-581. **Development of a solid sorption tube for sampling hydrogen fluoride in the work atmosphere,** J. Wing and J. K. Taylor, 45 pages (Oct. 1974). Order from NTIS as COM 75-10127.

Key words: air analysis; air sampling; gas analysis; hydrogen fluoride; industrial hygiene; sodium acetate; sorber; solid; work atmosphere.

The efficiencies of several solid substances in a sorption tube for collecting trace quantities of hydrogen fluoride gas in work atmosphere have been evaluated. Reagent-grade sodium acetate crystals proved to be a very efficient sorbent for hydrogen fluoride. Its solubility in water and pH buffer properties are highly advantageous for subsequent fluoride determination by the ion selective electrode. Experimental results are presented for collection efficiencies of hydrogen fluoride gas at several concentration levels, flow rates, and collection times, the effects of elevated temperatures and humidity, and also breakthrough, bleed-out, storage and shipment studies. Specifications for construction of the sorption tubes are also given.

NBSIR 74-583. **The role of passive film growth kinetics and properties in stress corrosion and crevice corrosion susceptibility,** J. Kruger and J. R. Ambrose, 88 pages (Sept. 1974). Order from NTIS as AD767326.

Key words: chloride; crevice corrosion; ellipsometry failure prediction; molybdenum; repassivation kinetics; stainless steels; stress corrosion; testing techniques.

A study of the effect of alloying chromium and molybdenum in ferritic stainless steels has been made using techniques to study repassivation kinetics (tribo-ellipsometry) and depassivation kinetics (a recently developed ellipsometry technique for studying optical changes occurring within a crevice). Results indicate that chromium additions affect both repassivation and depassivation processes while molybdenum appears to affect only the repassivation processes. A discussion is given of a generalized mechanism for localized corrosion which postulates that susceptibility to attack is determined by the competition between depassivation and repassivation processes.

Constant strain rate studies were performed using AISI 304 stainless steel exposed to acidified 1.ON NaCl solution (pH = 3.0). In this particular environment, repassivation kinetics measurements using the tribo-ellipsometric technique had shown that the metal dissolution rates were rather large due to reduced film repair kinetics, indicating the possibility of susceptibility to stress corrosion cracking (SCC). Reduced time to failure and maximum sustained load at a one strain rate suggest a relationship between SCC, repassivation kinetics,.and rate of pure metal production.

A review of current approaches to the study of stress corrosion and a discussion of how these approaches can lead to new failure prediction tools is given.

NBSIR 74-586. **Calibration of platinum resistance thermometers using an intercomparison scheme,** R. M. Schoonover and H. H. Ku, 19 pages (Dec. 1974). Order from NTIS as COM 75-10525.

Key words: adjustment for trend; calibration; capsule type thermometers; intercomparison; IPTS-68; platinum resistance thermometers; wire-to-wire calibration.

In this report we describe a procedure for the calibration of capsule type platinum resistance thermometers, PRT(s), using one or more standard platinum resistance thermometers, SPRT(s), in the temperature range of 0-35 °C. These PRT(s) were designed to be used in density work through hydrostatic weighing where SPRT(s) cannot be used because of space and other limitations, but the procedure is thought to be generally useful in other applications as well.

The schedule of intercomparisons was designed to eliminate possible trends in temperature variations of the constant temperature bath setup. Results of calibration can be expressed either in terms of the two constants alpha (α) and delta (δ), or in a table relating $R(t)/R(0)$ to t_{68} within the range of calibrations.

The uncertainty of the values of t_{68} calibrated by this procedure is believed to be within 2 millidegrees Celsius, not including the uncertainty of the SPRT that is used as standard.

NBSIR 74-588. **Development of a bench test for Type X core gypsum board,** J. L. Houser, 26 pages (Dec. 1974). Order from NTIS as COM 75-10040.

Key words: building codes; construction materials; fire endurance ratings; fire tests; gypsum.

This paper describes the development of a test method for determining that the core material in a gypsum board sample qualifies as Type X. A 2 inch (5.08 cm) by 16 inch (40.64 cm) specimen is flexurally stressed during the test by suspending a weight from the cantilevered end of the test sample. The specimen is swiveled into the center of a two burner turbulent flame at an average temperature of 1,780 °F (971 °C). The burners are positioned from above and below. The test is terminated when the specimen either breaks or deflects through an arc three times the specimen thickness. Results show this method to be repeatable with a coefficient of variation equal to ± 8 percent for a given type of material from a single manufacturer.

NBSIR 74-590. **A study of the feasibility of establishing generic environmental test parameters for all consumer products,** S. D. Toner, 9 pages (Mar. 1975). Order from NTIS as COM 75-11434.

Key words: environmental tests; product safety.

A study was conducted to determine the feasibility of establishing a set of generic environmental test parameters that would be applicable to all types of consumer products, with a potential for developing injury producing hazards as a result of environmentally induced failure. It was concluded that this approach is not a practical one. It is apparent that the safeness of a product or type of product should be determined on the basis of simulated environmental tests appropriate to its specific end use.

NBSIR 74-591. **Some problems noted in the use of Taguchi semiconductor gas sensors as residential fire/smoke detectors,** R. W. Bukowski and R. G. Bright, 12 pages (Dec. 1974). Order from NTIS as COM 75-10101.

Key words: false alarm; fire detector; fire test; residential smoke detector; semiconductor gas sensor; sensor contamination.

This paper examines some aspects of Taguchi semiconductor gas sensors and their use as residential fire/smoke detectors based on theoretical and experimental considerations. It was found that these sensors have difficulty detecting fires involving complete combustion along with a greater than normal propensity to false alarm to other than fire conditions. Both of these problems raise serious questions as to the suitability of these sensors as residential fire/smoke detectors, at least at their present state of development.

NBSIR 74-596. **Radiative heat transfer from products of combustion in building corridor fires,** K. Bromberg and J. G. Quintiere, 28 pages (Feb. 1975). Order from NTIS as COM 75-10209.

Key words: combustion products; full-scale fire; radiative heat transfer.

The contribution of radiative heat transfer from hot combustion products to corridor floors is examined. Data from full-scale corridor fire experiments is used to calculate emissivity and absorptivity of the combustion products. An empirical model based on attenuation by absorption is used to specify the absorption coefficient due to particulates in the products. In these experiments it is shown that radiation from the combustion products is just as significant as radiation from convectively heated walls and ceiling of the corridor. Calculations show that the ratio of radiant heat transfer to the floor due to ceiling emission to that by combustion product emission ranges from about 0.2 to 0.7. Also, molecular gas radiation and particulate radiation can both be significant for the combustion products. Calculations show that the emissivity of the gaseous combustion products alone would be about 0.3, but the inclusion of soot particles yields an emissivity for the total combustion product mixture of as high as 0.73, based on the experimental data considered.

NBSIR 74-597. **Piezoelectric accelerometer low-frequency response by signal insertion methods,** R. S. Koyanagi and J. D. Pollard, 33 pages (May 1975). Order from NTIS as COM 75-11069.

Key words: accelerometer; calibration; low frequency; signal insertion; vibration.

The purpose of this study was to compare the frequency response of selected piezoelectric accelerometers using a signal insertion method to the response using traditional mechanical vibration tests. Signal insertion methods included "voltage insertion" and "change insertion" techniques. The signal is inserted in series with the electrical low-side of the accelerometer by means of a suitable series resistance. Commercially available insertion devices were used. Confidence in the use of insertion methods is increased where there is agreement between the results from insertion tests and mechanically excited tests.

NBSIR 74-600. **Thermodynamics of chemical species important to rocket technology,** C. W. Beckett, 200 pages (Oct. 1, 1974). Order from NTIS as ADA008935.

Key words: bibliography on spectroscopy of fluorides and oxides of the lanthanide series; calculation of dissociation energies; electrical resistivity; enthalpy of transition; graphite; infrared matrix isolation spectroscopy; melting point; radiance temperature; reaction of Ba(g) and excited ozone; reaction of Fe(g) and oxygen; review of literature on rate of effusion and mass-spectrometric data; scandium group and rare-earth gaseous monoxides; specific heat; total emittance; vanadium; zirconium.

Using a subsecond-duration transient technique the specific heat, electrical resistivity, and hemispherical total emittance were simultaneously measured over the temperature range 1500-3000 K for some grades of graphite. Similar measurements were made on vanadium, and zirconium in the temperature range of 1500-2100 K. Melting points and radiance temperature (at 650 nm) are reported for zirconium and molybdenum. The temperature of the transition from the α-β phase of zirconium and the energy difference of these phases has also been measured using the subsecond duration transient technique.

The products of the reaction of Fe(g) and O_2 have been investigated and identified using the methods of infrared matrix isolation spectroscopy. A preliminary report on the study of the reaction of Ba(g) with vibrationally excited ozone is also presented.

The dissociation energies of the scandium group and rare-earth gaseous monoxides are evaluated by reviewing the literature available on Knudsen effusion rates and mass-spectrometric data. Criteria are discussed for choosing data for evaluation of dissociation energies. A bibliography of the available literature on the spectroscopy of fluorides, oxides, and oxyfluorides belonging to the lanthanide series is given.

NBSIR 74-602. **Efficient methods of extreme-value methodology,** J. Lieblein, 32 pages (Oct. 1974). Order from NTIS as COM 75-10048.

Key words: distribution of largest values; efficient estimators; extreme values; linear unbiased estimators; statistics; Type I distribution.

This report presents the essentials of modern efficient methods of estimating the two parameters of a Type I extreme-value distribution. These methods are an essential phase of the analysis of data that follow such a distribution and occur in the study of high winds, earthquakes, traffic peaks, extreme shocks and extreme quantities and phenomena generally. Methods are given that are appropriate to the quantity of data available—highly efficient methods for smaller samples and nearly as efficient methods for large or very large samples. Necessary tables are provided. The methods are illustrated by examples and summarized as a ready guide for analysts and for computer programming. The report outlines further work necessary to cover other aspects of extreme-value analysis, including other distribution types that occur in failure phenomena such as consumer product failure, fatigue failure, etc.

NBSIR 74-605. **Crush characteristics of automobile structural components,** D. C. Robinson, 65 pages (Jan. 1975). Order from NTIS as COM 75-10464.

Key words: automobile side impact; crush characteristics; displacement measurements; door structure; drop tests; dynamic crush tests; impact collisions; plastic deformation; static crush tests; strain measurements; structural components; test procedures.

Static and dynamic test procedures were developed for evaluating the crush characteristics of automotive structural components which perform a major structural function in side impacts. Laboratory tests were conducted on several 1969 to 1971 4-door intermediate size automobiles to evaluate the crush characteristics of some of their structural components. Static crush tests were conducted in the 12-million-lbf capacity universal testing machine at the National Bureau of Standards, employing its large working space. The dynamic tests were conducted using the monorails attached to the sensitive crosshead and the tie-down floor system which is incorporated in the foundation of this machine. The crush loads were applied perpendicular to the vehicle side for each of the tests. The response of the structural components was established based on the evaluation of displacement and/or strain measurements and detailed examination of the permanently deformed components following each test. Empirical factors were obtained which are useful for comparison of static and dynamic crush characteristics of a vehicle side door structure over a limited loading range. Further development of the test procedures is required in order to extend the range over which such results would be meaningful.

NBSIR 74-606. **Consumer product noise: A basis for regulation,** P. G. Weissler, G. A. Zerdy, and S. G. Revoile, 80 pages (Nov. 1974). Order from NTIS as COM 75-10340.

Key words: consumer products; criteria for safety standards; federal regulations; hearing impairment; hearing survey; noise emission; speech communication interference.

The Consumer Product Safety Commission is charged with the responsibility for promulgating safety standards to protect the public against unreasonable risks of injury associated with consumer products. There is a risk of injury from noisy products, directly by damage to hearing and indirectly by degradation of essential speech communication. This report develops criteria relevant to the specification of Safety Standards for noisy consumer products. Consumer product noise is discussed in relation to the existing body of knowledge regarding noise induced hearing loss and speech communication. Levels of product noise are identified that should protect against hearing impairment and against speech communication degradation. Methods of measurement for consumer product noise are described and a bibliography of standards relevant to the regulation of noisy consumer products is provided. A list of products that are potentially hazardous to the hearing of the operator is included with typical levels and usage patterns. The list is based upon reported data and some measurements made at NBS. Possible discrepancies among noise regulations established by different governmental agencies are discussed with suggestions for obtaining uniformity.

NBSIR 74-608. **Procedure for measuring noise emission from power lawn mowers,** J. I. Adler, 19 pages (Nov. 1974). Order from NTIS as COM 75-10056.

Key words: emergency messages; hearing loss; lawn mowers; noise emission; noise pollution; product safety.

A procedure is described for measuring the noise emission from power lawn mowers. The procedure covers both walk-behind and riding mowers, including suggestions of maximum noise levels for protection from hearing loss and for reception of emergency messages. The procedure employs a microphone located near the ear of the operator and mounted on a back-pack worn by the operator.

NBSIR 74-610. **Investigation of procedures for determination of thermal performance characteristics of plastic piping used in housing,** M. Tryon, 36 pages (Nov. 1974). Order from NTIS as COM 75-10072.

Key words: chlorinated polyvinyl chloride; hardness; internal stress; polyvinyl chloride; thermal mechanical analysis (TMA); thermal properties; thermogravimetric analysis (T-GA); thermoplastic pipe.

The rapid growth of the use of thermoplastic pipe for plumbing in housing has prompted a study to determine the critical factors affecting the performance of the pipe materials. The emphasis in this preliminary study is on thermal properties such as the softening point, relaxation of thermal stress, glass transition temperature, hardness-temperature relationship, and decomposition temperature. The techniques used were thermal mechanical analysis (TMA), thermogravimetric analysis (TGA), and hardness. Preliminary results obtained on several pipe samples of PVC and CPVC commercial samples are reported.

NBSIR 74-612. **Building and evaluation of a second polluted air delivery system,** G. P. Baumgarten, 11 pages (Nov. 1974). Order from NTIS as COM 75-10414.

Key words: air pollution; critical flow; laminar flow; nozzle; porous plug; sulfur dioxide concentration; carbon dioxide concentration.

The building and evaluation of a second configuration of a prototype SO_2 and CO polluted air delivery system (PADS) is discussed. The delivery system was built to deliver sulfur dioxide (SO_2) and carbon monoxide (CO) at a rate of 5 liters per minute. The design concentrations by volume were 1.0, 0.5, 0.1, and 0.04 parts per million (ppm) of SO_2 in air and 50, 20, and 2 parts per million of CO in nitrogen. It consists of a diluent air delivery system utilizing a critical flow sonic nozzle and three separate pollutant flow systems utilizing laminar flow porous plugs, one plug for each desired output concentration. The system is contained in a dispatch case and the gases are delivered to it from pressurized containers through detachable supply lines.

By maintaining specific upstream pressures on the critical flow nozzle and the laminar flow porous plugs, PADS 2 produced average output concentrations of: 0.95, 0.50, 0.117, and 0.057 ppm of SO_2; and 52.9 and 18.1 ppm of CO. These concentrations were determined by measurements with NBS calibrated analyzers. The expected output concentrations were 0.03, 0.52, 0.103, and 0.05 ppm of SO_2 and 51.2, 18.0, and 1.49 ppm of CO based on flow calibrations of the individual components. The uncertainty of the output concentration is estimated to be about 7 percent.

NBSIR 74-613. **Preliminary study of the slipperiness of flooring,** A. P. Cramp and L. W. Masters, 42 pages (July 1974). Order from NTIS as COM 75-10059.

Key words: floor slipperiness; resilient flooring; slipperiness standards; frictional tests; slip tests; coefficient of friction; human perambulation.

The National Commission on Product Safety reported in 1970, that falls in the home each year kill about 12,000 and injure 6,000,000 in the U.S.A. Slippery floors are listed as a large contributor to these very high casualty figures. Although there are some standardized test methods that are or might be suitable for such standards, there are no slipperiness standards for flooring. Thus, there is an immediate need for studies aimed at the development and establishment of such standards. Consequently, a preliminary study of floor slipperiness was sponsored by the Building Safety Section of the Center for Building Technology. The study included a state-of-the-art investigation on flooring slipperiness research and a laboratory evaluation of three existing test methods for measuring floor slipperiness. Samples of the three most commonly used resilient flooring materials, namely: vinyl asbestos, vinyl and linoleum were used in the study. The sliding material components for the frictional tests were leather and a commonly used styrene butadiene sole and heel rubber. The tests were performed both dry and wet. The results from this study were used in planning a large comprehensive study, which would lead to the development of accepted floor slipperiness standards. This report contains the results of the preliminary study.

NBSIR 74-614. **Mechanical tests of flammable liquid containers,** N. Halsey, A. F. Kirstein, and R. E. Snyder, 35 pages (Dec. 1974). Order from NTIS as COM 75-11013.

Key words: consumer products; flammable liquid containers; gasoline cans; mechanical tests; product standards; safety.

Because of the concern for safety in the storage and use of gasoline and other flammable liquids around the home, this study was made to determine if standards can be established to minimize the flammable liquid hazard by controlling or standardizing the containers. Attention was focused on performance standards for stability, leakage, carrying handle strength, and pour spout strength. In general, it was found that the technology involved in existing voluntary standards for safety cans could be applied to flammable liquid containers for home use for all of the above factors except pour spout strength.

NBSIR 74-618. **US/UK joint complementary research program in building, (wind loads, water supply, fire detection), July 1973-June 1974,** C. C. Raley, I. A. Benjamin, L. S. Galowin, and R. D. Marshall, 23 pages (Oct. 1974). Order from NTIS as COM 75-11014.

Key words: building technology; cooperation; fire safety; hydraulics; wind loads.

This is a status report of the progress achieved under the "Joint Complementary Research Program" sponsored by the Building Research Establishment (UK) and the Institute for Applied Technology (US), during the period July 1973 through June 1974. The program includes three projects: Wind Loads on Buildings, Design of Water Supply and Drainage Installations in Buildings, and Fire Detection in Buildings, each of which is discussed in the report.

NBSIR 74-619. **Measurement methodology for determining the sound output of toy guns,** M. A. Cadoff and D. S. Blomquist, 17 pages (Aug. 1974). Order from NTIS as COM 75-10047.

Key words: children; consumer safety; guns; hearing damage; noise; standard apparatus; toys.

In recent years, a great concern has been expressed for consumer protection and safety, especially for children. As an outgrowth of this concern, acoustical testing of potentially-hazardous noise-producing toys has been carried out at the National Bureau of Standards for the Consumer Product Safety Commission under the authority of the Toy Safety Act of 1969. This report outlines a methodology which was developed to measure the noise levels of toy guns. In addition, the rationale and technical back-up for the methodology are discussed, and the regulations setting allowable noise levels for toy guns are given.

NBSIR 74-620. **An in-line density and viscosity sensor,** L. O. Olsen and F. W. Ruegg, 20 pages (Nov. 1974). Order from NTIS as PB246622.

Key words: capillary tubes; density sensor; flow nozzle; laminar flow; liquid properties; viscosity sensor.

In-line density and viscosity sensors for liquids are developed to utilize measurements of differential pressure across a nozzle and a coiled capillary tube respectively, with known flowrates through each provided by a flow generator. Theory and principles of operation and instructions for calibration and use of the sensors are discussed, along with design consideration for the sensors and associated equipment. A calibration of the sensors demonstrated that viscosity and density each could be measured with a computed standard deviation of one percent. Viscosity was varied over the range of about 1 to 11 centistokes whereas density of the fluids used was near 0.8 g cm^{-3}. Application of well known similarity considerations is used to make the results applicable to other liquid densities, provided influence of other liquid properties (high vapor pressure, for instance) does not interfere.

NBSIR 74-621. **Stability and strength of home playground equipment,** B. M. Mahajan, 39 pages (Dec. 1974). Order from NTIS as COM 75-10422.

Key words: home playground equipment; stability; strength; test; testing; tipping.

Stability tests were performed on some items of home playground equipment to measure the magnitude of the force, applied to generate tipping moment, required to start the tipping of the equipment.

Strength tests were conducted by loading certain components of home playground equipment with estimated loads to determine if the tested equipment had adequate strength.

NBSIR 74-623. **Stability and abuse tests of riding toys,** W. C. Brown and H. A. Baker, 87 pages (Jan. 1975). Order from NTIS as COM 75-10210.

Key words: abuse testing; dynamic stability; hazards; obstruction; riding toys; stairway; static stability; test weight; tilt angle; toy testing.

Stability and abuse tests were conducted on 88 riding toys in order to provide information which can be utilized to set realistic abuse performance levels for riding toys, as well as characterize the types of stability hazards associated with this class of toys. The results of these tests are summarized in tabular form and a description of the discrepancies encountered as well as photographs of these discrepancies are presented.

The appendices of this report contain photographs of each test specimen as well as the tabulated raw data for each test conducted.

NBSIR 74-624. **The Shirley Highway Express-Bus-on-Freeway Demonstration Project. A study of reverse commute service,** R. Waksman, 44 pages (Dec. 1974). Order from NTIS as COM 75-10412.

Key words: bus-on-freeway operations; choice and captive riders; cost allocation formula; incremental costs and revenues; reverse commute bus service; Shirley Highway; transportation planning.

Bus-on-freeway operations generally provide peak period commuter transit service to persons traveling from suburban residences through congested corridors to jobs in the major employment centers of metropolitan areas. In a few cases, peak period reverse commute operations may provide service to persons traveling from residences near the downtown employment centers to jobs in the suburbs. In early 1973, two major Shirley Highway Express-Bus-on-Freeway Demonstration Project reverse commute routes began service to office buildings in Northern Virginia.

An analysis of this reverse commute service revealed that it was a successful operation because it provided considerable benefits to its patrons and was slightly profitable to the bus operator on an incremental cost basis.

Four conditions which were important for the success of the service were found to be important for the success of reverse commute operations, in general. The conditions are as follows: (1) A given route should serve a concentrated, high employment area. (2) The route should be accessible to people currently working within the employment area and to captive riders who can fill jobs there. (3) It should be possible to fit most of the reverse commute trips into existing bus schedules. (4) It should be possible to pair with peak direction trips any trips that cannot be fit into existing bus schedules.

Using a procedure which incorporates these conditions, one employment area within the Shirley Highway Corridor was identified as having potential as a market for a reverse commute service.

NBSIR 74-626. **Semiconductor nuclear radiation detector studies—A final report,** A. H. Sher, 10 pages (Sept. 1974). Order from NTIS as COM 75-10411.

Key words: carrier trapping; gamma-ray detector; germanium; Ge(Li) detector; infrared response; silicon.

In response to a problem that arose with regard to the availability of germanium for lithium-drifted germanium detectors [Ge(Li) detectors], a comprehensive program was undertaken aimed toward the development of a method for the rapid specification of germanium quality for nuclear radiation detector use, and the determination of factors affecting germanium quality. Measurements on a large number of germanium crystals, most of which had been rejected for detector use, and intercomparison of these measurements and the methods employed, led to significant developments in the measurement of lithium mobility and driftability, carrier trapping, and semiconductor defect and impurity determination via an improved infrared response (IRR) technique. The present improvement of the infrared response technique resulted in the observation of a number of discrete energy levels lying within the forbidden gap of germanium unobserved in previous studies. It was possible to assign the proper position of energy levels detected by IRR in the upper or lower half of the energy gap. It was thus possible, in some instances, to determine the nature of the defects responsible for the observed energy level from results reported in the literature. The goal of developing a method for the rapid specification of germanium quality was achieved.

NBSIR 74-627. **The influence of ink on the quality of fingerprint impressions,** R. T. Moore, 16 pages (Dec. 12, 1974). Order from NTIS as COM 75-10134.

Key words: film thickness; film uniformity; fingerprint impressions; fingerprint readers; image quality; ink films; lubricity.

Tests were conducted on several types of ink to determine their influence on the quality of fingerprint impressions which they could produce. The thickness and uniformity of the film used to ink the fingers were found to be the most significant factor in providing high quality impressions. A method is described for metering out printer's ink and estimating whether or not a uniform film of near optimum thickness has been rolled out on a glass inking plate.

NBSIR 74-628. **Mass transport and physical properties of large crystals of calcium apatites: Studies of $Ca(OH)_2$ crystals for use in electrolytic conversion of calcium fluorapatite crystals to calcium hydroxyapatite,** A. D. Franklin and K. F. Young, 22 pages (Sept. 1, 1973-Aug. 31, 1974). Order from NTIS as COM 75-10514.

Key words: Ac impedance; calcium apatites; calcium hydroxide; crystal growth; electrolysis; interfacial polarization; ionic conduction; mass transport.

In order to convert single crystals of calcium fluorapatite to calcium hydroxyapatite, an electrolytic cell technique will be explored. To utilize such a technique, the cathode compartment must consist of a source of hydroxyl ions and a barrier to the flow of all others. $Ca(OH)_2$ has been selected for the cathode material, backed by a Pt electrode in an atmosphere containing H_2O and O_2. $Ca(OH)_2$ crystals have been grown and Ag as well as Pt electrodes applied to them. Their ac admittance as a function of temperature has been measured and analyzed. A Warburg contribution to the admittance was observed to depend upon the presence of O_2. Equivalent circuits have been generated from the data allowing us to tentatively characterize the electrical properties of the electroded crystal system.

NBSIR 74-629. **Thermal properties of selected plastic piping used in housing,** M. Tryon, 28 pages (Apr. 1975). Order from NTIS as COM 75-11281.

Key words: ABS; coefficient of expansion; CPVC; glass transition temperature; hardness; PB; polybutene; polyvinyl chloride; PVC; residual stress; thermoplastic piping.

In a study of four thermoplastic piping materials, the following performance-related properties were measured: coefficient of thermal expansion, glass transition temperature, residual stress, hardness, and hardness-temperature coefficient. The purpose of the study was to determine typical values of these properties for each of the piping materials. Results are given with recommendations for performance tests and changes in previously-proposed interim performance criteria.

NBSIR 74-631. **Analysis of proposed air drying process,** L. Greenspan, 11 pages (Dec. 1974). Order from NTIS as COM 75-10208.

Key words: absorption; drying; phosphorous pentoxide; water vapor.

NASA proposal No. 7401-6-01A by the GCA Corporation describes a proposed air drying process which has been analyzed. The drying process, intended to reduce the water vapor content of a stratospheric sample to below one part per million by weight, is based upon the removal of the water as it passes through a phosphorous pentoxide absorber. The analysis indicates that the method is feasible. Dependence on ram pressure to maintain flow through the absorber appears questionable and consideration should be given to other means.

NBSIR 74-632. **Comparison of accelerated aging of book papers in 1937 with 36 years natural aging,** W. K. Wilson and E. J. Parks, 96 pages (Dec. 19, 1974). Order from NTIS as PB246554.

Key words: accelerated aging; aging; natural aging; paper, permanent; paper, stability; permanent papers; record papers; stability of paper.

A group of 36 book papers made in the NBS paper mill in 1937 were tested in 1937 before and after accelerated aging for 72 hours at 100 °C, and in 1973 after 36 years of natural aging. The data show that fairly good correlations exist between accelerated aging and natural aging when changes in alpha cellulose, copper number and, to a lesser extent, tearing strength, were used as criteria of change. pH is a reasonably good criterion of stability. It appears that zero span tensile strength, wet strength as a percentage of dry strength, and brightness are useful criteria for evaluating the aging of paper. When data in this report are compared with data from earlier reports, it appears that dry accelerated aging at 100 °C more nearly corresponds to natural aging than accelerated aging at 90 °C and 50 percent relative humidity.

NBSIR 74-633. **The NBS computerized carpool matching system: User's guide,** J. F. Gilsinn and S. Landau, 64 pages (Dec. 1974). Order from NTIS as COM 75-10691.

Key words: carpool matching; carpools; computer programs; transportation; urban transportation.

This report documents the NBS computerized carpool matching programs and the procedures used in maintaining the coordinate data base required by the matching system. The report includes flowcharts, input/output formats, and program listings for the programs, plus details of the manual process for coordinate coding. The matching program produces, for each person desiring it, a list of others residing within a pre-specified distance of him, and is thus applicable to a single work destination having primarily one work schedule. The system is currently operational on the National Bureau of Standards' UNIVAC 1108 computer and was run in March of 1974, producing lists for about 950 employees in less than four minutes computer time. Subsequent maintenance of the system will be carried out by the NBS Management and Organization Division.

NBSIR 74-634. **Method of testing for rating thermal storage devices based on thermal performance,** G. E. Kelly and J. E. Hill, 45 pages (May 1975). Order from NTIS as COM 74-10685.

Key words: solar energy; standard; standard test; thermal performance; thermal storage; thermal test.

A study has been made at the National Bureau of Standards of the different techniques that could be used for testing thermal storage devices and rating them on the basis of thermal performance. This document outlines a proposed standard test procedure based on that study. It is written in the format of a standard of the American Society of Heating, Refrigerating, and Air Conditioning Engineers and specifies the recommended apparatus, instrumentation, and test procedure.

NBSIR 74-635. **Method of testing for rating solar collectors based on thermal performance,** J. E. Hill and T. Kusuda, 63 pages (Dec. 1974). Order from NTIS as COM 75-10276.

Key words: solar collector; solar energy; solar radiation; standard; standard test; thermal performance.

The National Bureau of Standards has made a study of the different techniques that could be used for testing solar collectors and rating them on the basis of thermal performance. This document outlines a standard test procedure based on that study. It is written in the format of a standard of the American Society of Heating, Refrigerating, and Air Conditioning Engineers and specifies the recommended apparatus, instrumentation, and test procedure.

NBSIR 75-637. **Note on simplified estimators for type I extreme-value distribution,** J. Lieblein, 14 pages (Dec. 1974). Order from NTIS as COM 75-10055.

Key words: bias; efficiency; extreme values; linear unbiased estimators; simplified estimators; statistics; type I distribution.

Methods for extreme-value analysis (for the Type I extreme-value distribution) that have optimum properties involve up to 20 quantities (depending on sample size) whose values are known to 6 decimal places. The present note shows how to modify these to much simpler values involving 2 decimal places that are more convenient to use yet sacrifice very little of the optimum features.

NBSIR 75-639. **Optical materials characterization,** A. Feldman, D. Horowitz, R. M. Waxler, I. Malitson, and M. J. Dodge, 17 pages (Jan. 1975). Order from NTIS as COM 75-10135.

Key words: coefficient of thermal expansion; elastic constants; infrared laser window materials; photoelasticity; polycrystalline ZnSe; refractive index; stress-optical constants; thermal coefficient of refractive index.

We have measured the following parameters of chemical vapor deposited polycrystalline ZnSe (CVD ZnSe): Refractive index and change of index of refraction with temperature (dn/dT) over the wavelength range 0.5 μm to 18 μm using the method of minimum deviation; the coefficient of linear thermal expansion and dn/dT at 10.6 μm using Fizeau interferometry; and the elastic moduli and photoelastic moduli using Fizeau and Twyman-Green interferometry. A sensitive technique has been developed for measuring stress-optical constants of materials that exhibit a small stress-optical effect.

NBSIR 75-641. **Performance of mobile homes data acquisition and analysis methodology,** J. H. Pielert, W. E. Greene, Jr., L. F. Skoda, and W. G. Street, 75 pages (Feb. 1975). Order from NTIS as COM 75-11209.

Key words: construction; Hurricane Agnes; housing; mobile homes; mobile home parks; performance data; regulatory process; standards.

In a study at the National Bureau of Standards (NBS), funded by the Department of Housing and Urban Development (HUD), methods for inspecting mobile homes to identify performance problems, recording the problems and analyzing the problem data were developed. Maintenance work orders for 2881 mobile homes, a part of 12,500 provided by HUD for emergency housing in the aftermath of Hurricane Agnes, at Wilkes-Barre, Pa., were reviewed and computer coded by an interdisciplinary team of engineers. Also, performance data were obtained from State and other Federal agencies for over 967 privately owned mobile homes. A second task was the field inspection of 257 mobile homes to assist in the determination of the causes and consequences of the problems identified in the data acquisition task. Computer techniques were developed to process the data and print out problem summation tables, graphs to establish trends, compile data on obvious problems and ferret out those problems which may not be obvious. This first report documenting the data acquisition and analysis methodology will be followed by a series of reports which will present results and relate them to current standards, the regulatory and insurance processes.

NBSIR 75-647. **Mechanical tests of FAA-E2491 airport in-pavement approach and threshold lights,** D. C. Robinson, 26 pages (Jan. 1975). Order from NTIS as COM 75-10418.

Key words: airport approach and threshold lights; glass prism; impact tests; light bases; optical cover assembly; photometric measurements; static tests.

Static and impact load tests were performed on two style FAA-E-2491 airport in-pavement approach and threshold lights which were mounted in light bases encased in concrete. Static tests were conducted using either a 6-inch diameter steel plate or a rubber pad through which loads were applied to the center of the light optical cover assembly. Drop tests were conducted using a 5-lb steel ball which was directed to impact at various locations on the optical cover assembly. The old style lights were found to comply with load requirements for the current specification. The maximum load sustained by both style lights when loaded through a rubber pad was about two-thirds of the maximum load sustained when loading directly through the steel plate. A discussion is given of the photometric measurements of the light beam displacement measured during the load tests, the deflections and strains of two new style lights measured under two loading conditions and the test procedures for determining the performance of approach and threshold lights.

NBSIR 75-649. **Computer applications at the Ecuadorian Institute of Standardization (INEN): Observations and recommendations,** J. Hilsenrath, 16 pages (Apr. 1975). Order from NTIS as PB241237.

Key words: computer applications; OMNITAB II: Minitab; statistical computing; text editing.

This report contains specific suggestions for computer applications at the Ecuadorian Bureau of Standards (INEN). The suggestions, based on observations and discussion during a 10-day visit by the author in Quito, Ecuador, cover editing and typesetting of Ecuadorian standards, data storage and retrieval, and statistical analysis of experimental data.

NBSIR 75-651. **Procedural options to reduce the risk of injury from products installed in residences,** S. W. Stiefel, C. W. Hand, and D. W. Corrigan, 94 pages (June 1975). Order from NTIS as COM 75-11211.

Key words: building codes; Consumer Product Safety Act; product safety; residence-related products; residential safety; safety implementation approaches; safety standards.

The Consumer Product Safety Commission's (CPSC) list of consumer products with high relative incidence of reported injuries includes many products which are integral parts of the consumer's residence, such as stairs, doors, architectural glass, furnaces and water heaters. The safety aspects of these products are influenced by on-site construction practices and design considerations which are regulated through local building codes. The problem is to identify operational methods the CPSC can employ in dealing with unreasonable hazards associated with component parts of residential units.

This report identifies, for products installed in homes, (1) the product history stages, (2) institutional groups, (3) hazard sources, and (4) countermeasures available to the CPSC. It structures relationships among these four elements for evaluating the impacts of alternative countermeasures. Current mechanisms for control of products installed in homes are presented and sixteen potential countermeasures are postulated.

NBSIR 75-652. **Procedures for estimating sound power from measurements of sound pressure,** C. I. Holmer, 78 pages (July 1975). Order from NTIS as COM 75-11399.

Key words: air compressors; error of sound power measurement; noise; noise measurement; sound power level; standard test procedures for sound power measurement.

This report describes investigations of the accuracy and precision of various measurement methodologies for determining the estimated sound power output of "large" machines in the free field over a reflecting plane. One purpose of this investigation is to place empirical error bounds on many of the free field measurement procedures currently proposed or in use; and in particular, compare the results of "near-field" and "far-field" measurements. The sources used for the investigation included 17 portable air compressors of various types (powered by internal combustion engines), a "reference" sound source, and a loudspeaker driven by a pure tone source. The data recorded include sound pressure level (A-weighted, linear, and 1/3-octave band) on an 84 point hemispherical array of seven metre radius, and "near-field" measurements, sampled every square metre, on a rectangular surface one metre from the machine surface. These data were reduced to provide information on the deviation of "near field" sound power determinations from "far-field" power level (using subsets of the data as appropriate to various methodologies). The measured data for seventeen sources suggests that the value of a sound power estimate based on "near-field" sound pressure level measurements may be an upper bound to the sound power level estimated from far field measurements, subject to the limitations of sampling error. Estimates of total achievable measurement error of A-weighted sound power level of near field determinations relative to far field determinations are made for several measurement methodologies, based on the experimental data.

NBSIR 75-653. **Measurement methodology and supporting documentation for portable air compressor noise,** C. I. Holmer, 48 pages (Jan. 1975). Order from NTIS as PB248097.

Key words: acoustics; air compressor; internal combustion engine; noise; sound power level; sound pressure level.

This report presents recommendations and supporting rationale on a measurement methodology for portable air compressors. The methodology provides for the determination of A-weighted sound power level or the equivalent weighted sound pressure level at a reference distance. A-weighted level is used because of its correlation with community response to noise from internal combustion engine noise. It is recommended, however, that the spectra associated with the regulated source be monitored in some manner to insure that the spectra remain similar to those for which A-weighted sound level retains good correlation with community response. The methodology uses weighted sound level measurements at eight positions on a curved surface surrounding the source at a distance of one metre from the surface of the machine. Data recorded at these positions are used to calculate the average weighted sound pressure level of the machine on the measurement surface. This is combined with the area of the measurement surface to give the sound power level of the machine. From this value, a rating sound pressure at a rating distance may be calculated by subtracting a constant value. Procedures which permit the rapid estimation of A-weighted sound level are included. These are applicable for estimation of A-weighted sound level in a variety of circumstances when the sound power or equivalent sound pressure level at a reference distance is known.

NBSIR 75-654. **NBS interagency transducer project—A project report,** P. S. Lederer and J. S. Hilten, 15 pages (Feb. 20, 1975). Order from NTIS as COM 75-10367.

Key words: calibration; dynamic; photo flashbulb; pressure; pressure measurement; pressure transducer; thermal transient; transducer.

A method is being developed to apply short-duration thermal transients to pressure transducers and to observe the effects of these transients on transducer performance. The method consists of monitoring pressure transducer output as the transducer is exposed to radiation resulting from the ignition of a photographic flashbulb or from the discharge of an electronic flash. During this reporting period, the work has been exploratory in nature to determine values for method parameters. Thermal energy pulses as high as 0.4 J lasting 4 ms have been generated using an electronic flash; pulses as high as 1 J lasting 18 ms have been generated using No. 22 flashbulbs.

Work being performed for other agencies is also described briefly.

NBSIR 75-658. **Electron microscopic observations of microcracking about indentations in aluminium oxide in silicon carbide,** B. J. Hockey and B. R. Lawn, 39 pages (Jan. 1975). Order from NTIS as AD-A007445.

Key words: brittle solids; dislocation networks; electron microscopy; healing; indentations; microcracking; moiré patterns.

Transmission electron microscopy is used to examine the nature of microcracking about small-scale indentations in two highly brittle solids, sapphire and carborundum. The observed crack geometry is discussed in terms of an earlier model of indentation fracture beneath a point force, in which both loading and unloading half-cycles contribute to the crack growth. The residual interfaces are characterised mainly by moiré patterns, sometimes by dislocation networks. These observations are discussed in relation to spontaneous closure and healing mechanisms, and the "lattice mismatch" necessary for their production estimated at about one part in a thousand. It is shown that cleavage steps comprise the main source of obstruction to lattice restoration across the interfaces. Mechanical and thermal treatments of the indented surfaces are found to influence the extent of the residual cracking. Some practical implications of the observations are discussed.

NBSIR 75-659. **A new mode of chipping fracture in brittle solids, and its application in a model for wear under fixed abrasive conditions. I. Mode of chipping fracture. II. Wear model,** B. R. Lawn, 49 pages (Feb. 1975). Order from NTIS as COM 75-10515.

Key words: abrasion; brittle solids; brittle surfaces; chipping; fracture; hardness; indentation; residual stress; stress analysis; wear rate.

A description is given of the mode of chipping fracture observed in highly brittle solids. It is pointed out that residual stresses about indentation deformation centers play a vital role. The implications of this mode in a number of mechanical phenomena are discussed.

An explicit model for the wear of brittle surfaces under fixed abrasive conditions is presented in terms of indentation fracture concepts. The predicted wear rate for glass agrees with that observed experimentally to within an order of magnitude. Some implications concerning the parameters which influence the abrasion process, particularly the hardness, are discussed.

NBSIR 75-660. **Voluntary labeling program for household appliances and equipment to effect energy conservation: Annual report for calendar year 1974,** B. J. McGuire and E. A. Vadelund, 46 pages (Feb. 1975). Order from NTIS as COM 75-10609.

Key words: consumer information; consumer products; energy conservation; energy efficiency; energy use; household appliances; household equipment; labeling; residential.

The Voluntary Labeling Program for Household Appliances and Equipment to Effect Energy Conservation was established in response to an April 18, 1973 Presidential directive. Final procedures for the program became effective October 26, 1973. Only major energy consuming household appliances and equipment are covered. Purposes of the program are to encourage manufacturers to place energy efficiency labels on their appliances and to encourage consumers to utilize this information in making purchase decisions.

Specifications containing labeling requirements for each type of product are developed by NBS with assistance from consumers, retailers, manufacturers and interested Federal agencies. During the first full year of program operation, final specifications for labeling room air conditioners and proposed specifications for labeling refrigerators, combination refrigerator-freezers, and freezers were issued. Two consumer information pamphlets were published and other consumer information and education activities were undertaken. Labeling specifications for water heaters, clothes washers and dryers, and ranges and ovens were under development. This was accomplished, with assistance from manufacturers, retailers, consumers and other agencies, by a staff of six funded at a level of $375,000 per year.

At year's end, twenty-four room air conditioner manufacturers and private brand labelers, representing an estimated 95 percent of U.S. sales of this appliance, were participating in the program.

NBSIR 75-661. **Strength degradation of brittle surfaces: Sharp indenters,** B. R. Lawn, E. R. Fuller, and S. M. Wiederhorn, 38 pages (May 1975). Order from NTIS as COM 75-10763.

Key words: brittle solids; ceramic surfaces; degradation; fracture; indentation; strength.

A theory of strength loss for brittle surfaces in contact situations, developed in a previous paper for "blunt" indenters, is here extended to the case of "sharp" indenters. A prior fracture mechanics analysis of crack growth beneath ideal cone indenters serves as the basis for predetermining the prospective surface degradation of ceramic components in service. Compared to blunt indenters, severe degradation can occur at the lower contact loads. However, at high loads the extent of degradation becomes remarkably insensitive to indenter geometry. Essential theoretical predictions are verified by bend tests on glass slabs. The effect of indenter "sharpness" and initial specimen surface flaw state are investigated systematically, along with some secondary rate effects in the contract process. The possibility of minimizing degradation via adjustment of material parameters (including hardness) or surface condition (e.g., residual stresses, frictional properties) is briefly discussed.

NBSIR 75-662. **Sulphur dioxide reference materials,** J. K. Taylor and E. R. Deardorff, 16 pages (Feb. 1975). Order from NTIS as COM 75-10420.

Key words: air pollution; chemical analysis; pararosaniline method; quality control; reference materials; sulfur dioxide.

The development of reference materials to serve for quality control and performance evaluation of measurements of sulfur dioxide by the pararosaniline method is described. Powder samples consisting of sodium sulfite dispersed in mannitol can be prepared to evaluate measurements for the concentration levels of ambient interest. The samples are sufficiently stable in routine use, with a service life of at least three months. By the use of a series of five samples of graded sulfite content, measurement errors greater than five percent are significantly detected. A detailed procedure for preparation of the samples is included. Preliminary studies of an alternate method for preparation of quality control samples, by a freeze-drying process are also described.

NBSIR 75-664. **Strength degradation of brittle surfaces: Blunt indenters,** B. R. Lawn, S. M. Wiederhorn, and H. H. Johnson, 40 pages (Feb. 1975). Order from NTIS as ADA007447.

Key words: brittle solids; ceramic surfaces; cracks; degradation; fracture; Hertzian; indentation; strength.

Indentation fracture mechanics is used to develop a theoretical basis for predetermining the strength properties of brittle surfaces in prospective contact situations. Indenters are classified as "blunt" or "sharp," of which only the first is considered in the present work. The classical Hertzian cone crack conveniently models the fracture damage incurred by the surface in this class of indentation event. Significant degradation is predicted to occur at a critical contact load; however, with increasing load beyond this critical level the degradation rate becomes relatively slight. Bend tests on abraded glass slabs confirm the essential features of the theoretical predictions. The role of controlling variables in the degradation process, notably starting flaw size and indenter radius, is systematically investigated. An indication is also given as to optimisation of material parameters. The analysis leads to some novel suggestions concerning surface preparation procedures that might be followed in order to minimize strength losses.

NBSIR 75-665. **Point-to-Point Trip Management Program (preliminary analysis),** W. G. Kienstra and D. J. Minnick, 26 pages (Feb. 7, 1975). Order from NTIS as COM 75-10421.

Key words: computers; information systems; mass transportation; telephone systems.

This preliminary analysis of Point-to-Point Trip Management (PTPTM) was prepared for the Urban Mass Transit Administration in Washington, D.C. PTPTM is concerned with providing prospective riders of mass transit with the necessary detailed information for particular trips. This report contains the results of a literature search on automation in the telephone information center, and analyzes the data collected from 29 existing centers. Additionally, on-site visits were made to three operational centers, and tapes of actual telephone inquiries and responses were obtained and analyzed. The use of microfiche and computers are examined as an aid to the operators in these centers. Total automation of these centers is also discussed. Conclusions and recommendations for further study in this area, and an annotated bibliography, are also part of this report.

NBSIR 75-666. **Post optimality and parametric analysis with the National Bureau of Standards' linear programming subroutine RVSMPX,** T. B. Ayers, 47 pages (Feb. 1975). Order from NTIS as COM 75-11381.

Key words: algorithms; linear programming; parametric programming; post-optimality analysis.

This report is a sequel to NBS Report 10695 (February 1972), "The National Bureau of Standards' Linear and Quadratic Programming Subroutines," which documented one phase of an effort to provide users, of the facility operated by the National Bureau of Standards' Computer Services Division, with reliable, clearly-described solution algorithms for selected frequently-arising classes of special mathematical problems. The present report presents subroutines which perform post-optimality analysis and parametric programming studies on linear programming problems solved by the National Bureau of Standards' RVSMPX subroutine. (The present versions of these codes use internal storage only).

NBSIR 75-672. **A preliminary approach to performance requirements and criteria for electrical connections in residential branch circuit wiring,** W. J. Meese, R. L. Cilimberg, and A. A. Camacho, 37 pages (Mar. 1975). Order from NTIS as COM 75-10338.

Key words: branch circuits; contact resistance; electrical codes; electrical connections; fire safety; housewiring; performance testing.

During the Operation BREAKTHROUGH Research and Demonstration program the U.S. Department of Housing and Urban Development became concerned with the inability to properly evaluate innovative electrical connections. Innovation in electrical connections has been very slow because of the long-life requirements, stringent fire safety requirements, long established conventional practices and evaluation procedures and lack of a performance base for describing requirements. This preliminary report presents the framework for a proposed method to evaluate electrical connections on a performance basis and supplements information contained in a previous report on current technology of electrical connections used in residential branch circuit wiring. Innovations involving electrical connections may lead to significant advancements in housing construction if it can be demonstrated that functional and safety requirements over the expected life of electrical connections were adequately satisfied. Research is needed to enable prediction of long-term performance of electrical connections based on the results of accelerated performance tests.

NBSIR 75-673. **Development of a fire test method for flexible connectors in air distribution systems,** L. A. Issen, 31 pages (Apr. 1975). Order from NTIS as COM 75-10921.

Key words: aluminum; ducts; fire tests; flexible connectors; furnace pressures; glass fiber; heat ventilating and air conditioning systems; high-rise buildings; optical density; steel; terminal units.

The report describes fire tests on four flexible connectors of the type used in air conditioning systems. Four flexible connectors (aluminum, felted glass fiber, steel, and woven glass fiber) were exposed to a standard ASTM E-119 fire test. The results were in agreement with previous results in which a different sized branch duct was used in the assemblies. The results indicated a need to control furnace pressures. The test results were used to develop a proposed test method for fire testing flexible connectors. This proposed test method is described in the report.

NBSIR 75-675. **Evaluation of x-ray fluorescence analysis for the determination of mercury in coal,** R. L. Myklebust, M. M. Darr, and K. F. J. Heinrich, 20 pages (Dec. 1974). Order from NTIS as COM 75-10686.

Key words: background; mercury in coal; trace analysis; x-ray fluorescence; x-ray spectrography.

Limits of detection for mercury in coal have been determined on both a wavelength-dispersive and an energy-dispersive x-ray spectrometer. They are between 2 and 3 ppm under best conditions for both spectrometers. Techniques for reducing the background intensity measured by the energy-dispersive system are discussed along with methods of preparing coal specimens for analysis in both instruments.

NBSIR 75-677. **Hazard assessment of aluminum electrical wiring in residential use,** E. D. Bunten, J. L. Donaldson, and E. C. McDowell, 58 pages (Dec. 1974). Order from NTIS as COM 75-10516.

Key words: aluminum wire; consumer product safety; electrical failures; electrical fires; electrical wiring; fire hazards.

In the mid-1960s, aluminum wire began to be used in significant quantities for residential branch-circuit wiring. Reports of problems from various localities in the U.S. raised serious concern and controversy as to the safety of this application. An official determination on this matter is within the jurisdiction of the Consumer Product Safety Commission. This report reviews the history of the use of aluminum in residential wiring and describes the characteristics essential to data to be used to evaluate the performance of aluminum wiring in the field. The examination of existing field data shows that no available data have the characteristics necessary to develop a reliable estimate of the level of risk to consumers associated with aluminum wiring. Neither can the available data be used to establish the relative risk of aluminum compared to copper wiring. There is only a gross estimate of the extent to which aluminum wiring is now in use in U.S. residences. Statistically sound estimates of risk would be possible only after data collection on a large scale.

NBSIR 75-679. **Measurements of the behavior of incidental fires in a compartment,** J. B. Fang, 29 pages (Mar. 1975). Order from NTIS as COM 75-10419.

Key words: buildings; combustibility; fire intensity; flames; furnishings; heat release; ignition; smoke; thermal radiation; upholstery; waste receptacle.

A variety of upholstered chairs and wood cribs were burned within a ventilated compartment. The experimental measurements of weight loss, smoke concentration, temperature and heat flux levels are summarized. A reproducible fire obtained from burning a standardized wood crib array was found to be capable of representing the essential features of incidental fires of moderate intensity.

NBSIR 75-680. **Mobile home construction standards adopted by state regulatory programs—an analysis,** P. W. Cooke, L. P. Zelenka, and H. K. Tejuja, 107 pages (Mar. 1975). Order from NTIS as COM 75-10423.

Key words: enforcement; legislation; mobile homes; regulation; standards; state-of-the-art study.

This study examines the extent to which the nationally recognized standard for the construction of mobile homes (i.e., ANSI Standard A119.1/NFPA 501B) has been adopted and amended by the individual States that have implemented enforcement programs for the regulation of mobile homes. Summary data is presented on the existing status of the various versions of the standard adopted in each State. State-adopted amendments to the technical requirements in the national standard are compiled by State and construction discipline for comparative analysis.

NBSIR 75-682. **Basic considerations of densitometer adjustment and calibration,** R. E. Swing, 18 pages (Feb. 3, 1975). Order from NTIS as COM 75-10524.

Key words: calibration; calibration table; densitometer; densitometry; optical density; optical density standard.

The adjustment and calibration of a densitometer are considered. This is accomplished through the use of physical measurement standards with a procedure appropriate for the instrument, and brings the instrument response in line with measurements traceable to NBS. The difference between primary and secondary physical measurement standards for diffuse (visual) density is discussed. A calibration table is suggested for best use of the instrument and a computer program (BASIC language) is provided that will calculate and print a table relating instrument reading to diffuse (visual) density.

NBSIR 75-685. **Improved ultrasonic standard reference blocks,** D. G. Eitzen, G. F. Sushinsky, D. J. Chwirut, C. J. Bechtoldt, and A. W. Ruff, 83 pages (Apr. 1975). Order from NTIS as COM 75-10690.

Key words: aluminum ultrasonic standards; ASTM-type reference blocks; fabrication of reference blocks; immersion testing; longitudinal waves; metallurgical variables; nondestructive testing; pulse-echo; steel ultrasonic standards; titanium ultrasonic standards; ultrasonics.

A program to improve the quality, reproducibility and reliability of nondestructive testing through the development of improved ASTM-type ultrasonic reference standards is described. Reference blocks of aluminum, steel, and titanium alloys are to be considered. Equipment representing the state-of-the-art in laboratory and field ultrasonic equipment was obtained and evaluated. RF and spectral data on ten sets of ultrasonic reference blocks have been taken as part of a task to quantify the variability in response from nominally identical blocks. Techniques for residual stress, preferred orientation, and micro-structural measurements were refined and are applied to a reference block rejected by the manufacturer during fabrication in order to evaluate the effect of metallurgical condition on block response. New fabrication techniques for reference blocks are discussed and ASTM activities are summarized.

NBSIR 75-687. **Effective use of computing technology in vote-tallying,** R. G. Saltman, 140 pages (Mar. 1975). Order from NTIS as COM 75-11137.

Key words: computer security; computing technology; election administration; public administration; state and local government; systems analysis; technology utilization; vote-tallying.

The results of a systems analysis and evaluation conducted on the role of automatic digital processing in vote-tallying are presented. Included in the report are descriptions of hardware, software, and administrative problems encountered in fourteen elections in which electronic computing technology was utilized.

Methods of assuring more confidence in the accuracy and security of the vote-tallying process are presented and described. These methods include aids to audits of calculations, physical controls over ballots and computer records, and guidelines for the use of computer programs, computer facilities, and teleprocessing. Methods of improving the election preparation process also are presented and described. These involve the development and implementation of design specifications and acceptance tests for computer programs, election equipment and supplies, and guidelines for pre-election checkout of vote-tallying systems and for assurance of management control.

Institutional factors are discussed which should be considered if improved accuracy and security controls and more effective election preparations are to be implemented. Recommendations for additional research and other activities including a possible Federal role are provided.

NBSIR 75-688. **Performance of mobile homes—A field inspection study,** L. F. Skoda, J. H. Pielert, W. E. Greene, and W. G. Street, 119 pages (June 1975). Order from NTIS as COM 75-11222.

Key words: enforcement process; field inspection; house trailers; housing; Hurricane Agnes; mobile homes; performance data; standards.

A field inspection study of mobile homes was conducted for the Department of Housing and Urban Development. The objective of the study was to evaluate the causes of mobile home problems by physically inspecting available units at various locations in the United States. A total of 257 units were inspected consisting mostly of mobile homes purchased by HUD and used as temporary housing for victims of the 1972 Hurricane Agnes disaster. The total number of problems found was 3,528 for the 257 units inspected. Of these problems, 2120 were directly related to inadequacies in the ANSI A119.1 Standard for Mobile Homes or the mobile home enforcement process (plan review, certification of designs, plant inspection), 934 were routine maintenance problems, and 374 were attributed to mechanical/electrical appliances and equipment. This report presents a computer listing of all problems plus photographic examples of observed problems.

The number of mobile homes included in this study is small when compared to the total number of mobile homes now in use in the United States. Additionally, this was a problem oriented study and did not attempt to document the many areas of satisfactory mobile home performance.

NBSIR 75-689. **The Shirley Highway Express Bus-on-Freeway demonstration project/a study of park-and-riding,** J. T. McQueen, G. K. Miller, and C. Harrison, 51 pages (Mar. 1975). Order from NTIS as COM 75-11190.

Key words: bus-on-freeway operations; commuter surveys; mode choice decisions; park-and-ride; Shirley Highway; transportation planning.

The market for fixed route transit operations is not limited to travelers within walking distance of transit stops. This was demonstrated by the Shirley Highway Express-Bus-on-Freeway Project as project promoted park-and-ride operations led to sizable increases in bus patronage: Park-and-riders, commuters who traveled by auto to a bus stop and then by bus to work, greatly expanded the market for the fixed route bus service in the Shirley Highway Corridor area.

This report presents results of a study of the successful park-and-ride operation within the Shirley Highway Corridor area: Suburban fringe parking lots coupled with the high speed buses of the Shirley Highway Express-Bus-on-Freeway Project. Demographic characteristics of the park-and-riders as well as characteristics of their present park-and-ride and previous commute trips are examined. Factors important in the commuters' decisions to park-and-ride are identified. The report also describes the survey procedures used in the study.

NBSIR 75-690. **A compilation of problems related to the performance of mobile homes,** W. G. Street, W. E. Greene, J. H. Pielert, and L. F. Skoda, 86 pages (Apr. 1975). Order from NTIS as COM 75-11207.

Key words: computer techniques; enforcement process; housing; Hurricane Agnes; mobile home parks; mobile homes; performance data; standards.

Performance of mobile homes as housing units is of broad concern to mobile home owners. This study report prepared at the National Bureau of Standards (NBS) and funded by the Department of Housing and Urban Development (HUD) presents mobile home problem data obtained from two separate data sources. The first data base for 2881 units was selected from maintenance records retained by HUD on 12,500 mobile homes used as emergency housing following the Hurricane Agnes disaster at Wilkes-Barre, Pennsylvania. The second source consisted of data for 967 privately-owned units collected from the files of various Federal, state, and private agencies responsible for regulation or consumer protection functions with regard to mobile homes. The mobile home performance problem data was processed using computer techniques to produce problem summation tables which facilitated evaluation. Although the mobile home problems experienced in various categories are highlighted in this report, no attempt was made to relate these results to current standards, regulatory or mortgage insurance (durability) processes. Analyses of this kind are planned for future reports in this series.

NBSIR 75-691. **A characterization and analysis of NBS corridor fire experiments in order to evaluate the behavior and performance of floor covering materials,** J. G. Quintiere, 89 pages (June 1975). Order from NTIS as COM 75-11015.

Key words: corridor fire spread; energy release rate; fire induced flow; flame propagation; flashover; floor coverings; radiant heat flux.

Data is presented for four fire experiments which examine the fire propagation from a room fire to a floor covering material in a corridor. The four floor covering materials include a nylon and an olefin carpet, vinyl sheet, and red oak flooring. Limited flame spread occurred for the vinyl sheet material; however, the three other materials involved full fire propagation in the corridor. The data are analyzed to examine the factors influencing fire propagation. Included in this analysis is the rate of energy contribution from the room fire and floor covering material, the rate of flame spread, heat transfer to the floor covering, and flow interactions between the room and corridor. A review of previous related experiments is also presented.

NBSIR 75-693. **Measurement methodology for determining the sound output of model airplanes and noise producing bicycle attachments,** M. A. Cadoff and W. A. Leasure, Jr., 24 pages (Apr. 1975). Order from NTIS as COM 75-11194.

Key words: bicycle attachments; children; consumer safety; model airplanes; noise; toys.

In recent years, a great concern has been expressed for consumer protection and safety, especially for children. As an outgrowth of this concern, acoustical testing of potentially-hazardous noise producing toys has been carried out at the National Bureau of Standards for the Consumer Product Safety Commission under the authority of the Toy Safety Act of 1969. This report outlines a methodology which was developed to measure the noise levels of model airplanes and noise producing bicycle attachments. The technical back-up and rationale for the development of the methodology are discussed. In addition, data taken using the proposed methodology are presented.

NBSIR 75-696. **Proceedings of GSA/ETIP Symposium on Procurement Practices, May 29-31, 1974,** 96 pages (Jan. 1975). Order from NTIS as COM 75-10527.

Key words: ETIP; incentives; innovation; procurement; product improvement; specifications.

The topic of the symposium was "Government and Industry—A Joint Effort Toward Technological Innovation in Product Development for Government and Public Procurement." The general objectives of the symposium were to open government-industry dialogue on ways to encourage technological innovation in the development of products purchased by the Federal Government; to explore methods of developing a "spin-off" effort so that the consumer marketplace might benefit from such innovations; to set up a procedure for analyzing the effect on the consumer marketplace and to establish procedures for continuing a government-industry dialogue. The plenary session provided participants with information designed to generate dialogue and to develop source material. Workshops were organized to consider specific product grouping in: Office Machines (typewriters, calculators, copiers, and microfiche); Furniture (wood and metal office types); Containerization/Packaging; ADP-Peripheral/Supplies; Instrumentation (optical and electrical measuring devices); Electrical Equipment (appliances and powered hand tools); Automotive Products (after market replacement parts and tires); Photographic and Audio Visual; Chemical (coatings, cleaning agents and detergents).

NBSIR 75-697. **Consideration in the use of sampling plans for effecting compliance with mandatory safety standards,** V. L. Broussalian, A. J. Farrar, U. W. Lyons, C. O. Muehlhause, M. G. Natrella, J. R. Rosenblatt, R. D. Stiehler, and J. H. Winger, 58 pages (June 1975). Order from NTIS as COM 75-10920.

Key words: quality assurance; regulation; safety standards; sampling plan; sampling scheme.

Various means available to a regulator for gaining compliance with mandatory safety standards are examined. Particular attention is given to his option of mandating a sampling plan or scheme along with the standard. It is concluded that this option as well as the others identified are all viable under suitable conditions and should be available to the regulator for his possible application on a case by case basis.

NBSIR 75-699. **The calibration of photographic edges at NBS,** R. E. Swing, 37 pages (Apr. 22, 1975). Order from NTIS as COM 75-11016.

Key words: acutance; calibration; computer programs; microdensitometry; photographic edges; transfer function.

The method by which photographic edges made at NBS are calibrated is presented and discussed in some detail. The programs associated with the computational aspects of the analysis are listed, covered in narrative form, and their limitations and options are presented. The possible use of these edges to determine microdensitometer transfer function is discussed and limitations and relative error of all the calculations and procedures are covered in detail. Program listings are in BASIC language.

NBSIR 75-700. **Results of full-scale fire tests with photoelectric smoke detectors,** R. W. Bukowski and R. G. Bright, 55 pages (Sept. 1975). Order from NTIS as COM 75-11280.

Key words: fire detectors; ionization chamber smoke detectors; photoelectric smoke detectors; smoke detectors; Taguchi gas sensors.

In February 1974, a series of full-scale fire tests were conducted to determine whether photoelectric-type smoke detectors could respond to the same types of fires used to assess the performance of ionization-type smoke detectors. The types of fires employed in the tests are the same as those outlined in Underwriters' Laboratories, Inc., Standard No. 167. In addition to the UL-167 standard fires, fires involving polyurethane (flaming mode) and cotton (smoldering mode) were added to the test series. One detector, utilizing a Taguchi gas sensor (TGS), was included in the test series for evaluation purposes. The test results indicated that the better photoelectric smoke detectors, i.e., those having little obstruction to slow-moving smoke can, in general, detect the same test fires as the ionization chamber smoke detectors in approximately the same time scale. For the smoldering cotton fire, the photoelectric detectors were significantly faster than the ionization chamber detectors. The TGS fire detector was unable to detect most of the test fires.

NBSIR 75-701. **Evaluation of smokeproof stair towers and smoke detector performance,** F. C. W. Fung and R. H. Zile, 23 pages (Sept. 1975). Order from NTIS as COM 75-11282.

Key words: high-rise buildings; photoelectric smoke detector; smoke control; smoke movement simulation; smokeproof tower.

A study was made by the National Bureau of Standards to evaluate the effectiveness of a smokeproof stairwell tower installed in a high-rise apartment building. Tests were also made of photoelectric-type corridor smoke detectors. A quantitative experimental technique of smoke simulation and smoke movement measurement was used. Factors diminishing the effectiveness of the stair towers, preventing smoke infiltration and limiting the response of the detectors, are noted.

NBSIR 75-702. **Design criteria for firefighters' turnout coats,** J. W. Eisele, 37 pages (Oct. 1975). Order from NTIS as COM 75-11433.

Key words: firefighters; firefighter's turnout coats; protective clothing.

These design criteria cover requirements for the sizing, construction, outer shell, inner linings, weight, and thickness for firefighters' turnout coats as well as test methods, labeling requirements, and design considerations. Included also is a list of options and other items of concern to potential users of the criteria and a sample purchase specification to be used in conjunction with the criteria.

NBSIR 75-703. **A failure hypothesis for masonry shearwalls,** F. Y. Yokel and S. G. Fattal, 38 pages (May 1975). Order from NTIS as COM 75-11278.

Key words: brick; failure; failure theories; masonry; shear strength; shear test; shear walls; stress distribution; stresses; structural engineering.

Various failure hypotheses for wall panels subjected simultaneously to diagonal compressive load and to vertical compressive edgeload are compared with the results of thirty-two tests on four types of brick masonry walls which were published elsewhere. It is concluded that failure can occur by joint separation or by splitting. A failure hypothesis is advanced which is shown to be in good agreement with the test results examined.

NBSIR 75-705. **Thermal and flow characteristics of the ASTM E 84 tunnel test method,** J. G. Quintiere and J. W. Raines, 38 pages (Sept. 1975). Order from NTIS as COM 75-11217.

Key words: ASTM E 84; carpets; energy balance; flame spread; mass balance; test method.

Five experiments were conducted using an ASTM E 84 tunnel test facility. These included a calibration test, three standard tests involving carpet materials, and one test in which a carpet material was tested on the floor of the duct. In addition to the measurements recorded during a standard test, instrumentation was added to measure inlet air velocity, temperature within the test section of the duct, and heat flux. From these measurements mass and energy balances were determined for each experiment. The results indicate that inlet air mass flow rate dropped during a test and appears to depend on the extent of burning in the duct. The energy balance results indicate that for the calibration run about half of the energy of the gas burner is lost by radiation and convection to the walls in the test section of the tunnel. During combustion of a test specimen, significant energy losses occur in the last 9 feet of the test section even after the flame tip has reached the exit of the tunnel.

NBSIR 75-707. **Tamper-resistant television surveillance system,** O. B. Laug and K. W. Yee, 38 pages (May 1975). Order from NTIS as COM 75-11017.

Key words: safeguards; surveillance; tamper-resistant; television.

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This report describes a tamper-resistant television system. This system will be part of a larger system used for verifying compliance with certain international arms control or safeguard agreements. This work is part of a joint U.S.-Canada safeguards research program to develop and evaluate tamper-resistant, tamper-indicating techniques and instrumentation that might be applicable in safeguarding reactors or other nuclear facilities. The principal design objectives are to provide a system capable of unattended operation, data storage capacity for a period up to 90 days, and resistance to deception by insertion of false video information on the transmission line or substitution of false scenes in the camera's field of view. These objectives are accomplished by utilizing commercial high-resolution closed-circuit TV and photography coupled with a video encoding technique which permutes the luminance signal in a different pattern for each recorded picture. Motion detectors, utilizing the video signal, provide the ability to selectively record pictures when motion occurs in preselected areas, and protect the system against insertion of false scenes. The incorporation of these additional features adds comparatively little complexity to ordinary closed circuit TV while greatly increasing its effectiveness as a surveillance tool for safeguards applications.

NBSIR 75-708. **Development of a dynamic pressure calibration technique—A progress report,** C. F. Vezzetti, J. S. Hilten, and P. S. Lederer, 20 pages (June 5, 1975). Order from NTIS as COM 75-10817.

Key words: calibration; dynamic; liquid column; pressure; sinusoidal pressure; transducer.

Work continues on the development of a method of producing sinusoidally varying pressures of at least 34 kPa zero-to-peak with amplitude variations within ± 5 percent up to 2 kHz for the dynamic calibration of pressure transducers.

Sinusoidally varying pressures of 34 kPa zero-to-peak have been produced, to date, between 40 Hz and 750 Hz by vibrating a 10-cm column of a dimethyl siloxane liquid at 36 g_n zero-to-peak. Damping of the liquid column was accomplished by packing the fixture tube with a number of smaller diameter tubes.

NBSIR 75-710. **A small-scale enclosure for characterizing the fire buildup potential of a room,** W. J. Parker and B. T. Lee, 23 pages (June 1975). Order from NTIS as COM 75-11030.

Key words: fire growth; fire tests; flashover; room fires; scale models; thermal radiation.

A 0.76 by 0.76 m (30 by 30 inch) enclosure with a 0.61 m (24 inch) high ceiling was used to model some fires in a $3 \times 3 \times 2.4$ m ($10 \times 10 \times 8$ ft) burnout room. Temperatures, oxygen concentrations, air velocity, and conductive and radiative heat fluxes were measured. The highest average air temperature in the upper part of the room was taken as a measure of the fire buildup potential of the room. Upper air temperatures attained in the model were similar in most cases to those in the full-scale compartment. From energy balance considerations this air temperature was related to the oxygen depletion in the room and was shown to correlate well with the oxygen content of the combustion gas and air exhausting from the model and full-scale room fires.

NBSIR 75-711. **Site analysis and field instrumentation for an apartment application of a total energy plant,** J. B. Coble and P. R. Achenbach, 65 pages (May 1975). Order from NTIS as COM 75-10689.

Key words: air conditioning; air pollution; central utility systems; data acquisition system; efficiencies; electrical power; energy conservation; energy costs; fuel utilization; heat recovery; total energy systems; utilities for housing; utility system performance.

Under sponsorship of the Department of Housing and Urban Development, the National Bureau of Standards developed criteria in a feasibility study to select a site for, and to evaluate the requirements of a total energy system on one or more OPERATION BREAKTHROUGH housing sites. The total energy system produces its own electrical, heating and cooling energy services independent of the local utility system. Six OPERATION BREAKTHROUGH sites were selected for the feasibility study: Jersey City, N.J.; Macon, Ga.; Memphis, Tenn.; Indianapolis, Ind.; St. Louis, Mo.; and Sacramento, Calif. Ranking parameters for final selection were: number of dwelling units, density of dwelling units, climatic factors, energy utilization, owning and operating costs, and developer's attitude.

The Jersey City site was chosen as the location for the installation, evaluation, and field study of the total energy system. The site covers six acres, has four apartment buildings containing 488 dwelling units, a 50,000-sq.ft commercial building, an elementary school, a swimming pool, and the total energy plant.

The buildings and the total energy plant are being extensively instrumented to provide data on fuel utilization, system efficiencies, electrical and thermal energy generation, energy utilized and rejected. The environmental impact of the total energy plant with respect to noise, vibration, air pollution, and esthetics is under evaluation. The installed system will be compared with several types of conventional energy systems.

NBSIR 75-712. **Solar heating and cooling in buildings: Methods and economic evaluation,** R. T. Ruegg, 47 pages (July 1975). Order from NTIS as COM 75-11070.

Key words: economic optimization; HVAC systems; life-cycle cost analysis; solar energy; solar heating and cooling.

This report addresses economic issues important to the design, and evaluation of solar heating and cooling systems in buildings. It explains and illustrates with simple, but realistic examples the use of life-cycle cost analysis and benefit-cost analysis to evaluate and compare the economic efficiency of solar and conventional energy systems. It also explains the conditions for making cost-effective tradeoffs in solar system/building design. By presenting the basic methods and assessing the appropriateness of alternative assumptions, the paper provides a resource document for researchers and analysts.

NBSIR 75-713. **A file management system for a laboratory automation facility,** P. S. Shoenfeld and L. J. Kaetzel, 54 pages (June 1975). Order from NTIS as COM 75-11134.

Key words: data acquisition; file system; laboratory automation; multiprogramming; operating system; real-time.

The National Bureau of Standards' Analytical Chemistry Division operates a centralized laboratory automation facility built around a multiprogrammed minicomputer. A file manager was developed which allows the dynamic creation and manipulation of sequential disk files. Although the system was developed for real-time data acquisition, it is a general purpose addition to the computer's operating system and may be used for a variety of applications. A new operating system function was developed to allow the queued scheduling of programs. This is used to achieve more efficient multiprogramming. A comprehensive file utility package is also provided.

NBSIR 75-714. **Report on test on a sample of non-standard size baby cribs,** R. Pierson, Jr., R. I. Beall, and J. A. Huckeba, 33 pages (June 1975). Available from the author, NBS, Washington, D.C. 20234.

Key words: baby cribs; children's furniture; product safety; product testing; safety regulations; standard development.

A sample of non-standard size baby cribs was tested for compliance with the Consumer Product Safety Commission's Proposed Regulation for Non-Standard Size Baby Cribs in order to evaluate the Proposed Regulation, especially the tests and test procedures. The test procedures were found to be easy to interpret and to carry out. This report presents the results obtained from testing the cribs for compliance with the Proposed Regulation, a detailed description of some of the hazards, and some evaluative comments on the Proposed Regulation.

NBSIR 75-715. **The implementation of a provision against progressive collapse,** F. Y. Yokel, J. H. Pielert, and A. R. Schwab, 23 pages (Aug. 1975). Order from NTIS as COM 75-11208.

Key words: building systems; housing systems; large-panel structures; precast concrete construction; progressive collapse; structural design; structural joints.

The design solutions used by five U.S. precast concrete housing systems to comply with a provision against progressive collapse are studied and compared. Some common characteristics of the design solutions are identified.

NBSIR 75-716. **Proceedings of procurement practices symposium, Federal, State and local, January 28-30, 1975,** T. J. Fody and J. G. Berke, 168 pages (May 1975). Order from NTIS as COM 75-11210.

Key words: certification programs, ETIP; incentives; innovation; life cycle costing; procurement; product testing; specifications; unsolicited proposals.

The general objectives of the conference are to recommend ways to encourage information interchange and interaction between federal, state and local procurement levels and industry; to explore the use of special incentives such as life cycle costing, value incentives clauses, and unsolicited proposals as a means to promote innovation in products purchased by all levels of government; to establish the interrelationship between marketing, R&D and procurement and develop approaches to acquire the latest technology through the procurement process; to explore various product testing and evaluation efforts such as certification programs, tests by independent, company owned and association laboratories, university and government laboratories. Workshops were organized to consider procurement mechanisms, information interchange, testing and evaluation of products, and the interrelationship between marketing, R&D and procurement. Workshops were grouped as follows: (1) Procurement Incentives, (2) Interaction and Information Interchange, (3) Marketing, R&D and Government Procurement Cycles, (4) Product Testing and Evaluation, (5) Qualified Products Lists and Bid Samples, (6) Qualified Manufacturers, (7) Methods and Techniques of Contracting.

NBSIR 75-718. **Report of fire test on an AM General Metro Bus,** E. Braun, 21 pages (June 1975). Order from NTIS as COM 75-10750.

Key words: AM General Bus; arson; critical radiant flux; fire retardant; flammability; flooring radiant panel test; Metro; motor vehicle safety standard 302; urethane.

The Center for Fire Research at the National Bureau of Standards has conducted a study of the fire safety of a bus supplied by the Washington, D.C., Metropolitan Transit Authority. The objectives of the work were: (1) to determine the minimum ignition from source necessary to initiate a fire in the bus, and (2) to determine the means by which a fire, once started, is most likely to grow and spread.

A series of small-scale laboratory tests were run in addition to the three full-scale tests. Tests showed that accidental ignition by a cigarette or dropped match is unlikely. However, the seat can be ignited with one or two matches, if applied at the proper location, as by an arsonist. In full-scale tests, ignition of the seat occurs readily with the following ignition sources: (1) a small bag of paper trash on the seat, (2) a newspaper under the seat, (3) if the contents of a can of lighter fluid is poured on the seat.

Fire growth and spread in the bus is primarily through involvement of the seat cushioning. Fire spreads from seat to seat with little direct involvement of other interior materials. In all three tests, between one and two minutes after the urethane ignited, dense smoke filled the bus space seriously reducing visibility. Spread of fire beyond the seat of origin is not necessary for the level of smoke to be formed.

NBSIR 75-721. **Economic objectives of utility companies and developers in evaluating a MIUS,** B. J. Bartter, 39 pages (Nov. 1975). Order from NTIS as PB246864.

Key words: economic incentives; housing development; integrated utilities; utilities.

This report provides information to the Department of Housing and Urban Development-Modular Integrated Utility System (HUD-MIUS) program about the *economic* decision-making process for implementation of a MIUS by utility companies, developers, and a combination of these two groups.

Information was obtained through informal telephone interviews from these participant groups about their economic analysis of utility investment alternatives. The content of these conversations was synthesized into economic criteria which are perceived by each participant to be most important in evaluating alternative utility investments. From the analysis of these economic criteria, the possible combinations of participants and roles in the implementation of a MIUS are specified. These combinations are ranked, according to the degree of likelihood that each method will actually be employed.

The conclusion of this report is that a MIUS is most likely to be implemented by a governmental body, such as a municipal utility or governmental developer.

NBSIR 75-723. **Aluminum branch circuit wiring in residences summary report for the Consumer Product Safety Commission January-September 1974,** J. Rabinow, 91 pages (June 1975). Order from NTIS as COM 75-10753.

Key words: aluminum wire; consumer product safety; current cycle testing; electrical connection failure; electrical receptacles; residential wiring.

This report is a compendium of information on aluminum wiring in residences, originally prepared for the Consumer Product Safety Commission. It contains a summary of experimental research carried on at the NBS laboratories on the problems of terminating aluminum wires to screw connections as well as other pressure connectors. Since this report is an overview of the technical aspects of the aluminum wiring problem, it also contains a review by NBS staff members of available material furnished by Underwriters Laboratories and Battelle Institute. Both of these institutions are major contributors to this particular field of information.

The report also includes abstracts by NBS staff of some four volumes of testimony taken at public hearings at Washington, D.C. and Los Angeles, California during the spring of 1974. Additional information on the pertinent physical properties of aluminum, information on failure mechanisms, possible corrective actions, connector cycling tests, etc., is given in a brief literature survey and two relevant memoranda on the subject. The report concludes with a fairly extensive bibliography.

NBSIR 75-729. **Nondestructive tests to determine concrete**

strength—A status report, J. R. Clifton, 39 pages (July 1975). Order from NTIS as PB246858.

Key words: compressive strength; concrete; flexural strength; formwork removal; nondestructive testing; surface hardness.

Individual and combined nondestructive test methods have been critically reviewed as potential methods to determine safe formwork removal times. The techniques reviewed are the Windsor probe, the Schmidt Rebound Hammer, pull-out measurements, push-out cylinders, ultrasonic pulse velocity measurements, and the maturity and equivalent age concepts. The individual methods themselves do not give good estimates of the in situ strengths of concretes and it is recommended that future research emphasize combined methods.

A proposed research program which emphasizes combined nondestructive test methods has been developed.

NBSIR 75-730. **Equilibrium penny-like crack in indentation fracture,** B. R. Lawn and E. R. Fuller, Jr., 28 pages (Sept. 1975). Order from NTIS as COM 75-11461.

Key words: contact fracture; degradation; Hertzian cracks; indentation fracture; median vents; penny crack.

A study is made of the mechanics of two basic types of indentation fracture, *cone cracks* ("blunt" indenters) and *median cracks* ("sharp" indenters). The common feature which forms the central theme in this work is that both crack types, in their well-developed stages of growth, may be regarded as essentially "penny-like." On this basis a universal similarity relation is derived for equilibrium crack dimension as a function of indentation load. Experimental measurements confirm the general form of this relation. A more detailed fracture mechanics analysis is then given, to account for additional contact variables evident in the data. Notwithstanding certain analytical limitations, the study serves as a useful basis for investigating a wide range of contact-related problems, both fundamental and applied, in brittle solids.

NBSIR 75-731. **A study of air-gap breakdown at 28.5 kilohertz,** F. R. Kotter, 42 pages (June 20, 1975). Order from NTIS as COM 75-11071.

Key words: air gap; electrical breakdown; insulator flashover; lightning protection; VLF antenna; voltage breakdown.

Measurements of the electrical breakdown of both quasi-uniform and highly nonuniform-field air gaps at a frequency of 28.5 kHz are reported. Gaps between a variety of electrode geometries ranged from a few centimeters to over two meters in length.

Breakdown voltages significantly below the corresponding 60 Hz values were observed with electrodes for which appreciable pre-breakdown discharges occurred, and a pattern of "anomalous" flashovers at considerably lower than the normal breakdown voltages was noted with quasi-uniform field gaps. The results obtained appear to correlate well with the data found in the literature for higher frequencies but lower voltages.

On the basis of the gap behavior observed, a prototype protective gap system designed for application to the tower base insulator assembly of a VLF (15 to 30 kHz) radio transmitter was tested and found satisfactory.

NBSIR 75-732. **NBS InterAgency transducer project—A project report,** P. S. Lederer, J. S. Hilten, and C. F. Vezzetti, 23 pages (June 27, 1975). Order from NTIS as COM 75-11022.

Key words: calibration; dynamic, electronic flash; photoflash bulb; pressure; pressure transducer response; thermal transient; transducer.

The continuing development of a test method for evaluating the effects of short-duration thermal radiant-energy transients on pressure transducer performance is described. The method consists of monitoring pressure transducer output as the transducer is exposed to radiation resulting from the ignition of a photographic flashbulb or from the discharge of an electronic flash. Precision of the method is to be at least adequate for the method to serve as a first-cut screening test. During this reporting period, the following three parameters were investigated for each of three radiation sources: (1) the amount of energy per unit area available as a function of distance from the source, (2) the response of a selected transducer as a function of distance from the source, and (3) flash duration. Repeatability of the method for each source was determined. Work being performed for other agencies is also described briefly.

NBSIR 75-733. **An evaluation of proposed safety requirements for infants' pacifiers,** S. D. Toner and H. A. Baker, 20 pages (Aug. 1975). Order from NTIS as COM 75-11139.

Key words: consumer products, CPSC proposed regulation; pacifiers; product safety; safety requirements; safety testing.

This report is concerned with a review of a regulation proposed by the Consumer Product Safety Commission on the safety of infants' pacifiers. In addition, the results of a laboratory evaluation of the efficacy of various requirements and testing procedures are given.

NBSIR 75-734. **Report on an investigation of the high speed hazards of steel belted patrol tires on police patrol cars,** J. J. Collard, 51 pages (June 1975). Order from NTIS as COM 75-11212.

Key words: certification of steel belted radial tires; high speed radial tire hazard; radial tire failures.

Two police fatalities and one permanent disability have been caused by catastrophic failures of steel belted radial ply tires during high speed police operations. More than 200 other failures were reported by one State highway patrol department. The report recommends that police departments use caution in selecting tires for patrol cars, and that tire manufacturers be required to provide evidence that the tires sold for police use have been tested and certified at speeds of at least 125 miles per hour.

NBSIR 75-736. **Fire research publications, 1974,** N. H. Jason, 11 pages (June 1975). Order from NTIS as COM 75-11018.

Key words: bibliographies; building fires; construction materials; fire departments; fire tests; flame spread test; flammability tests; flammable fabrics; Operation BREAKTHROUGH; protective clothing.

"Fire Research Publications, 1974" is a supplement to the previous editions which covered the years 1969-1972 (NBSIR 73-246) and 1973 (NBSIR 74-511). Only publications prepared by the members of the Center for Fire Research (CFR), by National Bureau of Standards (NBS) personnel under contract or grant to the CFR, or by NBS personnel or external laboratories under contract or grant from the CFR are cited. Articles published in NBS house organs also are cited.

NBSIR 75-737. **Mathematical methods of site selection for electronic message systems (EMS),** C. Witzgall, 44 pages (June 1975). Order from NTIS as COM 75-11472.

Key words: communication; cost-benefit; deployment; electronic transmission; facility location; mail; mathematical programming; message network synthesis; network optimization; satellite; service improvement.

The concept of electronic message (mail) transmission has been the subject of several feasibility studies during the past decade. It requires the installation of electronic message handling facilities at selected locations. If transmission is to be via communications satellite, then any such facility can transmit to and receive from any other one. In this report, the mathematical aspects of choosing the number and locations of these facilities are examined. An inventory of solution methods is presented, along with recommendations as to which among them should be employed or developed further.

NBSIR 75-738. **A method and means of calibrating an air-bearing force plate for use with a towed pavement friction test trailer,** R. W. Kearns and J. F. Ward, 40 pages (Dec. 1974). Order from NTIS as COM 75-11279.

Key words: calibration procedures; force plate; pavement skid resistance; skid accident reduction; tire-pavement interface forces.

The equations for the variation of the external forces acting at the tire-pavement interface of a symmetrical two-wheeled towed trailer are given. Estimates, derived from experimental results, have been made for the displacement of the tire-plate interface with respect to the ground of an unrestrained locked test tire on the trailer. A description of the force plate calibration test frame, instrumentation and test method is given. The means of applying simultaneous vertical (normal) and horizontal (longitudinal) forces at the contact surface of the air-bearing plate in accordance with the equations are discussed. The change in force plate output with changes in the dimensions of the trailer calibrated in-turn with the force plate are given. A method of locating the coordinate axes of the internal force sensors with respect to level is given. Consistent application of these methods to both the force plate and trailer transducer calibrations results in reduced vertical-to-horizontal cross-axis differences.

NBSIR 75-739. **Development of specifications for archival record materials,** W. K. Wilson and E. J. Parks, 19 pages (Mar. 1975). Order from NTIS as COM 75-11189.

Key words: accelerated aging; natural aging; permanence; record materials; record papers; stability.

A specification for copies from office copying machines for permanent records has been prepared and is progressing through a standards organization. A project on the effects of 36 years of natural aging on a group of book papers of known composition was completed and reported. Work on the accelerated aging of handsheets at various relative humidities is incomplete, but data already obtained show that a low relative humidity is desirable in an accelerated aging procedure. Data on the sorption of oxygen by papermaking pulp at elevated temperatures are inconclusive.

NBSIR 75-740. **Piezoelectric polymer transducer for impact pressure measurement,** A. S. DeReggi, 39 pages (July 1975). Order from NTIS as COM 75-11127.

Key words: calibration; construction; impact; interface; piezoelectric polymer; polymer; pressure; pressure transducer; theory; transducer.

Described are development efforts relating to the design, construction, and calibration of a piezoelectric polymer transducer for the recording of pressure transients developed over the interface between two bodies as a result of impact. A bilaminate design was selected which uses electrically poled sheets of 25-μm poly(vinylidene fluoride) as the active material. The intended primary response of the transducer is to compression in the thickness direction, which is produced by either hydrostatic or normal pressure; the transducer was also found to respond to extension in the membrane direction. Individual-sheet activity in the thickness-compression mode is approximately 15 pC/N, resulting in a bilaminate transducer pressure response of 4.5 μV/Pa(30 mV/psi). Instructions for poling sheets and for constructing transducers are given in detail. Static and dynamic methods for characterizing transducer output are described. In particular, in order to simulate field conditions in which the transducer may bend or stretch, or both, during impacts, a drop-test procedure with curved impactors has been devised and a theoretical analysis (simplified to the extent of considering the membrane-stress contribution negligible) has been developed to yield the interface pressure.

NBSIR 75-741. **Mechanistic studies of triphenylphosphine oxide-poly (ethyleneterephthalate) and related flame retardant systems,** J. W. Hastie and C. L. McBee, 45 pages (Aug. 1975). Order from NTIS as COM 75-11136.

Key words: flame retardancy; mass spectrometry; optical spectroscopy; phosphorus; polyester.

A combination of mass spectrometric and optical spectroscopic studies has been made to establish a mechanism for phosphorus controlled flame retardancy in thermoplastics. It is shown that a vapor phase mode of flame inhibition can account for the known flame retardancy effect of triphenylphosphine-oxide in polyester substrates.

NBSIR 75-744. **Proposed implementation for development of user-terminal protocols for computer network access,** A. J. Neumann, 16 pages (July 1975). Order from NTIS as COM 75-11072.

Key words: command languages; computer; man-machine systems; networks; system commands; user protocols.

This report summarizes activities undertaken at the National Bureau of Standards in the area of User-Terminal Protocol Standardization with support from the National Science Foundation, during the latter part of 1974 and 1975. Also discussed are present status of related standardization activities in areas of command languages, terminal keyboards, and terminology. Legal implications of standardization are indicated, and establishment of a Federal Task Group for Standardization is proposed to work under the Federal Information Processing Standards Coordinating and Advisory Committee (FIPSCAC).

NBSIR 75-745. **A model for salmon fishery regulatory analysis,** F. C. Johnson, 33 pages (July 10, 1975). Order from NTIS as PB247657.

Key words: fisheries; fishery; fishery modeling; mathematical modeling; regulatory analysis; resource management; salmon fisheries; salmon fishery modeling; simulation; State of Washington; Washington State; Washington State Fisheries.

The salmon fishery modeling project is a joint State-Federal program for the development of improved techniques for analyzing the economic and biological effects of regulatory changes in the Pacific Coast salmon fisheries. This interim report covers the second segment of the project – the implementation of a multi-species, multi-stock fishery analysis model. This segment of the project was sponsored by the Washington State Department of Fisheries under Service Contract No. 588.

NBSIR 75-746. **Preparation of reference data sets for character recognition research.** M. L. Greenough and R. M. McCabe, 52 pages (June 30, 1975). Order from NTIS as COM 75-11432.

Key words: character recognition; context research; data bases; optical character recognition; pattern recognition; reading machines.

A reference data set contained on magnetic tape has been generated for research in optical character recognition and related fields. The data set contains video data in 16 levels for each point in a 24 × 24 scanning grid, applied to approximately 30 000 characters. The input material, on some 2200 simulated address mailpieces, includes a range of character quality from excellent to poor.

The data set was prepared by first microfilming the address fields and printing positive transparencies. Then preselected characters were scanned in the NBS FOSDIC. Through the use of calibrated gray scales which were filmed and scanned along with the addresses, corrections were applied to assure linearity of overall response.

A second reference data set was also prepared from the same input material of simulated mailpieces. Through analysis of the recognition results printed out during runs on one address reader, details of identification on both alphabetic and numeric recognition modes were noted. These were encoded into six-character groups on the data tapes, formatted to provide one such group for each input character in the original addresses. Recognition results are shown for approximately 110 000 input characters.

NBSIR 75-747. **Building energy authority and regulations survey: State activity,** R. M. Eisenhard, 25 pages (June 1975). Order from NTIS as COM 75-11131.

Key words: authority; building; energy; legislation; regulations; state.

Information describing the status of State regulations and authority to regulate energy use in new and existing buildings is presented in tabular form. The tables reference available information on pending bills, acts, or general authority which is embodied in a State Building Code Act. Programs relating to solar energy, insulation, and other building energy items are also listed.

NBSIR 75-748. **Power saws: A review of injury data and power saw industry survey,** V. J. Pezoldt and J. J. Persensky, 95 pages (July 1975). Order from NTIS as COM 75-11031.

Key words: accident research; consumer products; injury data; opinion survey; portable circular saws; power saws; radial arm saws; safety; table saws.

Two activities of an investigation of power saws are described: a review of power saw injury data and two surveys of saw manufacturers' opinions concerning safety aspects of saw use and design. The injury data reviewed consisted of information from the National Electronic Injury Surveillance System and from summaries of In-Depth Investigation Reports compiled by the Consumer Product Safety Commission. The two surveys, dealing with portable circular saws and table and radial arm saws respectively, were directed toward obtaining the opinions of technical representatives of power saw manufacturers on five major areas of saw use and design, i.e., electrical safety, blade contact hazards and prevention, accidental starting, the design of various saw components and the judged adequacy of saw instruction manuals. Power saw engineers and designers recognize some problems with present saw designs, especially relating to kickbacks. Overall, however, the survey respondents believe saws to be reasonably free from hazards introduced by product design. The area in which the saw manufacturers believe the most hazards to exist is that of the operator's use of power saws. This human element in saw accidents is recognized as a major contributor to saw related injuries, but little is known about how to assure that safe practices will be followed. Areas for further study are suggested.

NBSIR 75-760. **Proceedings of piezoelectric and pyroelectric symposium-workshop,** M. G. Broadhurst, 222 pages (Sept. 1975). Order from NTIS as COM 75-11436.

Key words: electrets; hydrophone; piezoelectric; polymers; polyvinylidene fluoride; pyroelectric; radiometer; transducers.

The purpose of this Symposium-Workshop was to bring together scientists and program managers from federal (primarily DoD), industrial, university, and foreign laboratories who are involved in the research on and manufacture of piezoelectric and pyroelectric polymer materials and devices, in order to exchange information about and stimulate further work on the new and rapidly developing measurement technology involving polymer transducers. This meeting is particularly important at this time because highly active polymer films are not yet available to device manufacturers in the U.S. or to potential users such as DoD.

NBSIR 75-761. **The demonstration of experimental lead paint hazard abatement methods in Washington, D.C.,** T. H. Boone, H. W. Berger, A. P. Cramp, and H. A. Jackson, 105 pages (June 1975). Order from NTIS as COM 75-11377.

Key words: abatement; barrier materials; building materials; housing; lead-based paint; lead poisoning; paint removal.

This report describes the first stage of an experimental lead paint hazard abatement program carried out in 30 dwelling units in Washington, D.C. The entire program will ultimately involve the abatement of lead paint hazards in a total of approximately 250 dwelling units located in three or more cities.

The procedures, demonstrated in Washington, included: paint removal methods using chemical solvents and a heat producing device; the replacement of components such as windows, doors and wood trim; and the installation of flexible sheet and rigid board barrier materials over existing lead paint on wall.

The report presents procedures and the forms used in inspecting and selecting dwellings for lead paint hazard abatement, evaluations of the suitability and implementation characteristics of the abatement methods and recommendations for their use.

Subsequent reports will present the results of comparable programs in additional cities and a final report will compare the cost-effectiveness of the alternative abatement methods.

NBSIR 75-763. **Thermodynamic and transport properties of ethylene and propylene,** I. A. Neduzhii (Principal Author), 210 pages (June 1972). Order from NTIS as COM 75-11276.

Key words: critically evaluated data; ethylene; propylene; thermodynamic properties data; transport properties data.

A comprehensive review of the data on the thermodynamic and transport properties of ethylene and propylene is given. Subjects covered include equation of state for liquid and vapor, second virial coefficient, enthalpy, etc., heat capacity, speed of sound, viscosity, and thermal conductivity. New experimental measurements are given for several properties, especially speed of sound, densities of the liquid and transport properties. Tables of properties covering the temperature range from 160 K to 500 K are given. The book has been translated into English from the original Russian.

NBSIR 75-766. **Properties and interactions of oral structures and restorative materials,** J. M. Cassel, 51 pages (July 1975). Order from NTIS as COM 75-11376.

Key words: adhesive materials; composites; dental materials; polymer grafting; resins; restorative materials; sealants; wear resistance.

A diversity of experimental approaches is being investigated to develop techniques which can be applied in formulation of adhesive restorative and caries-preventive dental materials. A newly developed testing procedure, still in the evaluation stage, has demonstrated expected ranking of adhesive bond strengths within a group of selected coating agents, both coupling and release types. Deterioration on exposure to water of cohesive bond strength in the Bis-GMA matrix has been indicated without concurrent deterioration of the coupling agent. A monomer system with potential as a composite or pit and fissure sealant resin and giving a polymerizable liquid of desired viscosity at room temperature was derived from three low-melting, crystalline isomers of ether-ester linked aromatic dimethacrylates. A series of monomers of varying chemical structure was evaluated for possible application in photopolymerization experiments designed to investigate modification of hard tissue by grafting. Modifications to extend the running time of a dental restorative wear-generating experiment three-fold and which allow the computerized recording of ten, instead of two, depth of wear measurements around the circular wear track have significantly reduced the standard error of measurement. Surface coating techniques being developed to strengthen interfacial bonding in dental cements and other dental materials show more promise with titanate than with carbon reinforcing fibers.

NBSIR 75-767. **A methodology for establishing conditioning requirements for building materials and composites,** L. W. Masters and M. Tryon, 35 pages (Oct. 1975). Order from NTIS as PB246879.

Key words: building composite; building material; conditioning; equilibration; gypsum wallboard; methodology; relative humidity; structural sandwich panel; temperature; testing.

The measured properties of building materials and their composites sometimes reflect the conditions to which they have been exposed while being prepared for test. Conditioning these materials to some standard reference state is sometimes used to minimize this effect.

A methodology for establishing conditioning requirements for building composites and materials is presented and its use illustrated by applying it to two building composites.

NBSIR 75-769. **Report on an NBS/AID/OAS Workshop on standardization and measurement services in industrializing economies,** H. S. Peiser, R. S. Marvin, M. McNeil, and J. Mejeur, Eds., 227 pages (Sept. 1975). Order from NTIS as PB247978.

Key words: AID; assistance; economics; foreign relations; industrializing nations; LDC's; measurement services; OAS; standardization.

On November 3-16, 1974, a Workshop was held at the National Bureau of Standards, Gaithersburg, under the sponsorship of AID and the Organization of American States, the object of which was to give standards officials of industrializing nations insight into the standards and measurement systems in the United States and the role of the National Bureau of Standards, so that these officials might consider what parts of the U.S. system might usefully be adapted to conditions in their home countries. The report contains copies of speeches and presentations by the U.S. hosts and the participants from the other nations. In addition, information is given on the general agenda of discussions, presentations, and tours of laboratories at NBS and other U.S. organizations.

NBSIR 75-770. **The equation of state for ammonia,** L. Haar and J. Gallagher, 27 pages (Sept. 1975). Order from NTIS as COM 75-11370.

Key words: ammonia; correlation; gas; liquid; thermodynamic properties; thermodynamic surface.

An outline is presented of the basic results of the extensive correlation for the thermodynamic properties of ammonia recently completed at this laboratory. Computer programs are presented for the calculation of thermodynamic properties in the range including the triple point temperature to 5/3 the critical temperature and pressures from the dilute gas to 8000 bar.

NBSIR 75-772. **The dynamic response of helicoid anemometers,** J. M. McMichael and P. S. Klebanoff, 54 pages (Nov. 1975). Order from NTIS as PB246861.

Key words: air; analytical; anemometer; dynamic response; experimental; lag; unsteady flow.

The results of an analytical and experimental investigation of the dynamic response of a helicoid anemometer are presented. The experimental investigation was conducted using the NBS Unsteady Flow Facility and data are presented which illustrate the dynamic behavior in a spatially uniform, fluctuating flow with varying amplitudes, frequencies, and mean velocities. An analytical model governing the dynamic response is also presented and compared with the experimental results.

NBSIR 75-774. **Calibration of Kerr systems used to measure high voltage pulses,** R. E. Hebner, Jr., 51 pages (Aug. 7, 1975). Order from NTIS as COM 75-11364.

Key words: automated measurements; dielectrics; dividers; electrical measurement; electric fields; electro-optics; high voltage measurements; insulating fluids; Kerr effect; nitrobenzene; pulse measurements; space charge.

The purpose of this work is to define, develop and refine techniques for calibrating pulse voltage measurement systems, particularly those based on the electro-optic Kerr effect. The approach used exploits the assumed frequency independence of the Kerr coefficient of nitrobenzene. Theoretically, the Kerr coefficient should exhibit the same frequency dependence as the relative permittivity. Measurements have shown the relative permittivity to be approximately frequency independent over the frequency range from direct voltage to 10^9 Hz. The realization of this calibration approach has been hampered by the fact that the electric field distribution, in the liquid exhibiting the electro-optic Kerr effect, is itself frequency dependent.

This report describes the present best comparison of cell calibration under direct voltage with calibration under low frequency alternating voltage and calibration under pulsed high voltage. The results under all three types of waveforms agree to within ± 0.5 percent. From these results it can be inferred that it is feasible to use an electro-optic Kerr system as an independent, and possibly more accurate, device against which to calibrate other pulse voltage measurement systems.

In addition to this discussion of Kerr system calibration, the report contains two appendices. One presents an improved technique for analysis of data obtained from a Kerr system and the other discusses space charge in a nitrobenzene-filled Kerr cell.

NBSIR 75-778. **ETIP: THE FIRST 18 MONTHS. A progress report of the experimental technology incentives program, National Bureau of Standards,** J. D. Lewis, 74 pages (Aug. 1975). Order from NTIS as PB246435.

Key words: civilian R&D policy; ETIP; incentives; innovation; procurement policy; regulatory policy; small business policy; technology.

This internally prepared report describes the overall accomplishments of the experimental Technology Incentives Program in carrying out its mission. Progress is compared with the plans that were established in a program plan approved by the Secretary of Commerce in February of 1974. An appendix to the report describes the purpose and shows progress of each of the individual projects that ETIP has launched.

NBSIR 75-781. **Optical materials characterization,** A. Feldman, D. Horowitz, R. M. Waxler, I. H. Malitson, and M. J. Dodge, 24 pages (Aug. 1975). Order from NTIS as COM 75-11375.

Key words: birefringence; elastic constants; infrared-laser window materials; interferometry; KCl; photoelasticity; polycrystalline ZnSe; refractive index; stress-optical constants; thermal coefficient of refractive index; ZnSe.

The refractive index of each of two prismatic samples of chemical vapor deposited (CVD) ZnSe was measured from 0.5086 μm to 18.2 μm by means of the minimum-deviation method on a precision spectrometer. Data were obtained at temperatures near 20 and 34 °C and each set of data was fitted to a three-term Sellmeier-type dispersion equation, which permits refractive index interpolation within several parts in 10^{-5}. From the data obtained at the two temperatures, dn/dT was calculated for both samples. A comparison of refractive index and dn/dT is made with other types of ZnSe. Preliminary photoelastic data are presented for single crystal specimens of Ge, reactive atmosphere processed (RAP) KCl, and KCl doped with KI. The Ge data, which were obtained at 10.6 μm differ from previously reported data. Data on the two types of KCl were obtained at 10.6 μm, 0.633 μm and 0.644 μm. These data are compared with values from the literature. Also presented are revised photoelasticity data for CVD ZnSe. The design of an improved stressing apparatus that was developed for the measurement of photoelastic constants is discussed.

NBSIR 75-783. **Validation of the DELCAP airport simulation model,** J. F. Gilsinn, 167 pages (July 1975). Available from the author at the National Bureau of Standards, Washington, D.C. 20234.

Key words: airport; airport capacity; airport simulation; models; model validation; runway capacity; simulation; validation.

This report documents exercises of the DELCAP airport simulation model performed to validate the outputs of that model. Airport throughput levels were calculated by DELCAP for five runway configurations, with three or four appropriate operating policies chosen for each, and for three different mixes of aircraft types. These estimates from DELCAP agreed well, generally within 6 to 8 percent, with current values provided by the FAA. An attempt at validating DELCAP's delay-figure output, using existing data on scheduled and actual times of aircraft departures and arrivals, is also reported. It proved unsuccessful, because available data are not sufficient to isolate that portion of total delay which DELCAP is designed to measure, i.e., terminal area ATC delay. A collection effort to accumulate the necessary data is formulated. Appendices to the report contain program listing, flowcharts, descriptions of program changes from earlier versions, and user instructions for the model's operation.

NBSIR 75-784. **Fire incidents involving flammable liquids, gas, and dry explosives,** E. A. Tyrrell, 58 pages (Oct. 1975). Order from NTIS as PB246862.

Key words: accidents; burn injuries; burn severity; explosives; fabric fires; FFACTS; flammable liquids; gas; gasoline; ignition-causing activities; ignition sources; injury disposition.

From the NBS Flammable Fabrics Accident Case and Testing System as of December 1973, flammable liquids, gas, and dry explosives were found to be involved in 832 incidents, injuring 863 victims. Volatile flammable liquids represented 77 percent of the incidents; 72 percent of these liquids were gasoline. Male victims outnumbered females more than 3 to 1. Young adults, ages 21-45, and youth, ages 13-20, were injured most frequently. Children and youth were injured primarily through what was considered as play activities. Adults generally were injured while engaged in activities traditionally considered as being oriented to the particular sex involved. Streetwear, particularly shirts/blouses, was reported most frequently as igniting first. Thirty-six percent of the fabrics represented in these incidents were contaminated with a flammable liquid. Most of the victims sustained burn injuries covering 1-10 percent of their bodies; only 6 percent sustained burn injuries covering 61 percent or more of their bodies. Most of the victims were hospitalized for treatment of their injuries. Although the very young and the elderly were involved in these incidents less frequently than other age groups, they generally were burned more severely and represented 46 percent of the victims who died in the hospital or were dead on arrival.

NBSIR 75-785. **The review of standardization and measurement services at the Ecuadorian Institute for Standardization,** R. Estrada and H. S. Peiser, 17 pages (June 27-29, 1974). Order from NTIS as PB246345.

Key words: AID; development assistance; economics; Ecuador; less developed countries; measurement services; review; standardization; survey.

An international team of standards and measurement specialists visited the Ecuadorian Institute for Standardization on June 27-29, 1974, to review the operations of that organization in light of the recommendations made two years earlier by a Survey of Standardization and Measurement Services in Ecuador conducted by a team which was organized and sponsored by the U.S. National Bureau of Standards and the U.S. Agency for International Development. The review consists of the historical background of the Institute, results of the 1972 Survey, and recommendations for future planning.

NBSIR 75-787. **Piezo- and pyroelectric properties of electrets,** M. G. Broadhurst and G. T. Davis, 55 pages (Oct. 1975). Order from NTIS as COM 75-11471.

Key words: electrets; piezoelectricity; polarization; polymers; polyvinylchloride; polyvinylfluoride; polyvinylidenefluoride.

A model for piezo- and pyroelectricity in polymers is presented. These effects are true piezo- and pyroelectricity rather than electrostriction, conduction, electromechanical effects or the motion of conductors in the field of space charges. Two distinct types of polymers can be piezoelectric. Amorphous polymers are piezo- and pyroelectric by virtue of a nonequilibrium but kinetically stable net dipole orientation. The semicrystalline polymers are piezoelectric due to alignment of polar, ferroelectric crystals dispersed in the amorphous phase. In both types the magnitudes of the piezo- and pyroelectric effects are in accord with the expected temperature and pressure dependence of the dipolar polarization. Space charges embedded in the polymer normally will not produce a piezo- or pyroelectric current. Those embedded near the crystal-liquid interfaces tend to reduce the piezo- and pyroelectricity. Improved orientation of dipoles and reduction of ionic impurities should increase p and d for PVF_2 by a factor of three above typical values presently reported. The sensitivity of amorphous polymers is limited mainly by dipole moment per unit volume and breakdown strength.

NBSIR 75-793. **Microsecond-resolution pulse calorimetry for semiconducting materials at high temperatures (a feasibility stu-**

dy), A. Cezairliyan and C. W. Beckett, 51 pages (Oct. 1975). Order from NTIS as PB247538.

Key words: capacitor discharges; heat capacity; high-speed measurements; high temperature; thermodynamics; uranium dioxide.

A feasibility study is conducted for the applicability of microsecond-resolution pulse heating techniques to the measurement of selected thermodynamic properties of semiconducting substances at high temperatures. The method of pulse heating of the specimen using capacitor discharges is described and general design considerations, including electrical circuitry and various physical, electrical and chemical phenomena, are presented. Measurements of experimental quantities, such as current, voltage, temperature, and pressure are described. The special problems in relation to measurements of heat capacity and vapor pressure of uranium dioxide in the temperature range 2000 to 6000 K are discussed. It is concluded that the capacitor discharge circuitry and the measurement of the experimental quantities, although difficult, are not likely to present major problems. However, problems are likely to stem from the experiment chamber and the specimen. The nature of these problems is discussed, and the performance of some preliminary experiments is suggested.

NBSIR 75-794. **Heat transfer in furnaces for CIB cooperative program and heat balance analysis of wall furnace,** J. B. Fang and J. T. Scott, 48 pages (Nov. 1975). Order from NTIS as PB247203.

Key words: fire resistance ratings; fire test furnace; heat balance; heat transfer; temperature-time curve.

Tests were conducted in the NBS wall panel furnace as part of a CIB international cooperative program to measure and compare heat transfer in fire endurance furnaces. Additionally, a heat balance analysis showed that a cellular concrete block wall specimen absorbed more heat by convection than by radiation. The rate of radiant heat transfer was found to decrease slowly, while the furnace exhaust heat loss increased during the test from 42 to 58 percent of the heat output. The calculated radiant heat fluxes incident at furnace walls was found to be somewhat lower than the experimental values measured at the test wall.

NBSIR 75-795. **Recommended criteria for retrofit materials and products eligible for tax credit,** W. J. Rossiter, Jr. and R. G. Mathey, Eds., 44 pages (Nov. 1975). Order from NTIS as PB246866.

Key words: caulks and sealants; clock thermostats; energy conservation; insulation; retrofitting; storm doors; storm windows; tax credit; vapor barriers; weatherstripping.

The Federal Energy Administration requested the National Bureau of Standards to develop criteria for retrofitting for possible use by the Internal Revenue Service in implementing the Presidential initiative authorizing tax credit to homeowners. Criteria are recommended for materials and products considered eligible for proposed tax credit for retrofitting one and two family residences to conserve energy. The materials considered include insulation and vapor barriers, storm windows and doors, caulking and weatherstripping, and clock thermostats. A list of these retrofit materials was compiled by generic type and recommendations made on their installation.

In addition to recommended criteria for materials and products eligible for tax credit, desired levels of performance for the retrofit materials are presented as a guide to homeowners to achieve maximum benefits in energy conservation through retrofitting.

NBSIR 75-796. **An analysis of the Salmon Statistical Information System,** F. C. Johnson, 20 pages (Sept. 29, 1975). Order from NTIS as PB247656.

Key words: Anadromous Fish Catch Record System; catch record system; fisheries statistics; fish record system; fishery management model; fishery modeling; modeling; salmon; salmon fishery; salmon information system; Washington State Fisheries.

This report contains an analysis of the official salmon statistical information system of the Washington State Department of Fisheries relative to the changing data requirements of the Department. Recommendations are given for revising the current system in order to assure the availability of complete, accurate statistics on a timely basis. In addition, the principal requirements are identified for the development of improved procedures for generating input to the hatchery and fishery management models in use by the Department. This project was sponsored by the Washington State Department of Fisheries under Service Contract No. 626.

NBSIR 75-797. **An evaluation of a range-top warning light system,** M. E. Stefl and J. J. Persensky, 22 pages (July 1975). Order from NTIS as COM 75-11465.

Key words: consumer products; human factors; kitchen; ranges; reaction time; safety; warning lights.

A descriptive analysis of In-Depth Injury Investigations of range-related accidents revealed a series of incidents where range-users were unaware that surface elements were energized. One proposed solution to this problem involved a system of four warning lights to indicate individual surface unit activation. A laboratory study using human subjects evaluated the effectiveness of such a system. The backgrounds against which the warning lights were fitted and the intensity of the lights were not shown to influence subjects' responses in a reaction time task; however, the position of the lights and the type of ancilliary task being performed by the subject did. These results are discussed in terms of product design and safety, and implications of the study for methodological development are considered.

NBSIR 75-804. **Generation of standard EM fields for calibration of power density meters 20 kHz to 1000 MHz,** M. L. Crawford, 44 pages (Jan. 1975). Order from NTIS as COM 75-10395.

Key words: hazard level fields; power density meter calibration; TEM transmission cells.

This report describes techniques for calibrating power density meters used by the Department of Defense in measuring high intensity (hazard level) RF fields in the frequency range 20 kHz to 1000 MHz. It reports on part of the work sponsored by the Calibration Coordination Group (CCG), of the Department of Defense covering the frequency range 20 kHz to 20 GHz.

Several techniques were considered for producing a standard field including parallel plate and parallel wire transmission lines, transverse electromagnetic mode (TEM) transmission cells, various directive antennas and open ended waveguide (OEG). The major emphasis in this report is on the TEM cells, which are recommended for the frequency range 20 kHz to 500 MHz. Design and evaluation details and an error analysis associated with the TEM cell measurement system are given. Power density levels can be established in the cells from a few $\mu W/cm^2$ to 100 mW/cm^2 with uncertainties less than ± dB.

Limited information is also given describing the use of OEG, the recommended technique for the frequency range 500 MHz to 2.6 GHz, and giving the results of intercomparisons among parallel plate lines, TEM cells, OEG, and standard gain horns.

NBSIR 75-806. **Phase equilibrium and flow-induced desorption data for He-CO, He-N_2O, and He-N_2 systems,** W. G. Steward,

R. O. Voth, J. Hord, W. R. Parrish, C. F. Sindt, and J. M. Arvidson, 62 pages (Mar. 1975). Order from NTIS as COM 75-10368.

Key words: binary mixture; cavitating venturi; enhancement factors; experimental vapor-liquid equilibria; flow induced desorption; helium-carbon monoxide system; helium-nitrous oxide system; Henry's law constants; two phase choking; two phase flow.

Liquid-vapor equilibrium data were obtained for the helium-carbon monoxide and helium-nitrous oxide systems at pressures to 138 bars. Liquid and vapor phase compositions were measured at nominal temperatures of 80, 85, 90, 100, and 120 K (144, 153, 162, 180, and 216 °R) for the helium-carbon monoxide system, and at 235, 245, 265, and 285 K (423, 441, 477, and 513 °R) for the helium-nitrous oxide system. Internal consistency of the data was checked by using pseudo-Henry's law constants and enhancement factors.

The effects on flow of helium absorption and subsequent flow-induced desorption were investigated by means of reduced scale model experiments. Friction losses attributable to helium desorption in the long channels proved to be negligible both in experimental measurements and in calculations based on assumed equilibrium of liquid and gas. Contrarily, the assumption of phase equilibrium leads to gross miscalculations of flow rates in cavitating or near cavitating nozzles or venturis. Actual venturi mass flow rates reached in the experiments were fifty times the theoretical choking flow rates; however, definite mass flow rate reductions due to helium desorption were measured, ranging from four percent for nitrogen to twelve percent for nitrous oxide. Pertinent experiences in handling these fluids and operating the test equipment are also discussed.

NBSIR 75-807. **Turbulent natural convection of liquid deuterium, hydrogen, and nitrogen within enclosed vessels,** D. E. Daney, 82 pages (Feb. 1975). Order from NTIS as COM 75-10396.

Key words: cryogenic; heat transfer; hemisphere; horizontal cylinder; liquid deuterium, liquid hydrogen, liquid nitrogen; natural convection; sphere; vertical cylinder.

Quasi-steady natural convection of liquid deuterium, hydrogen, and nitrogen within a sphere, hemisphere, horizontal cylinder, and vertical cylinder has been studied experimentally for the case of a nearly isothermal wall. A single expression relating the Nusselt and Rayleigh numbers,

$$Nu = 0.104\ Ra^{0.352},$$

fits the deuterium and nitrogen data over the range $7 \times 10^8 < Ra < 6 \times 10^{11}$, while the hydrogen Nusselt numbers are 8 percent lower. The temperature field within the vessels is virtually free of horizontal temperature gradients. A single dimensionless temperature profile characterizes the vertical temperature distribution for each vessel shape, with the profiles for the sphere, hemisphere, and horizontal cylinder being nearly identical.

NBSIR 75-809. **Non-planar near-field measurements: Spherical scanning,** P. F. Wacker, 67 pages (June 1975). Order from NTIS as COM 75-10989.

Key words: antennas; arrays; coordinate transformations; data processing; group representations; measurements; near field; non-planar; patterns; scanning; spherical; symmetry.

The advantages and limitations of near-field antenna measurements are compared with those of conventional far-field measurements. Further, the advantages and limitations of planar, circular cylindrical, and spherical scanning are compared.

Spherical scanning is advantageous for arrays steered well off-axis and for antennas with wide angle side lobes, but the data processing has been quite impractical except for very simple antennas and probes. A new highly efficient data processing scheme is given for spherical scanning with and without probe pattern correction. The translation-of-centers transformation of the probe pattern coefficients (required only with the probe pattern correction) is carried out once and for all for a given probe, scanning radius, and frequency. The routine computations involve Fast Fourier "Transforms" and multiplication by matrices with constant elements, matrices which are independent of the detailed nature of the probe, the radius of the scanning sphere, the points at which measurements are made, and the nature of the test antenna. The FFT's and matrix multiplications supplant matrix inversion, ordinary solution of simultaneous equations in more than two unknowns, ordinary numerical integration, and (in routine processing) ordinary evaluation of functions, even for computation of the far field. Except for the truncation of the infinite series of spherical modes, no analytical or data processing approximations are made, even in the use of the FFT.

So that readers may draw from their understanding of planar and cylindrical scanning, a unified theory of near-field data processing is given, treating planar, cylindrical, and spherical scanning as mere special cases.

NBSIR 75-810. **Semi-annual report on materials research in support of superconducting machinery,** R. P. Reed, J. G. Hust, M. B. Kasen, H. M. Ledbetter, R. P. Mikesell, R. E. Schramm, L. L. Sparks, R. L. Tobler, and W. F. Weston, 201 pages (Apr. 1975). Order from NTIS as COM 75-10919.

Key words: composites; elastic properties; fracture; liquid helium; mechanical properties; structural materials; superconducting machinery; thermal conductivity.

Results of six months of study on materials in support of superconducting machinery (October 1974 through March 1975) are reported to the sponsor, the Advanced Research Projects Agency of the U.S. Department of Defense. The report is divided into five sections: thermal conductivity, magnetothermal conductivity, fatigue and fracture-toughness properties, properties of advanced composites, and elastic properties. The temperature range 4 to 300 K is covered by the study. Materials studied are either being used or are candidates for use in superconducting machinery and include: aluminum alloys, composites, copper, age-hardened, nickel-base superalloys, stainless steels, and titanium alloys.

Special results of the study include: thermal conductivity data for comparison of the effects of heat treatment on age-hardenable alloys, the first determination of a complete set of elastic constants for a composite at liquid helium temperature, boron-aluminum composite tensile data at 4 K, and a summary of fatigue crack-growth rate behavior at 4 K for a number of different structural alloys. These data provide considerable insight into material characteristics at extremely low temperatures, assisting in material selection and efficient design.

NBSIR 75-812. **The Kapitza conductance of the (100) surface of copper and polycrystalline indium and niobium,** N. S. Snyder, 51 pages (June 1975). Order from NTIS as COM ADA012889.

Key words: heat transfer to helium II; interfacial thermal resistance; Kapitza conductance of copper; Kapitza conductance of indium; Kapitza conductance of niobium; x-ray diffraction examination of single crystal lattice damage; (100) surface of copper.

Measurements of the Kapitza conductance to liquid helium II across the (100) surface of single crystals of copper are presented. The temperature range of these measurements was 1.6 to 2.1 K.

The sample surfaces were subjected to several different treatments. Some surfaces were cleaned by low energy argon ion bombardment, annealed in an ultrahigh vacuum system, and preserved under vacuum until purified liquid helium was admitted. Other surfaces were intentionally damaged by machining and/or exposure to the atmosphere. The conductance after these latter treatments was found to be about a factor of three higher than that of the more ideally cleaned and annealed surfaces, and a significant increase in the temperature dependence of the conductance was also observed. Indications are that these effects on the conductance are produced primarily by the last few atomic layers of the solid, so extensive cold-working, which impairs the thermal conductivity of the bulk, need not be undertaken to improve surface heat transfer. This finding has important implications for the design of practical heat transfer surfaces. Good reproducibility was found for the conductances of similarly treated surfaces and good correlation with studies of damage carried out by x-ray diffraction. The relationship of these results to the numerous current theories of the Kapitza conductance is discussed. Conductance measurements of polycrystalline niobium and indium are presented in the appendices.

NBSIR 75-814. **A modified Benedict-Webb-Rubin equation of state for parahydrogen-II,** H. M. Roder and R. D. McCarty, 54 pages (June 1975). Order from NTIS as COM 75-11132.

Key words: critical point; density; enthalpy; equation of state; hydrogen; index of refraction PVT; saturation properties; scaling laws; specific heat.

A 32 term modified Benedict-Webb-Rubin equation of state has been applied to data for parahydrogen. The adjustable parameters in the equation of state were determined using 2665 points including very recent measurements at low temperatures and high pressures. The new values extend the range of the PVT data sufficiently to warrant a refitting of the equation of state. Temperatures for the data range from the triple point to about 700 K with pressures reaching 3000 atmospheres near ambient temperatures. The PVT data were adjusted to the T_{68} scale. In addition, extensive modifications have been made to the previously accepted PVT surface in the region near the critical point. These adjustments have been made on the basis of more recent refractive index data and the application of scaling law equations. Detailed comparisons between experimental and calculated values are given for density. Corresponding comparisons are made for enthalpy and the specific heat at constant pressure.

NBSIR 75-816. **Performance characteristics of a liquid helium pump,** P. R. Ludtke, 55 pages (July 1975). Order from NTIS as COM 75-11133.

Key words: cavitation; cryogenic motors; induction motors; liquid helium pumps; motor efficiency; net positive suction head; pump efficiency; pump performance.

Part A of this report presents performance data for a simple, preinduced, single stage, centrifugal liquid helium pump powered by a close-coupled submersible cryogenic induction motor. Data on pump efficiency and the motor efficiency are given, and the effects of decreasing the pump leakage loss and removing the pre-inducer were also investigated.

Part B describes a study of the cavitation characteristics of the pump in liquid helium I. The net positive suction head at cavitation of the pump was extensively investigated, and found to be near zero; the effects of removing the inducer, changing the pump inlet geometry, and varying the helium temperature were determined.

NBSIR 75-818. **Bibliography of the Electromagnetics Division June 30, 1974 to June 30, 1975,** M. L. Woolley, 27 pages (Sept. 1975). Order from NTIS as PB246439.

Key words: antenna parameters; attenuation; automated measurements; EM metrology; field strength; impedance; laser parameters noise; optical electronics; phase; power; pulsed quantities; squids; transmission lines; waveform analysis; waveguides.

This bibliography lists the publications of the NBS Electromagnetics Division between June 30, 1974 and June 30, 1975.

NBSIR 75-820. **Study of cryogenic propellant systems for loading the space shuttle—Part II, Hydrogen systems,** W. G. Steward, 63 pages (Oct. 1975). Order from NTIS as PB246658.

Key words: computer modeling; cooldown; cryogenic flow; stresses; two phase flow.

This report covers computer simulation studies of liquid hydrogen fill and vent systems for the space shuttle. The computer programs calculate maximum and minimum permissible flow rates during cooldown as limited by thermal stress considerations, fill line cooldown time, pressure drop, flow rates, vapor content, vent line pressure drop and vent line discharge temperature. The input data for these programs are selected through graphic displays which schematically depict the part of the system being analyzed. The computed output is also displayed in the form of printed messages and graphs. Digital readouts of graph coordinates may also be obtained.

Procedures are given for operation of the graphic display unit and the associated minicomputer and timesharing computer.

NBSIR 75-822. **Study of errors in absolute flux density measurements of Cassiopeia A,** M. Kanda, 34 pages (Oct. 1975). Order from NTIS as PB246933.

Key words: accuracy; antenna; calibration; Cassiopeia A; error analysis; flux density; ground station; G/T (system gain/system noise temperature); radio star.

An error analysis for absolute flux density measurements of Cassiopeia A is discussed. The lower-bound quadrature-accumulation error for state-of-the-art measurements of the absolute flux density of Cas A around 7 GHz is estimated to be 1.71 percent for 3σ limits. The corresponding practicable error for the careful but not state-of-the-art measurement is estimated to be 4.46 percent for 3σ limits.

NBSIR 75-823. **Helium research in support of superconducting power transmission,** V. D. Arp, D. E. Daney, N. V. Frederick, M. C. Jones, P. R. Ludtke, W. R. Parrish, and R. L. Powell, 79 pages (Oct. 1975). Order from NTIS as PB246436.

Key words: cooling system; cryogenics; helium-cooled electrical leads; helium impurities; microwave cavities; negative differential flow resistance; pressure measurement; system dynamics; thermometers.

This is the first annual report on a program of helium-related research in support of superconducting power transmission. Program areas reported on are concerned with the dynamics of helium cooling systems—theoretical aspects of oscillatory behavior and experiments—and helium related measurements. The latter include pressure measurement, temperature measurement and the problem of impurity levels in the helium refrigerant.

NBSIR 75-901. **Smoke and carbon monoxide formation from materials tested in the smoke density chamber,** T. Y. King, 40 pages (Oct. 1975). Order from NTIS as PB246860.

Key words: carbon monoxide; electrostatic precipitation; heat flux; oxygen depletion; particulate mass; scanning electron microscope; smoke.

The effects of physical and chemical factors on the smoke and carbon monoxide generated by burning polymers and red oak in the NBS Smoke Density Chamber are reported.

Smoke and carbon monoxide formation was found to depend on irradiance level and oxygen concentration in the chamber. Smoke optical density correlations with particulate mass density showed that the ratio of these two varied with material composition and burning conditions.

NBSIR 75-903. **San Antonio Veterans Administration Hospital smoke movement study,** F. C. W. Fung and R. H. Zile, 37 pages (Nov. 1975). Order from NTIS as PB246859.

Key words: experiments; full-scale; gas tracer; interstitial space; penetration through ceiling; smoke movement; smoke simulation; sulfur hexa-fluoride (SF_6); Veterans Administration Hospital.

A series of full-scale smoke movement experiments was conducted using a sulfur hexa-fluoride (SF_6) gas tracer, smoke simulation system. The experiments were designed to study smoke movement in a hospital building with an interstitial space between floors. The penetration of smoke through ceiling and interstitial space and the vertical smoke movement in such a building were investigated.

NBSIR 75-908. **Characterization of sharp points and edges by electrical breakdown,** J. Cohen, 21 pages (Aug. 1975). Order from NTIS as PB247270.

Key words: consumer products; electrical breakdown; gases; hazard; high voltage; sharp edges; sharp points; threshold.

Experiments were made to determine the feasibility of using the phenomenon of electrical breakdown in air to characterize sharp metallic edges and points. A fixed voltage was applied between a sample edge or point and a parallel plane, and threshold gap length for breakdown observed. Results were quite favorable for edges, but not for points, and the polarity on the sample was required to be negative.

NBSIR 75-909. **Index of automated system design requirements as derived from the OMB Privacy Act implementation guidelines,** D. K. Branstad and R. A. Krell, Standards Coordinators, 14 pages (Oct. 1975). Order from NTIS as PB246863.

Key words: computer; data processing; index; information processing; privacy; requirements definition; security; systems design.

This index is a list of certain requirements which must be considered by Federal technical and administrative personnel in order to comply with those provisions of the Privacy Act of 1974 relating to automated systems design and development. This index has been derived from the Office of Management and Budget (OMB) guidelines for implementing those provisions. Each requirement listed contains a reference to an applicable part of the Privacy Act and to a page and column number of the OMB guidelines as they appear in the *Federal Register*. Therefore, these documents must be used in conjunction with this index. Furthermore, a familiarity with these documents will increase the utility of this index.

NBSIR 75-917. **A multiple-chamber humidity apparatus,** L. Greenspan, 22 pages (Dec. 1975). Order from NTIS as PB247655.

Key words: humidity; humdity chamber; microbiological growth; relative humidity; salt solutions; saturated salt.

An apparatus has been developed for studying the growth of microbiological organisms on food under controlled conditions of humidity and temperature. This apparatus contains twenty-eight individual humidity chambers within a temperature controlled bath. A wide range of humidities can be provided within the individual chambers by means of saturated salt solutions. These chambers can be maintained at stable temperatures from 5 to 50 °C with a constancy and uniformity within ± 0.02 °C. Individual chambers may be conveniently removed or changed without affecting the other chambers.

NBSIR 75-956. **An interference simulator for quantitative determination of the susceptibility of flame detectors to false alarm,** A. Scheidweiler, 16 pages (Nov. 1975). Order from NTIS as PB247654.

Key words: false alarms; false alarm simulator; fire detection; fire detector; flame detection; flame detector.

All fire detectors are susceptible to false alarms, i.e., responding to fire-like conditions when no fire is present. Of all the known fire detectors, flame detectors are probably the most false alarm prone of any of the fire detectors, primarily because these detectors are subjected to more environmental influences resembling the detectors' operating mode than any other fire detector.

In this paper, the author describes an investigation into the susceptibility of flame detectors to false alarms. The author describes a test apparatus, constructed and used by his firm, to evaluate the susceptibility of currently-available flame detectors to false alarms. In addition, the apparatus can be used to evaluate prototype flame detectors.

The data developed indicates the false alarm susceptibility of each type of flame sensor. The data also provides a means of selecting a flame detector having the greatest resistance to known or predictable pseudo-fire sources.

NBSIR 75-962. **An outdoor noise monitoring system with automatic calibration and remote digital display,** D. S. Blomquist, J. S. Forrer, and D. M. Corley, 11 pages (Oct. 1975). Order from NTIS as PB247639.

Key words: acoustics (sound); environmental acoustics; instrumentation; noise monitoring; outdoor noise.

An Outdoor Noise Monitoring System is described. This system uses a microprocessor for automatic calibration. The design concepts of the system are applicable to other remote noise monitoring systems.

4. TITLES AND ABSTRACTS OF PAPERS PUBLISHED IN NON-NBS MEDIA, 1975

Reprints from the journals listed in this section may often be obtained from the authors. See page 5 for additional information.

14720. Edgerly, D. E., **Are aerosol packages proliferated within the meaning of The Fair Packaging and Labeling Act?**, *Proc. 1969 Chemical Specialties Manufacturers Association 55th Annual Meeting, Washington, D.C., Dec. 8-11, 1968*, pp. 68-69 (1968).

Key words: aerosols; Fair Packaging and Labeling Act; packages; proliferation; voluntary standardization.

The purpose of this presentation is to familiarize the manufacturers of aerosol packages with the undue proliferation provision of the Fair Packaging and Labeling Act, and Department of Commerce responsibilities in interpreting proliferation. The scope of the talk centers upon the application of the undue proliferation provision to aerosol packages offered for sale at retail. A discussion of the market of several aerosol products and their place in the retail outlet is considered in light of the consumer's ability to make value comparisons. Considerations of a technical and/or marketing nature are discussed in view of problems which affect voluntary standardization. Finally, and of great importance, the manufacturer's responsibility within the spirit of the Fair Packaging and Labeling Act is discussed.

14721. Blevin, W. R., Geist, J., **Infrared reflectometry with a cavity-shaped pyroelectric detector**, *Appl. Opt.* **13**, No. 10, 2212-2217 (Oct. 1974).

Key words: directional-hemispherical; polyvinyl fluoride; pyroelectric detectors; reflectance.

A new type of reflectometer has been developed for measuring directional-hemispherical spectral reflectances in the infrared region. The instrument is based upon a cavity-shaped pyroelectric detector that itself collects the radiation reflected by the test sample, thereby obviating the need for an intermediate collector such as an integrating sphere or concave mirror. This detector is made from an electrically polarized plastic film of polyvinyl fluoride, coated with gold-black on its inner surface and backed with brass shim on its outer surface in order to provide mechanical strength. The reflectometer has been used with a Fourier spectrometer to measure spectral reflectances over the wavelength range 5-30 μm.

14722. Jacox, M. E., Milligan, D. E., **Vibrational spectrum of CO_2^- in an argon matrix**, *Chem. Phys. Lett.* **28**, No. 2, 163-168 (Sept. 15, 1974).

Key words: charge transfer; CO_2^-; infrared spectrum; ion-molecule aggregates; matrix isolation; molecular structure.

Absorptions which appear near 1600 cm^{-1} on co-deposition at 14 K of Ar:CO_2 mixtures with an alkali metal have been assigned to ν_3 of an $M^+ ... CO_2^-$ ion pair, with an OCO valence angle near 130°. Molecular aggregates contribute significantly to the observed spectrum.

14723. Runyan, C. C., Moulder, J. C., Clark, A. F., **Time-resolved spectra of bulk titanium combustion**, *Combust. Flame Brief Communication* **23**, No. 1, 129-133 (Aug. 1974).

Key words: combustion; laser ignition; spectra (visible); titanium.

The combustion of titanium specimens is supported by a laser in gaseous oxygen. Utilizing a high-speed mechanical shutter driven by a time-delay circuit, the presence of titanium and its oxides is monitored above the surface of the burning Ti metal as a function of time. Spectra are taken with a grating spectrometer and are compared for various stages of the combustion process. The stages are defined by the shape of the total emitted intensity curve. Discrete spectra of titanium and titanium monoxide are seen in emission but disappear as the combustion progresses. The results are correlated with metallographic and x-ray analyses of quenched specimens.

14724. Davis, G. T., Weeks, J. J., Martin, G. M., Eby, R. K., **Cell dimensions of hydrocarbon crystals: Surface effects**, *J. Appl. Phys.* **45**, No. 10, 4175-4181 (Oct. 1974).

Key words: crystal surfaces; density; lamella thickness; paraffins; polyethylene; unit cell; x ray.

The unit-cell dimensions of a given polyethylene have previously been shown to vary nearly linearly with the reciprocal of lamella thickness. Data obtained at 153.2 and 296.2 K are presented to show that the slope of this dependence is different for crystals of orthorhombic *n*-paraffins, melt-crystallized polyethylene, and solution-crystallized polyethylene. Within the limits of error, all extrapolate to the same basal area at infinite lamella thickness, and this agrees with the measured value for sample crystallized from the melt under high pressure to yield a long period of about 3500 Å. Since the effect is a surface one, it is proposed that these differences result from the differences between methyl interactions, fold interactions, different fold planes, domains, etc. It is shown that the variation of cell dimension with lamella thickness leads to a quadratic term in the variation of macroscopic density. This term permits the separation of the thickness and density of a lower-density surface layer in a two-phase model.

14725. Crawford, M. L., **Generation of standard EM fields using TEM tranmission cells**, *IEEE Trans. Electromagn. Compat.* **EMC-16**, No. 4, 189-195 (Nov. 1974).

Key words: compatibility; standard fields; susceptibility; testing; transverse electromagnetic.

A new technique developed at the National Bureau of Standards (NBS) for establishing standard, uniform, electromagnetic (EM) fields in a shielded environment is described. The technique employs transverse electromagnetic (TEM) transmission cells that operate as 50 Ω impedance-matched systems. A uniform TEM field is established inside a cell at any frequency of interest below that for which higher order modes begin to propagate. Standard field strength levels from 10 μV/m to 500 V/m can be established with uncertainties of less than 1.0 dB to 2.0 dB inside the NBS cells for frequencies from dc to 500 MHz. The cells are especially useful for calibrating EM radiation hazard meters, for emission and susceptibility testing of small to medium sized equipment, and for special low level calibration of very sensitive field strength meters.

14726. Adair, R. T., Hoer, C. A., Kamper, R. A., Simmonds, M. B., **RF attenuation measurements using quantum interference in superconductors**, (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest No. 113*, 4-5 (Institution of Electrical Engineers, London, England, 1974).

Key words: Josephson junction; quantum interference; rf attenuation; superconductivity.

A unique portable system has been developed for measuring rf attenuation over a dynamic range of 65 dB at 30 MHz. A Superconducting QUantum Interference Device (SQUID) is the basis of the system.

Measurements made with this system have an rms deviation from the NBS National Reference Standard of ± 0.002 dB.

A SQUID is a loop of superconducting metal closed by a Josephson junction, operating in liquid helium. It converts variations in magnetic flux to periodic variations in impedance which are sensed at microwave frequencies. This provides a convenient, natural means of measuring electrical quantities such as voltage, current, power and attenuation.

14727. Wexler, A., **Humidity measurement system—A micro study,** *Nat. Conf. Stand. Lab. Newsletter* **14,** No. 2, 38-41 (Oct. 1974).

Key words: humidity measurement; moisture; standard; water vapor.

A comprehensive study of the humidity measurement system is being conducted by Arnold Wexler, Chief of the Humidity Section in the Mechanics Division at NBS.

14728. Raveché, H. J., Mountain, R. D., Streett, W. B., **Freezing and melting properties of the Lennard-Jones system,** *J. Chem. Phys.* **61,** No. 5, 1970-1984 (Sept. 1, 1974).

Key words: equation of state; freezing; freezing criteria; melting; molecular correlation functions; phase transitions.

Using Monte Carlo simulations, we investigate average molecular arrangements that occur with the fluid-solid transition in a classical Lennard-Jones system. The crystalline order of the solid phase is explicitly shown by the angularly averaged molecular correlation functions which, in the solid, exhibit a behavior not observed in the fluid. The pair and triplet correlation functions delineate the crystalline pattern of the ordered phase out to internuclear separations of many nearest-neighbor distances. A molecular criterion for freezing is reported which claims a proportionality between the values of the pair correlation function in the fluid at the positions of the first and second nearest neighbors. The general behavior of the triplet correlation function in the fluid phase is interpreted. We also compare predictions for melting pressures and the densities of the coexisting fluid and solid phases.

14729. Kline, F. J., Crannell, H., Finn, J. M., Hallowell, P. L., O'Brien, J. T., Werntz, C. W., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Search for the lowest $T=2$ state in ^{14}C by inelastic electron scattering,** *Il Nuovo Cimento* **23A,** No. 1, 137-144 (Sept. 1, 1974).

Key words: analog states; electron scattering; inelastic electron scattering; particle-hole model; resonance energy; ^{14}C.

A search for the lowest-energy $T=2$ state in ^{14}C has been attempted employing inelastic electron scattering techniques. Spectra obtained at 61 and 81 MeV incident-electron energy and 145.7° scattering angle fail to reveal significant structure at the predicted resonance energy. The implications of this result are discussed in terms of the particle-hole model and the ground-state structure of the ^{14}B analogue of this level.

14730. Greer, S. C., Moldover, M. R., Hocken, R., **A differential transformer as a position detector in a magnetic densimeter,** *Rev. Sci. Instrum. Notes* **45,** No. 11, 1462-1463 (Nov. 1974).

Key words: densimeter; density; differential; transformer.

We describe the use of a differential transformer to detect the position of the buoy in a magnetic densimeter, an instrument for precise measurement of fluid densities. This detector can be used in cases where the buoy is not visible and it can be assembled from commercial electronic components.

14731. Carrington, C. G., Gallagher, A., **Blue satellite bands of Rb broadened by noble gases,** *Phys. Rev. A* **10,** No. 5, 1464-1473 (Nov. 1974).

Key words: line-broadening; rubidium; satellite.

Measurements are presented for the blue-wing satellite bands of the Rb first resonance line (780 nm) emitted in the presence of the noble gases Ne, Ar, Kr, and Xe. The continuum intensity per spectral interval and perturber density is expressed as a fraction of the total Rb (780 nm) fluorescence from optically thin vapor. Over the $\sim 10^{18} - 10^{19}$ cm^3 density range investigated this normalized satellite-peak intensity is found to scale linearly with perturber density and approximately exponentially in $-1/T$, T being the absolute temperature. In the classically forbidden region beyond the satellite peak the intensity drops exponentially with frequency for Xe perturbers, but departs from exponential behavior in the Ar and Kr data. We observe undulations in the spectra between line center and the satellite. This is expected due to the possibility of interference between contributions to the transition probability at two internuclear separations, the separations at which the difference potential equals the photon energy.

14732. Jednačak, J., Pravdić, V., Haller, W., **The electrokinetic potential of glasses in aqueous electrolyte solutions,** *J. Colloid Interface Sci.* **49,** No. 1, 16-23 (Oct. 1974).

Key words: electrokinetic potential glass; interface; liquid/solid interface; solid/liquid interface; surfaces; Zeta-potential.

Electrokinetic potentials of several glasses of well defined bulk composition in aqueous electrolyte solutions were computed from streaming current measurements. The composition of the bulk is reflected in the magnitude of the potential and in the shape of the curves relating the electrokinetic potential and the pH of the solution. No differences have been found between the crystalline and the vitreous state of silica. Addition of Al_2O_3 to the bulk results not in doping effects but rather in surface neutralization making the surface less acidic. Glasses with an appreciable amount of B_2O_3 have higher negative potentials at the same pH, and the derivatives of electrokinetic potential vs pH show them to belong to a different type of surface than vitreous or crystalline silica. Studies involving controlled pore glasses of various pore sizes have shown the importance of below-the-surface ionic penetration and/or adsorption in the pores in establishing the solid-movable liquid interfacial electrical equilibrium.

14733. Lawton, R. A., Nahman, N. S., **Pyroelectric detector application to baseband pulse measurements,** *Electron. Lett.* **8,** No. 12, 318-320 (June 15, 1972).

Key words: detector circuits; power measurement; pulse circuit; pyroelectricity.

A square-law detector for picosecond baseband pulse comparison techniques has been realised using the pyroelectric effect. By using thin-film techniques, a broadband signal transfer to the detector was obtained. The theoretical principles of the detector and some applications are briefly discussed. Attention is given to measurements of pulse-energy content, pulse autocorrelation function and pulse crosscorrelation function.

14734. McLaughlin, W. L., **Solid-phase chemical dosimeters,** (Proc. Int. Conf. on Sterilization by Ionizing Radiation, Vienna, Austria, April 1-4, 1974), Paper in *Sterilization by Ionizing Radiation*, E. R. L. Gaughran and A. J. Goudie, Eds., pp. 219-252 (Multiscience Publication Ltd., Montreal, Quebec, Canada, 1974).

Key words: dose distribution; dosimetry; dyes; electron beams; gamma rays; glasses; plastics; radiation chemistry; radiation sterilization; solid-state detectors; spectrophotometry.

The radiation chemistry and response characteristics of some solid-phase chemical dosimeters (plastics, dyed plastics, and glasses) are reviewed. The analysis used for dosimetry is mainly spectrophotometry in the ultraviolet and visible spectrum. Systems having a reproducible response and a stable optical absorbance are selected from as many as 28 candidate systems, some of those showing promise for radiation sterilization applications being: polymethyl methacrylate, dyed polymethyl methacrylate, polycarbonate, tetrazolium salt in polyvinyl alcohol, dyed polychlorostyrene, and dyed polyamide. Major sources of dosimetric error, such as temperature and dose rate dependence instability, non-uniformities, and batch differences, are examined.

14735. Schneider, S. J., McDaniel, C., **Problems in accurate temperature measurement: The melting point of Y_2O_3,** *Can. Met. Quart.* **13,** No. 2, 365-368 (1974).

Key words: IPTS-68; melting point; secondary temperature standards; temperature scales; Y_2O_3.

Modern day pyrometry permits the measurement of temperature with maximum uncertainties ranging between about 0.1 °C at 1064 °C (gold point) and 2 °C at 3525 °C. These uncertainties refer to the realization of the International Practical Temperature Scale (IPTS) and represent the level of accuracy a temperature per se can be determined under optimized conditions. Unfortunately, the measurement of a material property as a function of temperature imposes experimental constraints which seriously degrade the inherent accuracy of the temperature measurement system, often to unknown levels. Consequently, in situ temperature calibrations are required which must employ the use of a well characterized reference material compatible with the environment of the experiment. Suitable secondary temperature reference standards are not generally available and this lack is being addressed by the High Temperature Commission (IUPAC) through its current melting point program on Y_2O_3 and formerly by its efforts on Al_2O_3.

The determination of fixed points presents many experimental difficulties relevant to a wide range of physico-chemical measurements and can serve as an illustrative example of the high temperature problems which may be encountered. Through a description of the experimental determination of the melting point of Y_2O_3 (2422 °C) this paper delineates major problem areas and includes discussions on IPTS, temperature measurement techniques and calibration and materials behaviour and compatibility.

14736. Streett, W. B., Raveché, H. J., Mountain, R. D., **Monte Carlo studies of the fluid-solid phase transition in the Lennard-Jones system,** *J. Chem. Phys.* **61,** No. 5, 1960-1969 (Sept. 1, 1974).

Key words: fluid-solid phase transition; Lennard-Jones model; melting and freezing densities; Monte Carlo simulation; symmetry change; van der Waals isotherm.

Monte Carlo calculations for 108- and 256-particle Lennard-Jones systems have been carried out at 140 temperature-density points in the vicinity of the fluid-solid phase transition. Several types of initial configurations have been used, including fcc lattice arrays, disordered arrays, and combinations of lattice and disordered arrays. The results of runs at high densities show that for small periodic systems the calculations are dependent on the initial configuration and that such systems can exist in many different metastable states from which minimum energy states are not accessible in runs of the order of 10^6 to 10^7 configurations. In the vicinity of the smallest density at which the fcc lattice is stable, the calculated pressure-volume curve exhibits many of the features of a "van der Waals loop"; however, because a single phase is thermodynamically unstable over part of this region, the loop cannot be completely resolved through machine calculations. The use of the van der Waals loop to estimate the melting parameters for the Lennard-Jones system leads to fluid and solid densities 3 to 4 percent lower than those calculated by the indirect method of Hansen and Verlet.

14737. Smith, R. L., Case, W. E., Rasmussen, A. L., Russell, T. W., West, E. D., **A calorimeter for high power CW lasers,** (Proc. Conf. on Precision Electromagnetic Measurements, Boulder, Colo., June 26-29, 1972), Paper in *CPEM Digest, pp. 138-139 (1972).*

Key words: laser; laser calorimetry; laser energy measurements; laser power measurements.

A calorimeter was built to measure the total energy emitted by a CW laser whose output wavelength is in the region from 1 μm to 11 μm. This instrument can measure energies from 10^5 to approximately 10^7 joules with about 5 percent uncertainty and it can measure energies down to about 10^4 joules with a larger uncertainty. The calibration factor for this device is approximately 2.26×10^6 joules/volt, where one volt corresponds to a temperature interval of approximately 12 °C. The laser power that can be accommodated by this instrument ranges from about 500 watts to 100,000 watts. The maximum beam diameter it will accept is 10 cm.

14738. Little, W. E., **Automated computer controlled measurements,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest* No. 113, 331-332 (Institution of Electrical Engineers, London, England, 1974).

Key words: automated measurements; computer; concepts; reliability; state-of-the-art; survey.

The primary intent of this paper is to give a state-of-the-art survey of automated-computer controlled measurements in the context of what has been done in the past that has direct bearing on the present work and the directions that the near future work will take.

The paper will cover some of the evolution of computer controlled measurement systems including concepts utilized in the system designs. The discussion will start with the concept of utilizing the computer to handle large amounts of data from *traditional* systems to give more data handling reliability and then go into the concepts of using the computer not only to collect the data but to control the actual measurement instruments to allow for even more reliability and in some cases improved measurement accuracy. From there, it will go into the concept of using the compuer not only to control the instruments and collect the data but to actually model the system. Here, numerical data which represents system parameters is stored in the computer memory and later utilized to correct the measurement data so that the system will appear nearly perfect and an improvement in measurement accuracy is achieved.

Finally, a summary of the state-of-the-art in automated computer controlled measurement equipments and techniques will be given. It will be given in the context of measurement accuracy achieved, measurement efficiency, reliability, and measurement concepts employed in the system design.

14739. Beatty, R. W., **2-port standards for evaluating automatic network parameter measurement systems,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest No. 113,* 87-89 (Institution of Electrical Engineers, London, England, 1974).

Key words: automatic measurement; coaxial standards; network parameters; reflection coefficient; scattering coefficients; transmission coefficient; waveguide standards; 2-port standards.

2-port standards have been developed for evaluating the performance of automatic systems which measure network parameters over a broad frequency range.

The standards consist of short sections of coaxial line or waveguide which include or produce simple discontinuities. One can calculate the complex reflection and transmission coefficients for any frequency given the dimensions.

In use, the standards are terminated by a port of the measurement system which is made effectively non-reflecting by means of a calibration procedure and computer correction.

A number of types of standards are described and measurements with a typical automatic system are presented.

14740. Kerns, D. M., **Comment on correction of errors in aerial far-field radiation-pattern determinations,** *Electron. Lett.* **7,** No. 24, 706 (Dec. 2, 1971).

Key words: antenna radiation patterns; gain measurement.

In the communication being commented on, a method is "proposed" for correcting for the effects of the measuring antenna in the determination of far-field aerial patterns from near-field measurements. This method was previously proposed in a talk in 1963 and has been substantially implemented in theoretical, experimental, and computational work. References are given.

14741. Lawton, R. A., **Autocorrelation and power measurement with pyroelectric and dielectric bolometers,** *IEEE Trans. Instrum. Meas.* **IM-22,** No. 4, 299-306 (Dec. 1973).

Key words: autocorrelation; detector; pulse; pyroelectric.

A pulse comparison technique is described which yields the autocorrelation function and the power spectrum of a repetitive time-domain waveform. The autocorrelation function is realized with a sliding short in a coaxial transmission line to provide time delay; a pyroelectric bolometer to provide multiplication through a square law voltage response; and a capacitor to provide integration. Problems of realization of a perfect time delay and integration limitations are considered, and it is found that noise fluctuations yield the main time resolution limitation that is equivalent to 8 ps for 15-V pulses and a 50-s integration time. The pyroelectric voltage-sensing bolometer is then compared to a pyroelectric capacitance sensing bolometer. It is shown that the capacitance sensing bolometer can handle much longer pulse durations than the voltage sensing bolometer. It is also demonstrated that the sensitivities of the two techniques are equivalent in a typical case at a capacitance sensing bolometer bridge voltage of 3 V. Measurement results of the autocorrelation function and power spectrum, using a voltage sensing pyroelectric bolometer, are given for a nominal 15-V, 500-ps time duration, whose baseband pulses have a 100-pps (pulses per second) repetition rate.

14742. Lawless, W. N., Radebaugh, R., Siegwarth, J. D., **Improvements on "low-temperature dielectric bolometer,"** *J. Opt. Soc. Amer.* **64,** No. 6, 820-822 (June 1974).

Key words: bolometer; cryogenics; dielectric; glass-ceramic; optics.

This paper corrects a definitional error in the previous paper on this topic and reports a considerably better dielectric material for this type of detector (i.e., $d\ln\epsilon/dT$ values as large as 30% K^{-1} in the range 0.3 to 10 K). Computed responsivity (times the square root of the detector area) based on this material varies from 6×10^6 to 2×10^4 $V \cdot W^{-1} \cdot cm$ for reservoir temperatures between 0.3 and 10 K. The corresponding variation of the detectivity is from 2×10^{14} to 1×10^{11} $cm \cdot W^{-1} \cdot Hz^{1/2}$.

14743. Ogburn, F., **Methods of testing,** Chapter 30 in *Modern Electroplating,* 3d Edition, pp. 673-709 (July 1974).

Key words: coatings; electroplated coatings; metal coatings; test methods for metal coatings; testing electrodeposits.

A brief description and evaluation is given of each of the methods used to test electroplated coatings for thickness, corrosion resistance, porosity, internal stress, ductility, hardness, and solderability.

14744. Carter, G. C., Kahan, D. J., **NMR, soft x-ray, and other physical properties of rare earth metals and alloys—an annotated bibliography,** (Proc. 11th Rare Earth Research Conference, Traverse City, Mich., Oct. 7-10, 1974), Paper in *Proceedings of the 11th Rare Earth Research Conference,* J. M. Haschke and H. A. Eick, Eds., **II,** 1014-1018 (1974).

Key words: alloy data; bibliography; index; Knight shifts; NMR; rare earth metals and alloys; soft x ray.

The Alloy Data Center (ADC) has deep-indexed about 18,000 papers dealing with physical properties of metals and alloys, and maintains these in a computerized file. Of these, approximately 3,000 contain information on transuranic or rare earth metals (including Sc, Y, La), or alloys with one or more such components. These literature references have been printed out alphabetically by chemical symbol to form a rare-earth annotated bibliography, which is available as an NBS Special Publication. The ADC collects all nuclear magnetic resonance (NMR) and soft x-ray spectroscopy (SXS) papers, and many papers dealing with other electronic-structure related properties as well. This bibliography, therefore, contains all NMR and SXS papers for rare-earth related metallic materials. The ADC does not intend to compete with the Rare Earth Information Center, which is far more comprehensive for many other physical properties of rare earth materials. Rather, this bibliography of the ADC's holdings is thought to represent a valuable bibliographic tool in the interim period until the Rare Earth Information Center has completed its conversion to an automated system.

14745. Das, E. S. P., deWit, R., Armstrong, R. W., Marcinkowski, M. J., **Kinks, jogs, and a regeneration mechanism for Volterra disclinations,** *J. Appl. Phys.* **44,** No. 11, 4804-4806 (Nov. 1973).

Key words: crystal; defect; disclination; dislocation; elasticity; jog; kink; multiplication; plasticity; Volterra.

A regenerative mechanism is proposed which can lead to unlimited multiplication of disclinations. This mechanism consists of a glissile segment of a disclination pinned by two sessile "jogs," and therefore is similar to a Frank-Read source for dislocations. It is also possible to have a U-mill, Z-mill, and L-mill for disclination multiplication. It is further shown that a single source can give rise to disclinations of opposite signs (and this allows rotation in both directions of that part of the crystal above the source, relative to the part below), depending upon the direction in which the source operates.

14746. Zhukov, V. V., Weisman, I. D., Bennett, L. H., **Nuclear**

magnetic resonance in cadmium alloys, *J. Magn. Resonance* **16,** 29-34 (1974).

Key words: anisotropic Knight shift; Cd; Hg; isotropic Knight shift; Knight shift; Korringa product; nuclear magnetic resonance; spin lattice relaxation.

Experimental isotropic and anisotropic Knight shift data on ^{113}Cd and on ^{199}Hg in Cd-Hg alloys have been obtained between room and liquid-helium temperatures. The ^{113}Cd spin-lattice relaxation times in Cd and in a Cd + 10 at.% Hg alloy have also been measured at these temperatures. The Hg concentration dependence of the anisotropic and isotropic Knight shifts at the ^{199}Hg site was found to be qualitatively similar to that of the corresponding shifts at the ^{113}Cd site. The Korringa relation for ^{113}Cd is obeyed, indicating that only one mechanism contributes to the Knight shift and spin-lattice relaxation. The ratio of isotropic Knight shifts, (Hg:Cd), extrapolated to zero Hg concentration, 4.67, is somewhat greater than the ratio, 3.69, of atomic hyperfine fields. This suggests that the amount of electronic "*s*" character at the Cd Fermi surface is anomalously low due to anisotropy effects and that adding Hg rapidly destroys the anisotropy by weakening and symmetrizing the lattice potential.

14747. Ruff, A. W., Fraker, A. C., **Investigation of the anisotropic anodic polarization behavior of titanium,** *Corrosion* **30,** No. 7, 259-264 (July 1974).

Key words: corrosion; passivation; single crystals; sulfuric acid; titanium.

Anodic polarization measurements have been made potentiostatically on single crystal and polycrystal titanium in 1N H_2SO_4 at 23 C (73 F). Three low index surfaces, (0001), (1120), and (1010) were studied together with polycrystalline rolled sheet material. A strong influence of crystallographic orientation on the anodic current densities was found in both the active and the passive regions. The most active surface was (1120), the least active (0001). The most passive surface was also (0001), unless the specimen had been in a cathodic region, whereupon that orientation became the most reactive. That effect and others that are associated with titanium hydride formation are discussed. The effect on the reactivity of the polycrystalline surface due to preferred orientation texture is mentioned.

14748. Boettinger, W. J., **The structure of directionally solidified two-phase Sn-Cd peritectic alloys,** *Met. Trans.* **5,** 2023-2031 (Sept. 1974).

Key words: alloy; directional solidification; incongruent melting alloy; peritectic reaction; Sn-Cd alloys; structure.

The structure of Sn-Cd two-phase peritectic alloys directionally solidified at various values of G/v (temperature gradient in the liquid divided by growth rate) is reported. The minimum value of G/v as a function of composition required for the solidification of two-phase peritectic alloys with a planar liquid-solid interface is estimated using a simple constitutional super-cooling stability criterion. At a value of G/v just below this minimum value, these alloys solidify with a nonplanar interface consisting of cells of α (the high temperature phase) and intercellular β (the low temperature phase). This produces a coarse rod-like microstructure consisting of rods of α phase imbedded in a β matrix. At a value of G/v above this minimum value, these alloys solidify with a planar interface which alternately deposits bands of α and β transverse to the growth direction. No coupled growth of α and β at a planar interface is observed in Sn-Cd two-phase peritectic alloys as was expected. To understand this, an analysis of coupled (eutectic-like) growth of two-phase peritectic alloys is presented and contrasted with the results of the Jackson-Hunt theory of lamellar eutectic growth. This calculation indicates that the coupled growth of two-phase peritectic alloys is unlikely on theoretical grounds.

14749. Radebaugh, R., Siegwarth, J. D., **Heat transfer between fine copper powders and dilute ^{3}He in superfluid ^{4}He,** (Proc. 13th Int. Conf. on Low Temperature Physics, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics LT 13,* K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., 1, 401-405 (Plenum Press, New York, N.Y., 1974).

Key words: copper; heat transfer; helium 3-helium 4; Kapitza resistance; phonon-electron interaction; phonon-quasiparticle interaction; powder; sintering.

The recently measured value of the phonon-electron thermal resistance is too low to have been seen in previous measurements of the Kapitza resistance of high surface area materials below 0.1 K. We report here measurements of the thermal resistance between dilute ^{3}He liquid and copper powder of characteristic spherical diameter, based on adsorption studies, of 1.6 μm. With this fine powder we should expect to see, below about 50 mK, the phonon-electron thermal resistance and the phonon-^{3}He quasiparticle thermal resistance. However, measurements down to 15 mK on three different samples of this powder show no signs of these additional resistances. The thermal resistance-surface area product has the typical Kapitza resistance behavior of $R\sigma T^3 \approx$ constant for temperatures below that where the thermal resistance of the liquid in the sponge dominates. The value for the constant is in fair agreement with the value 280 cm^{2}K^4/W that we find for annealed bulk OFHC copper in dilute ^{3}He.

14750. Reed, R. P., Schramm, R. E., **Relationship between stacking-fault energy and x-ray measurements of stacking-fault probability and microstrain,** *J. Appl. Phys.* **45,** No. 11, 4705-4711 (Nov. 1974).

Key words: deformation; dislocations; face-centered cubic metals; faults; Fourier analysis; review; stacking fault energy; x-ray diffraction.

Stacking-fault energies can be determined by measuring the positions and profiles of x-ray diffraction lines. Use of this method has been hampered by the uncertainty of the relationship between stacking-fault energy and the ratio of microstrain to stacking-fault probability. Microstrains and stacking-fault probabilities have been determined for five fcc metals by x-ray diffraction line profile analysis. For these metals, Ag, Au, Cu, Al, and Ni, stacking-fault energies have been estimated from a comprehensive updated review of the experimental literature. A linear correlation does exist between γ and $\langle \epsilon_{50}^2 \rangle_{111}/\alpha$ and thus, the x-ray technique can be applied more confidently. The possible role of elastic anisotropy is also considered.

14751. Mihalas, D., Hummer, D. G., **Theory of extended stellar atmospheres. I. Computational method and first results for static spherical models,** *Astrophys. J. Suppl. Ser.* **28,** No. 265, 343-372 (Oct. 1974).

Key words: astrophysics; early-type stars; radiative transfer; spectral line formation; stellar atmospheres.

A method is presented that makes possible, for the first time, the calculation of extended spherical non-LTE model stellar atmospheres in hydrostatic and radiative equilibrium. This method is a generalization of the complete-linearization technique of Auer and Mihalas. Models have been obtained for a star with $\mathscr{M} = 60\mathscr{M}_\odot$, $L = 1.25 \times 10^6 L_\odot$, and $R = 24\ R_\odot$, whose atmosphere is characterized by an effective temperature $T_{eff} = 39{,}500$ K and a surface gravity log $g_6 = 3.45$, i.e., with a spectral type near O6. These models are differentiated by the magnitude and radial dependence of a radiation force multiplier γ that is inserted into the equation of hydrostatic equilibrium to simulate the effect of radiation force on opacity sources which have not been included explicitly in the calculation. Models have been obtained very close to the limit at which the radiation force and gravity balance; as this condition is approached, the atmospheres become more and more extended. Only hydrogen and helium ($Y = 0.1$) have been included, and six hydrogen lines have been treated explicitly. Although these models show only modest extension, they predict Lα in emission, the lower Balmer lines in absorption, the Balmer jump in absorption, and an infrared excess and ultraviolet deficiency relative to the visual. Continuous energy distributions and the profiles and equivalent widths of Lα, Hα, Hβ, and Hγ are tabulated. The models predict an intrinsic reddening of the colors of extended envelopes relative to plane-parallel atmospheres. A procedure for the extraction of the intrinsic colors of luminous stars from heavily reddened observations is described.

14752. Farmer, B. L., Eby, R. K., **Methyl branches in hydrocarbon crystals: Calculation of relaxation effects,** *J. Appl. Phys.* **45,** No. 10, 4229-4238 (Oct. 1974).

Key words: mechanical relaxation; methyl branches; paraffins; polyethylene; potential energy calculations; relaxation strength; two-site model.

A two-site model for a relaxation process has been used in conjunction with the results of illustrative potential-energy calculations on a model system to examine the effects of isolated methyl branches on the chain packing and mechanical relaxations of a linear hydrocarbon host crystal. The results indicate that a branched molecule can be accommodated in an array of linear chains in two different modes of packing and that each mode has two orientations. For one of the modes, the two orientations have nearly equal energies. Upon mechanical deformation of the array, this mode gives rise to a relaxation. The relative strengths are evaluated for different deformations, some of which yield values of the order of those observed experimentally. This relaxation is much weaker for unbranched chains in the planar zigzag conformation.

14753. Cowan, R. D., Radziemski, L. J., Jr., Kaufman, V., **Effect of continuum configuration interaction on the position of $s\,p^6$ in neutral chlorine and other halogens,** *J. Opt. Soc. Amer.* **64,** No. 11, 1474-1478 (Nov. 1974).

Key words: atomic spectra; chlorine; halogens; photoionization.

Ab initio Hartree-Fock calculations in the single-configuration approximation predict that the $3s\ 3p^6\ {}^2S_{1/2}$ level of Cl I lies far above the ionization limit, although this level is observed to be the lowest of all even $J = 1/2$ levels other than $3s^2\ 3p^4\ 4s\ {}^4P_{1/2}$, ${}^2P_{1/2}$. The solution of this anomaly lies in configuration interaction with the high-lying portion of the $3s^2\ 3p^4\ \epsilon d\, {}^2S_{1/2}$ continuum, which is sufficiently strong to depress the computed $s\,p^6$ level to its observed position. This interaction with the continuum is an extension of the well-known interaction of sp^{w+1} with the discrete $s^2p^{w-1}\ nd$ Rydberg series, and is important in all neutral third-row elements Al to Cl, as well as in Br and I and probably other fourth- and fifth-row elements. The effect is, however, somewhat smaller in Br I and I I than in Cl I, with the result that there exists no bromine nor iodine level that is primarily $s\,p^6$ in nature. The interactions produce large changes in computed transition probabilities and photoionization cross sections.

14754. Sanchez, I. C., Peterlin, A., Eby, R. K., McCrackin, F. L., **Theory of polymer crystal thickening during annealing,** *J. Appl. Phys.* **45,** No. 10, 4216-4219 (Oct. 1974).

Key words: annealing; crystalline polymers; material transport; thickening; volume change.

A previous theory of thickening has been extended to encompass the possible dependence of cooperative chain transport on lamella thickness and crystallinity changes during annealing. These have marked effects on the thickening rate leading to changes in slope and departures from straight-line behavior of the plots of lamella thickness versus the logarithm of time. The resulting curves bear a resemblance to many experimental ones in the literature. Also brought out by the analysis is the important fact that the volumes of the coherently thickening domains are not known from experiment.

14755. Sugar, J., Spector, N., **Spectrum and energy levels of doubly ionized europium (Eu III),** *J. Opt. Soc. Amer.* **64,** No. 11, 1484-1497 (Nov. 1974).

Key words: energy; energy levels; europium; ionization; spectrum.

The spectrum of Eu III obtained with a 6 A sliding-spark discharge has been measured from 2000 Å to 9000 Å. Of the 890 spectral lines observed, one-third are classified in an energy-level scheme consisting of 104 excited levels. These belong to the $4f^7$ configuration and to the $4f^6(^7F)5d$, $4f^6(^7F)6s$, and $4f^6(^7F)6p$ subconfigurations. Except for $4f^7$, calculations of these configurations with least-squares-adjusted parameters were carried out. A reasonably suitable truncation for the energy matrices of each configuration was found.

14756. Van Brunt, R. J., Kieffer, L. J., **Angular distribution of O^- from dissociative electron attachment to NO,** *Phys. Rev. A* **10,** No. 5, 1633-1637 (Nov. 1974).

Key words: dissociation; electron; ionization; molecular oxygen.

The electron energy dependence of the angular distribution of O^- produced by dissociative electron attachment to NO has been measured in the energy range 8.0-11.0 eV. The distributions are observed to be anisotropic and of a form that is nearly $\sin^2\theta$ at all energies. Deviations from a $\sin^2\theta$ dependence are discussed in terms of the relative contributions of different partial waves to the differential cross section. The results indicate that the final repulsive negative-ion resonances involved must be either Σ or Δ states.

14757. Haynes, W. M., **Measurements of the viscosity of compressed gaseous and liquid fluorine,** *Physica* **76,** No. 1, 1-20 (Aug. 1974).

Key words: experimental; fluorine; gas; graphs; liquid; tables; torsional crystal; viscosity.

A torsionally oscillating quartz crystal has been used to make absolute measurements of the coefficient of shear viscosity for compressed fluid fluorine at temperatures from 90 to 300 K, at pressures up to 20 MPa; and for saturated liquid fluorine at temperatures from 70 to 144 K. Special features of the viscometer, necessary to provide an instrument suitable for measurements on an extremely reactive fluid such as fluorine, are described. The accuracy of the results is estimated to be of the order of 2 percent with the precision somewhat better, approximately 0.5 percent. The dependence of the viscosity on density has been investigated by representing the gaseous data along isotherms in power-series expansions. Dilute-gas viscosities were subsequently derived from this analysis. An equation has been developed that can be used to calculate the viscosity of fluorine over the range of the present measurements. Comparisons with experimental data and theoretical predictions are presented for the few measurements and calculations previously attempted for fluorine.

14758. Choi, C. S., Bulusu, S., **The crystal structure of dinitropentamethylenetetramine (DPT),** *Acta Crystallogr. B30,* Part 6, 1576-1580 (June 1974).

Key words: crystal structure; cyclic nitramine; organic compound.

The crystal structure of dinitropentamethylenetetramine, or DPT, $C_5H_{10}N_6O_4$, has been studied by using three-dimensional x-ray (Mo $K\alpha$) diffraction data. The unit cell is monoclinic $P2_1/c$, with $a = 9.345$ (5), $b = 8.284$ (5), $c = 11.566$ (5) Å, $\beta = 105.6$ (1)° and $Z = 4$. The structure was solved by direct methods and refined by full-matrix least-squares methods to a final $R = 0.035$, $R_w = 0.037$. The two N-NO_2 groups in a DPT molecule are planar, with the two nitramine carbons out of the plane. The molecule has approximate mirror symmetry bisecting each of the two nitro groups.

14759. Wyllie, L. A., Jr., Wright, R. N., Sozen, M. A., Degenkolb, H. J., Steinbrugge, K. V., Kramer, S., **Effects on structures of the Managua earthquake of December 23, 1972,** *Bull. Seismol. Soc. Amer.* **64,** No. 4, 1069-1133 (Aug. 1974).

Key words: building; codes; earthquake damage; earthquakes; hazards; hospital; natural disasters; seismic; structural engineering.

The December 23, 1972, earthquake in Managua, Nicaragua caused extensive damage to structures throughout the city of Managua. There was damage to virtually every building in Managua, a city of approximately 400,000 inhabitants. An estimated 10,000 people were killed, mostly in the collapse of homes built of native taquezal construction. The city contained numerous reinforced concrete structures designed to recent standards. Although many of these buildings were heavily damaged, with some collapses, some had only minor damage. There were also several structures of structural steel.

The paper provides an overview of structural effects and discusses the performance of selected buildings in Managua illustrating the range of performance of modern construction. Damage to numerous other buildings will be discussed. The paper, while emphasizing the structural effects on buildings, also discusses the performance of non-structural elements, mechanical equipment, etc.

14760. Phelan, R. J., Jr., Peterson, R. L., Hamilton, C. A., Day, G. W., **The polarization of PVF and PVF_2 pyroelectrics,** *Ferroelectrics* **7,** 375-377 (1974).

Key words: polyvinylfluoride; polyvinylidene fluoride; pyroelectrics.

Through detailed investigations of the modulation frequency response of pyroelectric detectors, nonuniform polarizations have been shown to exist in polyvinylfluoride and polyvinylidene fluoride plastics. The nonuniform polarization is also confirmed by measurements using multilayer structures. The direction and magnitude of the gradients in polarization are dependent on the magnitude and polarity of the poling voltage. The gradients in the polarization for PVF and PVF_2 are opposite in direction. Using structures that allow for poling to 2×10^6 V/cm uniform polarizations, the highest responsivities and improved frequency responses were obtained.

14761. Massey, R. G., Druckenbrod, W. F., **Terms and definitions for police patrol cars,** *LESP-RPT-0401.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1974).

Key words: patrol car definitions; patrol car functions; patrol car systems; patrol car terms.

This document contains the definitions of terms related to four-wheeled, on-road vehicles used in law enforcement. The terms and definitions have been selected on the basis of usefulness to those responsible for the selection, procurement, and use of those vehicles.

14762. Jackson, J. A. A., Lias, S. G., **Primary processes in the photolysis of n-butane with 8.4 and 10.0 eV photons,** *J. Photochem.* **3,** 151-162 (1974).

Key words: alkane; electronically excited molecule; hydrogen iodide; n-butane; radical scavenging; vacuum ultraviolet photolysis.

The photolyisis of n-C_4D_{10} has been investigated with 8.4 eV and 10.0 eV photons, using HI to scavenge free radicals through the reaction: $R_D + HI \rightarrow R_DH + I$ (where R_D is a fully deuterated alkyl or alkenyl radical). From the results of such experiments, the quantum yields of the molecular and radical products are obtained over a pressure range from 3 to 47 torr at both energies. In addition, the photolysis of $CD_3CH_2CH_2CD_3$ and $CD_3CD_2CH_2CH_3$ have been investigated in the presence of radical scavengers over a range of pressures at both energies. The results are discussed with particular emphasis on deriving the quantum yields of all the primary processes, and following changes in the quantum yields as a function of energy. Major conclusions are: (a) the quantum yield of the process ($C_4D_{10} \rightarrow C_4D_8 + D_2$) diminishes from 0.70 to 0.37 when the photon energy is increased from 8.4 to 10.0 eV; (b) the relative overall importance of direct C-C bond cleavage processes, alkane elimination processes, and D-atom elimination processes do not change significantly as a function of energy; (c) processes involving breakage of the 2, 3 C-C bond strongly predominate over processes involving the 1, 2 C-C bond at both energies, although there is a lower probability for localization of the energy in the center bond when the energy is increased.

14763. Bridges, J. M., Kornblith, R. L., **ARC measurements of Fe I oscillator strengths,** *Astrophys. J.* **192,** 793-812 (Sept. 15, 1974).

Key words: arc; f-values; iron and oscillator strengths.

Oscillator strengths for 534 lines of Fe I have been measured from a wall-stabilized arc. These lines have wavelengths between 2900 and 5800 Å and cover a wide range in intensity and upper energy level. Lifetime values were used in normalizing to an absolute scale and in determining the arc temperature. This temperature agreed with that found independently, using LTE plasma diagnostics. Comparisons with other recent oscillator strength measurements generally show agreement within combined error estimates.

14764. Geltman, S., **The Coulomb-projected Born approximation V. Ionization of helium,** *J. Phys. B* **7,** No. 15, 1994-2002 (1974).

Key words: electron impact; helium; ionization; theoretical study.

The triple differential cross section for the electron impact ionization of helium is calculated in the Coulomb-projected Born approximation, including exchange. Detailed comparison is made with the ordinary Born result and with available experiment in both the coplanar and non-coplanar geometries. The agreement with experiment in almost all cases is appreciably better for the Coulomb-projected Born results than for the ordinary Born results.

14765. Jarvis, S., Jr., **Determination of velocity distributions in molecular beam frequency standards from measured resonance curves,** *Metrologia* **10,** No. 3, 87-98 (1974).

Key words: accuracy evaluation; atomic beam frequency standards; cavity phase shift; second order Doppler shift.

It is shown that the Ramsey resonance curves for most atomic beam machines can be conceived as depending on two distributions of velocity, ρ (V) and ξ (V), the second being a correction for beam width.

An analysis and computer program are described which permit one to obtain ρ, ξ and the nominal microwave power parameter from three or more measured Ramsey resonance curves at properly spaced power levels whose ratios are known. The determination from the functions (ρ, ξ) of bias errors due to second order Doppler shift, cavity phase difference, and cavity pulling is described.

The method may also be used to improve an experimentally obtained velocity distribution (i.e., one obtained through the pulse technique); to provide the proper function ξ; and to provide diagnostic checks of the measurement technique and the validity of the model chosen for the transition probability.

The method is applied to the NBS frequency standard. Error estimates indicate that it is feasible by microwave power shift measurements to evaluate the total bias error due to the above sources to within one part in 10^{13}.

14766. Wacker, P. F., **Near-field antenna measurements using a spherical scan: Efficient data reduction with probe correction,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Paper in *CPEM Digest,* No. 113, 286-288 (Institution of Electrical Engineers, London, England, 1974).

Key words: antenna measurements; data reduction; near field; probe correction; probe design; spherical scan.

A new data reduction scheme makes practical the determination of patterns of electrically large antennas from near-field spherical scans.

14767. Mies, F. H., **Calculated vibrational transition probabilities of OH(X^2 Π),** *J. Mol. Spectrosc.* **53,** 150-188 (1974).

Key words: Einstein coefficients; line strengths; Meinel bands; molecular spectra; OH; radiative lifetimes; spin uncoupling; vibration-rotation interaction; vibrational transitions.

The theoretically derived dipole moment function of OH(X^2 Π) obtained by Stevens, Das, Wahl, Neumann, and Krauss is used to calculate the absolute intensities of the vibrational-rotational transitions of the OH Meinel bands. The calculations take full account of the spin uncoupling and vibration-rotation coupling which markedly influence the radiative transition probabilities. The effect of lambda-doubling on the vibrational transitions is analyzed and generally found to be negligible. Results are tabulated for $\Delta v = v' - v''$ ranging from the fundamental transitions $\Delta v = 1$ to the $\Delta v = 5$ overtone, for $v' = 1$-9 and $J' = 0.5$-15.5. A comparison is made with available data, and various features of the OH spectrum are examined that are of aeronomical and experimental interest. Thermally averaged emission rates are presented for $\Delta v = 1$-5, and the validity of the rotational temperatures commonly derived from experimental intensity distributions is questioned.

14768. Hummer, D. G., Norcross, D. W., **Light ions of astrophysical interest—radiative transition probabilities for C III, N IV, O V and Ne VIII,** *Mon. Notic. Roy. Astron. Soc.* **168,** No. 2, 263-272 (1974).

Key words: atomic physics; atomic structure; oscillator strengths; radiative transition probabilities; spectra.

Multiconfiguration calculations of energy levels and bound-bound radiative transition probabilities for four astrophysically important ions of the Be isoelectronic sequence are presented. Convergence of the results with respect to the number of configurations included in the expansion is discussed. Results are presented for all ions from models with 11 and 16 configurations; including transition probabilities for 24 allowed electric dipole transitions. Some significant differences with previous calculations are obtained. The theoretical lifetimes are generally in good accord with those obtained by the beam-foil technique, and the results of other *ab initio* calculations.

14769. Lafferty, W. J., Sams, R. L., **High resolution infra-red spectrum of the $2\nu_3$ band of NO_2,** *Mol. Phys.* **28,** No. 4, 861-878 (1974).

Key words: Coriolis resonance; high resolution; infrared; NO_2; spin splitting; $2\nu_3$.

The $2\nu_3$ B-type band of NO_2 has been measured, assigned and the spin splitting has been accounted for satisfactorily. Ground-state rotational constants have been obtained by fitting 6 microwave pure rotational transitions with 119 ground-state combination differences obtained in this work. The resulting ground-state rotational constants in cm^{-1} are:

$$\begin{gathered}\mathscr{A}'' = 8\cdot002366 \pm 0\cdot000048,\ \Delta_{NK}'' = -(1\cdot943 \pm 0\cdot048) \times 10^{-5},\\ \mathscr{B}'' = 0\cdot433705 \pm 0\cdot000014,\ \Delta_N'' = (3\cdot24 \pm 0\cdot20) \times 10^{-7},\\ \mathscr{C}'' = 0\cdot410448 \pm 0\cdot000013,\quad \delta_K'' = (1\cdot8 \pm 7\cdot2) \times 10^{-6},\\ \Delta_K'' = (2\cdot685 \pm 0\cdot020) \times 10^{-5},\ \delta_N'' = (2\cdot95 \pm 0\cdot26) \times 10^{-8},\\ H_K'' = (2\cdot04 \pm 0\cdot95) \times 10^{-6},\end{gathered}$$

where uncertainties are 3σ. Upper-state constants have also been obtained. Anomalous line intensities are observed throughout the band. The most striking of these anomalies is the observation of very strong ^PR_K series even for moderately high K values while no ^PP_K or ^RP_K lines have been observed.

14770. Eyler, J. R., **Intracavity dye laser technique for the study of laser-induced ionic processes,** *Rev. Sci. Instrum.* **45,** No. 9, 1154-1156 (Sept. 1974).

Key words: intracavity technique; ion cyclotron resonance; mass spectrometry; negative ions; photodetachment; tunable dye laser.

An intracavity dye laser technique has been used to study the photodetachment of electrons from gaseous OH^- ions in an ion cyclotron resonance (icr) spectrometer. Enhancement of the photodetachment effect by a factor of 6.8 when comparing the intracavity technique to a double-pass experiment has been observed. Under the conditions of these experiments approximately 93 percent of the OH^- ions in the icr cell undergo photodetachment using the intracavity technique.

14771. Eyler, J. R., Atkinson, G. H., **Dye laser-induced photodetachment of electrons from SH^- studied by ion cyclotron resonance spectroscopy,** *Chem. Phys. Lett.* **28,** No. 2, 217-220 (Sept. 15, 1974).

Key words: ion cyclotron resonance; mass spectrometry; negative ions; photodetachment; spin-orbit coupling; tunable dye laser.

The photodetachment of electrons from gaseous SH^- ions has been studied in an ion cyclotron resonance mass spectrometer using a flashlamp-pumped organic dye laser as a light source. The onset of the photodetachment process at 538.7 ± 0.3 nm ($2.301_6 \pm 0.001_3$ eV, 18563 ± 10 cm^{-1}) agrees well with that obtained in an earlier study. Coarse structure in the photodetachment curve with a spacing of 11.8 nm (0.052 eV, 422 cm^{-1}) has been identified with spin-orbit coupling in the SH· radical. Finer structure, with a spacing of ca. 2.5 nm (0.011 eV, 89 cm^{-1}), has also been observed in the curve, but remains unexplained.

14772. Sengers, J. M. H. L., Greer, W. L., Sengers, J. V., **Scaled**

parametric equation of state for oxygen in the critical region, (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper in *Advances in Cryogenic Engineering,* K. D. Timmerhaus, Ed., **19,** 358-364 (Plenum Press, New York, N.Y., 1974).

Key words: critical coefficients; critical exponents; critical region; density profile; dielectric constant; linear model; oxygen; scaling laws; statistical analysis.

A method is described for fitting critical-region equation-of-state data with a particular scaled equation-of-state, the so-called Linear Model. The method has been applied to the density profiles observed by Weber in the critical region of oxygen. The Linear Model is shown to fit these data well, except for a small region on the critical isochore close to T_c. The optimized critical exponents, however, do not agree very well with those from Weber's power-law analysis. Some sets of equation-of-state parameters are presented as starting points for further thermodynamic calculations on oxygen.

14773. Collin, G. J., **Photolyse du butène-1 dans l'ultraviolet à vide,** *Can. J. Chem.* **51,** No. 17, 2853-2859 (1973).

Key words: far ultraviolet; free radical reactions; ion-molecule reactions; photochemistry; primary processes; 1-butene.

The vacuum u.v. photolysis of 1-butene was studied in the 147-105 nm region. The main products formed from the fragmentation of excited molecules are allene, 1,3- and 1,2-butadienes, ethylene, and acetylene. The addition of a hydrogen atom to the double bond produces mainly secondary butyl radicals (91%) at 147 nm. At 123.6 nm, this proportion becomes 82 percent. Thus at shorter wavelengths (10 and 11.6-11.8 eV), hydrogen atoms are produced with a kinetic energy higher than the thermal energy.

14774. Mann, D. B., Dean, J. W., Brennan, J. A., Kneebone, C. H., **Cryogenic flow measurement—positive displacement volumetric flowmeters,** (Proc. 1st Symp. on Flow, Its Measurement and Control in Science and Industry, Pittsburgh, Pa., May 9-14, 1971), Paper in *Flow, Its Measurement and Control in Science and Industry,* Part 2, pp. 381-386 (Instrument Society of America, Pittsburgh, Pa., 1974).

Key words: cryogenic; flow; flowmeters; liquid nitrogen; measured; positive displacement.

The National Bureau of Standards and the Compressed Gas Association (CGA) have jointly sponsored a research program on cryogenic flow measurement. A cryogenic flow research facility was constructed and was first used to evaluate commercially available cryogenic flowmeters operating on a positive displacement principle. The operation and the accuracy of the flow facility is briefly described. The performance of the flowmeters on liquid nitrogen is summarized by reporting the precision and bias of the meters before and after an 80-h stability test and by defining the existence of temperature, flow rate, subcooling, and time order (wear) dependencies. Meters were evaluated with flow rates ranging from 0.00126 to 0.0063 m^3/s (20 to 100 gpm), pressures ranging from 0.34 to 0.69 MN/m^2 (50 to 100 psig), and with temperatures ranging from 72 to 90 K.

14775. Ely, J. F., McQuarrie, D. A., **Calculation of dense fluid transport properties via equilibrium statistical mechanical perturbation theory,** *J. Chem. Phys.* **60,** No. 11, 4105-4108 (June 1, 1974).

Key words: argon; Barker-Henderson perturbation theory; modified Enskog theory; thermal conductivity; transport properties; viscosity.

The viscosity and thermal conductivity coefficients of dense fluid argon have been calculated using the modified Enskog theory and the equilibrium statistical mechanical perturbation theory of Barker and Henderson. Agreement with experimental transport data is shown to be, in general, quite good. The results of these calculations are also compared to those obtained using the modified Enskog theory and an experimental equation of state. In this case, the results are seen to be excellent, which indicates that this approach provides us with a method of predicting transport properties of simple dense fluids from fundamental molecular theory.

14776. Andrews, J. R., **Precision picosecond pulse measurements using a high quality superconducting delay line,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest* No. 113, 316-318 (Institution of Electrical Engineers, London, England, 1974).

Key words: delay line; picosecond; pulse measurement; superconductivity.

With the aid of a high quality superconducting delay line, it is now possible to perform direct oscillographic measurements of the picosecond transition times of very fast electrical signals that do not furnish pretriggers. A 15 meter superconducting delay line has been constructed. It has an attenuation of 14 dB/km at 1 GHz. The 10 percent-90 percent transition time of this line and its associated air lines leading into and out of the liquid helium dewar is 18 ps. Some applications of this delay line are shown. They include the measurement of the pulse outputs from mercury switch and spark gap pulse generators and the transient response of a traveling wave oscilloscope.

14777. McKinney, J. E., **PVT behavior of polymeric liquid-glass systems,** *Proc. 30th National Conf. on Fluid Power, Philadelphia, Pa., Nov. 12-14, 1974,* **XXVIII,** 393-411 (1974).

Key words: density; entropy; free volume; glasses; glass transition; liquid; polymer; poly(vinyl acetate); PVT; relaxation; viscosity.

Techniques and procedures are described which are appropriate to obtain proper PVT data on liquid-glass systems. As a result of the non-equilibrium character of glasses (resulting from their very long viscoelastic relaxation times), the thermodynamic history of glass formation has considerable influence on structure and corresponding properties. Accordingly, highly systematic experimental procedures are necessary to obtain meaningful data to properly specify the properties of a liquid-glass system.

Most of the data presented here pertain to poly(vinyl acetate), and amorphous polymer, for which the thermodynamic response is considered to be in a qualitative sense typical of the liquid-glass systems. This polymer is particularly convenient to study because of its glass transition near room temperature. Through the appropriate choice of histories, two types of glass transition temperatures (with their corresponding PVT surfaces) may be observed and defined. One of these may be considered to be a thermodynamic transition applicable to thermodynamically reversible systems, the other, a kinematic transition for which dT/dP approximates the isoviscous state. The latter is therefore of interest in application to fluid transfer analysis at high pressures. In general, the values of dT/dP of the former exceed those of the latter by roughly a factor of two. The thermodynamic data describing these two transitions make possible the proper evaluation of the Ehrenfest Relations for liquid-glass systems.

The use of high pressure to "permanently" densify glasses during formation is described. This procedure results in commensurately higher refractive indices which have applications in optical technology.

The results from the more recent experiments of this type reveal certain contradictions with present phenomenological and molecular theories. A few of the more promising examples are given along with the types of modifications necessary for more accurate prediction of thermodynamic and kinematic properties.

14778. Pella, P. A., **A discussion of a performance standard for evidential breath alcohol instruments,** (Proc. 1974 Carnahan and International Crime Countermeasures Conf., Lexington, Ky., April 16-19, 1974), Paper in *Proceedings 1974 Carnahan and International Crime Countermeasures Conference, UKY Bull.* **105,** 98-101 (1974).

Key words: breath alcohol; instruments; performance standard; specifications; test procedures.

The variety of commercially available breath alcohol instruments for use in law enforcement programs has been increasing steadily. As a result of these developments, officials involved in countermeasures programs are requesting guidance concerning their reliability. The need for accuracy of the measured values obtained with these instruments has been emphasized in the courts. Therefore, it is essential that criteria be established to provide a basis for the selection of acceptable breath-testing equipment. In response to this need, the National Highway Traffic Safety Administration (NHTSA) has sponsored the development of a performance standard [1]. Instruments which are in compliance with this standard will be placed on a qualified products list. Funds used to purchase such equipment can then be utilized more effectively. Performance standards are presently being developed by the National Bureau of Standards for NHTSA. The first of these standards, described in detail in reference 1, applies to evidential breath alcohol instruments. Some selected highlights from this standard will be the subject of this presentation.

14779. Kuriyama, M., Early, J. G., Burdette, H. E., **An immobile dislocation arrangement in as-grown copper single crystals observed by x-ray topography,** *J. Appl. Crystallogr.* **7,** 535-540 (Dec. 1974).

Key words: anomalous transmission; as-grown copper crystal; crystal perfection; Czochralski growth; Lomer-Cottrell locks; sessile dislocations; x-ray topography.

X-ray diffraction topography using transmission geometry has revealed an interesting array of extremely straight and narrow long-line images in sizeable copper single crystals grown under particular growth conditions by the Czochralski technique. These images are analyzed and elucidated by a model of Lomer-Cottrell dislocations. The formation of these sessile dislocations usually aids the growth of large copper crystals of high perfection. The high degree of perfection over the entire volume of the crystals accounts for macroscopic arrangements of Lomer-Cottrell dislocations which have not previously been observed by electron microscopic techniques.

14780. Melmed, A. J., Carroll, J. J., Meclewski, R., **Dependence of work function on coverage for aluminum/tungsten in the field electron microscope,** *Surface Sci.* **45,** 649-656 (1974).

Key words: aluminum; field emission; tungsten; work function.

Aluminum adsorption on tungsten has been investigated by field electron microscope techniques. Changes in average work function and work functions of the (001) plane and (111) region were determined as a function of aluminum deposition. The average work function exhibits a minimum of about (4.11 ± 0.04) eV (relative to an assumed value of 4.50 eV for the tungsten substrate) and reaches a value of (4.21 ± 0.04) eV for thick deposits. The (001) plane and (111) region exhibit complicated work function dependences on aluminum coverage. Some qualitative observations of aluminum on tungsten surface diffusion are also reported.

14781. Iverson, W. P., **Microbial corrosion of iron,** Chapter 19 in *Microbial Iron Metabolism,* Dr. Neilands, Ed., pp. 475-513 (Academic Press, Inc., New York, N.Y., 1974).

Key words: economics; history; iron mechanisms; microbial corrosion; prevention.

A review of the corrosion of iron by microorganisms with extensive literature survey intended as a Chapter for a 1-volume book entitled "Microbial Iron Metabolism." Includes a historical survey and economic significance of microbial corrosion, general principles of corrosion, a brief discussion of the electrochemical theory of corrosion, the thermodynamics and kinetics of corrosion, electrochemical techniques for measuring the rate of corrosion, and prevention of corrosion. The microorganisms, including fungi and bacteria involved in the corrosion of iron, are discussed extensively as well as the prevention of microbial corrosion of iron.

14782. Johnson, C. R., **Sufficient conditions for D-stability,** *J. Econ. Theory* 9, No. 1, 53-62 (Sept. 1974).

Key words: diagonally dominant; diagonal matrix; *D*-stability; Gersgorin's theorem; Lyapunov's theorem; M-matrix; oscillatory; positive definite; principal minor; Routh-Hurwitz conditions; sign stable; sign symmetric; stability; tridiagonal.

Sufficient conditions for an n by n matrix to be D-stable are surveyed. Use is made of some transformations under which the D-stables are invariant and relations among the conditions are given. The verifiability of the thirteen conditions cited is also discussed. The lack of an effective characterization of D-stability motivates the discussion.

14783. Arp, V., **New forms of state equations for helium,** *Cryogenics* **14,** No. 11, 593-598 (Nov. 1974).

Key words: enthalpy; entropy; equations of state; helium; pressure.

Accurate helium properties must be measured to develop refrigeration systems for superconducting motors and generators. Normally when measuring these properties a double iteration is necessary on the equation of state to find density and temperature. In this paper new state equations are developed which eliminate iterative procedures. These equations are subsets of three overlapping sets of reference equations. They are thermodynamically inconsistent to the reference equations by a small degree of error, but have been found useful for many calculations.

14784. Wacker, P. F., **Antenna measurements at the National Bureau of Standards near-field and extrapolation techniques,** (Abstract only), (Proc. 5th Colloquium on Microwave Communication, Budapest, Hungary, June 24-30, 1974), pp. ME-113–ME-114 (Academy of Sciences, Budapest, Hungary, 1974).

Key words: antennas; extrapolation; measurements; near-field.

Near-field antenna measurements can yield especially accurate patterns and gain values, since they are subject to the precise control of a closely-coupled laboratory system and are free of errors due to ground reflections and grazing reflections from the walls of an "anechoic" chamber. Moreover, for a planar, circular-cylindrical, or spherical scanning surface, the far-field pattern may be computed from near-field data without significant approximation, provided the probe pattern is known, the medium is homogeneous and isotropic, and the medium, probe, and antenna or array are electrically linear. (The full complex-vector transmitting, receiving, and scattering properties of the antenna and probe are expressed by means of a generalization of an n-port scattering matrix, each mode (e.g., plane wave of a given direction and polarization) being considered as a port. Data processing consists primarily of a Fast Fourier Transform, followed in the spherical case by a matrix multiplication.) If the antenna is mounted on a conventional rotator, "spherical scanning" requires no probe transport.

For fixed orientations of two antennas, exact functional forms for the received signal as a function of distance permit correction for multiple-reflection and proximity effects and so yield accurate far-field values from measurements made on small ranges.

Recent NBS developments and measurements with these techniques will be described.

14785. Durst, R. A., **Ion selective electrodes,** (Proc. Int. Conf. on Localized Corrosion, Williamsburg, Va., Dec. 6-10, 1971), Paper in *Localized Corrosion,* R. W. Staehle, B. F. Brown, J. Kruger, and A. Agrawal, Eds., pp. 151-157 (National Association of Corrosion Engineers, Houston, Texas, 1974).

Key words: electrode review; ion-selective electrodes; membrane electrodes; potentiometry.

The state of the art of the newer non-glass types of ion-selective electrodes is reviewed. This survey includes the theory, characteristics, and methodology of the solid-state, liquid ion-exchange and heterogeneous membrane electrodes.

The applications of these sensors to a wide variety of scientific disciplines is discussed, ranging from various physicochemical studies and biochemical research to industrial analysis and control systems. Since this field has been growing so rapidly in the past several years, only a few of the many applications of ion-selective electrodes are presented. Special emphasis is placed on the experimental ferric ion-selective electrode as a possible sensor in corrosion studies. Much remains to be done with these sensors in the very fruitful and socially relevant areas of environmental pollution and public health. Ion-selective electrodes can provide a wealth of information if used with the proper precautions and their usefulness is limited only by the imagination and ingenuity of the users.

14786. Cook, R. K., Schade, P. A., **New method for measurement of the total energy density of sound waves,** (Proc. 1974 International Noise Control Engineering Conference, Washington, D.C., Sept. 30-Oct. 2, 1974), Paper in *Inter-Noise 74 Proceedings,* J. C. Snowdon, Ed., pp. 101-106 (Inter-Noise 74, Institute of Noise Control Engineering, Poughkeepsie, N.Y., 1974).

Key words: acoustical measurements; acoustics; noise measurement; reverberation chambers; sound energy measurement; sound power measurement.

The total energy of a sound field in reverberation chambers is usually sampled by an array of microphones. Each measures the time-average of the squared sound pressure at its location. This is equivalent to sampling the time-average of the *potential* energy density of the sound field. It would be advantageous to measure as well the time-averaged squared particle velocity. This would yield the *kinetic*-energy density, which added to the *potential*-energy density would then yield the *total*-energy density. A principal advantage of the total energy density is that its spatial variance is in general appreciably less than the potential variance. We find this from an analysis of the variances for the eigenmodes of rectangular chambers having reflecting (rigid) walls. A microphone for total energy density can be made from a spatial array of six elements arranged at the corners of a regular octahedron. Electret microphones seem to be particularly suitable for the elements. The total energy density can be computed from the sums and differences of the electret outputs, with the help of integrated circuits, and displayed as a running function of time, e.g., as a graphic recording. For a standing-wave tube, only two elements are needed, and the total-energy-density microphone then takes a very simple form.

14787. Gerola, H., Linsky, J. L., Shine, R., McClintock, W., Henry, R. C., Moos, H. W., **Evidence for a corona of Beta Geminorum,** *Astrophys. J.* **193,** No. 3, L107-L110 (Nov. 1, 1974).

Key words: stellar atmospheres; stellar coronae; ultraviolet stellar spectrum.

Using the Princeton spectrometer on the satellite *Copernicus*, a strong emission line has been detected in the K0 giant β Gem at 1218.4 Å, which is identified as the ${}^1S_0 - {}^3P^o{}_1$ intercombination line of O v. The strength of the line is such that it is probably formed in a corona at temperatures near 260,000 K rather than in an analog of the solar chromosphere-corona transition region.

14788. Goldman, A. J., **Fractional container-loads and topological groups,** *Oper. Res. Letters to Editor* **16,** No. 6, 1218-1221 (Nov.-Dec. 1968).

Key words: inventory theory; topological groups.

The problem treated is that of finding those probability distributions of fractional "tails" on the input volumes to a unitization facility during successive time periods that yield a time-invariant distribution of backlog levels. It is shown that this reduces to the determination (which is carried out) of all closed subgroups of the circle group.

14789. Alvarez, R., **Sub-microgram per gram concentrations of mercury in orchard leaves determined by isotope dilution and spark-source mass spectrometry,** *Anal. Chim. Acta* **73,** 33-38 (1974).

Key words: agriculture; environment; isotope dilution; mass spectroscopy; NBS Standard Reference Material; orchard leaves; trace mercury.

A stable isotope dilution procedure in conjunction with the spark source mass spectrograph was developed for determining sub-μg g^{-1} concentrations of mercury in orchard leaves. A 5-g sample was spiked with a solution of mercury, isotopically enriched in ^{201}Hg and ^{198}Hg served as a carrier. After wet-ashing the sample with nitric and perchloric acids under reflux and distilling most of the acid, the isotopically equilibrated mercury was electrodeposited onto high-purity gold wires for sparking in the mass spectrograph. The concentration was calculated from the altered isotope ratio, ^{201}Hg/^{202}Hg, and other data. The results were compared with those obtained by atomic absorption spectrometry and neutron activation, leading to a certified value of 0.155 ± 0.015 μg g^{-1} for the mercury content of Orchard Leaves, SRM 1571 of the National Bureau of Standards.

14790. Goldman, A. J., **The minimax transportation problem,** *Transp. Sci. Letter to Editor* **2,** No. 4, 383-387 (Nov. 1968).

Key words: linear programming; network flows; single commodity; transportation; transportation problem.

This note demonstrates a simple solution method for the following single-commodity flow problem: Given a set of origins each with a known supply, and a set of destinations each with a known demand, find the minimum possible capacity for a vehicle which is to perform all the origin-to-destination transfers one at a time.

14791. Goldman, A. J., **Optimal locations for centers in a network,** *Transp. Sci.* **3,** No. 4, 352-360 (Nov. 1969).

Key words: concave functions; networks; optimal locations.

The problem treated is that of locating n centers (processing facilities) in a network, so as to minimize the total transportation cost associated with their use. On the assumption that all movements occur between a vertex and a center nearest it, *HAKIMI* has shown that only vertex locations for the centers need be considered. The present paper shows that this conclusion remains valid under alternative assumptions more appropriate for some applications.

14792. Shine, R. A., Linsky, J. L., **A facular model based on the wings of the Ca II lines,** *Solar Phys.* **37,** 145-150 (1974).

Key words: sun-faculae; sun-photospheric models; Van der Waals line broadening.

We develop a relatively simple procedure for deriving models of upper photospheric regions based on the damping wings of the Ca II resonance and infrared triplet lines. The procedure is used to derive a facular model but can also be applied to late-type stars. We compare our model to that of Chapman.

14793. Weissler, P. G., Kobal, M. T., **Noise of police firearms,** *J. Acoust. Soc. Amer.* **56,** No. 5, 1515-1522 (Nov. 1974).

Key words: damage risk criteria for impulse noise; gunfire noise; noise-induced hearing damage; noise of police firearms.

In an effort to provide guidelines for law enforcement personnel to protect their hearing, the peak pressure level and signal duration (A and B duration) of eight popular firearms were measured and compared with the requirements of OSHA (1970), CHABA DRC (1968), and EPA levels (1974). Small condenser microphones and a storage oscilloscope were used to record the blast wave signatures from a 9-mm automatic, 0.357-cal. Magnum revolver, 0.41-cal. Magnum revolver, 0.22-cal. revolver, 0.45-cal. automatic, 0.44-cal. Magnum revolver, 12-gauge shotgun, and 0.22-cal. rifle. Measurements were made at the ear of the person shooting and at the approximate position of a neighbor at a firing range. Some measurements were also made at a practice firing range. A portable tape recorder was found useful for recording gun signals and measuring B durations. The peak pressure levels of the signatures of all the firearms tested exceed the OSHA maximum of 140 dB. It was found that in an anechoic environment the noise from five of the handguns exceeded the CHABA DRC (1968), while the noise from all of the firearms tested, except the 0.22-cal. rifle, exceeded the EPA levels (1974). At a sound-insulated firing range, the noise from all the firearms tested, except the 0.22-cal. rifle, exceeded the CHABA DRC (1968), while all the firearms tested exceeded the EPA levels (1974).

14794. Krasny, J. F., **Fabric flammability: Needs for research,** *Home Econ. Res. J.* **2,** No. 3, 160-166 (Mar. 1974).

Key words: apparel; burn injury; fabric; fire modeling; flame spread; flammability; flammability testing; garments; heat transfer; ignition.

The objective of this paper is to give a brief overview of the present status of attempts to model real life accidents involving garment fires in the laboratory, and to suggest experiments which could be carried out in the textile laboratories of home economists. The main purpose of laboratory modeling should be the definition of hazard due to the ignition and burning of garments varying in fit, fiber content, and fabric weight and construction.

Hazard from burning garments depends on the ease of ignition, rate of flame spread, heat transfer to the body, and the ease of extinguishing the garments. The literature on each of these factors is briefly reviewed, and suggestions are made for experiments which could illustrate the effects of various fabric and garment parameters on injury hazard.

14795. Ruegg, F. W., **Expansion factors for two variable area flow meters,** *J. Eng. Ind. Trans. ASME Papers No. 73-WA/FM-2,* **96,** No. 4, 1347-1353 (Nov. 1974).

Key words: coefficients of discharge; expansion factor; flow coefficients; flowmeter; fluid meter coefficients; rotameter; variable area meter.

Data acquired in the years 1958 to 1960 at the Naval Ship Engineering Center under sponsorship of the American Society of Mechanical Engineers are used to derive semiempirical equations for the performance of two variable area meters with both liquid and gas flow. As the measurements are put to a usage for which they were not intended, the data treatment is considered illustrative of the application of a flow equation derived by an analysis based upon a force and momentum balance. The hydraulic flow coefficient is expressed in terms of a function of (a) pressure drop divided by float weight and of (b) a dimensionless length ratio β for float position. Density ratio is used to modify the function of β to derive the expansion factor Y for gas flow as suggested by the analysis. Reasonable agreement between measured and derived values of Y is demonstrated, and approximate measures of the velocity profiles in the meter are derived from the correlation equations. One set of air tests at one float position in which the viscous influence number N was changed from 500,000 to 783,000 indicated (within this range) a possible insensitivity of the derived function of β to change of N.

14796. Cook, R. K., **Paraholography—a new method for measurement of the directional distribution of sound waves in a reverberation chamber,** *J. Acoust. Soc. Amer.—Technical Notes and Research Briefs* **56,** No. 4, 1305-1307 (Oct. 1974).

Key words: acoustics; acoustical holography; acoustical measurement; paraholography; reverberation chambers; sound propagation.

We describe a method for experimental determination of the complex of plane waves composing the sound field in a reverberation chamber. The basic holographic principle is comparison of the actual sound field with a family of reference plane waves having precisely known directions of propagation, sound pressures, and phases. The reference waves are not "real" waves but are created electronically, on the electrical side of microphones sensing the actual sound field, so as to be "parallel" to real waves.

14797. Hall, K. R., Waxman, M., **Geometrically transformed weights for least squares analyses,** *Cryogenics* **14,** No. 11, 612-614 (Nov. 1974).

Key words: implicit model; least-squares analysis; transformed weights.

The most generalized algorithm for the least-squares estimation of parameters in nonlinear, implicit models is the modified Deming approach. This technique is very complicated; however, simpler approaches for many problems lead to reasonable solutions. One widely accepted alternative is the Δ transformation of Hust and McCarty. This article offers another equally simple alternative: geometrically transformed weights.

14798. Johannesen, R. B., Peake, S. C., Schmutzler, R., **The fluorine-19 NMR spectrum of methylthiotetrafluorophosphorane,** *Z. Naturforsch. B* **29b,** 699-700 (1974).

Key words: fluorine; methylthiotetrafluorophosphorane; nuclear magnetic resonance; phosphorus.

The low-temperature ^{19}F NMR spectrum of the stereochemically nonrigid compound, CH_3SPF_4, shows three fluorine environments, one for the equatorial and two for the nonequivalent axial fluorine atoms. Each of the twelve lines of the upfield ^{19}F (axial) resonance shows further fine structure, due to coupling between ^{19}F and the protons of the CH_3S group. The center peaks of the two multiplet components reveal apparent quintet structure which, based on a computer simulation of the ^{19}F spectrum of CH_3SPF_4, is rationalized in terms of accidental overlap of two quartets.

14799. Achenbach, P. R., **Simplified laboratory procedures for simulating the effect of air leakage into refrigerated enclosures,** (Proc. Joint Conf. Office for Research and Experiments of the International Union of Railways and International Institute of Refrigeration, Vienna, Austria, May 6-8, 1969), Chapter in *Refrigerated Vehicles and Containers, Annex 1969-3,* pp. 89-94 (International Union of Railways, Paris, France, 1969).

Key words: air leakage; cooling load measurement; refrigerated enclosures; testing of vehicles; wind effects on structures.

A laboratory test method is needed that can be used universally for rating or acceptance of refrigerated vehicles and containers employed in international transport. Various investigators have shown that air and moisture leakage into an insulated body under the influence of impact air pressure or wind can represent a significant fraction of the total cooling load. Since road testing and laboratory testing of vehicles and containers under realistic air flow conditions are both complex and expensive, simplified test procedures are urgently needed for simulating the effect of air leakage during cooling load tests. By making certain logical assumptions regarding the distribution of openings in an insulated body and the nature of the fluid flow through these openings, it is shown that a negative pressure of 1 mm W.G. (0.04 in W.G.) inside the cargo space will produce an air leakage into the body as large as a 100 km/hr (62.5 mph) wind on one end or a 50 km/hr (31.3 mph) wind on one long side of most vehicles and containers. A second simplified method involves determining the total cooling load by the addition of the measured heat transmission with interior heating and a calculated air leakage effect based on a measured air flow rate and an assumed change in sensible and latent heat content of the leakage air. Both of these methods need laboratory study.

14800. Cook, R. K., **Colloquium on infrasound in Paris,** *J. Acoust. Soc. Amer.* **56,** No. 2, 721-722 (Aug. 1974).

Key words: atmospheric acoustics; infrasound; physiological effects of infrasound.

The Colloque International sur les Infra-sons, held 24-27 September 1973 in Paris, France, was organized by the Centre National de la Recherche Scientifique and by the Groupement des Acousticiens de Langue Francaise. Professor L. Piminow planned the program of the Colloquium to "contain all aspects of atmospheric infrasounds, namely production, diffusion, detection and measurements; infrasounds of natural sources (oceanic origin, high atmosphere, meteorites, etc....); infrasounds of technical origins, technical applications of infrasounds, the inconveniences of infrasounds in physiology and industry, particularly in the chambers of combustion, detection of explosions, etc...." Infrasound was regarded as being oscillations at frequencies below 20 Hz.

14801. Mann, W. B., **The calibration of the National Bureau of Standards' tritium standards by microcalorimetry and gas counting,** (Proc. Tritium Symp., Las Vegas, Nev., Aug. 30-Sept. 2, 1971), Chapter 3 in *Tritium,* A. A. Moghissi and M. W. Carter, Eds., pp. 86-102 (Messenger Graphics, Las Vegas, Nev., 1971).

Key words: gas counting; microcalorimetry; tritium standards.

The calibration of the National Bureau of Standards tritium standards by microcalorimetry and gas counting will be described.

14802. Mielenz, K. D., **Spherically corrected reflecting objective for unit magnification,** *Appl. Opt.* **13,** No. 11, 2580-2584 (Nov. 1974).

Key words: Cassegrain; reflecting objective; spectrometers; spherical aberration; third-order theory; unit magnification.

Cassegrainian-type reflecting objectives are useful as in-line imaging devices for fast spectrometer systems. They are inherently free from chromatic aberrations and may be corrected for spherical aberration. A particularly simple design, consisting of two mirrors with oppositely equal curvatures, is possible when unit magnification is desired. This system has zero third-order spherical aberration, and all other aberrations are small also. Its main disadvantage is the loss due to the central obstruction of the beam, amounting to about 28 percent exclusive of reflection losses.

14803. Durst, R. A., **Ion-selective electrode response in biologic fluids,** (Proc. Conf. on Workshop on Ion-Selective Microelectrodes, Boston, Mass., June 5, 1973), Chapter 2 in *Ion-Selective Microelectrodes,* H. J. Berman and N. C. Hebert, Eds., pp. 13-21 (Plenum Publ. Corp., New York, N.Y., 1974).

Key words: electrode response in biological fluids; electrodes; ion-selective electrodes; microelectrodes.

The response of ion-selective electrodes in biological fluids may be affected by a wide variety of physical and chemical factors. These may influence the indicator electrode directly or may affect the liquid junction of the reference electrode. A brief discussion is presented of the various sources of error and uncertainty in electrode measurements in biologic media especially with microelectrodes. A serious need exists for the development of practical standards for the calibration of ion-selective electrodes in physiologic media in order to ensure the consistency of interlaboratory measurements.

14804. Goebel, D. G., Poole, E. W., Hartsock, R. G., **Instrument for measuring phototube spectral response,** *Appl. Opt.* **8,** No. 8, 1749-1750 (Aug. 1969).

Key words: photodetector; photodetector spectral response; photomultiplier tubes; phototubes.

An instrument has been designed to plot automatically the relative spectral response of a phototube over the range of 0.35 μm to 0.84 μm. The response as a function of wavelength is recorded directly by using a digital printer or an x-y plotter.

14805. Stevens, W. J., Das, G., Wahl, A. C., Krauss, M., Neumann, D., **Study of the ground state potential curve and dipole moment of OH by the method of optimized valence configurations,** *J. Chem. Phys.* **61,** No. 9, 3686-3699 (Nov. 1, 1974).

Key words: dipole moment function; dissociation energy; electronic structure; hydroxyl radical; potential curve; self-consistent-field.

Accurate theoretical potential and dipole moment curves are presented for the $X\ ^2\Pi_i$ state of the hydroxyl radical. The theoretically determined dissociation energy is 4.53 eV as compared to the experimental value of 4.63 eV. The computed dipole moment at the experimental equilibrium internuclear separation is 1.674 D, which is in excellent agreement with the most reliable experimental value of 1.66 ± 0.01 D. A detailed, general prescription for constructing optimized valence configuration wavefunctions for diatomic hydrides is presented with OH as a specific example.

14806. Gadzuk, J. W., **Angular distributions of electrons photoemitted from chemisorbed atoms,** *Solid State Commun.* **15,** No. 6, 1011-1016 (1974).

Key words: angular distributions; chemisorption; photoemission; photoionization.

A theory which describes the angular distributions of electrons photoemitted from chemisorbed atoms is presented. Due to hole delocalization and preferential orientation, interference effects due to emission from various centers in a molecule do not average out, as they do in gas phase photoionization and much more structural information pertaining to chemisorption bonds is contained in such measurements.

14807. Plummer, E. W., Waclawski, B. J., Vorburger, T. V., **Photoelectron spectra of the decomposition of ethylene on (110) tungsten,** *Chem. Phys. Lett.* **28,** No. 4, 510-515 (Oct. 15, 1974).

Key words: C_2H_4 decomposition; chemisorption bonds; LEED; photoelectron spectra; tungsten; work function.

Photoelectron spectra, LEED patterns, and work function changes were obtained for ethylene adsorbed on (110) tungsten at room temperature, and with subsequent heat treatment. For saturated adsorption of C_2H_4 on (110)W at room temperature, features in the photoelectron spectrum were observed which are believed to be due to the C – H, C – C, and C – metal bonds in an adsorbed species of the form C_2H_2. The work function decreased by 1.2 eV at saturation, but LEED showed no change from the clean surface pattern. Upon heating to ≈ 500 K, where hydrogen is known to desorb, the C – H bond was broken, whereas the C – C and C – metal bonds remained. The work function increased, from saturation, by ≈ 0.6 eV and the LEED pattern exhibited a large diffuse background with no new spots. Upon heating to ≈ 1100 K the C – C bond broke and the LEED pattern ordered into the characteristic carbon contamination pattern.

14808. Krauss, M., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Electron impact energy loss spectra of the 1 $^2B_2 \leftarrow \tilde{X}\ ^2A_1$ transition in NO_2,** *Chem. Phys. Lett.* **27,** No. 2, 285-288 (July 15, 1974).

Key words: electron impact; energy loss; excitation; NO_2.

Long vibrational progressions are observed in the electron impact energy loss spectrum of NO_2 in the 1.5-4.1 eV energy loss range. These progressions can be assigned to the 1 $^2B_2 \leftarrow \tilde{X}\ ^2A_1$ transition and suggest that the 1 $^2B_2$ state is asymmetric.

14809. Heaton, H. T. II, Menke, J. L., Schrack, R. A., Schwartz, R. B., **Total neutron cross section of carbon from 1 keV to 15 MeV,** *Nucl. Sci. Eng.* **56,** 27-36 (1975).

Key words: carbon; neutron total cross section; pulsed neutron sources; time-of-flight.

The total neutron cross section of carbon was measured over the energy range 1 keV to 15 MeV, using the U.S. National Bureau of Standards electron linear accelerator as a pulsed neutron source. Neutron energies were measured by the time-of-flight method. The measurement accuracy is estimated to be $\pm 3/4$ percent below 100 keV and ± 1 percent above. The carbon cross section was fit with a polynomial from 0.001 to 1.4 MeV with the following coefficients

$$\sigma = 4.757 - 3.419\,E + 1.548\,E^2 - 0.328\,E^3,$$

where σ is in barns and E in MeV. Data are compared with other results.

14810. Hessel, M. M., Smith, E. W., Drullinger, R. E., **Transition dipole moment of Na_2 and its variation with internuclear distance,** *Phys. Rev. Lett.* **33,** No. 21, 1251-1254 (Nov. 18, 1974).

Key words: electronic dipole moment; internuclear distance; laser fluorescence; Na_2; transition moment.

The electronic transition dipole moment was determined for the transition $X^1\Sigma_g^+ \leftarrow B^1\Pi_u$ of Na_2 and was found to be $6.8 + 0.5r$ D over a range of internuclear distance r of 2.6 – 5.0 Å. Our results agree with earlier lifetime measurements and are in qualitative agreement with semiquantitative theoretical calculations, but they strongly disagree with the recent work of Callender, Gersten, Leigh, and Yang.

14811. Hayward, E., Barber, W. C., McCarthy, J. J., **Nuclear scattering of plane-polarized photons,** *Phys. Rev. C* **10,** No. 6, 2652-2653 (Dec. 1974).

Key words: giant resonances; nuclear photon scattering; nuclear surface oscillations; plane-polarized photons.

Monochromatic 15.1 MeV plane-polarized photons have been scattered from seven additional targets having their $E1$ giant resonances near 15 MeV. They are In, Sb, Nd, Hg, Pb, Th, and U. Photons scattered through 90° were observed in the planes both parallel and perpendicular to the plane of the polarization vector. The observation of photons scattered along the polarization vector by the spherical vibrators indicates that the giant resonance is coupled to the quadrupole oscillations of the nuclear surface. The agreement with the predictions of the dynamic collective model is not particularly striking though there is little doubt that the phenomenon is qualitatively understood.

14812. Cavallo, L. M., Schima, F. J., Unterweger, M. P., **Decay of $^{133}Xe^g$,** *Phys. Rev. C* **10,** No. 6, 2631-2632 (Dec. 1974).

Key words: enriched source; Ge(Li) detector; measured $T_{1/2}$; pressured ionization chamber; radioactivity $^{133}Xe^g$; ν relative intensity.

The half-life of isotopically separated $^{133}Xe^g$ was determined by measurement in a $4\pi\gamma$ pressure ionization chamber. The value obtained was 5.245 days with an uncertainty of 0.006 days which is the linear sum of the standard error at the 99 percent confidence limit and the estimated systematic errors. This result was confirmed by two separate half-life measurements employing a Ge(Li) detector. The γ rays which deexcite the level at 383 keV in ^{133}Cs have been observed. The intensities of the 383- and 221-keV γ rays relative to the 302-keV γ ray intensity were found to be 0.489 and 0.020 with the respective standard errors calculated to be 3.8 percent and 40 percent.

14813. Lamaze, G. P., Carlson, A. D., Meier, M. M., **A new measurement of the $^{10}B(n,\alpha)^7Li$ branching ratio,** *Nucl. Sci. Eng.* **56,** Tech. Note, 94-96 (1975).

Key words: $^{10}B(n,\alpha)^7Li$ reaction; branching ratio; gas proportional counter; neutrons; nuclear physics; T(p,n) neutrons.

To resolve a discrepancy in determinations of the $^{10}B(n,\alpha)^7Li$ branching ratio, a new measurement has been made at the National Bureau of Standards (NBS). The measurement was made with a $^{10}BF_3$ gas proportional counter and monoenergetic 790-keV neutrons obtained at the NBS 3-MV Van de Graaff laboratory. A branching ratio of 0.66 ± 0.03 was obtained. This determination agrees with the measurements of Petree et al. and Davis et al.

14814. Sugar, J., Kaufman, V., **Spectra and energy levels of three- and four-times ionized hafnium (Hf IV and Hf V),** *J. Opt. Soc. Amer.* **64,** No. 12, 1656-1664 (Dec. 1974).

Key words: energy levels; hafnium; ionization energies; Slater parameters.

The spectra of hafnium produced by a sliding-spark discharge operating at peak currents of 6 to 1200 A were photographed in the spectral range of 400 to 2100 Å. Sixty-three lines of Hf IV were measured in the limited range of ~500-900 Å, of which 43 were classified. New levels in the $4f^{14}nl$ doublet term system of Hf IV were found for $nl=6f$, $7p$, and $8s$. In addition, the resonance transition array $4f^{14}5d$-$4f^{13}5d^2$ was interpreted. In Hf V 216 lines were observed. With these data, all levels of the configurations $4f^{13}nl$ for $nl=6s, 7s, 6p, 5d$, and $6d$ were found except for two levels of $4f^{13}6d$. Theoretical interpretations are given of all of the above configurations. Values for the ionization energies of both species were derived.

14815. Molino, J. A., **Measuring human aversion to sound without verbal descriptors,** *Percept. Psychophys.* **16,** No. 2, 303-308 (Oct. 1974).

Key words: aversion for sound; avoidance; differential reinforcement of high rate; escape; high school students; key press; pure tones; second order schedules.

High school students tapped rapidly on a telegraph key to reduce the intensity of a continuous acoustic stimulus presented through earphones. Failure to respond resulted in an intensity increase of 1 dB every 4 sec. In Experiment 1, a group of 19 students responded to three pure tones (125, 1,000, and 8,000 Hz) and a white noise. The different asymptotic levels observed after 4 min were taken as a measure of equal-aversion levels for the stimuli. In Experiment 2, the effect of the starting intensity level (45, 70, and 90 dB SPL) was determined for a 1,000-Hz tone. Differences in the asymptotic intensity levels observed after 6 min were not significant. In Experiment 3, no significant effect was found upon varying the number of responses required to produce a 1-dB intensity decrement in a 1,000-Hz tone. Together, the experiments demonstrated the feasibility of determining equal-aversion levels for sounds.

14816. Debye, N. W. G., Linzer, M., **Correlation of nuclear quadrupole resonance and ^{119m}Sn Mössbauer spectral parameters,** *J. Chem. Phys.* **61,** No. 11, 4770-4776 (Dec. 1974).

Key words: Mössbauer; NQR; nuclear quadrupole coupling; organotin; organometallic.

A precise redetermination of the ^{119m}Sn Mössbauer spectral parameters of a large number of organotin (IV) halides and of the tin (IV) tetrahalides has been made. The ^{35}Cl NQR resonance spectra of $(CH_3)_3SnCl$ and of $(n\text{-}C_5H_{11})_2SnCL_2$ have been measured for the first time. These data, in conjunction with literature values of other halogen frequencies in this series, yield correlations of both the central tin atom Mössbauer isomer shift and quadrupole splitting values with the reduced ligand NQR coupling constants. The correlations may be interpreted qualitatively in terms of the bonding trends expected on the basis of ligand electronegativities, and the uniformities of the correlations strongly indicate a lack of sharply defined structural variations within these compounds.

14817. Kuyatt, C. E., DiChio, D., Natali, S. V., **Third-order asymptotic aberration coefficients of electron lenses. III. Formulas and results for the two-tube electrostatic lens,** *Rev. Sci. Instrum.* **45,** No. 10, 1275-1280 (Oct. 1974).

Key words: aberration integrals; asymptotic aberration coefficients; electron lenses; strong lenses; third-order aberration coefficients; two-tube electrostatic lens; weak lenses.

The third-order asymptotic aberration coefficients of round electrostatic electron lenses are formulated, following Hawkes, in a form independent of object and aperture positions. Six quantities are sufficient to specify completely the third-order aberration properties of electrostatic electron lenses. Equations for these six quantities are derived in the form of integrals involving derivatives of the axial potential no higher than the second. Using these equations and our previously calculated potentials and first-order trajectories we have computed the six aberrations coefficients for the two-tube electrostatic lens for voltage ratios from 1.1 to 10 000. The results are believed accurate to better than 0.2 percent.

14818. Pella, P. A., **Mössbauer spectrometry,** Chapter 26 in *Systematic Materials Analysis,* J. H. Richardson and R. V. Peterson, Eds., **III,** 241-267 (Academic Press, New York, N.Y., 1974).

Key words: materials characterization; Mössbauer spectrometry; nuclear resonance.

This book chapter entitled "Mössbauer Spectrometry," which appears in *Systematic Materials Analysis,* Vol. III, pp. 241-267, J. H. Richardson and R. V. Peterson, Eds., Academic Press, Inc., New York, 1974, is essentially tutorial. This chapter describes the theory and practice of this technique in a manner oriented toward the student on the graduate level or analyst who finds himself with a materials characterization problem. This chapter draws heavily on already published material, and written, I hope, with the intention of conveying to the reader what information can be obtained by this technique. The chapter includes theory, instrumentation, sample preparation, and gives examples of application in the areas of mineralogy, metallurgy, magnetic properties, chemical structure and bonding, solid-state studies, and data handling.

14819. Zapf, T. L., **Calibration of quartz transducers as ultrasonic power standards by an electrical method,** *Proc. 1974 Ultrasonics Symp., Milwaukee, Wisconsin, Nov. 11-14, 1974, IEEE Cat. No. 74 CHO 896-1SU,* pp. 45-50 (IEEE, Inc., New York, N.Y., 1974).

Key words: piezoelectric transducers; standards of ultrasonic power; ultrasonic power; ultrasonic transducers.

Ultrasonic beam power from specially-designed quartz piston transducers can be determined from an appropriate set of electrical measurements. The characterized transducers can be used as transportable standards of ultrasonic power. A highly accurate twin-T null circuit is employed for the measurement of electrical conductances of half-wave resonant quartz transducers under certain loading conditions. This permits calculation of the equivalent resonant radiation conductance which, when multiplied by the square of the applied voltage, yields the emitted ultrasonic power into a load. Quartz transducers, thus characterized, can serve as standards of ultrasonic power for checking or calibrating ultrasonic power measuring equipment such as radiation force, calorimetric, and acousto-optic devices. With the equipment used at the National Bureau of Standards, uncertainties are estimated at less than ± 5 percent in the frequency range from 1 to 5 MHz.

14820. Ayres, R. L., Cavallo, L. M., Coursey, B. M., Hutchinson, J. M. R., Mann, W. B., **National Bureau of Standards gamma-ray standards and techniques for gamma-ray measurements, (Abstract),** *Proc. Trans. 1973 Annual Meeting of the American Nuclear Society, Chicago, Ill., June 10-14, 1973,* **16,** 69 (1973).

Key words: energy efficiency curves; gamma ray; mixed radio nuclide; standards.

The National Bureau of Standards provides gamma-ray standards in a number of forms for different purposes. Our earliest standards were solution standards of various gamma-ray-emitting radionuclides. These were later supplemented by point-source standards covering the range of photon energies from 60 keV to 2.61 MeV. Currently we are also issuing mixed-radionuclide solution standards, each covering the photon energy range from about 88 keV to 1.84 MeV.

The values of most of our gamma-ray standards are preserved on calibrated atmospheric-air and pressurized-argon ionization chambers. Efficiency-energy curves for these chambers have been accumulated over a great many years, based on data collected by direct methods of measurement such as coincidence counting. Cesium-137 and ^{85}Kr standards were produced, respectively, by means of the ion chamber, using efficiency interpolation, and by comparison with ^{85}Sr standards. The mixed-radionuclide, gamma-ray solution standards were primarily designed for the calibration of detectors used in measuring power reactor effluent, and are issued in bottles of standard dimensions.

14821. Molino, J. A., Zerdy, G. A., Frome, F. S., **Toward a more musical foghorn,** *Hum. Factors.* **16,** No. 6, 567-575 (Dec. 1974).

Key words: acoustic navigation aids; applied psychoacoustics; applied psychology; aversiveness; foghorns; preference; pure tones.

Ten college students gave preference judgments for 4 pure tones (120, 300, 500, and 835 Hz) and 11 tone composites constructed from combinations of the pure tones. Equal aversion (tolerance) levels were also measured for the four pure tones and for five of the composites. Sensation-level measures were employed to express aversion thresholds in order to take account of the differential sensitivity of the human ear at different frequencies. Certain operational conclusions were suggested for the design of acoustic navigation aids. The higher frequency pure tones and composites were generally more preferred, and were also tolerated at higher sensation levels. The 120-Hz pure tone was a highly non-preferred signal. The presence of a 120-Hz component in any composite lowered both the preference value and the maintained sensation level. In the case of the moderately preferred 500-Hz pure tone, adding other more-preferred, pure-tone components increased the preference for the signal.

14822. Eisenhart, C., **Karl Pearson,** Paper in *Dictionary of Scientific Biography,* X, 447-473 (Charles Scribner's Sons, New York, N.Y., 1974).

Key words: bibliography; *Biometrika*; Chi-square tests; correlation, regression; R. A. Fisher; Francis Galton; frequency curves, method of moments; Karl Pearson; statistics; *Tables for Statisticians and Biometricians*; W. F. R. Weldon.

A review of the life and work of Karl Pearson (1857-1936), founder of the science of statistics. His student days at Cambridge and in Germany. His pre-1890 career as a professor of applied mathematics and mechanics, as a philosopher of science, and as a social reformer. The role of Francis Galton and W. F. R. Weldon in redirecting his career to founder (1891-1936) of the science of statistics. Method of Moments and Pearson System of Frequency Curves; Correlation and Regression; Chi Square Tests. *Biometrika; Annals of Eugenics; The Treasury of Human Inheritance; Tables for Statisticians and Biometricians; Tracts for Computers; Tables of the Incomplete* Γ*-function; Tables of the Incomplete* β*-function.* Bibliography of principal Original Works; and of major Secondary Literature.

14823. Komarek, E. L., Tryon, P. V., **An application of the power equation concept and automation techniques to precision bolometer unit calibration,** *IEEE Trans. Microwave Theory Tech., Part II, 1974 Symposium Issue,* **MTT-22,** No. 12, 1260-1267 (Dec. 1974).

Key words: automated measurements; bolometer unit calibration; power equation concept.

The power equation concept has been implemented into a multioctave precision bolometer unit calibration system employing automation techniques in conjunction with an automatic network analyzer (ANA) system. Using statistical methods the system is being evaluated as a calibration transfer system operating in the 2-12.4-GHz frequency range at 1-10 mW. Preliminary results reported here show a single measurement standard deviation of 0.2-1 percent from 2-10 GHz. Upon a successful evaluation, the system will be qualified as an integral part of the national measurement system.

14824. Flynn, J. H., **Theory of differential scanning calorimetry—coupling of electronic and thermal steps,** Paper in *Analytical Calorimetry,* R. S. Porter and J. F. Johnson, Eds., **3,** 17-44 (Plenum Publ. Corp., New York, N.Y., 1974).

Key words: differential scanning calorimetry (DSC); electronic and thermal coupling; instrumental limitations; supercooling; theoretical model; thermal analysis; thermodynamic properties.

A model system for differential scanning calorimetry (DSC) is developed in which the electronic response of the instrument is coupled with the heat flow across an interface. Equations are derived which relate the time constants for this two-step process with the thermal properties of the sample and the amplitudes, areas, slopes and dwell times of DSC traces. The cases discussed include first and second order transitions, partial and total "supercooling" and effects of a temperature dependence of the heat capacity and the rate of temperature change. The magnitude of the lag terms of these cases is determined from typical experimental data. The equations permit an independent determination of the interfacial time constant and an assessment of the limits for the validity of the theoretical model.

14825. Andrews, J. R., **Precision picosecond-pulse measurements using a high-quality superconducting delay line,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 468-472 (Dec. 1974).

Key words: delay line; picosecond; pulse measurement; superconductivity.

A high-quality superconducting delay line now makes it possible to perform direct oscillographic measurements of the picosecond transition times of very fast electrical signals that do not furnish pretriggers. A 15-m superconducting delay line package has been assembled. The package consists of connectors, connector adapters, normally conducting input/output air lines, and a 15 m length of a miniature 1.6-mm superconducting coaxial transmission line. The package exhibits an attenuation of 0.8 dB at 10 GHz and a system 10-90 percent transition time of 18 ps. Some applications of this delay line are shown. They include the measurement of the pulse output from a mercury switch and the transient response of a traveling-wave oscilloscope.

14826. Engen, G. F., **Calibration technique for automated network analyzers with application to adapter evaluation,** *IEEE Trans. Microwave Theory Tech., Part II, 1974 Symposium Issue,* **MTT-22,** No. 12, 1255-1260 (Dec. 1974).

Key words: adapter; automation; efficiency; microwave; microwave measurement; network analyzer.

Although conceptually straightforward, the application of existing automated network analyzers to the problem of adapter evaluation is inhibited by the limited accuracy of the detection process, the requirement for several impedance standards at each frequency, and software problems. A hardware modification, which yields improved accuracy for adapter evaluation, is described. An alternative calibration procedure is outlined which exploits this improved accuracy potential, and which requires only one impedance standard.

14827. Gray, J. E., Allan, D. W., **A method for estimating the frequency stability of an individual oscillator,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 243-246 (Electronic Industries Association, Washington, D.C., 1974).

Key words: Flicker noise; frequency stability; noise measurement; oscillator stability.

A method is given for estimating the intensity of random noise frequency modulation of an individual oscillator, using data obtained by comparing it with two or more other oscillators. This method is appropriate even if the oscillators available for comparison are less stable than the oscillator being evaluated, but their frequency fluctuations must be independent. The statistical uncertainty of the results is discussed briefly.

14828. Wainwright, A. E., Walls, F. L., McCaa, W. D., **Direct measurements of the inherent frequency stability of quartz crystal resonators,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 177-180 (Electronic Industries Association, Washington, D.C., 1974).

Key words: Allan variance; flicker of frequency modulation; Johnson noise; linewidth; random walk frequency modulation; spectral density of frequency fluctuations $S_y(f)$; white phase modulation.

A technique is presented that allows one to measure directly the fluctuations of the natural resonant frequency of quartz crystal resonators in a passive circuit. This technique greatly aids in modeling the noise in both crystal resonators and crystal controlled oscillator circuits. Definite changes of slope in the spectral density of the frequency fluctuations, as a function of frequency offset from the natural resonant frequency of the crystals indicate that several mechanisms are contributing to the frequency instabilities in crystals. Our measurements also indicate that the electronics in the oscillators seriously degrade the frequency stability for sample times less than 100 s. The effects are especially dramatic for times less than 1 s.

14829. Howe, D. A., Bell, H. E., Hellwig, H., DeMarchi, A., **Preliminary research and development of the cesium tube accuracy evaluation system,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 362-372 (Electronic Industries Association, Washington, D.C., 1974).

Key words: cavity phase shift; cesium beam tube; frequency synthesis; pulse method; Ramsey dual interaction region; second-order doppler; velocity distribution.

A method has been developed which measures the velocity distribution of the atoms in a beam tube using the Ramsey dual interaction region principle. The method involves pulsing the RF excitation signal at a period related to the atoms' time-of-flight between the interaction regions. The pulse method, with its ability to measure velocity distribution enables calculations of cavity phase shift and second-order Doppler effect. This research has motivated the development of a system, complete unto itself, for determining the accuracy of cesium beam tubes. Design goals for the system are outlined. The system development to date is discussed. Frequency synthesis is accomplished at 5.00688 MHz. This avoids frequency synthesis at X-band and thereby eliminates packaging and weight problems. A novel synthesizer design is used which incorporates a digital frequency lock of the 5.00688 MHz VCXO. A resolution of 1.4 millihertz/second is realizable; lock is within 2.8×10^{-10} at one second of a 5.0000 MHz reference with potential to better than 1×10^{-12} at one second. This synthesizer and its application to the accuracy evaluation system are discussed. Some results on the evaluation of commercial cesium beam tubes are given.

14830. Hellwig, H., **Atomic frequency standards: A survey,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 315-339 (Electronic Industries Association, Washington, D.C., 1974).

Key words: application of standards; basic standards; cesium standards; frequency accuracy; frequency stability; frequency standards; hydrogen standards; ion storage; laser stabilization; rubidium standards; saturated absorption; time standards.

The last comprehensive survey on atomic frequency standards was given by A. O. McCoubrey in 1966 (Proc. IEEE 54, p. 116). This survey reviews the more recent historical background of atomic frequency standards leading to the present developments. A discussion of the underlying physical and engineering principles is given. Modern atomic frequency standards, including their performance, are compared quantitatively, and projections are attempted at likely future developments and performance characteristics.

As in 1966, the standards principally used in technical and scientific applications are rubidium gas cell devices, cesium beam tubes, and hydrogen maser oscillators. However, substantial advances in physical and performance characteristics can be reported.

New developments include passive hydrogen devices, saturated absorption stabilized lasers, ion storage devices, and atomic beams in the far infrared and infrared region, as well as new techniques to evaluate frequency biases such as those encountered in cesium and hydrogen standards.

The survey includes a discussion of the effects of past and current developments in atomic frequency standards on the technical and scientific user community.

14831. Harris, K. R., Mills, R., Hanley, H. J. M., Woolf, L. A., **The self-diffusion of simple fluids: Tabulated values for argon and methane,** *Aust. Nat. Univ. Rev.* **DRU-RR 2,** pp. 1-32 (The Australian National University Press, Canberra, A.C.T. Australia, 1974).

Key words: argon; critical review; krypton; measurement technique; methane; self-diffusion coefficient.

Data for the self-diffusion coefficient (D) of several simple fluids—He, Ne, Ar, Kr, Xe, CH_4, H_2, N_2, CF_4, CO_2, and SF_6—in the dense gas and liquid states are reviewed. The general behaviour of the self-diffusion coefficient with respect to temperature and density is examined making use of the excess function approach. Tabulated values of D for methane and argon are presented as a function of temperature, pressure and density. The pressure range covered is 2-50 MPa and the temperature range is 170-320 K for methane and 100-250 K for argon. The estimated error of the tabulated coefficients is $\pm$ 10 percent.

14832. Klots, C. E., Sieck, L. W., **Argon sensitized formation of Xe_2^+: A new mechanism for the Jesse effect,** *Chem. Phys. Lett.* **27,** No. 1, 71-72 (July 1, 1974).

Key words: cross sections; excited states; ionization; mass spectrometry; radiation chemistry; rare gases.

Photoexcitation of the argon resonance states in the presence of xenon leads to Xe_2^+. Kinetic analysis indicates rapid near-resonant energy transfer between argon and xenon atoms. The possibility of an analogous mechanism in other rare gas systems is examined.

14833. Ambler, E., Mangum, B. W., Pfeiffer, E. R., Utton, D. B., **Magnetic ordering of crystalline and vitreous $Gd(PO_3)_3$,** *Phys. Lett.* **50A,** No. 4, 249-250 (Dec. 16, 1974).

Key words: antiferromagnetism; comparison of magnetic properties of glasses and crystals; $Gd(PO_3)_3$; glass; magnetic order; polycrystal; vitreous $Gd(PO_3)_3$.

We have measured the magnetic susceptibilities of vitreous and polycrystalline $Gd(PO_3)_3$. The Weiss constants for these materials were found to be −0.3 K. Vitreous $Gd(PO_3)_3$ exhibited short-range antiferromagnetic order below 0.175 K and polycrystalline $Gd(PO_3)_3$ short-range order between 0.242 K and 0.052 K and long-range order below 0.052 K.

14834. Hudson, R. P., Pfeiffer, E. R., **Dipolar heat capacity of CMN,** *J. Low Temp. Phys.* **16,** Nos. 3/4, 309-316 (1974).

Key words: CMN; cryomagnetism; low temperature specific heat; magnetic dipole interaction; paramagnetic salt.

The magnetic contribution to the low-temperature specific heat of cerous magnesium nitrate (CMN) was determined by the Casimir-Du Pré ac susceptibility method in the region of 1 K. The value found for the coefficient of the major (T^{-2}) term is in good agreement with that determined in this laboratory in magnetic cooling experiments. It is some 10 percent less than that calculated for the magnetic dipole interaction between the Ce^{3+} ions.

14835. Mabie, C. P., Wallace, B. M., **Optical, physical and chemical properties of pineal gland calcifications,** *Calcif. Tissue Res.* **16,** 59-71 (1974).

Key words: apatite; calcospherulites; calculi; petrography; pineal.

Calcifications of the pineal gland in the form of calcospherulites have been studied by optical microscopy, electron microscopy, electron probe analysis, x-ray diffraction, thermogravimetry, and infrared and chemical analysis. Complex calcospherulite textures have been observed which have a granular substructure made up of apatite crystals averaging 218 Å in length and 38 Å in width. These apatite crystals appear to be a carbonate-containing hydroxyapatite, mineralogically similar to enamel.

14836. Hanson, D. W., Hamilton, W. F., **Satellite broadcasting of WWV signals,** *IEEE Trans. Aerosp. Electron. Syst.* **AES-10,** No. 5, 562-573 (Sept. 1974).

Key words: broadcasting; dissemination; frequency; satellite; synchronization; time.

An experiment concerning the broadcasting of time and frequency information from geostationary satellites is discussed. Included are discussions on satellite motion, time delay, Doppler shift, and delay calculations. Ground station requirements, time recovery techniques, and timing resolution and accuracy are also included. Delay computation aids for the user were designed to provide free space delays between the master clock and the user. Measurements made in North and South America demonstrated a timing resolution of about 10 μs and an accuracy of 25 μs.

14837. Dalke, J. L., **Why metric and when?,** *Tappi* **57,** No. 12, 72-75 (Dec. 1974).

Key words: conversion; international standards; legislation; measurement language; metrication; metric system.

Whatever the relative merits of the metric system, it has won overwhelming international approval in the last 20 years. The Chinese, Japanese, Indians, and all English-speaking nations of the British Commonwealth are abondoning their traditional measurement language and going metric. The metric system has been legal in the United States since 1866. In the past our major trading partners used the British Imperial system of measurements which also forms the basis for our customary system of units. Major industrial companies and some state educational systems in the United States are now switching. Legislation is before Congress that would coordinate and facilitate an orderly change from predominately customary to predominately metric usage on a voluntary and reasonable basis. This paper explores the problems that would accompany such a change in technology, economics, international relations, and other areas.

14838. Adair, R. T., Simmonds, M. B., Kamper, R. A., Hoer, C. A., **RF attenuation measurements using quantum interference in superconductors,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 375-381 (Dec. 1974).

Key words: Josephson junction; quantum interference; rf attenuation; superconductivity.

A unique portable system has been developed for measuring RF attenuation over a dynamic range of 62 dB at 30 MHz. A superconducting quantum interference device (SQUID) is the basis of the system. A SQUID is a loop of superconducting metal closed by a weak point contact called a Josephsón junction, operating in liquid helium. It converts variations in magnetic flux to periodic variations in impedance which are sensed at microwave frequencies. This provides a convenient natural means of measuring electrical quantities such as voltage, current, power, and attenuation.

14839. Ausloos, P., Eyler, J. R., Lias, S. G., **Thermal energy charge transfer reactions involving CH_4 and SiH_4. Lack of evidence for nonspiralling collisions,** *Chem. Phys. Lett.* **30,** No. 1, 21-25 (Jan. 1, 1975).

Key words: charge transfer; Franck-Condon factors; ion-molecule reactions; methane; rare gas ions; rate constants; silane.

Rate constants for reaction of a number of thermal ions with methane and silane have been determined. It is demonstrated that within experimental error none of the reactant pairs undergoes a charge transfer reaction with a rate constant higher than the estimated collision rate constant. It is concluded that there is no evidence for the occurrence of charge transfer reactions of thermal ions by an "electron jump" mechanism involving nonspiralling ion-molecule collisions in which no momentum is transferred.

14840. Mielenz, K. D., **Aberrations of ellipsoidal reflectors for unit magnification,** *Appl. Opt.* **13,** No. 12, 2931-2933 (Dec. 1974).

Key words: aberrations; aspheric optics; ellipsoidal reflector; Fermat's principle; Hamiltonian point characteristic; limiting aperture; unit magnification.

Ellipsoidal reflectors are useful for the 1:1 imaging of small objects without spherical and chromatic aberration. The magnitude of the off-axis aberrations of such reflectors is computed by application of Fermat's principle to the Hamiltonian point characteristic. The limiting form of the mirror aperture for which these aberrations do not exceed a set tolerance is an ellipse whose semiaxes depend on object size and angle of incidence.

14841. Ayres, T. R., Linsky, J. L., Shine, R. A., **A possible width-luminosity correlation of the Ca II K_1 and Mg II k_1 features,** *Astrophys. J.* **195,** No. 3, L121-L124 (Feb. 1, 1975).

Key words: Ca II; spectral line; stellar chromospheres.

Existing high resolution stellar profiles of the Ca II and Mg II resonance lines suggest a possible width-luminosity correlation of the K_1 minimum features. We show that such a correlation can be simply understood if the continuum optical depth of the stellar temperature minimum, τ_c^*, is relatively independent of surface gravity as suggested by three stars studied in detail.

14842. Geist, J., Steiner, B., **Report of the workshop on accurate radiometry for solar conversion,** Paper in *Report and Recommendations of the Solar Energy Data Workshop,* pp. 204-208 (Sept. 1974).

Key words: atmospheric physics; radiometric physics; radiometry; solar conversion.

This report presents recommendations of a workshop on accuracy radiometry for solar conversion that was jointly sponsored by NOAA and NSF.

14843. Lamaze, G. P., Whittaker, J. K., Schrack, R. A., Wasson, O. A., **After-pulse suppression for 8850 and 8854 photomultipliers,** *Nucl. Instrum. Methods Letters to Editor* **123,** 403-404 (1975).

Key words: after-pulse; GaP first dynode; neutron; photoelectron; photomultiplier; resolution; suppression.

After-pulsing suppression of semiconducting first dynode photomultipliers (RCA 8850 series) has been successfully accomplished by applying a positive pulse to a wire mesh directly in contact with the tube face.

14844. Sieck, L. W., Gorden, R., Jr., Lias, S. G., Ausloos, P., **Ionic polymerization of vinyl halides initiated by photoionization using photons with energies near the ionization threshold,** *Int. J. Mass Spectrom. Ion Phys.* **15,** 181-196 (1974).

Key words: ion-molecule reactions; mass spectrometry; photoionization; rate constants; reaction mechanisms; vinyl halides.

Thermal bimolecular rate coefficients have been obtained for the reactions of the parent monomer ions in the vinyl halides with the respective neutral molecules when the ions are formed by photoionization at or very near the ionization thresholds. The values obtained are as follows: $C_2H_3F^+$, 0.27 eV above threshold, $k=3.2\times10^{-10}$ cm^3 molecule^{-1} s^{-1}, $C_2H_3Cl^+$, within kT of threshold, $k=1.78\times10^{-10}$ cm^3 molecule^{-1} s^{-1}, and $C_2H_3Br^+$, 0.2 eV above threshold, $k=1.25\times10^{-10}$ cm^3 molecule^{-1} s^{-1}. An increase in photon energy drastically lowers the values of these coefficients. The reactions of $C_2H_3F^+$ and $C_2H_3Cl^+$ were also investigated at high pressures in order to elucidate certain aspects of the cationic polymerization scheme. The formation of $(C_2H_3Cl)_2^+$ and $(C_2H_3Cl)_3^+$ is reported for the first time. The factors controlling the relative importances of various modes of dissociation of the vinyl halide dimer ions are discussed in terms of thermodynamic and structural considerations.

14845. Harris, F. K., **A cooperative experiment in measurement education,** (Proc. Conf. on Measurement Education, University of Warwick, Coventry, England, July 8-10, 1969), *IEE Conf. Publ. No.* **56,** pp. 140-141 (Institute Electrical Engineers, London, England, 1969).

Key words: measurement education; metrology curriculum.

A discussion of the cooperative NBS-GWU metrology program.

14846. Hellwig, H., Bell, H. E., Bergquist, J. C., Glaze, D. J., Howe, D. A., Jarvis, S., Jr., Wainwright, A. E., Walls, F. L., **Results in operation, research, and development of atomic clocks at the National Bureau of Standards,** (Proc. IX Int. Congress of Chronometry, Stuttgart, Germany, Sept. 16-20, 1974), Paper in *Proc. IX International Congress of Chronometry,* G. Glaser, Ed., A, A5-1–A5-13 (Herausgegeben von der Deutschen Gesellschaft fur Chronometrie E. V., Stuttgart, Germany, 1974).

Key words: accuracy; atomic clocks; cesium standards; hydrogen standards; hydrogen storage device; methane stabilized helium-neon lasers; noise studies; quartz crystal oscillators; quartz crystal resonators.

Since the last CIC, significant progress has been made in various laboratories leading to new capabilities and new future uses of atomic clocks. This paper summarizes the contributions of the National Bureau of Standards to these developments and tries to forecast future developments.

Two primary cesium standards, NBS-4 and NBS-5, are now in operational use with an accuracy of near 1×10^{-13}, and with a stability of better than 1×10^{-14} (sample time of 3 hours). The concept and feasibility of a passive hydrogen storage device has been demonstrated leading to the projection of long term stabilities (hours to weeks) of at least 1×10^{-14} for these devices. Studies of different electronic systems as well as wall and magnetic field effects promise significant improvements in the accuracy of hydrogen standards. Methane stabilized helium-neon lasers were operated and demonstrated excellent frequency stabilities, and research on a methane beam system is in progress. Novel noise studies of quartz crystal resonators confirmed that quartz crystal oscillators with short-term stabilities of parts in 10^{12} (1 millisecond) are possible, an important fact in its own right and of significance to the development of atomic clocks of extreme short-term stability.

14847. Hubbell, J. H., McMaster, W. H., Del Grande, N. K., Mallett, J. H., **X-ray cross sections and attenuation coefficients,** Paper in *International Tables for X-Ray Crystallography, Section 2, Absorption and Scattering,* J. A. Ibers and W. C. Hamilton, Eds., **4,** Paper 2.1, 47-70 (Kynoch Press, Birmingham, England, 1974).

Key words: attenuation coefficient; compilation; Compton scattering; cross section; crystallography; photoelectric absorption; photons; Rayleigh scattering; x rays.

Tables of total cross sections (in barns/atom) for photon interaction with atoms, representing sums over the photoelectric effect, coherent (Rayleigh) scattering, and incoherent (Compton) scattering cross sections are presented for 87 elements from Z= 1 to 94 at the 24 wavelengths from 0.4970 to 2.7496 angstroms (24.942 to 4.509 keV) which are of most use in x-ray crystallography. Corresponding tables of mass attenuation coefficients (in cm^2/g) are also given. These tables are an interpolation from a more extensive compilation (UCRL-50174 (1969) by McMaster et al) and the input data and procedures for constructing the latter compilation are described.

14848. Tilford, S. G., Simmons, J. D., **Reexamination of the vacuum ultraviolet emission spectrum of CO in the 950-1200 Å region,** *J. Mol. Spectrosc.* **53,** 436-442 (1974).

Key words: band assignments; carbon monoxide; electronic spectrum; emission spectrum; high resolution spectrum; vacuum ultraviolet region.

New spectrograms of CO below 1200 Å reveal that emission bands terminating on the high energy $E_0\ {}^1\Sigma^+$ and ${}^1\Pi$ states plus most of the previously reported unidentified emission bands of CO actually originate from molecular nitrogen. Four new emission band systems in CO, tentatively identified as $V^1\Pi - X^1\Sigma^+$, $W^1\Pi - X^1\Sigma^+$, $Y^1\Sigma^+ - X^1\Sigma^+$, and $Z^1\Sigma^+ - X^1\Sigma^+$, have been observed. The corresponding T_{v0}'s are 98917, 102804, 99963, and 105724 cm^{-1}, respectively.

14849. Phelps, A. V., **Applications of gaseous electronics to laser technology**, Chapter 3 in *Gaseous Electronics, Some Applications*, J. W. McGowan and P. K. John, Eds., pp. 25-46 (North-Holland Publishing Co., Amsterdam, The Netherlands, 1974).

Key words: atoms; electron excitation; excitation transfer; gaseous electronics; lasers; molecules.

Applications of the results of research in the physics of gaseous electronics to recent laser technology are illustrated. Excitation transfer, charge exchange, metastable atom production and destruction are dominant processes in the HeNe laser and the metal ion lasers. Rather extensive data on cross sections for elastic and inelastic scattering, attachment and ionization in gases such as N_2 and CO_2 make possible fairly accurate predictions of the gain, efficiency, etc., of CO_2-N_2-He lasers. The new class of ground state dissociation lasers is discussed in terms of a proposed laser utilizing stimulated emission between the bound excited state and the dissociating ground state of the LiXe molecule.

14850. McKinney, J. E., Simha, R., **Configurational thermodynamic properties of polymer liquids and glasses. I. Poly(vinyl acetate)**, *Macromolecules* **7**, No. 6, 894-901 (Nov.-Dec. 1974).

Key words: configurational; glass; glass transition; hole theory; polymer; poly(vinyl acetate); PVT; thermodynamic; liquid.

Recent experimental PVT data on poly(vinyl acetate) are analyzed using the hole theory of Simha-Somcynsky. The data were obtained at temperatures from -30 to 100° and pressures up to 800 bars. These ranges encompass the glass transition and include large portions of the liquid and glassy regions. Three different thermodynamic histories of glass formation, all isobaric cooling at 5 °C/hr, were applied. With the variable formation history the glass was formed by isobaric cooling runs at different pressures. In the two constant formation histories each of the glasses was formed by a different formation pressure, namely atmospheric and 800 bars, with subsequent temperature and pressure changes in the glass in each case. In the equilibrium state good agreement between the theoretical and experimental PVT surfaces results, in accord with earlier observations on amorphous systems. As for the transitions the theory gives the correct values of dT/dP using the assumption that the hole fraction h be constant along either of the two constant formation transition lines. Similarly, the generalization of the Ehrenfest type relation involving the single ordering parameter h results in good numerical agreement with the experimental values of dT/dP for the variable formation transition line. As previously demonstrated, H does not freeze at temperatures below the glass transition, thus a constant h does not describe the structure of the glass. Parameters which describe the extent of freezing are evaluated. The fact that these parameters are independent of formation pressure would be consistent with the existence of a single entropy surface with formation pressure, as suggested by other experimental evidence.

14851. O'Connell, J. S., Lightbody, J. W., Jr., **Momentum transfer sum rules in electron scattering**, *Nucl. Phys.* **A237**, 309-318 (1975).

Key words: charge density; Coulomb energy; Coulomb excitation; electron scattering; form factors; sum rules; transition charge.

The integral properties of elastic and inelastic Coulomb form factors are examined. Relations are given for the nuclear Coulomb energy, central charge density, transition charge, radial moments, and squared density integral.

14852. Ku, H. H., Kullback, S., **Loglinear models in contingency table analysis**, *Amer. Statist.* **28**, No. 4, 115-122 (Nov. 1974).

Key words: categorical data; contingency tables; loglinear model; minimum discrimination information; statistical analysis.

This is an expository paper on the statistical analysis of categorical data arranged in the form of contingency tables. Beginning with a 2×2 table, the estimation and testing of parameters in the loglinear model is illustrated and compared to that for the linear model in the continuous case. This is followed by detailed analysis of two examples: one for a three-way table on biomedical data, and one for a four-way table on social survey data.

14853. Prince, E., Dickens, B., Rush, J. J., **A study of one-dimensional hindered rotation in NH_3OHClO_4**, *Acta Crystallogr.* **B30**, Part 5, 1167-1172 (May 1974).

Key words: constrained refinement; hindered rotation; hydrogen bonds; hydroxylammonium; neutron diffraction; perchlorates; thermal motion; torsional oscillation.

The structure of the phase of hydroxylammonium perchlorate, NH_3OHClO_4, which is stable at 25 °C has been refined from 3-dimensional neutron diffractometer data. The structure has space group $P2_1cn$, cell dimensions $a=7.52$ (2), $b=7.14$ (1), $c=15.99$ (2) Å, and 8 formula units per unit cell. There are very large thermal motions of the hydrogen atoms, and the environment of the two crystallographically different NH_3OH^+ ions suggests hindered rotation of each NH_3 group around the axis defined by the N–O bond. Therefore the structure was refined using a model in which the perchlorate groups and the hydroxyl hydrogens were given conventional anisotropic temperature factors, but the ONH_3 groups were treated as rigid bodies, each with an isotropic translation, and isotropic libration of the group as a whole, and a torsional oscillation of the NH_3 group. The final weighted R for 684 observed reflections was 0.051. There are 12 hydrogen bonds between the NH_3OH^+ ions and the ClO_4^- ions, and one hydrogen bond between NH_3OH^+ ions. The apparent r.m.s. amplitude of torsional oscillation of the NH_3–O groups about the N–O vector, as derived from the structural refinement, is $\sim 25°$, and is therefore consistent with frequent reorientation of the NH_3 parts of the NH_3OH^+ ions. Other apparent r.m.s. amplitudes in the structure are only slightly higher than normal values. The NH_3OH^+ ions are in staggered conformations and the ClO_4^- ions are essentially regular tetrahedra.

14854. Rowe, J. M., Rush, J. J., Smith, H. G., **"In-band" modes of vibration of $PdH_{0.03}$**, *Phys. Rev. B* **8**, No. 12, 6013-6014 (Dec. 15, 1973).

Key words: crystal; fermi surface; interstitial hydrogen; lattice dynamics; palladium hydride; phonons.

The [110] transverse branch of the phonon dispersion relation in a single crystal of $PdH_{0.03}$ has been measured and compared to the results for pure Pd. A limited amount of data has been taken for other branches, and the mean frequency ratio ($PdH_{0.03}$/Pd) observed for all measurements is 0.995. No change was observed in the shape or strength of the anomaly in the [110]T_1 branch.

14855. Malloy, T. B., Jr., Lafferty, W. J., **On the barriers to planarity and the isotope effect in cyclobutane and cyclobutane-d_8**, *J. Mol. Spectrosc.* **54**, 20-38 (1975).

Key words: barriers to planarity; cyclobutane; cyclobutane-d_8; isotope effect; kinetic energy terms; potential functions.

The infrared and Raman data on the ring-puckering vibration in cyclobutane and cyclobutane-d_8 have been reexamined including the coordinate dependence of the reduced mass in the Hamiltonian. This was done for the purpose of estimating the importance of these small terms in the determination of barrier heights for four-membered rings and also on the determination of the dihedral angle corresponding to the potential minimum.

The conclusions reached are that there is an isotopic dependence of the barriers to planarity in cyclobutane and cyclobutane-d_8 yielding a difference of ~ 14 cm^{-1}, but the precise value of the difference in barrier heights is ill determined. The higher-order kinetic energy terms in the Hamiltonian can account for a spread of ~ 3 cm^{-1} in each of the barriers derived for cyclobutane and cyclobutane-d_8, depending on the details of the model used for the vibration, but not a difference of 14 cm^{-1}, which undoubtedly indicates the effects of coupling with other vibrational modes. It is also found that the derived values of the dihedral angles are quite sensitive to the details of the vibrational model, in fact, much more so than to the uncertainties in the bond distances and bond angles. A relationship between the potential constants derived for cyclobutane and cyclobutane-d_8 assuming an effective constant reduced mass and those derived for a semirigid model is demonstrated.

14856. Filliben, J. J., **The probability plot correlation coefficient test for normality,** *Technometrics* **17,** No. 1, 111-117 (Feb. 1975).

Key words: correlation coefficient; medians; normal distribution; order statistics; probability plot; statistical methods; statistics; tests of distributional hypotheses.

This paper introduces the normal probability plot correlation coefficient as a test statistic in complete samples for the composite hypothesis of normality. The proposed test statistic is conceptually simple, is computationally convenient, and is readily extendible to testing non-normal distributional hypotheses. An empirical power study shows that the normal probability plot correlation coefficient compares favorably with 7 other normal test statistics. Percent points are tabulated for $n=3(1)50(5)100$.

14857. Holt, H. K., **Laser intracavity absorption,** *Phys. Rev. A* **11,** No. 2, 625-629 (Feb. 1975).

Key words: high sensitivity; intracavity absorption; laser; quantitative analysis.

The characteristics of a laser with an intracavity absorption cell have been calculated for the case in which the gain atoms are homogeneously broadened and the absorber atoms are inhomogeneously broadened. The sensitivity of the laser intensity to the density of absorbers is determined.

14858. Wood, L. A., **Physical constants of different rubbers,** Paper in *Polymer Handbook, 2nd Edition,* J. Brandrup and E. H. Immergut, Eds., pp. V-7 – V-12 (John Wiley & Sons, Inc., New York, N.Y., 1975).

Key words: butyl rubber; constants; natural rubber; neoprene; physical constants; polymers; properties; rubbers; styrene-butadiene rubbers.

Selected values from 65 published literature references are tabulated for about 30 physical constants (mechanical, optical, thermal, etc.) for natural rubber, styrene-butadiene rubber (SBR), butyl rubber (IIR), and polychloroprene rubber (CR or neoprene). This is revision and extension of the tables published in 1966 in the first edition of the Polymer Handbook, J. Brandrup and E. H. Immergut, ed.

14859. Lamotte, M., Dewey, H. J., Keller, R. A., Ritter, J. J., **Laser induced photochemical enrichment of chlorine isotopes,** *Chem. Phys. Lett.* **30,** No. 2, 165-170 (Jan. 15, 1975).

Key words: dye laser; isotope; isotope separation; photochemistry.

Chlorine isotopic abundances were significantly altered by laser induced, selective excitation of particular isotopic species of thiophosgene followed by a chemical reaction between the electronically excited thiphosgene and diethoxyethylene. The concentration of ^{35}Cl in thiophosgene was changed from 75 to 64 percent or 80 percent depending upon the isotopic species initially excited.

14860. Utton, D. B., **Proton spin-lattice relaxation in cerous magnesium nitrate hydrate,** *J. Chem. Phys.* **62,** No. 2, 670-674 (Jan. 15, 1975).

Key words: cerous magnesium nitrate hydrate; lattice; proton; relaxation; spin; 65-335 K.

The proton spin-lattice relaxation in powdered $Ce_2Mg_3(NO_3)_{12} \cdot 24H_2O$ has been measured in the temperature range 65-335 K. In contrast to other paramagnetic salts it has been found that the nuclear relaxation due to nuclear dipole-dipole interactions is comparable in magnitude with the relaxation due to the electronic moments on the paramagnetic ions in this temperature range. Below 160 K the relaxation times are independent of the resonance frequency and have a temperature dependence given by $\tau_1=0.375 \exp(-182/T)$ sec. This is attributed to relaxation via the $Ce^{3\pm}$ ions and hence makes it possible to calculate a value for their relaxation times. It is also concluded that the second excited doublet of the Ce^{3+} ions is at an energy of 200 ± 18 K. At higher temperatures two relaxation time minima are observed. At 14 MHz the minimum values are 71 and 69 msec at 244 and 303 K, respectively. The weak temperature dependence of the NMR second moment indicates that 180° flips of the water molecules provide the relaxation mechanism in this temperature range. Calculated values of τ_1, using the published crystallographic data, and assuming that there are two types of water molecule, are in reasonable agreement with experiment. The observed activation energies are approximately 6.8 and 9.5 kcal/mole.

14861. West, E. D., Case, W. E., **Current status of NBS low-power laser energy measurement,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), *IEEE Trans. on Instrumentation and Measurements,* **IM-23,** No. 4, 422-425 (Institute of Electrical and Electronics Engineers, New York, N.Y., Dec. 1974).

Key words: laser calorimeter; laser energy; laser power.

A set of four electrically calibrated calorimeters is currently in use at the Boulder Laboratories of the National Bureau of Standards to calibrate and test devices for measuring average laser power in the range from 100 μW to 1 W and energies in the range 0.03 to 10 J. Laser sources used with these calorimeters are argon, krypton, helium-neon and neodymium-doped YAG, all CW, and pulsed YAG with pulse energies about 0.1 J and pulsewidths of about 200 μs and 30 ns.

The calorimeters have been intercompared as a check on systematic errors. The national standard is taken as the average for three of the calorimeters of the current C4 design, because these were designed to permit better measurements of the absorptance and window transmittance. Deviations from the group average are -0.12, -0.01, and $+0.13$ percent. The earlier standard C3-1 differs from the group average by $+0.21$ percent.

14862. Feeney, J. J., Meijer, P. H. E., **Magnetic properties of paramagnetically doped crystals Fe^{3+}, Nd^{3+} and Ho^{3+} in various**

compounds, *J. Phys. Chem. Solids* **36**, 175-185 (1975).

Key words: convergence criterion; crystal field parameters; energy levels; holium 3^+ ions; neodymium 3^+ ions; susceptibility.

In this work we calculate the energy levels, wave functions and transition probabilities for a number of compounds whose crystal field parameters have been determined. We introduce a convergence criterion in the diagonalization of the Hamiltonian matrices dependent upon a self consistency test on the eigenvectors. This assures us of numerically accurate wave functions.

First we calculated energy level and susceptibility differences in $(Nd^{3+})PbMoO_4$ dependent on the multiplicative constants θ_n, used with the published A_l^m to determine the crystal field parameters B_l^m, ($B_l^m = \theta_n A_l^m$). Calculated energy levels as a function of external magnetic field strength and orientation are compared with experimental results for three different sets of published crystal field parameters, B_l^m, for $(Fe^{3+})TiO_2$. The ground state energy levels, and wave functions, have been calculated for the non-Kramers Ho^{3+} ion in the crystals $PbMoO_4$, $LaCl_3$ and $HoCl_3$. Easily distinguishable variations in the temperature dependence of the χ_{zz} component of the susceptibility are found as a function of the host crystal. It is pointed out that susceptibility calculations, based upon measured crystal field parameters, in conjunction with subsequent susceptibility measurements, provide a good check on the validity of the crystal field parameters.

14863. Shine, R. A., Linsky, J. L., **Physical properties of solar chromospheric plages. II. Chromospheric plage models,** *Solar Phys.* **39**, No. 1, 49-77 (Nov. 1974).

Key words: radiative transfer; solar active regions; solar chromosphere; spectral line formation.

We propose chromospheric models of plages to explain profiles of the Ca II H, K, λ8498, λ8542, and λ8662 lines described in Paper I. These models are consistent with boundary conditions imposed by the photosphere and the Lyman continuum. We find that increasing emission in these lines is consistent with a picture of increasing temperature gradient in the low chromosphere and the resulting increase in pressure and electron density at similar line optical depths. With this picture we suggest how to empirically determine the distribution of chromospheric parameters across the solar disk directly from Ca II filtergrams. We also propose that the high density aspects of solar activity are produced by steep temperature gradients in the low chromosphere and thus by the enhanced heating mechanisms that steepen these gradients.

14864. Schroeder, L. W., Prince, E., Dickens, B., **Hydrogen bonding in $Ca(H_2PO_4)_2 \cdot H_2O$ as determined by neutron diffraction,** *Acta Crystallogr.* **B31**, Part 1, 9-12 (Jan. 1975).

Key words: hydrate; hydrogen bonding; monocalcium phosphate; monohydrate; neutron diffraction; phosphate; water molecule.

The hydrogen positions in $Ca(H_2PO_4)_2 \cdot H_2O$ have been determined and the structure refined to $R_w = 0.068$ and $R = 0.055$ using 1045 neutron data. No evidence is found for any disorder of the protons. The two crystallographically distinct $H_2PO_4^-$ ions are hydrogen bonded to each other and to the water molecule. The oxygen atom of the water coordinates to a calcium ion and a hydrogen atom from $H_2PO_4^-$ along its lone-pair orbital directions with distances Ca...O_w = 2.479 Å and H...O_w = 1.679 Å. One of the hydrogen atoms of the water molecule is 2.106 and 2.315 Å from two oxygen atoms, with O_w − H...O angles of 110.9 and 147.5°. The distances and angles indicate that only the stronger of these two interactions is structurally significant. The other hydrogen atom of the water molecule is involved in a hydrogen bond with H_w...O = 1.823 Å and the angle O_w − H...O = 160.4°.

14865. Phaneuf, R. A., Crandall, D. H., Dunn, G. H., **Production of $D^*(n=4)$ from electron-D_2^+ dissociative recombination,** *Phys. Rev. A* **11**, No. 2, 528-535 (Feb. 1975).

Key words: cross sections; D_2^+; dissociative recombination; product $D^*(n=4)$.

Crossed beams of electrons and D_2^+ ions were used to measure absolute cross sections for the dissociative recombination process, $e + D_2^+ (X\ ^2\Sigma_g^+) \rightarrow D + D^*(n=4)$ over a range of electron energies extending from 0.6 to 7 eV. The process was monitored by detecting a known portion of the 485.9-nm emission resulting from radiative decay of the product $D^*(n=4)$ atoms. The cross sections, which correspond to a known vibrational-state distribution of the target ions, exhibit the same dependence on electron energy as recent measurements of the total dissociative recombination cross section reported by Peart and Dolder, and have a magnitude of about 10 percent of the total cross section, suggesting that the product D atoms are formed in excited states with a variety of principal quantum numbers. Systematic measurement uncertainties at high confidence are about 14 percent, and random uncertainties are at the 25 percent (standard deviation) level. The calculation of cross sections from the observed light intensities depends on the mean lifetimes and branch ratios for 485.9-nm emission, whose evaluation in turn requires assumptions concerning the recombination process. The situation is complicated by the presence of an electron-beam-confining magnetic field in the collision volume, which causes the incident ions and product atoms to experience a transverse motional electric field. A time-independent perturbation calculation of the weak-field Stark and Zeeman effects was performed and mean lifetimes and branch ratios were estimated under different assumptions concerning the recombination process. Assuming that all perturbed product $n=4$ states are equally populated by dissociative recombination yields an experimental cross section of 1×10^{-16} cm² at 0.7 eV, decreasing to 3.3×10^{-17} cm² at 3 eV, and to 1×10^{-17} cm² at 7 eV. Assuming that only the perturbed $4s$ states are intitially populated results in cross sections larger by some 50 percent.

14866. Flynn, D. R., **Accuracy and precision,** *Noise Control Eng.—Editorial Section* **3**, No. 3, p. 2 (Nov.-Dec. 1974).

Key words: accuracy; acoustics; noise; precision; repeatability; reproducibility.

This is an invited editorial pointing out the need for uncertainty estimates in papers published in the noise field.

14867. Lovas, F. J., **Small silicon molecules: Possible sources of the unidentified molecular lines U81.5, U86.2, U89.2, and U90.7,** *Astrophys. J.* **193**, No. 1, 265-272 (Oct. 1, 1974).

Key words: microwave spectra; predicted spectra; radio astronomy; silicon molecules; structures: unidentified molecular lines.

Several small silicon molecules are considered as possible sources for the unidentified molecular lines: U81.5, U86.2, U89.2, and U90.7. The best spectroscopic and structural data available have been utilized to predict the lowest rotational transitions for SiO^+, SiN, SiC, HSiN, and for vibrationally excited SiO. Transitions from each of these molecules are predicted to occur close to one or more of these unidentified molecular lines. Rotational transitions which could aid the confirmation of each of the suggested assignments are also presented. In all cases, an effort has been made to estimate the uncertainties for the predicted transitions.

14868. Hord, H., **Cryogenic H_2 and national energy needs,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper A-1 in *Advances in Cryogenic Engineering* **19,** 1-11 (Plenum Press, New York, N.Y., 1974).

Key words: cryogenic; energy; fuel; hydrogen.

Our impending fossil fuel shortage is a clear challenge to the cryogenics industry and government to provide efficient and economical means of satisfying specific national fuel requirements. Large scale production of liquid hydrogen was stimulated by the U.S. space exploration program. Now, civilian demands for synthetic fuels beckon cryogenic hydrogen.

National and world energy shortages are briefly summarized to demonstrate the relevance of synthetic fuels in satisfying future energy markets. A perspective of national energy needs, as they relate to cryogenic hydrogen fuel, is given. Hydrogen and alternate synthetic fuels are briefly reviewed and potential applications for cryogenic hydrogen are described. Technical research and development efforts, required to satisfy specific current and future national needs, are identified. The mechanism for implementation of synthetic fuels and the indistinct timetable for transition to these fuels are discussed.

14869. Sindt, C. F., **Heat transfer to slush hydrogen,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper K-3 in *Advances in Cryogenic Engineering* **19,** 427-436 (Plenum Press, New York, N.Y., 1974).

Key words: boiling heat transfer; convective heat transfer; heat transfer; liquid hydrogen; slush hydrogen.

Heat transfer to slush hydrogen was measured at one atmosphere and at triple-point pressure. The data were compared with those for heat transfer to liquid hydrogen, and to classical heat transfer correlations for nucleate boiling. The slush data fit convective heat transfer correlations quite well. In general, the data show that for a given heat flux, the temperature difference between the wall and the bulk liquid is not as highly influenced by pressure as predicted by the correlation for nucleate boiling.

14870. Parrish, W. R., Hiza, M. J., **Liquid-vapor equilibria in the nitrogen-methane system between 95 and 120 K,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper H-2 in *Advances in Cryogenic Engineering* **19,** 300-308 (Plenum Press, New York, N.Y., 1974).

Key words: binary mixture; excess Gibbs energy; experimental phase equilibria data; heat of mixing; liquid-vapor equilibria; nitrogen-methane system.

A study was undertaken to obtain liquid-vapor equilibria data for the nitrogen-methane system at uniform temperature increments between the triple point of methane and the critical point of nitrogen. The measured liquid and vapor phase equilibrium compositions and the derived excess Gibbs energy values for six isotherms from 95 to 120 K are compared with the corresponding values taken from other investigations. The excess Gibbs energy for the equimolar mixture exhibits a zero to slightly positive temperature dependence, in qualitative agreement with calculations based on the Snider-Herrington hard sphere model. This temperature dependence of the excess Gibbs energy also suggests that the excess enthalpy (heat of mixing) must be equal to or slightly less than the excess Gibbs energy.

14871. Ledbetter, H. M., **Elastic constants of polycrystals: Equivalence of Laurent-Eudier and Voigt averaging methods,** *Phys. Status Solidi A* **26,** K67-K70 (1974).

Key words: bulk modulus; compressibility; elastic constants; elasticity Lamé constant; Poisson ratio polycrystals: shear modulus; single crystals; Young's modulus.

The equivalence of the methods of Laurent and Eudier and of Voigt for averaging cubic single-crystal elastic coefficients to obtain polycrystal elastic constants is proven and discussed. Other ways to obtain Voigt's equations are enumerated.

14872. Flynn, T. M., Powell, R. L., Chelton, D. B., Birmingham, B. W., **Superconducting electrical generators for central power station use,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper B-1 in *Advances in Cryogenic Engineering* **19,** 35-43 (Plenum Press, New York, N.Y., 1974).

Key words: cryogenics; electricity; energy; helium; power; superconductivity.

The electrical industry is faced with a need for dramatically larger generators to optimize the utilization of large new power sources, such as gigawatt-sized fast breeder reactors. Earlier increases in generator capacity have been achieved by improving the cooling of the heat-producing components of the generator. For the first time in the evolution of power generators, a unique technology, superconductivity, is available to the electric machine designer. Superconductivity may offer a way of achieving higher capacities while maintaining present costs, weights, and overall dimensions.

In the Fall of 1971, the Cryogenics Division of the NBS began a program in cooperation with industry to accelerate the application of superconductivity to large scale generators. The program stopped short of actual experimental construction since sufficient funds did not become available, but did endure sufficiently to demonstrate outstanding industry-government cooperation in this area of national need. This paper presents the results of several government-industry studies conducted in the course of this program in order to show such potential benefits from the use of cryogenics as improved generator rating, efficiency, reliability, transportation and site erection, cost and power system stability.

14873. Leasure, W. A., Jr., Corley, D. M., Farrer, J. S., Flynn, D. R., **Truck noise—1. Peak A-weighted sound levels due to truck tires (final report),** *DOT Report No. OST-ONA-71-9,* 248 pages (Available as PB204188 from the National Technical Information Services, Springfield, Va., 22161, Sept. 1970).

Key words: acoustics; noise measurement; noise pollution; noise (sound); sound transmission; tire noise; transportation noise; trucks; urban planning.

This initial report presents an inventory or "catalog" of peak A-weighted sound levels measured during an extensive parametric study conducted to characterize the noise generated by typical rib, cross-bar and retread type truck tires. A test sample of nine tread designs, estimated to represent 70-80 percent (these exact designs) of the truck tire population on the road today, was investigated considering the following variables: wear, loading, speed, pavement surface, and tire location. Test vehicles included both single-chassis vehicles and a tractor-trailer.

The results show that the A-weighted sound level increased with either an increase in load or speed. The "pocket retread" design always produced the highest level followed by the cross-bar tires and then the rib tires. This ranking held for both new and half-worn tires. The influence of wear and pavement surface is more complex. For all of the tread designs except one there was an increase in noise level between the new and half-worn states. The results for different pavement surfaces are much the same as with wear in that the generated noise appears to depend on both the specific tread design and the surface roughness. Individual tires do contribute differently to the overall level depending on their location on the vehicle. In some cases, significant reductions in the noise level were observed when "noisy" tires were mounted inboard of "quieter" tires.

The report includes a discussion of the measurement and analysis techniques utilized for the establishment of this data base.

14874. Leasure, W. A., Jr., Corley, D. M., Farrer, J. S., Flynn, D. R., **Truck noise—1. Peak A-weighted sound levels due to truck tires (addendum),** *DOT Report No. OST/TST-72-1*, 223 pages (Available as PB238912 from the National Technical Information Services, Springfield, Va., 22161, July 1972).

Key words: acoustics; noise measurement; noise pollution; noise (sound); sound transmission; tire noise; transportation noise; trucks; urban planning.

This report is the second in a series of reports to be published as a result of Department of Transportation sponsored truck tire research conducted by the National Bureau of Standards. In conjunction with the first report (OST-ONA-71-9) which contains details of the test design, test procedures, and all data acquired during the first period of testing, this report presents an inventory of peak A-weighted sound levels generated by typical rib, cross-bar and retread type truck tires. A test sample of nine tread designs, estimated to represent 70-80 percent (based on discussions with fleetowners) of the truck tire population on the road today, was investigated considering the following variables: wear, loading, speed, pavement surface, and tire location. Test vehicles included both single-chassis vehicles and tractor-trailers.

The results show that the A-weighted sound level increased with either an increase in load or speed. The "pocket retread" design always produced the highest level followed by the cross-bar tires and then the rib tires. This ranking held for tires in all states of wear. The influence of wear and pavement surface, however, is more complex. In general there was an increase in noise level between the new and half-worn states and a slight decrease between the half-worn and fully-worn states. The influence of pavement surface on the generated noise depends on the specific tread design, tire wear condition and the surface roughness. Tires do contribute differently to the overall noise level depending on their location on the vehicle. The data for tractor-trailor tests, for instance, would strongly indicate that the major contribution is made by the tires mounted on the drive axles of the tractor and that the relative contribution of tires mounted on either the front or rear trailer axles depends on the specific tire type and speed of the vehicle.

Future reports will broaden the data to include one-third octave band spectral data, directionality data in the form of equal sound level contours and other refined analysis of the data reported herein and in OST-ONA-71-9.

14875. Leasure, W. A., Jr., Mathews, D. E., Rinkinen, W. J., **Truck noise 1-A: Noise evaluation tests of military truck tires (final report),** *DOT Report No. DOT-TST-74-21*, 54 pages (Available as PB234348 from the National Technical Information Services, Springfield, Va., 22161, Feb. 1974).

Key words: acoustics; military vehicles; noise; sound; tire noise; truck tires.

This report presents the A-weighted sound level and one-third octave band spectral data resulting from a study conducted to characterize the noise generated by military truck tires. The study was conducted by the National Bureau of Standards in cooperation with the U.S. Department of Transportation under the sponsorship of the U.S. Army Tank-Automotive Command. The data base established will allow for comparison of the tire noise generated by military and commercial truck tires.

The study investigated the influence of load and speed on the noise generated by tires with four different tread designs: the standard Army tire, a retread of Army design and commercial tires with rib and cross-bar type tread patterns. Army and commercial trucks were utilized as test vehicles.

In addition, the report includes a discussion of the measurement and analysis techniques utilized for the establishment of this data base.

14876. Frederikse, H. P. R., **Electrons in oxides: A summary,** *J. Solid State Chem.* **12,** 411-415 (1975).

Key words: applications (optical, magnetic); electronic properties; oxides.

A short overview of the optical, magnetic, electrical and surface properties of oxides is presented. Some of the major applications (electronic, electro-optical, magnetic devices, high temperature components, catalysts, etc.) are listed and the relevant physical parameters are being discussed.

14877. Souders, T. M., **An audio-frequency four-terminal resistance bridge,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 342-345 (Dec. 1974).

Key words: audio-frequency; bridge; four-terminal resistance; high current; operational amplifier; phase angle; resistance; transformer-ratio-arm.

The design and performance of an audio-frequency four-terminal resistance bridge is described which compares resistors from 1 to 0.001 Ω over a frequency range of 50 Hz-10 kHz.

Current scaling establishes equal voltage across the resistors, permitting the standard to have the larger value and most optimum design while dissipating less power than the unknown. An amplifier-aided two-stage current transformer forms the ratio arms. Ratios of 1, 2, 4, 5, 10, and 20 are available, and a maximum applied current of 200 A is accommodated. Bridge ratio errors are less than 2×10^{-6} in both magnitude and phase at frequencies up to 1 kHz, increasing to 2×10^{-5} at 10 kHz.

Simple transformer scaling techniques are described for producing accurate and stable resistance standards at the 0.001-Ω level.

14878. Turgel, R. S., **Digital wattmeter using a sampling method,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 337-341 (Dec. 1974).

Key words: analog-to-digital conversion; digital; electricity; electric power; measurement; sampling; wattmeter.

Average electric power can be measured by a system that samples voltages and currents at predetermined intervals. The sampled signals are digitized and the result is computed by numerical integration. The response of the system agrees with that of a standard electrodynamic wattmeter within 0.02 percent from dc to 1 kHz, with the possible exception of zero power factor measurements. Measurements up to 5 kHz can be made with somewhat greater uncertainties.

14879. Hord, J., **Discussion of "experimental studies on thermodynamic effects of developed cavitation" by Robert S. Ruggeri,** Article in *Fluid Mechanics, Acoustics and Design of Turbomachinery, Part 1*, pp. 394-395 (1974).

Key words: cavitation; cavity pressure; steam; steam vapor pressure; thermodynamic effects; vapor pressure.

A method for predicting thermodynamic effects of cavitation (changes in cavity pressure relative to steam vapor pressure) is presented. The prediction method accounts for changes in liquid, liquid temperature, flow velocity, and body scale. Both theoretical and experimental studies used in formulating the method are discussed. The prediction method provided good agreement between predicted and experimental results for geometrically scaled venturis handling four different liquids of widely diverse physical properties. Use of the method requires geometric similarity of the body and cavitated region and a known reference cavity-pressure depression at one operating condition.

14880. Brauer, G. M., Termini, D. J., **Grafting of polymeric side chains to soft tissues,** *J. Biomed. Mater. Res.* **8,** 451-470 (1974).

Key words: ceric ion initiated grafting; chemical attachment to ratskin; grafting to tissues; persulfate initiated grafting; surface grafting; tissue modification.

Soft tissues such as calfskin or ratskin can be modified by acrylic, methacrylic or vinyl monomers containing a variety of functional groups using ceric ions, persulfate-bisulfite or comonomers forming donor-acceptor complexes as initiators. Reactions take place within 20 minutes to 3 hours under experimental conditions which, with suitable changes, might be tolerated clinically. The resulting products are insoluble in solvents for the respective homopolymers. It is likely that the polymeric side chain is attached chemically to the collagenous backbone. With ratskin, the grafting takes place mainly at the surface, resulting in a change in wettability and water sorption of the substrate. Modified hydrophilic, hydrophobic or even oil repellent surfaces can be prepared by judicious choice of monomer used. Thus, hydrophobic, oleophobic subdermal ratskin surfaces are obtained on reaction with fluorinated monomers. Treated ratskins appear more resistant to micro-organisms than the original substrate. It is conceivable that the polymeric side chains could act as adhesive liners since the modified surface may improve the ability of the substrate to adhere to restorative materials.

14881. Lentner, K. J., **A current comparator system to establish the unit of electrical energy at 60 Hz,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 334-336 (Dec. 1974).

Key words: calibration; current comparator; electrical energy unit; metrology; standard; unit; watthour meter calibration; watthour meter.

A compensated current comparator system to establish the United States legal unit of electrical energy at the National Bureau of Standards at energy levels of approximately 30 and 60 kJ is described. Analysis of the system uncertainties and experimental data indicates that the registrations of three standard type watthour meters were determined with total estimated uncertainties of about 30 ppm at unity power factor (PF) and 40 ppm at 0.5 PF. Of these uncertainties, 18 ppm represents the three standard deviation bound for the effects of random errors, and the remainder the root sum of squares of bounds to possible calibration and systematic effects. These results indicate that it should now be possible to disseminate the energy unit with uncertainties less than the presently quoted 500 ppm.

14882. Ambrose, J. R., Kruger, J., **Tribo-ellipsometric studies of the relationship between repassivation kinetics and stress corrosion of low carbon steel,** (Proc. 5th Int. Congress on Metallic Corrosion, Tokyo, Japan, May 21-27, 1972), Paper in *5th International Congress on Metallic Corrosion,* pp. 406-409 (National Association of Corrosion Engineers, Houston, Texas, 1974).

Key words: chloride; ellipsometry; low carbon steel; nitrate; nitrite; repassivation; stress corrosion.

Since the susceptibility of a material to stress corrosion cracking (SCC) may be related to the rupture of a protective film and the repassivation rate of the material thus exposed, a technique, tribo-ellipsometry, has been developed which simulates film rupture by abrading off the surface oxide. During the subsequent repassivation of this exposed surface, tribo-ellipsometry allows simultaneous determination of film growth kinetics by ellipsometry and current transient following removal of a protective film. From these measurements a repassivation ratio R_p (total change/film thickness) can be determined. Using R_p, the following results were found: 1) SCC susceptible system (1N $NaNO_3$ at 90 °C) – partial passivation, high rate of metal dissolution; 2) SCC nonsusceptible system – (1N $NaNO_2$ at 25 °C) – rapid and effective passivation low metal dissolution rate; and 3) SCC nonsusceptible but highly corrosive system (1N NaCl) – no passivation, high metal dissolution rate.

14883. Kasa, I., **Closed-form mathematical solutions to some network analyzer calibration equations,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 399-402 (Dec. 1974).

Key words: calibration; sliding termination; standards.

A general evaluation procedure is described for calibration of a linear complex reflectometer (network analyzer and for two-port measurements. New closed-form formulas and procedures are given for two practical cases: 1) calibration or measurement with two known standards and a sliding termination; 2) calibration or measurement by one standard and two different sliding terminations.

The reflection coefficient magnitudes and phases of these sliding terminations need not be known.

The closed-form formulas make it possible to determine calibration constants by direct calculation without approximations or complicated multivariable iterations.

14884. Lias, S. G., **Ion-molecule reactions in radiation chemistry,** (Proc. NATO Advanced Study Institute Conf. on Ion-Molecule Interactions, Biarritz, France, June 24-July 6, 1974), Paper in *Interactions Between Ions and Molecules,* P. Ausloos, Ed., pp. 541-562 (Plenum Publishing Corp., New York, N.Y., 1975).

Key words: ion-molecule reaction; ion structure; ionic fragmentation; radiation chemistry; rate constants.

This brief review presents several illustrations of how ion-molecule reactions are studied in radiation chemical experiments and also of the kinds of information about ion-molecule reactions and other ionic phenomena (such as fragmentation and isomerization) which have been obtained from such experiments. Absolute rate coefficient determinations through spectroscopic measurements in the gas and liquid phase radiolysis, as well as absolute and relative rate coefficient determinations based on chemical analysis of reaction products are described. Illustrations from radiation chemical investigations which have given unique information about mechanistic details of certain ion-molecule reactions in hydrocarbon systems are also presented. A historical review and general description of the conditions prevailing in radiation chemistry experiments are also included.

14885. Zobrist, D. W., Fassbender, P., Bearden, F. E., Costrell, L., **Software standards and CAMAC,** *Instrum. Technol.* **22,** No. 3, 33-38 (Mar. 1975).

Key words: CAMAC; computer systems; control systems; industrial control; software; standards.

One month prior to a meeting of the International Purdue Workshop on Industrial Computer Systems, the idea was conceived to demonstrate software transportability, using ANSI X3.9-1966 Standard FORTRAN and ISA-S61.1 external procedures for process control, and the demonstration was to point out the need and potential of standards in other areas. Two complete computer systems, including peripherals and CAMAC interfaces, and process instrumentation, were borrowed from a dozen scattered sources. The systems were hooked up and running in about two days. This article describes the demonstration project, the many obstacles encountered, and lessons learned.

14886. Wachtman, J. B., Jr., **Highlights of progress in the science of fracture of ceramics and glass,** *J. Amer. Ceram. Soc.* **57,** No. 12, 509-519 (Dec. 12, 1974).

Key words: ceramics; fracture; fracture mechanics; glass; impact damage; strength; thermal shock; time to failure.

Rapid, catastrophic propagation of cracks is described in terms of stress concentration and energy balance conditions from a fracture-mechanics viewpoint. Slow crack propagation by stress corrosion or other mechanisms is also presented in fracture-mechanics terms. Data on slow crack propagation and accompanying acoustic emission in a variety of ceramics and glasses are reviewed. A survey is presented of the application of these results to the quantitative treatment of strength, dependence of strength on loading rate, time to failure, proof testing, acoustic emission monitoring, thermal shock, impact damage, and erosive machining. Some limitations in the application of fracture mechanics to ceramics are discussed.

14887. Klein, R., Yates, J. T., Jr., **Nitric oxide and its decomposition on the (110) plane of tungsten,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 461-464 (1974).

Key words: decomposition; nitric oxide; tungsten.

Nitric oxide is adsorbed on the (110) plane of tungsten with a high sticking coefficient independent of coverage. Programmed thermal desorption of a W(110) surface with adsorbed NO shows no desorbed NO, but only nitrogen. Two peaks are observed in the resulting nitrogen desorption spectra. The first, appearing at low coverages of NO, shifts to lower temperatures with increasing initial coverage. The second appears at higher coverages and shifts slightly to higher temperatures with increasing coverage. The temperature region covering both states is 900-1350 K for the temperature rates employed. A simple, consistent model is developed. Work function-relative coverage measurements for NO on W(110) show an initial slow $\Delta\phi$ increase, a linear potion, and a maximum. The maximum $\Delta\phi$ is 0.85 eV and the saturated coverage value is 0.72 eV.

14888. Rains, T. C., **Atomic absorption spectrometry—general considerations for the application of experimental techniques,** *Amer. Soc. Testing Mater. Spec. Tech. Publ.* **564,** pp. 50-66 (1974).

Key words: accuracy; atomic spectroscopy; atomic vapor; chemical analysis; evaluation; interferences; light sources; precision.

In applying atomic absorption spectrometry to an analytical problem, the analyst must have an understanding of the basic instrumental components. The essential components of an atomic absorption instrument consist of a primary source of radiation, a means of producing atomic vapor from the analyte, wavelength selection, signal detection, and readout. While several types of radiation sources are available, hollow cathode lamps are the primary choice for most workers in the field.

The production of atomic vapor of the analyte is probably the most important parameter in atomic absorption spectrometry. The selection of the oxidant-fuel or nonflame method of producing neutral atoms will depend upon the concentration of analyte and the matrices. While the analyst has a wide choice of methods at his disposal, an understanding of the problems related to the production of atomic vapor is essential to obtain the maximum precision and accuracy. Also, interferences, sample preparation, and methods for evaluation of data are discussed.

14889. Weisman, I. D., Bennett, L. H., McAlister, A. J., Watson, R. E., **$LaNi_{5-x}Pt_x$: NMR investigation of structural and electronic properties,** *Phys. Rev. B* **11,** No. 1, 82-91 (Jan. 1, 1975).

Key words: alloys; contact term; core polarization; exchange enhancement; Knight shifts; $LaNi_5$; $LaNi_{5-x}Pt_x$; $LaPt_5$; NMR; ordering; relaxation times; solid solutions.

Pt-site Knight shifts κ, relaxation times, and crystallographic data have been obtained for the $LaNi_{5-x}Pt_x$ ($0 \leq x \leq 5$) system. There are two transition-metal sites: one, A, in a La layer and one, B, between La layers; different κ's are observed for each site. The system is found to be completely miscible and NMR intensities and crystallographic results show that Pt prefers the B site and that considerable ordering occurs for $x \lesssim 4$. The ^{195}Pt κ's are ~ 1 percent and ~ 0 percent for the A and B sites, respectively, in $LaPt_5$; the A-site κ is approximately 0 at $LaNi_4Pt$ and the B-site κ reaches − 2 percent in $LaNi_{4.75}Pt_{0.25}$. The shifts, taken together with relaxation times, indicate that s-band effects dominate, particularly for the A-site, in $LaPt_5$ and that the Pt atoms on both sites become more transition-metal-like with increasing x. Exchange enhancement is shown to be an essential factor at the Ni-rich end. Variations in chemical activity, as in hydride formation, are discussed in light of these electronic differences between $LaNi_5$ and $LaPt_5$.

14890. Collin, G. J., **Réactions des ions iso-$C_4H_8^+$ et t-$C_4H_9^+$ avec l'isobutène en phases liquide et gazeuse,** *Can. J. Chem.* **52,** No. 12, 2341-2347 (1974).

Key words: free radical reactions; G-values; ion-molecule reactions; neopentane; proton transfer; radiolysis.

The radiolysis of neopentane has been studied in gas and liquid phases. It was shown that, in the liquid phase, the iso-$C_4H_8^+$ ion reacts at least as quickly with isobutene as with methylcyclopentane. The t-$C_4H_9^+$ ion reacts at least 10 times more rapidly with isobutene and the main reaction is one of resonant transfer of a proton with isobutene; fewer than 5 percent of the t-$C_4H_9^+$ ions add to isobutene. In the gas phase, the condensation reaction is more important than that of resonant proton transfer since proton transfer represents only 30 percent of the total reaction: $k(\text{addition})/k(\text{transfer}) \simeq 2.35 \pm 0.15$. Finally, the resonant transfer of a deuteron occurs about 2.9 more slowly than proton transfer.

14891. DePrima, C. R., Johnson, C. R., **The range of $A^{-1}A^*$ in** $GL(n, \mathrm{C})$, *Linear Algebra and Its Applications* **9,** 209-222 (1974).

Key words: adjoint; Hilbert's Theorem 90; involution; normal; similar; spectrum; unitary.

Let A be an invertible linear operator on a finite dimensional complex Hilbert space. We carry out a detailed study of the map $A \rightarrow A^{-1}A^* \equiv \Phi(A)$. It is shown that the range of Φ is exactly the set of all invertible operators T for which T^{-1} is similar to T^*. In particular, unitaries and similarities of unitaries are in the range of Φ and we prove, among other things, the equivalence of the assertions: (i) T is similar to a unitary, (ii) every $A \in \Phi^{-1}(T)$ is congruent to a normal operator, (iii) there exists $B \in \Phi^{-1}(T)$ whose field of values omits the origin of the complex plane. For general T in the range of Φ, we determine *all* $A \in \Phi^{-1}(T)$ in terms of the self-adjoint invertible operators fixed by the map $X \rightarrow T^* XT$. Many of the results contained in this paper have known analogues for operators which are similar to their adjoints.

14892. Mulholland, J. D., Plotkin, H. H., Silverberg, E. C., Wilkinson, D. T., Alley, C. O., Bender, P. L., Currie, D. G., Dicke, R. H., Faller, J. E., Kaula, W. M., Williams, J. G., **A self-consistent set of surface coordinates for the Apollo lunar laser retroreflectors deduced from laser range measures,** (Proc. 15th Planetary Meeting of COSPAR, Madrid, Spain, May 1972), Paper in *Space Research* **XIII**, M. J. Rycroft and S. K. Runcorn, Eds., **2**, 1009-1013 (Akademie-Verlag, Berlin, Germany, Dec. 1973).

Key words: astronomy; cartography; geophysics; laser; lunar distance; moon; selenodesy.

Laser ranges from the McDonald Observatory to the three Apollo retroreflectors have been used to obtain simultaneous solutions to the selenocentric coordinates of the three arrays, using two different approaches. The original coordinates, which were obtained either from LEM orbit determination or from orbital triangulation, suffered adjustments that were compatible with their *a priori* uncertainties, which ranged up to about a kilometer. It was decided also to correct the lunar moments of inertia. The corrections thus far obtained are not definitive, since the differential residuals are still of significant size. Nonetheless, order of magnitude reductions in the differential residuals have been secured.

14893. Reader, J., **Spectrum and energy levels of singly ionized rubidium (Rb II),** *J. Opt. Soc. Amer.* **65,** No. 3, 286-301 (Mar. 1975).

Key words: rubidium; spectra; ultraviolet; wavelengths.

The spectrum of Rb II has been observed in a pulsed radiofrequency discharge with the NBS 10.7-m normal-incidence vacuum spectrograph, the NBS 10.7 m Eagle spectrograph in air, and the NBS 3.34 m plane-grating spectrograph in air. The observations cover the regions 1489-2661 Å and 4380-10 081 Å. The wavelengths of the strong resonance lines in the 530-741 Å region were accurately measured in the 3rd and 4th orders with a sliding-spark discharge. Analysis of the spectrum has provided the positions of the previously missing levels of the $4p^5$ $4d$, $4f$, and $6d$ configurations. The energy-level system has been extended to include the complete $4p^5$ $5f$, $5g$, $6f$, and $6g$ configurations, most of the levels of the $4p^5$ $6p$, $7f$, $7g$, $8s$, and $9s$ configurations, and parts of the $4p^5$ $7d$, $8d$, $8f$, $8g$, $9d$, and $9f$ configurations. 600 lines are classified as transitions between 165 levels. Most of the observed configurations have been theoretically interpreted. The energy parameters determined from least-squares fits to the observed levels are compared with Hartree-Fock calculations. The ionization energy, derived from the $4p^5nf\,3/2\,[9/2]_5$, $n=4-7$, and $4p^5ng\,3/2\,[11/2]_6$, $n=5-8$, series, is 220 105.0 $\pm$ 0.5 cm^{-1} (27.2898 $\pm$ 0.0001 eV).

14894. Kaufman, V., Sugar, J., **Spectrum and energy levels of five-times ionized tantalum (Ta VI),** *J. Opt. Soc. Amer.* **65,** No. 3, 302-309 (Mar. 1975).

Key words: spectra; tantalum.

The spectrum of Ta VI produced with a sliding-spark discharge was photographed in the region of ~ 200-2000 Å utilizing grazing-incidence and normal-incidence spectrographs. A system of seventy excited energy levels was deduced from 228 spectral lines. These arise from excitations out of both the $4f$ and $5p$ closed shells of the $4f^{14}\,5s^2\,5p^6$ ground configuration, giving the observed configurations $4f^{13}nl$ with $nl=5d$, $6s$, $6p$, $6d$, $7s$ and $5p^5nl$ with $nl=5d$, $6s$, $6p$. Radial integrals were fitted for all of these configurations. A value of 785 130 $\pm$ 400 cm^{-1} for the ionization energy was derived. A graph of lowest excited levels of $4f^{13}\,5d$ and $5p^5\,5d$ from Lu IV to Re VIII predicts the crossing of these configurations after W VII.

14895. Mauer, F. A., Hubbard, C. R., Piermarini, G. H., Block, S., **Measurement of anisotropic compressibilities by a single crystal diffractometer method,** Paper in *Advances in X-Ray Analysis,* W. L. Pickles, C. S. Barrett, J. B. Newkirk, and C. O. Ruud, Eds., **18,** 437-453 (Plenum Press, New York, N.Y., 1975).

Key words: compressibility; single crystal; x-ray diffraction.

The beryllium diamond-anvil pressure cell described by Weir, Piermarini and Block has been mounted on a Bond diffractometer equipped with an orienter of the fixed-χ type. Molybdenum radiation is used to penetrate the diamonds and beryllium of which the cell is constructed, and special techniques are required to retain adequate precision in measuring cell parameters using diffraction angles in the low 2θ range. The method described provides high sensitivity in determining peak positions and eliminates the effect of centering errors on measured values of 2θ. Under favorable conditions, diffraction angles are measured with an accuracy of $\pm 0.001°$ in 2θ. The method has been tested by measuring the lattice parameter of vacuum float zone refined silicon. Measurements of the compressibilities of silicon and of α-Pb $(N_3)_2$ (orthorhombic) have been carried out using the method of Barnett, Block, and Piermarini to determine pressure by measuring the shift in the R-line fluorescence spectrum of ruby.

14896. Lias, S. G., Viscomi, A., Field, F. H., **Chemical ionization mass spectra. XXI. Reactions in *t*-$C_5H_{11}Cl$, *t*-$C_5H_{11}Br$, *t*-$C_5H_{11}OH$, and *t*-$C_5H_{11}SH$,** *J. Amer. Chem. Soc.* **96,** No. 2, 359-364 (Jan. 23, 1974).

Key words: alcohols; alkyl halides; chemical ionization; ion-molecule reactions; mass spectrometry; mercaptans.

Mixtures of isobutane with small amounts (0.01-1%) of added *t*-$C_5H_{11}Cl$, *t*-$C_5H_{11}Br$, *t*-$C_5H_{11}OH$, and *t*-$C_5H_{11}SH$ have been studied in a high-pressure mass spectrometer as a function of total pressure, temperature, and concentration of additive. It is seen that proton transfer occurs only to *t*-$C_5H_{11}SH$, and even in this case, proton transfer is a minor process. The major reaction observed with each of the four molecules is the formation of a condensation ion which dissociates rapidly to give ($C_9H_{19}^+$ + HX) or ($C_5H_{11}^+$ + neutral products) where X is Cl, Br, OH, or SH. The formation of $C_5H_{11}^+$ is favored under all conditions, but the formation of $C_9H_{19}^+$ becomes more important as the pressure is raised or the temperature is lowered. When *i*-C_4D_{10} is substituted for *i*-C_4H_{10}, it is seen that in the mercaptan, where proton transfer may be slightly exothermic, the departing hydrogen sulfide molecule carries away a D species from the reacting *tert*-butyl ion with a high probability; conversely, in *t*-$C_5H_{11}Br$, the departing hydrogen bromide molecule has a low probability of containing a hydrogen species from the reacting *tert*-butyl ion. This result suggests that when proton transfer competes with the displacement reaction, the two reactions proceed through the same intermediate ion, a $C_9H_{20}H^+$ species, in which "internal" proton transfer has occurred. The product $C_5H_{11}^+$ ion undergoes an analogous displacement reaction with all of these molecules to form the following as products: ($C_{10}H_{21}^+$ + HX) and ($C_6H_{13}^+$ + neutral products). The $C_6H_{13}^+$ product ion also undergoes a displacement reaction with all of these molecules to form as products ($C_{11}H_{23}^+$ + HX).

14897. Yakowitz, H., **Electron-probe microanalysis—a capsule survey,** *J. Vac. Sci. Technol.* **11,** No. 6, 1100-1104 (Nov./Dec. 1974).

Key words: electron probe microanalyzer; microanalysis; qualitative analysis; quantitative analysis; specimen preparation; x rays.

A brief overview of the way in which electron-probe microanalysis can be used to obtain information from microvolumes comprising 10^{-12} g or less of specimen material is presented. Elemental identification, distribution, and quantitative analytical procedures are outlined. Energy-resolving detectors and wavelength-dispersive spectrometers are compared; analysis of elements with atomic number < 11 is also briefly considered in this context. An example of the solution of a service failure by means of elemental-distribution mapping is offered. Finally, an indication is given of the accuracy which can be expected from quantitative electron-probe microanalysis.

14898. Prosen, E. J., Goldberg, R. N., Staples, B. R., Boyd, R. N., Armstrong, G. T., **Microcalorimetry applied to biochemical processes,** (Proc. U.S. Japan Joint Seminar, Akron, Ohio, April, 8-12, 1974), Paper in *Thermal Analysis: Comparative Studies on Materials*, H. Kambe and P. D. Garn, Eds., pp. 253-289 (Kodansha Ltd. and John Wiley and Sons, Tokyo and New York, 1974).

Key words: analysis; assay in serum; bacterial growth calorimetry; enzyme catalyzed processes; glucose; microcalorimetry; serum thermochemistry of enzyme processes.

A single-reaction-vessel, batch-type, conduction microcalorimeter is described, having a volume of about 0.3 ml. The sensitivity in terms of electrical output voltage per unit of heat transfer power is 60 mV · W^{-1}, the lower limit of detectable thermal power is about 0.1 μW, and the lower limit of total heat that can be measured is < 0.2 mJ. The calorimeter is calibrated electrically and by known chemical reactions such as the neutralization of HCl by NaOH in solution. The calorimeter has been applied to the measurement of enzyme catalyzed biochemical processes. On the basis of measurements made in aqueous buffer solutions, the *hexokinase* catalyzed phosphorylation of glucose has been used to assay glucose in the complex media human serum and blood plasma, with results that correlate well with customary clinical laboratory procedures. The growth of *Enterobacter cloacae, Proteus rettgeri,* and *Klebsiella pneumoniae* in the calorimeter under controlled conditions show characteristic energy evolution patterns. In a somewhat larger reaction cell, the fertilization and growth of *Arbacia punctulata* eggs were observed.

14899. Lias, S. G., Ausloos, P., **Structure and reactivity of $C_4H_8^+$ ions formed in the radiolysis of cycloalkanes in the gas phase,** *J. Amer. Chem. Soc.* **92,** No. 7, 1840-1847 (Apr. 8, 1970).

Key words: charge transfer reactions; cycloalkanes; cyclohexane; gas phase; methylcyclopentane; parent ions.

The structure and reactivity of the $C_4H_8^+$ formed in the fragmentation of cyclohexane and methylcyclopentane parent ions has been examined ($[C_6H_{12}^+]^* \rightarrow C_2H_4 + C_4H_8^+$). It is noted that $C_4H_8^+$ consists of 1-$C_4H_8^+$, *i*-$C_4H_8^+$, and 2-$C_4H_8^+$. The relative abundances of these isomer ions depend on the energy content of the cycloalkane ion. According to the mass spectral cracking pattern of cyclohexane-1,1,2,2,3,3-d_6 the high energy parent ion splits out $C_4H_8^+$ without extensive prior rearrangement. The $C_4H_8^+$ so formed is analogous to the $C_4H_8^+$ ion produced in the photoionization or radiolysis of cyclobutane. The various $C_4H_8^+$ isomers react with the cycloalkanes by acceptance of an H_2^- entity: $C_4H_8^+ + C_6H_{12} \rightarrow C_4H_{10} + C_6H_{10}^+$. The relative reaction rates, which are determined by means of isotopic labeling experiments, differ widely with a change in the structure of both the reactant ion and the reactant molecule, with the rate of reaction being generally higher for the more exothermic process.

14900. Kerns, D. M., **Scattering-matrix description and nearfield measurements of electroacoustic transducers,** *J. Acoust. Soc. Amer.* **57,** No. 2, 497-507 (Feb. 1975).

Key words: acoustics; electroacoustic transducers; nearfield measurements.

Recently developed and successfully applied analytical techniques for the measurement of microwave antennas at reduced distances are "translated" into corresponding techniques for the measurement of electroacoustic transducers in fluids. The basic theory is formulated in scattering-matrix form and emphasizes the use of plane-wave spectra for the representation of sound fields. This theory, in contrast to those based on asymptotic description of transducer characteristics, is suitable for the formulation and solution of problems involving interactions at arbitrary distances. Two new techniques (in particular) are described. One, utilizing deconvolution of transverse scanning data, taken with a known transducer at distances d which may be much less than the Rayleigh distance $d_R (\equiv D^2/2)$, provides a means of obtaining complete near- and farfield characteristics, *corrected for the effects of the measuring transducer.* Applicability of a (two-dimensional, spatial) sampling theorem and of the "fast Fourier transform" algorithm, with greatly facilitate the necessary computations, is shown. The second technique provides a means of extrapolating received signal as a function of distance (observed with $d \sim d_R$) to obtain on-axis values of effective directivity. Other possible applications are indicated. These techniques rigorously utilize observed transducer output, which need not be simply related to pressure or normal velocity at a point.

14901. Rains, T. C., Menis, O., **Determination of aluminum by flame emission spectrometry with repetitive optical scanning,** *Anal. Lett.* **7,** No. 11, 715-727 (1974).

Key words: aluminum; flame emission spectrometry; interferences; repetitive optical scanning.

The distribution of atomic aluminum emission in the nitrous oxide-acetylene flame was investigated by means of repetitive optical scanning in the derivative mode. In this system, the difficulties encountered with this source from the CN, CH, and C_2 band systems were overcome. This technique which doesn't require a separation or preconcentration step was applied to the determination of aluminum in various types of ferrous materials. The results were compared with other classical methods. By the proposed method aluminum was also determined in a high-purity iron at the 5 μg/g level with a relative standard deviation of 10 percent.

14902. Manghnani, M. H., Brower, W. S., Parker, H. S., **Anomalous elastic behavior in Cu_2O under pressure,** *Phys. Status Solidi* **25,** 69-76 (1974).

Key words: cuprous oxide; elastic constants.

The elastic constants C_{ij} of single-crystal Cu_2O measured to 3 kbar show linear variation with pressure. The best-fit values of the C_{ij} and dC_{ij}/dP are: $C_{11} = 1228.8$, $C_{44} = 121.0$, $C' = (C_{11} - C_{12})/2 = 81.9$ kbar, $dC_{11}/dP = 3.62$, $dC_{44}/dP = -0.69$, and $dC'/dP = -0.63$, respectively. The elastic behavior of Cu_2O is found to be anomalous in that dC_{44}/dP and dC'/dP are both negative, and $d\mu/dP$, where μ is the isotropic shear modulus, is significantly negative (-0.67). This anomalous behavior suggests an instability of crystal structure. The high- and low-temperature limiting values of Grüneisen γ, γ_H and γ_L, computed from the dC_{ij}/dP are -1.98 and -3.59, respectively. The value of γ_H is in fairly good agreement with the reported Grüneisen γ value based on the nuclear quadrupole relaxation data. The negative Grüneisen γ values are consistent with the observed negative thermal expansion. The implication of γ_L being appreciable more negative than γ_H is that the coefficient of thermal expansion of Cu_2O should become more negative at low temperatures.

14903. Ederer, D. L., Dhez, P., **Some applications of GM counters in the vacuum ultraviolet spectral region,** *Rev. Sci. Instrum.* **46,** No. 2, 144-146 (Feb. 1975).

Key words: absolute radiation detector; absorption measurements; filters; GM counter; sensitive detector; vacuum ultraviolet.

The applicability of GM and proportional counters naturally extends into the vacuum ultraviolet (vuv) spectral region. A simple modification to this detector enables GM counters to be used to measure very small cross section variations or to be used as high efficiency detectors over a narrow spectral range with excellent second order discrimination.

14904. Moore, L. J., Machlan, L. A., Shields, W. R., Garner, E. L., **Internal normalization techniques for high accuracy isotope dilution analyses-application to molybdenum and nickel in standard reference materials,** *Anal. Chem.* **46,** No. 8, 1082-1089 (July 1974).

Key words: isotope dilution; isotopes; mass spectrometry; molybdenum; nickel; normalization; standard reference materials; thermal ionization.

General exact equations and iteration techniques have been developed for internal normalization to eliminate the effect of thermal fractionation from isotope ratio measurements, and therefore isotope dilution analyses, by thermal ionization mass spectrometry. The techniques are applicable to more than 20 elements, and have been extensively applied to the determination of Mo in ore concentrates (55% Mo) and silicate trace standards (50 and 500 ppm M.). The standard deviations of all internally corrected Mo isotope ratio measurements were < 0.1 percent. The Mo sample size was 40 μg, but normalization techniques should apply to μg and smaller samples with a more sensitive ion detection system. Procedures are described for the chemical separation of Mo from matrix interferences and for the mass spectrometric analysis of Mo. Application of the techniques to Ni in three pollution standard reference materials is described.

14905. Hubbard, C. R., Swanson, H. E., Mauer, F. A., **A silicon powder diffraction standard reference material,** *J. Appl. Crystallogr.* **8,** Part 1, 45-48 (Feb. 1975).

Key words: powder diffraction standard, silicon; silicon powder diffraction standard; standard, powder diffraction; standard reference material, silicon.

A silicon powder Standard Reference Material, SRM-640, has been prepared for use as a standard in powder diffractometry. Powder diffraction measurements were performed with a tungsten internal standard and a high-angle goniometer. The measured a/λ is 3.525176. With λ(Cu $K\alpha_1$ peak) taken as 1.5405981 Å, $a = 5.430880$ (35) Å, uncorrected for refraction. Comparison of a with values obtained with a single crystal from one of the boules reveals a difference of 3 parts in 10^5. This difference suggests a subtle systematic error in powder diffractometry or a change in lattice spacing near crystal boundaries. Use of the SRM should permit individual measurements of lattice parameters to be made reproducible to near 1 part in 10^5 and an absolute accuracy of at least 3 parts in 10^5.

14906. Garn, P. D., Diamondstone, B. I., Menis, O., **Variations in the cooling transitions of potassium nitrate,** *J. Therm. Anal.* **6,** 623-630 (1974).

Key words: potassium nitrate; procedure of ICTA Standards Committee and NBS; standard in thermal analysis; transition from I → III.

Because of questions concerning the suitability of potassium nitrate as a dynamic temperature standard for DTA, the relation between the experimental procedure and the resulting curves was ascertained for the Standard Reference Material KNO_3. The material behaves differently *on cooling* in open pans than in cylindrical holders because confinement in the latter case initiates reversion to the room temperature form. Under the conditions of use as a dynamic temperature reference material, the curves are accurately reproducible.

14907. Ederer, D. L., Lucatorto, T. B., Saloman, E. B., Madden, R. P., Sugar, J., **Photoabsorption of the 4d electrons in barium,** *J. Phys. B: Atom. Molec. Phys., Letter to Editor* **8,** No. 3, L21-L25 (1975).

Key words: barium vapor; configuration interaction; $N_{IV,V}$ ionization thresholds; photoabsorption; 4d absorption; 4f orbital contraction.

The absorption spectrum of gaseous barium was obtained between 120 Å, the region of the $N_{IV,V}$ thresholds. The similarity to lanthanum of some of the features observed in barium suggests that the 4f orbital contracts and overlaps the 4d orbit. This contraction produces two terms, ^3P and ^3D, of the $4d^9$ 4f configuration below the 4d ionization limits, while the large electrostatic exchange interaction drives the ^1P term of this configuration some 10 eV above the limit. Furthermore, extensive mixing of the $4d^9$ $(6s^2)6p$ configuration with $4d^9(5d^2)6p$ and $4d^9(5d6s)6p$ produces many weak resonances in addition to the resonances associated with the $4d^9$ 4f configuration. A suggested classification of these features is given with the aid of known features of the La I spectrum. Finally, from the known x-ray splitting of the $N_{IV,V}$ threshold and the energy interval between the $6s^2$ 6p ^2P and $6s^2$ ^1S levels in La I and La II, the ionization thresholds of the 4d electron were determined to be 814 800 (1000) cm^{-1} and 792 500 (1000) cm^{-1}.

14908. Lias, S. G.; Rebbert, R. E., Ausloos, P., **Carbonium ions in radiation chemistry. II. Isomerization processes in $C_3H_7^+$ and $C_4H_9^+$ ion,** *J. Amer. Chem. Soc.* **92,** No. 22, 6430-6440 (Nov. 4, 1970).

Key words: butyl ion; carbonium ion; ion fragmentation; isomerization; propyl ion.

The structures of propyl and butyl ions formed in the gas-phase radiolysis of appropriate alkanes have been deduced from the structures of the neutral products formed in proton transfer reactions with ammonia, or from the isotopic structures of hydride (or deuteride) transfer reaction products formed in labeling experiments. *n*-Propyl ions rearrange within 10^{-10} sec to the *sec*-propyl or the protonated cyclopropane structure. Rearrangement to the *sec*-propyl ion is favored under all conditions but increases in importance with increasing internal energy content of the ion. Both isomerization reactions are reversible, but the rate constants of the reverse reactions are very low owing to the energy requirements of these processes. The isomerization of the *sec*-butyl ion to the *t*-butyl structure is observed; this rearrangement also increases in importance with increasing internal energy content of the ion. The H (or D) atoms in the secondary and tertiary carbonium ions are seen to undergo energy-dependent hydrogen-scrambling processes. The protonated cyclobutane ion formed by proton transfer to cyclobutane isomerizes mainly to the *sec*-butyl structure. The results presented here demonstrate that most of the propyl and butyl ions formed in the dissociation of butane and hexane parent ions, respectively, originate as primary carbonium ions from simple C-C cleavage processes, rather than being formed initially with the secondary structure, as they are at the threshold energies.

14909. Chow, L. C., Brown, W. E., **Formation of $CaHPO_4 \cdot 2H_2O$ in tooth enamel as an intermediate product in topical fluoride treatments,** *J. Dent. Res.* **54,** No. 1, 65-76 (Jan.-Feb. 1975).

Key words: dicalcium phosphate dihydrate; fluorapatite; fluoride; hydroxyapatite; tooth enamel.

Significant amounts of $CaHPO_4 \cdot 2H_2O$ (DCPD) were deposited in tooth enamel by pretreatment with a solution saturated with respect to DCPD. When these enamel samples were treated with a given fluoride solution, the fluoride uptake increased with increasing amounts of DCPD produced by the pretreatment. The interactions between enamel and acidic solutions to yield DCPD can be understood as dissolution-precipitation reactions and analyzed through the use of solubility phase diagrams.

14910. Hougen, J. T., **The assignment of molecular infrared spectra from a laser magnetic resonance spectrometer,** *J. Mol. Spectrosc.* **54,** No. 3, 447-471 (Mar. 15, 1975).

Key words: asymmetric rotors; doublet states; HO_2; laser magnetic resonance; least squares fit; rotational analysis; Zeeman spectrum.

Mathematical techniques are presented which have proved useful in assigning the laser magnetic resonance pure-rotation spectrum of HO_2, i.e., useful in assigning an absorption spectrum obtained when molecular energy levels are Zeeman shifted by an external magnetic field until transition frequencies coincide with a fixed-frequency radiation source. The techniques described should have general applicability to the laser magnetic resonance vibration-rotation spectrum of any molecule in an orbitally nondegenerate electronic state and a doublet electronic spin state ($S = 1/2$). Equations involving both Zeeman line positions and Zeeman line intensities are presented. These allow the assignment of M_J quantum numbers, the determination of the spin-rotation interaction constant γ and rotational quantum number N for both the upper and the lower state, and the determination of the zero-field transition frequency. The equations can be used without prior knowledge of the molecular structure or energy levels.

14911. Niemeijer, T., Meijer, P. H. E., **Quantum-mechanical ground state of crystals with dipole-dipole and exchange interactions,** *Phys. Rev. B* **10,** No. 7, 2962-2967 (Oct. 1, 1974).

Key words: antiferromagnetism; cerous magnesium nitrate; dipole-dipole interaction; ferromagnetism; ground state; magnetic; permutation group; quantum mechanics.

The general quantum-mechanical extension of Luttinger and Tisza's approach to the ground state of crystals with dipole-dipole and exchange interactions is given. It is shown that within this approach the ground state can only be ferro- or antiferromagnetic if the unit cell contains only one or two magnetically equivalent atoms or ions.

14912. Brill, R. H., Barnes, I. L., Adams, B., **Lead isotopes in some ancient Egyptian objects.** Paper in *Recent Advances in Science and Technology of Materials,* A. Bishay, Ed., **3,** 9-27 (Plenum Publishing Corp., New York, N.Y., 1974).

Key words: archaeological materials; Egyptian glasses; galena ores; kohl; lead isotopes; Ptolemaic and Roman Periods.

The determination of isotope ratios in lead extracted from a variety of archaeological materials is very useful for classifying the objects according to their geographical origins. On the basis of data for lead from about 450 ancient objects and galena ores, geographical patterns have been established. Our previous studies have included metallic leads, bronze alloys, silver and gold coins, pigments, glazes and glasses from many areas of the Ancient World. In this study we have investigated specimens of ancient Egyptian glasses and glazes containing the colorant-opacifier $Pb_2Sb_2O_7$, samples of kohl (which consist of powdered galena) and a few ores from Egypt. The leads used for making the pigment and kohl are similar to one another, but very different from leads from other parts of the Ancient World, and are almost certainly made of locally-occurring galena ores. Relatively small differences among the ancient Egyptian kohls separate those dating from different dynasties. Glasses and bronzes of the Ptolemaic and Roman Periods excavated in Egypt do not contain the same type of lead found in the earlier glasses and kohls. The later leads are of the Laurion, "Levantine" and Italian types. The authenticity of one very important glass object of the XVIIIth Dynasty has been verified by this technique.

14913. Yakowitz, H., **Role of the divergent beam (Kossel) x-ray technique in scanning electron microscopy,** (Proc. Seminar on Quantitative Scanning Electron Microscopy, London, England, Sept. 13-15, 1972), Chapter 13 in *Quantitative Scanning Electron Microscopy,* M. D. Muir, E. M. Boswarba and D. B. Holt, Eds., pp. 451-486 (Academic Press, London, England, Dec. 1974).

Key words: channelling of electrons; crystal orientation; Kossel; lattice spacing determination; microdiffraction; scanning electron microscopy; strain analysis; x ray.

The Kossel method is a divergent beam x-ray diffraction technique which requires a point source of x rays for optimum application. The scanning electron microscope provides the investigator with an almost ideal point source of x rays as well as a means for viewing the actual region irradiated.

Using Kossel patterns, one can study regions about 15 μm in size or larger. In particular, precise lattice spacing data from small crystal regions can be obtained. Furthermore, orientation information of microcrystals or crystal-line inclusions can be obtained within 1/4 to 1/2° of arc. Complete elastic stress-strain analysis of crystals can also be carried out. The method can also be combined with x-ray topographic methods to provide basic perfection data.

Methods for determining lattice spacings are critically compared. The most satisfactory general method—the regressive analysis of the conic equation (RACE) method is fully discussed. Information obtainable from the stress-strain analysis will be outlined, and the reliability limits of the computed strains is discussed using Fe-3 1/4 PCT.Si as an example. Instrumental requirements indicated by the results of the reliability analysis are described. Finally, some of the newer possibilities such as comparison with channelling pattern results are taken up.

14914. Wu, Y. C., **Thermodynamics of mixtures of aqueous electrolyte solutions—a viewpoint on the structure of electrolyte solutions,** (Proc. Int. Symp. on Structure of Water and Aqueous Solutions, Marburg, West Germany, July 1973), Chapter II, Section 6, in *Structure of Water and Aqueous Solutions,* W. A. P. Luck, Ed., pp. 189-206 (Verlag Chemie and Physik Verlag, Weinheim/Bergstr., Germany, 1974).

Key words: electrolyte solutions; ionic cosphere; structure of solutions; thermodynamics of mixture.

The structural effect of water on aqueous ionic solutions is best interpreted by the concept of ion-solvent cosphere overlapping, developed by Gurney and Frank. Friedman has advanced a theory which includes the overlapping effect. The success of the theory to fit experimental data for several 1-1 electrolytes up to 1 molal concentration has proven the existence of the overlapping effect.

Experimentally, one of the best methods of differentiating the ionic cosphere overlapping effect seems to be the study of mixed electrolyte solutions. The excess function of mixing, $\Delta_m Q^E$, is a measure of the difference of the excess function of the mixture from those of the pure binary electrolyte solutions. In the common ion mixture, this difference has been shown from the same charge ion interactions. Recently, Robinson, Wood, and Reilly have derived theoretically that the same effects are specific. The specificity of the same charge ion interactions appears to rise from the cosphere overlapping effect. Gurney postulated a rule that the mean activity coefficients, based on the order-disorder character of each ionic cosphere, go "from dissimilar character downward to similar character." The ionic cosphere overlapping effects on the thermodynamics of mixtures to parallel the same rule.

14915. Huang, J. S., Goldburg, W. I., Moldover, M. R., **Observation of anomalously large supercooling in carbon dioxide,** *Phys. Rev. Lett.* **34,** No. 11, 639-642 (Mar. 17, 1975).

Key words: carbon dioxide; CO_2; critical point; nucleation; supercooling.

We have observed supercooling in liquid CO_2 near the critical temperature greatly exceeding that allowed by existing theories of homogeneous nucleation.

14916. Stewart, S. L., **STAPLE, an experimental structured programming language,** *Comput. Languages* **1,** No. 1, 61-71 (Jan. 1975).

Key words: block structure; control flow; GOTO-less programming; language design; precompiler; quality software; structural programming.

STAPLE is a structured programming language with nested block structure in the source language to indicate flow of control. The semantics of the non-control structures are essentially the same as FORTRAN. The design goals were an easily implemented, easily modified tool for experiments and demonstrations of structured versus unstructured programming techniques.

14917. Bussey, H. E., Morris, D., Zal'tsman, E. B., **International comparison of complex permittivity measurement at 9 GHz,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 3, 235-239 (Sept. 1974).

Key words: cavity resonators; dielectric constant; loss measurements.

Dielectric constant and loss measurements made by three government laboratories (of the USSR, Canada, and the U.S.A.) are compared. The two materials measured were glasses. The measurements utilized cavity resonators in the H_{01n} mode. The errors in dielectric constant reported by the laboratories were usually ± 0.3 percent; actual differences between laboratories of the average corrected results were only ± 0.05 percent. The loss tangent results disagreed when multimoding occurred; however, the errors may be as low as ± 0.00002 or ± 3 percent, whichever is the larger, if multimoding is avoided.

14918. Barnes, I. L., Shields, W. R., Murphy, T. J., Brill, R. H., **Isotopic analysis of Laurion lead ores,** Chapter 1 in *Archaeological Chemistry, Advances in Chemistry Series,* No. 138, 1-10 (1975).

Key words: archaeology; isotopic ratios; Laurion; lead; mass spectrometry; ores.

The lead isotopic ratios of a carefully selected suite of ore samples from the Laurion region have been determined by a precise mass spectrometric procedure. The ores were taken from various levels in mines, some known to have been worked in ancient times. All are nearly indistinguishable isotopically within the precision of the method ($\pm 0.05\%$), and they closely match leads from archaeological objects found in Greece. A comparison with isotopic data for ores from other mining regions in the ancient world has been made. The uniformity of the Laurion ores facilitates the interpretation of lead isotope data for archaeological objects from Greece.

14919. Finnegan, T. F., Wilson, J., Toots, J., **Interactions in small systems of coupled Josephson junctions on microwave frequencies,** *Rev. Phys. Appl.* **9,** No. 1, 199-205 (Jan. 1974).

Key words: coherent radiation; Josephson junction; microstrip; quality factor; transmission coefficient.

A major factor in the practical utilization of any Josephson device for microwave and higher frequency applications (such as the generation and detection of electromagnetic radiation) is the success with which the junction device can be coupled to an external transmission line. As part of an experimental investigation of the electrodynamics of small arrays of Josephson tunnel junctions, the properties of the coherent radiation emitted both by individual junctions and by coupled junction systems have been studied at frequencies between 2 and 12 GHz. Near 9 GHz, more than 10^{-9} W of coherent radiation has been detected from a single Pb-Pb oxide-Pb junction coupled via waveguide. The development of thin film devices in which the tunnel junctions form part of a microstrip line have made it feasible to observe directly (in a single device) the radiation emitted both at the fundamental geometrical frequency and at the low order harmonics. The observed temperature dependence of the junction cavity Q indicate the low temperature losses are primarily due to cavity loading of the external transmission line.

14920. Griffin, R. J., Jr., **The thermesthesiometer—an innovation in heat measurement,** *Lab. Data Winter,* pp. 13-14 (1975).

Key words: computer science; laboratory accreditation; measurement; national measurement system; technology transfer; voluntary standards.

As technology becomes more complex, and as world trade increases, there is a growing need for measurement capabilities and consensus standards. In this interview the Director of the National Bureau of Standards discusses the role of NBS in these vital areas.

14921. Guildner, L. A., Terrien, J., **Mercury absolute manometers,** Chapter 4 in *Experimental Thermodynamics, Vol. II, Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 1, pp. 115-131 (Butterworth and Co., London, England, 1975).

Key words: pressure; manometry; mercury manometer.

The most accurate pressure measurements attainable in the range of 5×10^2 Pa to 1.3×10^5 Pa can be made by using mercury manometers. In the design of a mercury manometer the principal concerns are those of locating the crown of the meniscus, and of determining the height of the mercury column. Different techniques are cited by describing some accurate instruments in use at BIPM, NRLM, NBS and VNIIM.

14922. Taggart, H. E., Nelson, R. E., Scott, W. W., Shafer, J. F., Tary, J. J., Workman, J. L., Treado, M. J., **Mobile FM transmitters,** *NILECJ-STD-0202.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: communications; law enforcement; mobile transceiver; performance standard; transceiver; transmitter.

This standard for law enforcement communications transmitters specifies minimum performance requirements for mobile transmitters. Frequency ranges over which the standard applies are 25-50 MHz, 150-174 MHz, and 400-512 MHz.

14923. Eliason, L. K., Hamlin, G. L., Grover, C. G., **Selection and application guide to fixed surveillance cameras,** *NILECJ-GUIDE-0301.00,* 24 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Dec. 1974).

Key words: cameras; demand cameras; employee theft; fixed surveillance; motion picture surveillance; robbery; sequence cameras; shoplifting; surveillance; surveillance cameras.

The guide discusses the methods and types of fixed surveillance photography and their application in combating criminals. Its purpose is to provide the potential user with the necessary general background information to analyze his security needs, decide if photographic surveillance seems to answer those needs, plan generally what type of system best fits his requirements, and discuss his needs intelligently with the manufacturers and installers of the equipment. Fixed surveillance photography involves the use of permanently installed cameras and equipment to monitor areas where criminal activity is likely. The three types of equipment addressed are still cameras, motion-picture cameras, and television systems.

14924. Shields, J. Q., **Measurement of four-pair admittances with two-pair bridges,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 345-352 (Dec. 1974).

Key words: Ac DRRS; coaxial cable effects; coaxial star connectors; extrapolation techniques; four-pair admittances; permutation techniques; precision admittance standards; precision capacitance measurements; transformer bridges; transformer ratio measurements; two-pair admittances.

The purpose of this paper is twofold: 1) to show how extrapolation techniques can be used to obtain well-defined and versatile measuring systems; and 2) to apply such techniques to the measurement of four-pair admittances with two-pair bridges. When four-pair admittances are large, measurements with two-pair bridges have limited precision, but with reasonably small admittances, measurement precision is essentially equal to that attained with four-pair bridges.

14925. Cutkosky, R. D., Field, B. F., **Standard cell enclosure with 20-μK stability,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 295-298 (Dec. 1974).

Key words: Ac transformer-ratio bridge; platinum resistance thermometer; standard cell enclosure; standard cells.

Groups of standard cells are needed to maintain the National Bureau of Standards (NBS) volt between periodic reassignments via $2e/h$. An enclosure to hold six standard cells has been designed and three enclosures have been assembled. The enclosures consist of four concentric aluminum cylinders separated by foamed polystyrene insulation. Two of the four cylinders are controlled, an outer one by a platinum resistance thermometer and dc amplifier and the inner one at 30 °C by a second platinum resistance thermometer and an ac transfomer-ratio bridge followed by a phase-sensitive detector, a dc amplifier, and a heater. The innermost of the four cylinders is a thermally lagged cell compartment. The temperature excursions over periods of at least several days were found to be less than 20 μK, thus having a negligible effect on the standard cell EMF's.

14926. McNesby, J. R., Hughes, E. E., **Calibration gas standards,** *Proc. Int. Instrumentation-Automation Conf. and Exhibit, New York, N.Y., Oct. 28-31, 1974,* Paper 74-633, 1-5 (Instrument Society of America, Pittsburgh, Pa., 1974).

Key words: aircraft; air pollution; automobile; standard reference materials.

Accurate measurement of emissions is best accomplished by means of specific measurement methods using instruments which are calibrated by reference to Standard Reference Materials. The National Bureau of Standards has developed a number of gas Standard Reference Materials during the past two years for the measurement of pollutant gases in automobile exhaust emissions. These Standard Reference Materials include carbon monoxide in nitrogen, propane in air, carbon dioxide in nitrogen and nitric oxide in nitrogen at concentrations relevant not only to auto exhaust emissions but also to aircraft exhaust emissions. The technical problems associated with the development of those Standard Reference Materials are discussed and a description of the ranges of concentrations available is outlined.

14927. Cutkosky, R. D., **New NBS measurements of the absolute farad and ohm,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 305-309 (Dec. 1974).

Key words: absolute farad; absolute ohm; calculable capacitor; cross capacitor; electrical units; farad; ohm; units.

A recently completed calculable cross capacitor in conjunction with a previously described collection of ac and dc bridges has made possible a highly accurate measurement of the farad and the ohm. The cross capacitor and its auxiliary equipment, as well as those components of the measurement system which have not been covered in prior publications, are described in detail. The measurements indicate that the National Bureau of Standards (NBS) unit of capacitance is given by $F_{NBS} = 1\ F + 1.787\ \mu F$, and that the NBS unit of resistance is given by $\Omega_{NBS} = 1\ \Omega - 0.819\ \mu\Omega$.

14928. Williams, E R., Olsen, P. T., Field, B. F., **Standard cell calibration via current transfer,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 299-302 (Dec. 1974).

Key words: gyromagnetic ratio of the proton; fine structure constant; volt transfer.

The EMF's of standard cells are now being transferred between laboratories over a 1 1/2-km cable with a precision of 4 parts in 10^8 to provide an instantaneous comparison of the $2e/h$ and γ_p' experiments being carried out at the two facilities. This is accomplished by transferring a constant current that produces a 1-V drop across standard resistors located at both ends of the cable.

14929. Olsen, P. T., Williams, E. R., **A more accurate determination of γ_p' through improved dimensional measurement techniques,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 302-305 (Dec. 1974).

Key words: automated measurement systems; gyromagnetic ratio; magnetic field; protons; solenoid.

An increase in the accuracy of the gyromagnetic ratio of the proton can be achieved by determining the magnitude of a calculable magnetic field to higher accuracy. Such an increase requires dimensional measurements of a physical object to an absolute accuracy of a few parts in ten million. A unique computer-controlled automated measurement system for carrying out such measurements has been developed at the U.S. National Bureau of Standards and is currently in operation at its nonmagnetic facility. This measurement system provides an order of magnitude improvement over all previous measurements.

14930. Giarratano, P. J., Hess, R. C., Jones, M. C., **Forced convection heat transfer to subcritical helium I,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper K-1 in *Advances in Cryogenic Engineering* **19**, 404-416 (Plenum Press, New York, N.Y., 1974).

Key words: critical heat flux; film boiling; forced convection; heat transfer; helium; nucleate boiling; subcritical; supercritical.

Results of an experimental investigation of heat transfer to liquid helium under forced downward flow conditions are reported for a 0.213 cm i.d. × 10 cm long vertical test section subject to the following range of operating conditions: System pressures – 1-2 atm (0.1-0.2 MN/m²); Mass velocities – 4-65 g/s-cm²; Heat fluxes – 0.01-1 W/cm²; Inlet subcooling – 0-0.3 K.

Data are presented for the nucleate and film boiling regions and a correlation has been developed for predicting the critical heat flux (transition from nucleate to film boiling). A comparison of forced convection boiling of helium with other modes of helium heat transfer (pool boiling and supercritical) is also included.

14931. Heydemann, P. L. M., Welch, B. E., **Piston gages,** Chapter 4 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 3, pp. 147-202 (Butterworth and Co., London, England, 1975).

Key words: calibration; piston gages; pressure measurement.

Piston gages are instruments which measure pressure as force per unit area. There are a number of sources of error among which elastic distortion is the largest. Several types of piston gages have been developed to reduce the elastic distortion errors and to allow operation at a variety of pressures. A minimum of elastic distortion error is found with the controlled clearance piston gage. Other sources of error include temperature effects, air buoyancy, and head corrections. To reach the highest precision operating procedures must be followed which insure adequate control of all important parameters.

14932. Sengers, J. M. H. L., **Thermodynamic properties near the critical state,** Chapter 14 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 657-724 (Butterworth and Co., London, England, 1975).

Key words: critical region; dielectric constant; equation of state; homogeneity; light scattering; power laws; refractive index; scaling; Schlieren method; specific heat; speed of sound; x-ray scattering.

A review is given of experimental methods for the determination of thermodynamic properties in the critical region of gases. The typical experimental difficulties: near-instability of the system, long equilibrium times and gravity effects, are discussed. Optical and dielectric measurements for the determination of density and of density gradients, are emphasized. A survey of the potential of light and x-ray scattering experiments is given. Other topics covered are constant-volume specific heat, conventional P-V-T, coexistence curve and speed of sound determinations. The discussion of experimental methods is preceded with a summary of the present state of critical region thermodynamics; power laws, gas-liquid symmetry, homogeneity, scaling and extended scaling are discussed.

14933. Ruthberg, S., **Pressure measurements for the range 1 kPa to 100 μPa,** Chapter 4 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 6, pp. 229-271 (Butterworth and Co., London, England, 1975).

Key words: capacitance-diaphragm gauge; Knudsen radiometer; McLeod gauge; micromanometry; quartz Bourdon gauge; static expansion; thermal transpiration; vapor-stream pumping; viscosity gauge.

Methods of measurement and calibration are analyzed for the range 1 kPa to 100 μPa (nominally 10 torr to 10^{-6} torr). Those procedures are considered for which measurements data, uncertainty analyses, and history exist in sufficient amount to allow for a reasonable confidence in their use. Precision liquid column micromanometers of the point contact and interferometric principles are assessed. Capillarity, density, leveling, sorption and leakage, and length measurement uncertainties are derived. McLeod gauge operation and uncertainties are derived including thermal transpiration and vapor-stream pumping effects at the cold trap. Viscosity manometers of the oscillating vane and spinning disc are described. The Knudsen radiometer manometer is considered. Uncertainties are detailed for the volumetric pressure divider-static expansion calibration procedure. The precision of transfer gauges is included.

14934. Cezairliyan, A., Beckett, C. W., **Electrical discharge techniques for measurements of thermodynamic properties of fluids at high temperatures,** Chapter 24 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 1161-1192 (Butterworth and Co., London, England, 1975).

Key words: capacitor discharges; high-speed measurements; high temperatures; thermodynamics; thermophysics.

Electrical discharge techniques (millisecond and submillisecond resolution) which may be used for the measurement of thermodynamic properties of electrically conducting fluids (liquids and gases) at high temperatures (above 2000 K) are described. Design considerations, including electrical circuit characteristics and discussion of various phenomena, are presented. Measurement of experimental quantities, such as current, voltage, temperature, are discussed and various other high-speed techniques, such as high-speed photography, high-speed recording, are reviewed. Pertinent examples of utilization of discharge techniques for the measurement of thermodynamic properties are given.

14935. Eicke, W. G., Jr., Auxier, L. M., **Regional maintenance of the volt using NBS volt transfer techniques,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 290-294 (Dec. 1974).

Key words: regional maintenance of the volt; standard cells; surveillance of local units of voltage; voltage standards; voltage transport standards; unit of voltage.

In cooperation with five industrial standards laboratories, the National Bureau of Standards (NBS) studied the feasibility of establishing a regional volt maintenance and surveillance program in the greater Los Angeles, Calif., area. The objectives were to improve surveillance, to reduce dependence on NBS, and to have each laboratory maintain its unit of voltage to within 1 ppm of the U.S. legal volt. A two-phase program was established, the first to characterize the five laboratories and the second to carry out the surveillance. After 3 years all laboratories were found to be maintaining their unit to within better than 1 ppm of the U.S. legal volt.

14936. Hord, J., **Research opportunities in cryogenic hydrogen-energy systems,** (Proc. Symp. on Hydrogen Energy Fundamentals, Miami Beach, Fla., March 3-5, 1975), Paper in *Hydrogen Energy Fundamentals,* T. N. Viziroglu, Ed., pp. S3-11 – S3-24 (University of Miami, Coral Gables, Fla., 1975).

Key words: cryogenic; energy; hydrogen; research and development.

As liquid hydrogen pervades the commercial fuel market, new and improved products and technologies will be needed. To meet these demands appropriate research and development (R&D) must be performed on hydrogen fuel systems. Candidate markets for cryogenic hydrogen-energy systems are reviewed and discussed, and associated R&D needs are outlined herein. A wide variety of cryogenic R&D opportunities exist.

14937. Sullivan, D. B., Dziuba, R. F., **A low-temperature direct-current comparator bridge,** *IEEE Trans. Instrum Meas.* **IM-23,** No. 4, 256-260 (Dec. 1974).

Key words: current comparator; low temperature electrical measurement; quantum interference device; ratio transformer; resistive divider; superconductivity.

The application of superconducting direct-current comparators to the measurement of resistance ratios is described. One comparator consists of a binary set of ratios between 1:1 and 160:1 providing for self-calibration by a buildup procedure. A second comparator exhibiting discrete ratios of 1:1, 10:1, and 100:1 is also described. Ratio uncertainty of less than 1 part in 10^9 is achieved by enclosing the ratio windings in overlapping toroidal superconducting shields. Superconducting quantum interference devices (SQUID's) serve as flux sensors for the comparators. One of these current comparators is used to calibrate a 100-Ω:1-Ω resistive divider, which at a current of 10 mA exhibits a self-heating error of 0.0023 ppm.

14938. Saxena, A. N., Weisberg, L. R., Mann, W. B., Schima, F. J., **Implantation of $^{14}N^+$ into monocrystalline GaN films,** *Int. J. Appl. Radiat. Isotop. Tech. Note* **26,** 33-34 (Jan. 1975).

Key words: *p*-type GaN; Schottky barrier diode; single crystal GaN; $14N^+$ implantation.

A rectifying Schottky barrier diode has been prepared in a thin film single crystal of GaN. Surface N-vacancy concentration was reduced by means of $^{14}N^+$ implantation.

14939. Byerly, R., **New developments in the measurement of gaseous pollutants in air,** *IEEE Trans. Nucl. Sci.* **NS-22,** No. 2, 856-869 (Apr. 1975).

Key words: air pollution; instrument; measurement; oxides of nitrogen; sulfur dioxide.

The pollution measurement needs driving the development of new techniques are reviewed as an introduction. These include needs for more sensitivity and more simplicity in actual use. Selected examples are described as illustrations: The phenomenon of chemiluminescence is used to measure ozone, sulfur, and oxides of nitrogen. Chemiluminescence refers to the emission of light from excited product molecules formed when the substance to be measured undergoes a chemical reaction. Fluorescence is used to measure SO_2 and NO. The molecule of interest is radiated with one wavelength light and emits (fluoresces) another wavelength which is detected. Absorption of infrared radiation by a pollutant molecule can be used to measure low concentrations. The use of tuneable diode lasers to measure sulfur dioxide and ethylene is described. Also described is the technique of tuning the pollutant absorption into coincidence with a fixed laser line by application of magnetic or electric fields. This technique, perturbation spectroscopy, has been used for vinyl chloride and nitric oxide measurement. Finally, a brief mention is made of the importance of long path techniques and possible approaches.

14940. Eisenhauer, C. M., Simmons, G. L., **Point isotropic gamma-ray buildup factors in concrete,** *Nucl. Sci. Eng.* **56,** 263-270 (1975).

Key words: adjoint; annihilation; buildup factor; concrete; gamma radiation; moments.

Gamma-ray buildup factors in ordinary concrete have been calculated by the moments method. Results for concrete kerma and air kerma are tabulated for source energies from 15 MeV to 15 keV. Parameters are given that allow calculation of the buildup factor by means of a simple analytic expression. Comparisons are made with earlier calculations, and the effects of annihilation radiation are discussed.

14941. Finnegan, T. F., Wilson, J., Toots, J., **Coupling between Josephson junctions and microstriplines,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 821-824 (Mar. 1975).

Key words: arrays; Josephson junctions; microstriplines; microwave filters; voltage standard.

A promising method for microwave coupling to thin-film Josephson devices via microstripline techniques has been developed which has significant advantages over more traditional waveguide techniques. In particular, direct determination of intrinsic junction cavity parameters such as the geometrical resonance frequencies and Q values are made practical and compact cryogenic multi-octave microwave holders readily realized. The results of coupling experiments with Pb-Pb oxide-Pb and Nb-Nb oxide-Pb tunnel junctions are discussed and applications of these results to the design and construction of shielded single junction 2e/h devices and small multi-junction arrays are described.

14942. Meshkov, S., Rosen, S. P., **Gauge theories and *M*-spin conservation,** *Phys. Rev. D, Comments and Addenda* **10,** No. 10, 3520-3521 (Nov. 15, 1974).

Key words: gauge theories; lepton; muon; *M*-spin; scattering amplitudes; Weinberg.

M-spin conservation is shown to be a property of Salam-Weinberg gauge theories. Amplitude relations such as $A(\nu_e e^- \rightarrow \nu_e e^-) - A(\nu_\mu e^- \rightarrow \nu_\mu e^-) = A(\nu_\mu e^- \rightarrow \nu_e \mu^-)$ derived from *M*-spin invariance alone also hold for the gauge theories up to the breaking due to Higgs scalars.

14943. Brauer, G. M., **Adhesion and adhesives,** Chapter 2 in *Scientific Aspects of Dental Materials,* J. A. von Fraunhofer, Ed., pp. 49-96 (Butterworths, London, England, 1975).

Key words: adhesion; adhesive restoratives; bonding to teeth; dental cements; dental sealants; reactivity of tooth surfaces.

The development of a truly adhesive restorative material is a primary goal of researchers in the field of dental materials. This review discusses the many fundamental investigations dealing with the reactivity of the tooth-adherent surface, followed by discussions of methods to modify hard tissue surfaces with the aim of enhancing adhesion. Potential adhesive systems are described that exhibit clinically significant adhesion to the hard tissues, especially enamel, in an environment approximating that encountered in the oral cavity. Evaluation of future adhesives will necessitate the development of well-designed standardized in vitro testing procedures that correlate with clinical experience. About 190 references are included in this extensive survey of studies conducted both at the National Bureau of Standards and by many other investigators.

14944. Greer, S. C., Block, T. E., Knobler, C. M., **Concentration gradients in nitroethane + 3-methylpentane near the liquid-liquid critical solution point,** *Phys. Rev. Lett.* **34,** No. 5, 250-253 (Feb. 3, 1975).

Key words: critical point; critical solution point; densimeter, magnetic; diffusion, pressure; gradient, concentration; gradient, density; gravity, effects of; 3-methylpentane; mixture; liquid; nitroethane; sedimentation.

Precise measurements of density profiles in the system nitroethane+3-methylpentane near the critical solution point demonstrate that concentration gradients form rapidly, but true equilibrium is not achieved even after long times. The data are in qualitative agreement with computer calculations of the behavior of a critical mixture in gravitational field which show that the initial gradients form by sedimentation. Thus, effects due to gravity may affect careful experiments in critical mixtures.

14945. Madey, T. E., Menzel, D., **Adsorption of CO on (001) ruthenium at temperatures ≥ 300 K,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2**, Part 2, 229-235 (1974).

Key words: carbon monoxide; chemisorption; defraction low energy electron; ruthenium; work function Auger spectroscopy.

The adsorption of CO on Ru(001) has been studied using a combination of techniques: LEED/Auger, Kelvin probe contact potential changes, and flash desorption mass spectrometry. Adsorption of CO is reversible at temperatures and pressures as high as 700 K and 10^{-4} torr, respectively. Two binding states of CO are identified, and isosteric heats determined both from work function changes and from LEED intensity measurements agree well with flash desorption energies. A disordering of the CO layer due to repulsive interactions between neighbors at high coverages is postulated. Electron beam-induced LEED pattern changes are characterized and found to have a high cross section ($\sim 7 \times 10^{-17}$ cm^2) at ~ 110 eV.

14946. Olver, F. W. J., **Second-order linear differential equations with two turning points,** *Phil. Trans. Roy. Soc. London* **278**, No. 1279, 137-174 (Mar. 20, 1975).

Key words: asymptotic approximations; connection formulas; error bounds; ordinary differential equations; parabolic cylinder functions; turning points; wave scattering; Weber functions.

Differential equations of the form

$$d^2w/dx^2 = \{u^2f(u,a,x) + g(u,a,x)\}w$$

are considered for large values of the real parameter u. Here x is a real variable ranging over an open, possibly infinite, interval (x_1, x_2), and a is a bounded real parameter. It is assumed that $f(u,a,x)$ and $g(u,a,x)$ are free from singularity within (x_1, x_2), and $f(u,a,x)$ has exactly two zeros, which depend continuously on a and coincide for a certain value of a. Except in the neighbourhoods of the zeros, $g(u,a,x)$ is small in absolute value compared with $u^2f(u,a,x)$.

By application of the Liouville transformation, the differential equation is converted into one of four standard forms, with continuous coefficients. Asymptotic approximations for the solutions are then constructed in terms of parabolic cylinder functions.

14947. Olver, F. W. J., **Legendre functions with both parameters large,** *Phil. Trans. Roy. Soc. London* **278,** No. 1279, 175-185 (Mar. 20, 1975).

Key words: asymptotic approximations; error bounds; Legendre functions; parabolic cylinder functions; turning points; Weber functions.

By application of the theory for second-order linear differential equations with two turning points developed in the preceding paper, some new asymptotic approximations are obtained for the associated Legendre functions when both the degree n and order m are large. The approximations are expressed in terms of parabolic cylinder functions, and are uniformly valid with respect to $x \epsilon (-1,1)$ and $m/(n+1/2) \epsilon [\delta, 1+\Delta]$, where δ and Δ are arbitrary fixed numbers such that $0 < \delta < 1$ and $\Delta > 0$. The values of m and $n+1/2$ are either both real, or both purely imaginary. In all cases explicit bounds are supplied for the error terms associated with the approximations.

14948. Gebbie, K. B., Steinitz, R., **A mechanism for the production of light and dark contrasts in radiatively controlled lines,** *Solar Phys.* **29,** No. 1, 3-15 (Mar. 1973).

Key words: contrasts in emergent intensity; radiatively controlled lines.

It is argued that visible contrasts can arise even in a line that is controlled wholly by an external radiation field. Lateral differences in the local shapes of the line absorption profile are shown to account for such contrasts. Two cases are treated explicitly: (a) a profile locally broadened by mass flow, and (b) a profile locally narrower due to the suppression of turbulent velocities, as might result from the presence of magnetic fields.

14949. Clough, R. B., **A new method for determination of proportional limit and machine stiffness,** *J. Test. Eval.* **3,** No. 2, 143-146 (Mar. 1975).

Key words: proportional limit; stiffness of testing machines.

A new method for determining the proportional limit of engineering materials, characterized by maximum stress rate, is presented. Simultaneous measurement of stress rate and strain rate also permits a new means of measuring machine stiffness which has certain advantages over present techniques.

14950. Isler, M., Grover, C., **Simplified procedures for evaluating the image quality of objective lenses for night vision devices,** *LESP-RPT-0304.00,* 16 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1974).

Key words: contrast curves; low contrast resolution; night vision; objective lenses; resolution test; variable contrast resolution.

This document provides two test methods for determining the comparative image quality of objective lenses intended for use on passive portable night vision devices. The two test methods are called the low contrast resolution test and the variable contrast resolution test. The criterion for lens evaluation in both tests is the limiting resolution of the image of a three bar test pattern, as a function of the contrast of the pattern.

14951. Bordé, C., Hall, J. L., **Ultrahigh resolution saturated absorption spectroscopy,** (Proc. Conf. on Laser Spectroscopy, Vail, Colo., June, 1973), Paper in *Laser Spectroscopy,* pp. 125-142 (Plenum Press, New York, N.Y., 1974).

Key words: laser spectroscopy; methane spectra; recoil; saturated absorption.

Conventional wisdom holds that natural lifetime sets the basic resolution limit in Saturated Absorption Spectroscopy. Since suitable molecular transitions are known which have lifetime-limited line Q above 10^{12}, it is interesting to try to achieve such resolution experimentally. By minimizing the usual broadening effects and by using large apertures (5 cm) to minimize the transit broadening, we have studied the hyperfine structure of a certain methane transition at 3.39 μm. Our highest resolution (2.4×10^{10}) leads to good evidence for recoil *splitting* (not *shift*) of the observed absorption line. Another factor of 2 resolution increase is expected from the new absorption cell (38 cm diam by 13 m length).

14952. Crawford, M. L., **Evaluation of reflectivity level of anechoic chambers using isotropic, 3-dimensional probing,** (Proc. 1974 Int. IEEE/AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper in *1974 International IEEE/AP-S Symposium Digest,* pp. 28-34 (IEEE Inc., New York, N.Y., June 1974).

Key words: anechoic chamber evaluation; omni-directional probe; reflectivity; three-dimensional scanning.

This paper describes an experimental technique for evaluating anechoic chamber reflectivity utilizing a new NBS isotropic probe mounted on a polyfoam track and support structure designed for probing the chamber's quiet zone in all three orthogonal planes. The probe is omni-directional within ± 1 dB and has sufficient sensitivity to permit evaluation of reflectivity levels as low as 59 dB. It can be used from 150 MHz to 10.0 GHz. Complete scattering information is obtained without applying a receiving antenna pattern correction with only 3 orthogonal scans per frequency required. The paper presents a brief treatment of the theory involved, a description of the system and measurement technique employed, and a discussion of typical measurement results.

14953. Olson, W. B., Maki, A. G., Sams, R. L., **Infrared measurements on arsine: ν_1 and ν_3 bands, perturbation-allowed transitions, equilibrium structure,** *J. Mol. Spectrosc.* **55,** Nos. 1-3, 252-270 (1975).

Key words: arsine; infrared high resolution; perturbation-allowed transitions; resonances; secular determinants; spectra; structure.

High resolution infrared measurements are reported on arsine (AsH_3) from 2260 to 1960 cm^{-1}. Numerous perturbation-allowed transitions have been found and are used to determine the C_0 rotational constant. Ten ground state rotational constants are determined including one that describes the splitting of the $k=3$ levels. A complete equilibrium structure is determined. A total of 26 upper state constants are determined by means of a computer program which simultaneously fits both ν_1 and ν_3 bands and includes many off-diagonal matrix elements. This analysis will fit transitions through $J=K=12$ to within experimental error, but it is concluded that to fit higher rotational transitions the perturbing effects of $2\nu_4$ must be taken into account explicitly.

14954. Engen, G. F., **An alternative calibration technique for automated network analyzers with application to adapter evaluation,** (Proc. 1974 IEEE S-MTT Int. Microwave Symp., Atlanta, Ga., June 12-14, 1974), Paper in *Microwave Symposium Digest,* pp. 261-262 (IEEE Inc., New York, N.Y., June 1974).

Key words: adapter; automation; calibration; microwave.

Although conceptually straightforward, the application of existing automated network analyzers to the problem of adapter evaluation is inhibited by the limited accuracy of the detection process, the requirement for several impedance standards at each frequency, and software problems. This paper describes a simple hardware modification, which for adapter evaluation yields an order of magnitude improvement in accuracy. An alternative calibration procedure is outlined which exploits this improved accuracy potential, and which requires only one impedance standard.

14955. Wasik, S. P., **Determination of hydrocarbons in sea water using an electrolytic stripping cell,** *J. Chromatogr. Sci.* **12,** 845-848 (Dec. 1974).

Key words: aromatic hydrocarbons; gas chromatography; hydrocarbon analysis; partition coefficient; sea water; stripping cell.

A stripping cell is described which can be used to analyze and to measure partition coefficients of hydrocarbons in sea water. Small hydrogen bubbles evolved electrolytically from a gold electrode are allowed to rise up a cylindrical cell containing a known amount of sea water. The dissolved hydrocarbons in the sea water are equilibrated with the hydrogen bubbles. The hydrocarbon concentration in the headspace is determined by gas chromatography. The partition coefficient and hydrocarbon concentration in the sea water are determined from the volume of sea water and the hydrocarbon concentration in the headspace after a given volume of hydrogen has bubbled through the cell.

14956. Herron, J. T., Huie, R. E., **Application of beam sampling mass spectrometry to the kinetics of ozone reactions,** *Int. J. Mass Spectrom. Ion Phys.* **16,** No. 1/2, 125-136 (1975).

Key words: kinetics; mass spectrometry; nitrogen dioxide; oelfin; ozone; rate constant.

A beam sampling mass spectrometer designed for the study of chemical reactions in the gas phase is described. It is a three stage, differentially pumped instrument using a molecular beam chopper and phase sensitive detection. The reactions of ozone with NO_2 and some olefins were studied using a temperature controlled stopped-flow reactor in conjunction with the beam sampling mass spectrometer.

14957. McLaughlin, W. L., Hjortenberg, P. E., Pedersen, W. B., **Low energy scanned electron-beam dose distributions in thin layers,** *Int. J. Appl. Radiat. Isotop.* **26,** No. 3, 95-106 (1975).

Key words: dose distributions; dosimetry; dye dosimeters; electron beams; radiation curing; radiation processing; radiochromic dyes; thin films.

Thin radiochromic dye film dosimeters, calibrated by means of calorimetry, make possible the determination of absorbed-dose distributions due to low-energy scanned electron beam penetrations in moderately thin coatings and laminar media. For electrons of a few hundred keV, calibrated dosimeters of about 30-60 μm thickness may be used in stacks or interleaved between layers of materials of interest and supply a sufficient number of experimental data points throughout the depth of penetration of electrons to provide a depth-dose curve. Depth doses may be resolved in various polymer layers on different backings (wood, aluminum, and iron) for scanned electron beams ($E_{max}=400$ keV) having a broad energy spectrum and diffuse incidence, such as those used in radiation curing of coatings, textiles, plastics, etc. Theoretical calculations of such distributions of energy depositions are relatively difficult to achieve.

14958. Jones, F. E., Quindry, T. L., Rinkinen, W. J., **Summary report on emergency vehicle sirens,** *LESP-RPT-0502.00,* 47 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Sept. 1974).

Key words: automobile; destructive interference; directivity; emergency vehicle; insertion loss; masking noise; siren; sound power level; sound pressure level.

A test program involving 23 test automobiles: four electronic sirens and nine electromechanical sirens has been completed. Measurements have been made of the directivity and sound power level-frequency spectra of the sirens, of the insertion loss (sound attenuation) of the automobiles, of the masking noise in the automobiles while being driven over a test route of our different segments, and of the phase cancellation due to reflection for an electronic siren. Measurements of directivity were made also for a pair of electronic siren speakers in three different arrangements.

14959. Westfall, M., Hurley, C. W., Eliason, L. K., **Metallic handcuffs,** *NILECJ-STD-0307.00,* 8 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: ace type pin tumbler lock; cheek plate tamper resistance; salt spray corrosion resistance; warded lock.

This standard establishes minimum performance requirements and test methods for metallic handcuffs intended to be used to restrict the physical movement of apprehended persons. Specific tests are described including visual inspection, dimensional measurements, test loading of handcuffs, test loading of locking mechanism, cheek plate tamper resistance, dust and salt spray corrosion resistance.

14960. Breckenridge, F. R., Tschiegg, C. E., Greenspan, M., **Acoustic emission: Some applications of Lamb's problem,** *J. Acoust. Soc. Amer.* **57,** No. 3, 626-631 (Mar. 1975).

Key words: acoustic emission; calibration of transducers; electrostatic transducers; Lamb's problem; seismic pulses; ultrasonic transducers.

A method for obtaining the signatures (waveforms) of certain acoustic-emission events has been developed. The waveform is that at the source, free of contamination by ringing of the specimen, apparatus, and transducer. The technique is based on the comparison of two signals at the transducer, one from the event in question and one from an artificial event of known waveform. The apparatus is also adapted to the calibration of transducers in a certain sense. The configurations of source (real or simulated acoustic-emission event) and receiving transducer correspond to those of some special cases of Lamb's problem. As a byproduct, the results may be of some interest to seismologists.

14961. Kapsch, R. J., **Life cycle costing techniques applicable to law enforcement facilities,** *LESP-RPT-0801.00,* 23 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: analysis; construction; cost; design; economics; flexibility; law enforcement facilities; performance; planning; present value analysis.

This report is concerned with the application of techniques from building economics to the problems involved in the planning, design and construction of law enforcement facilities. The formulas involved in the present value method of analysis are derived, and their use in analyzing the costs of alternative courses of action are explained and illustrated. Tabular equivalents of the formulas are given to facilitate the costing analysis.

14962. Giarratano, P. J., Jones, M. C., **Deterioration of heat transfer to supercritical helium at 2.5 atmospheres,** *Int. J. Heat Mass Transfer* **18,** No. 5-E, 649-653 (1975).

Key words: correlation; forced convection; heat transfer; helium; supercritical.

Heat transfer has been investigated for supercritical helium at 2.5 atm flowing inside a vertical tube with inlet bulk fluid temperatures less than the transposed critical temperature. Results indicate that for high heat flux conditions, the heat-transfer coefficient passes through a maximum and then deteriorates as the fluid temperature approaches the transposed critical temperature. This is contrary to the predictions of a correlation developed in an earlier study of supercritical helium heat transfer under low heat flux conditions, which only predicts enhancement in heat transfer as the transposed critical temperature is approached.

The experimental data are presented and conditions under which heat-transfer deterioration was observed are discussed. The probable limitations to the validity of the above mentioned heat-transfer coefficient correlation, developed for a different range of experimental data, are also discussed.

14963. Blackburn, D. L., Oettinger, F. F., **Transient thermal response measurements of power transistors,** *IEEE Trans. Ind. Electron. Control Instrum.* **IECI-22,** No. 2, 134-141 (May 1975).

Key words: computer simulation (transient thermal); current crowding (transistors); power transistors; thermal impedance measurements; thermal response measurements; transistors (thermal measurements).

Differences between the measured thermal impedance of power transistors when determined by the pulsed heating curve and cooling curve techniques are discussed. These differences are shown to result primarily because the power density distributions of these devices change as the devices heat; as a result of these changes the heating curve and the cooling curve are not conjugate. It is shown that the cooling curve technique, when the cooling curve is initiated from the most non-uniform steady-state thermal distribution, (maximum voltage, maximum power) will indicate a larger value for the thermal impedance than will the pulsed heating curve technique, even for pulses in excess of the dc power level. A one-dimensional model for power transistor cooling is described. The theoretical predictions of the model are shown to be in good agreement for practical applications with three-dimensional computer simulations and experimental results. Using this model, it is possible to estimate an average junction temperature and the area of power generation at steady-state. Both TO-66 and TO-3 encased devices of mesa and planar structures were included in this study.

14964. Kan, P. T., Peterson, G. A., Webb, D. V., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electroexcitation of ^{11}B,** *Phys. Rev. C* **11,** No. 2, 323-331 (Feb. 1975).

Key words: boron; electron scattering; giant resonance; longitudinal; reduced widths; transverse.

Electrons with incident energies between 52.3 and 90.0 MeV have been scattered from the nucleus of ^{11}B. Spectra of scattered electrons corresponding to excitation energies up to 32 MeV were observed at angles of 75° and 145°. Form factors of the states at 2.12, 4.44, 5.02, 8.57, and 8.93 MeV, and of the continuum region up to 30 MeV, have been separated into longitudinal and transverse components. The ^{11}B dipole giant resonance is smooth relative to those of ^{12}C and ^{13}C. A mixed $M1$-$E2$ transition was observed at 13.0 MeV and a broad transverse resonance, possibly magnetic, was seen at 15.5 MeV.

14965. Franzen, D. L., **Precision beam splitters for CO_2 lasers,** *Appl. Opt.* **14,** No. 3, 647-652 (Mar. 1975).

Key words: beam splitter; CO_2 laser; high power laser material.

Beam splitters for 10-μm lasers are discussed and then applied to the precision measurement of high average powers. In particular, beam splitter stability has been investigated in various materials over the 20 – 600-W power range with power densities up to 1 kW/cm^2. The absolute beam splitter ratios are given along with the achieved measurement precisions. The semiconductors investigated were GaAs, CdTe, and ZnSe in addition to one alkali-halide KCl. Standard deviations for the beam splitter ratios of 1 percent over the power range were typical. Absolute ratios agree with the predictions from Fresnel's equations to 1 percent or better. The best measurement was made on ZnSe when a standard deviation of 0.4 percent was obtained for the measurement of a ratio that agreed with a calculation from Fresnel's equations to better than 0.5 percent.

14966. Loebenstein, W. V., **The surface area of aggregates applied to dental materials,** *J. Biomed. Mater. Res.* 9, 35-53 (1975).

Key words: adsorption theory; aggregate, adsorption by; collagen; dental materials; dentin; enamel; surface area; teeth; water vapor adsorption.

There is a continuing need for the complete characterization of the physical and chemical properties of dental materials. Among these properties is surface area. The problem is further complicated by the fact that most dental materials are, themselves, mixtures of two or more identifiable components. If the vapor adsorptive properties of these components are different in the mixture from that which would be expected of them collectively, then interaction is present. Interaction must not be confused with the lack of additivity which results from the limitations of the BET theory applied to mixtures. Equations are derived herein to estimate the extent of this latter source of variability and to correct for it giving a "true" surface area for the aggregate. Conversely, the adsorptive properties of either component can be calculated from the properties of the mixture and the remaining component together with the percentage composition. An immediate application can be made in determining the water-vapor adsorptive properties of human dental collagen without necessitating its removal from dentin. Any attempt to extract it chemically may produce denaturation or chain rupture thus precluding the possibility of direct determination. In the case of nitrogen adsorption, however, interaction definitely is indicated.

14967. Ensslin, N., Bertozzi, W., Kowalski, S., Sargent, C. P., Turchinetz, W., Williamson, C. F., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electron scattering from excited states in ^{14}N and ^{9}Be,** *Phys. Rev. C* 9, No. 5, 1705-1717 (May 1974).

Key words: deduced wave functions; electron scattering; measured form factors; nuclear reactions; ^{14}N; $^{9}Be(e,e')$.

Electron scattering form factors have been measured for the first six excited states in ^{14}N and for the 2.429-MeV ($5/2^-$) level in ^{9}Be. The form factors for the lowest $T=1$ level in ^{14}N along with the previously measured ground-state magnetic moment are used to specify the $T=0$ and $T=1$ wave functions for the mass-14 system assuming two p-shell valence particles in an LS-coupling basis. The amplitudes of the various configurations so derived are generally in poor agreement with previous determinations, although the present wave functions yield values of the lifetime of the first $T=0$ state in ^{14}N and of the ^{14}N ground-state quadrupole moment that are in excellent agreement with previous measurements. The present data are not sufficiently precise to allow a direct separation of the $T=0$ and $T=1$ components for the first four negative-parity excited states. However, for two of these states which are excited primarily by $C1$ transitions, a comparison of the radiative strengths determined in this experiment with previous lifetime measurements sets a lower limit of 2 percent for the $T=1$ admixture.

14968. Fivozinsky, S. P., Penner, S., Lightbody, J. W., Jr., Blum, D., **Electron scattering from ^{88}Sr and ^{89}Y,** *Phys. Rev. C* 9, No. 4, 1533-1542 (Apr. 1974).

Key words: elastic and inelastic electron scattering; low lying levels; weak coupling; ^{88}Sr; ^{89}Y.

Inelastic scattering cross sections of low-lying levels and elastic scattering cross sections have been measured in ^{88}Sr and ^{89}Y using the National Bureau of Standards Linac and electron scattering facility. Incident-electron energies were varied between 45 and 121 MeV corresponding to a momentum transfer range of 0.4 to 1.0 fm^{-1}. Data were accumulated at two scattering angles, 110.5 and 128.2°. We present elastic scattering form factors and inelastic scattering form factors and $B(EL)\uparrow$'s for the 1.84- and 2.74-MeV states in ^{88}Sr, and the 1.51-, 1.74-, 2.21-, 2.52-, 2.86-, and 3.1-MeV states in ^{89}Y. A simple configuration mixing model based on the weak-coupling model has been applied to the octupole states in ^{89}Y. The measured elastic form factors for both nuclei have been fitted with a Fermi charge distribution.

14969. Kurylo, M. J., Braun, W., Xuan, C. N., Kaldor, A., **Infrared laser enhanced reactions: Temperature resolution of the chemical dynamics of the O_3+NO reaction system,** *J. Chem. Phys.* 62, No. 6, 2065-2071 (Mar. 15, 1975).

Key words: apparatus and methods; chemiluminescence; emission spectra; free radicals; kinetics of reactions; lasers, infrared; photochemistry.

The rate constant for the decay of vibrationally excited ozone, $O_3^\dagger$, in the $O_3^\dagger+NO$ reaction system has been measured from 153 to 373 K. Vibrationally excited O_3 was produced in the asymmetric stretch normal mode by absorption of square wave modulated emission from a CO_2 laser tuned to the $P(30)$ 9.6 μm transition. Under appropriate experimental conditions, a rapid $V\rightarrow V$ coupling process involving all three normal modes of O_3 is believed to set up a Boltzmann population distribution among them. Reaction or relaxation of O_3^+ out of this subset of normal modes is observed to proceed through a weighted average of rate constants. From the effects of temperature and buffer gas pressures an assessment can be made as to the predominant loss mechanism for the various modes. While there are three separate convolution schemes which appear to fit our data, we are persuaded to emphasize one whereby all three modes contribute via a reaction channel described by $k_D=(2.0\times10^{-11})\exp(-1525/T)$ cm^3 $molecule^{-1}\cdot sec^{-1}$ while ν_2 alone is active in a $V\rightarrow T$ relaxation process given by $k_A=(1.0\times10^{-13})\exp(-39.2/T)$ cm^3 $molecule^{-1}\cdot sec^{-1}$. A comparison of the Arrhenius parameters for the reaction channels of $O_3^\dagger$ with parameters for the corresponding processes involving thermal O_3 yields specific information about the effect of vibrational energy on the reaction dynamics.

14970. Kanda, M., **Accuracy considerations in the measurement of the power gain of a large microwave antenna,** (Proc. 1974 Int. IEEE/AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper in *1974 International IEEE/AP-S Symposium Digest,* 43-45 (IEEE Inc., New York, N.Y., June 1974).

Key words: calibration accuracy; effective area; effective radiated power; extrapolation method; gain comparison method; microwave antenna; power gain; satellite.

Accuracy considerations in the measurement of the power gain of a large microwave antenna are discussed. Using the gain comparison method with a standard antenna of approximately 40-dB gain, a large antenna with a power gain of approximately 60-dB can be calibrated to within an error of 0.17 dB (3σ).

14971. Kamper, R. A., **Review of superconducting electronics,** *IEEE Trans. Magn.* **MAG-11**, No. 2, 141-146 (Mar. 1975).

Key words: electronics; Josephson effect; precise measurements; superconductivity.

This review will sketch the present state of affairs in applications of Josephson junctions and SQUIDs to: magnetometry, DC and RF metrology, detection and amplification of electromagnetic signals, frequency metrology, noise thermometry and computers. It will also mention recent progress in super-stable oscillators using superconducting resonant circuits, pulse transmission lines, and thin-film devices to detect radiation or charged particles. Many of these topics are maturing nicely.

14972. Newman, M., **Congruence subgroups of the modular group,** *Math. Comput.* **29,** No. 129, 207-213 (Jan. 1975).

Key words: automorphs; elliptic classes; finite fields; genus; modular group; natural homomorphism; parabolic classes.

The congruence subgroups of the classical modular group which can be defined as the automorphs modulo q of some fixed matrix are studied, and their genera determined.

14973. Ekin, J. W., Deason, V. A., **Technique for preparing homogeneous bulk samples of concentrated alloys,** *Rev. Sci. Instrum. Notes* **46,** No. 3, 327-328 (Mar. 1975).

Key words: aluminum alloys; bulk alloy samples; casting; directional solidification; rapid quenching.

A technique has been developed for casting relatively large samples (~ 100 g) of concentrated alloys. It was used to prepare Al-Mg castings having Mg concentrations near the maximum limit of solid solubility. Concentration gradients and nonequilibrium eutectic solidification were minimized by the rapid cooling and directional solidification that are characteristic of the technique.

14974. DiChio, D., Natali, S. V., Kuyatt, C. E., **A new form for the third-order asymptotic aberration coefficients of electrostatic lenses; application to the two-tube electrostatic lens,** *Rev. Sci. Instrum.* **46,** No. 1, 71-76 (Jan. 1975).

Key words: aberration integrals; asymptotic aberration coefficients; electron optics; electrostatic lens; third-order aberration coefficients; two-tube lens.

The third-order asymptotic aberration coefficients of round electrostatic lenses are reformulated in terms of the coordinates formed by the projections of the asymptotic incident and final rays onto the reference plane of the lens. In this formulation, all aberration coefficients are finite for all lenses, in contrast to the formulation in terms of coordinates projected onto the focal planes of the lenses, where all of the coefficients become infinite in the limit of very weak lenses and for certain strong lenses. Equations for the six third-order aberration coefficients are derived in the form of integrals involving derivatives of the axial potential no higher than the second. Using these equations and previously calculated potentials and first-order trajectories, we have computed the six aberration coefficients for the accelerating and decelerating two-tube electrostatic lens for voltage ratios from 1.1 to 10 000. The results are believed accurate to better than 0.2 percent.

14975. Gadzuk, J. W., **Relaxation energies in chemisorption spectroscopy,** *J. Vac. Sci. Technol.* **12,** No. 1, 289-292 (Jan.-Feb. 1975).

Key words: chemisorption; image potential shifts; polarization energy shift; relaxation energies.

The upward shift in atomic energy levels (or decrease in electron binding energies) which occurs upon sorption of an atom on a metal surface due to polarization of the valence band electrons, is considered. The polarization shift or extra-atomic relaxation energy is treated within the framework established by Hedin, Johansson, and Lundqvist and the results are related to image potential shifts which have been previously discussed in chemisorption theories.

14976. Jordan, T. H., Dickens, B., Schroeder, L. W., Brown, W. E., **The crystal structure of $Ca(BF_4)_2$,** *Acta Crystallogr.* **B31,** Part 3, 669-672 (Mar. 1975).

Key words: calcium fluoroborate; calcium salts; crystal structure; single crystal; tetrahedral anion; x-ray diffraction.

$Ca(BF_4)_2$ crystallizes in the orthorhombic space group *Pbca* with $Z=8$. The unit-cell parameters are $a=9.2792$ (6), $b=8.9103$ (10) and $c=13.3719$ (10) Å. The structure was refined by full-matrix least-squares calculations to $R_w(F)=0.025$, $R=0.024$, using 2896 measurable x-ray data collected by a counter method and corrected for absorption. The refinement allowed for anisotropic thermal motion, isotropic secondary extinction and anomalous dispersion. The structure consists of columns of BF_4^- ions and columns of alternating Ca^{2+} and BF_4^- ions, all parallel to [010]. There are twice as many [Ca^{2+}, BF_4^-] columns as [BF_4^-, BF_4^-] columns. All columns are linked together through Ca...F bonds. The Ca^{2+} ion is coordinated by a square antiprism of fluorine atoms, each from a different BF_4^- ion. Each fluorine atom is bonded to one Ca^{2+} ion, and the four Ca^{2+} ions bonded to a BF_4^- ion are arranged approximately tetrahedrally about the BF_4^- ion. Although neither of the two crystallographically discrete BF_4^- ions occupies a site of special symmetry, each is essentially tetrahedral in configuration.

14977. Mabie, C. P., **Evaluation of the physical properties of crown dental porcelain and the effect of newly developed anti-balling additive,** *J. Biomed. Mater. Res.* **9,** 1-25 (1975).

Key words: additive; deformation; dental; porcelain; properties.

A colloidal silica-based substitute for the water added to dental porcelain has been developed which restricts rounding on firing and gives greater and indefinitely prolonged unfired biscuit strength. In conjunction with product evaluation, it has been found that both the modulus of rupture and the diametrical tensile strength of dental porcelains can be measured with a high degree of precision.

14978. Gadzuk, J. W., **Electron spectroscopy of chemisorbed atoms and surface molecules,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 851-858 (1974).

Key words: chemisorption; field emission; ion neutralization; photoemission; surface spectroscopy.

Chemical bonds formed between substrate and adsorbed atoms are characterized by new electronic energy levels which are derived from the atomic orbitals of each constituent. These energy levels are being observed experimentally through the techniques of field emission energy distributions, uv photoemission spectroscopy, and ion neutralization spectroscopy. These spectroscopies will be considered in the light of present day theoretical understanding of both the measurement and the chemisorption process.

14979. Clough, R. B., Simmons, J. A., **Thermodynamics of dislocation motion in multiaxial stress fields,** (Proc. from the John E. Dorn Symp., Cleveland, Ohio, Oct. 1972), Paper in *Rate Processes in Plastic Deformation of Materials,* J. C. M. Li and A. K. Mukherjee, Eds., pp. 266-283 (American Society for Metals, Metals Park, Ohio, 1975).

Key words: dislocation; multiaxial; plasticity; thermodynamics.

This paper presents a first-order consideration of dislocation motion through a multiaxial stress field. The concept of plastic power dissipation is developed as a measure of plastic flow due to multiaxial stresses. A result which emerges is the concept of the second-order activation volume tensor for plastic power dissipation. Usually, this is a deviatoric tensor with the same principal axes as the stress, which then only interacts with the deviatoric stress. Results are given for a biaxial yield surface calculated as a surface of constant plastic power dissipation. The yield surface varies from a Tresca to a von Mises shape, depending on the scalar activation volume, the uniaxial yield stress, and the temperature. Generally for low temperature conditions the yield surface resembles the Tresca yield surface, and its shape approaches the von Mises shape as a high temperature limit. The activation volume tensor is explicitly demonstrated for all materials in a state of uniaxial tension and for materials with a von Mises-like yield surface in any multiaxial stress state. Extension of this treatment to include the internal stress and prestrain and stress history effects on the yield surface is discussed.

14980. Heydemann, P., **Pulse shaper,** *Rev. Sci. Instrum. Notes* **46,** No. 3, 329-330 (Mar. 1975).

Key words: NMR; switching; ultrasonics.

The rounding of pulses is a convenient way to suppress transients when rf signals are switched with balanced mixers or semiconductor switches. The use of a serial-in, parallel-out shift register for shaping the leading and trailing edges of pulses is described. The original pulse is clocked through a shift register and the outputs of the register are weighted and added to form a new pulse. The maximum rise time is equal to the clock period times the bit-capacity of the register.

14981. Gadzuk, J. W., **Surface molecules and chemisorption, II. Photoemission angular distributions,** *Phys. Rev. B* **10,** No. 12, 5030-5044 (Dec. 15, 1974).

Key words: angular distributions; chemisorption; photoemission; photoionization; surfaces.

A theory of the angular distributions of electrons photoemitted from submonolayer films of chemisorbed atoms is presented. Chemisorption is treated within the surface-molecule limit of the Anderson model. It is shown that the key features which differentiate between solid-state photoemission and atomic photoionization are the localization of the hole left behind in the photoexcitation process and the preferential orientation of atomic or molecular orbitals (in photoemission from solids or chemisorbed atoms). The differential photoionization cross sections or angular distributions for spatially oriented atoms and surface molecules are obtained and contours of constant emission intensity, as projected on a flat fluorescent screen which is parallel to the surface, are presented. It is shown that the chemisorption bonding geometry can be ascertained from such measurements.

14982. Plummer, E. W., Waclawski, B. J., Vorburger, T., **Experimental observations of electronic energy levels at a solid-vacuum interface,** (Proc. Symp. on Electrocatalysis, San Francisco, Calif., May 13-15, 1974), Paper in *Electrocatalysis,* M. W. Breiter, Ed., pp. 43-57 (Electrochemical Society Inc., Princeton, N.J., 1974).

Key words: chemisorption; field emission; photoemission; single crystals; surface electron spectroscopy; surface state; tungsten.

A knowledge of the distribution of electrons both in energy and space at a surface is essential to the understanding of surface properties. Several techniques have been developed recently which have the potential capability of measuring the energy level spectrum of a surface. Two of these techniques, field emission and photoemission, will be discussed including a description of what can be measured, how it can be interpreted and the degree of consistency of the data. Experimental data will be presented to illustrate: (1) the surface density of states on clean single crystals and its relationship to bulk density of states; (2) the nature of the chemisorption bond and density dependent transitions; (3) dissociative or non-dissociative adsorption and (4) catalytic reactions involving adsorption of hydrocarbons.

14983. Zecca, A., Lazzizzera, I., Krauss, M., Kuyatt, C. E., **Electron scattering from NO and N_2O below 10 eV,** *J. Chem. Phys.* **61,** No. 11, 4560-4566 (Dec. 1, 1974).

Key words: electron impact; electron scattering resonances; exponential attenuation; low energy; negative ions; nitric oxide; nitrous oxide; total scattering cross section.

Total electron scattering cross sections for NO and N_2O in the energy range 0-10 eV were obtained from exponential attenuation in a straight-line collision chamber without a confining magnetic field. Good agreement is obtained with previous measurements where available. For NO, cross sections have been obtained for the first time for resonance structure in the energy range 0-2.5 eV. There appear to be small, sharp resonances between the large resonances. For both NO and N_2O the cross section is observed to increase rapidly at very low energies. Structure in the cross sections is interpreted in terms of electronic states of NO^- and N_2O^-.

14984. Šunjić, M., Šokčević, D., Gadzuk, J. W., **Determination of electron attenuation lengths in metals: Transmission through thin adsorbed films,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 753-756 (1974).

Key words: attenuation length; inelastic electron scattering; surface plasmons.

A quantitative theory of surface and bulk plasmon excitation in several electron spectroscopies (transmission, XPS, and Auger from thin film sandwiches) is presented. It is shown under what circumstances, the usual exponential attenuation law is valid.

14985. Brown, W. E., **Physicochemistry of apatite dissolution,** (Transactions of Colloquium on Physico-Chimie et Cristallographie des Apatites D'Intérêt Biologique, Paris, France, 1973), *Colloq. Int. Cent. Nat. Rech. Sci.,* No. 230, 355-368 (1975).

Key words: bone mineral; dental caries; electric currents; mechanism; solubility.

The dissolution of apatites, during formation of caries lesions in enamel or remodeling of bone, has two aspects, thermodynamic and kinetic, which are intimately related. One can approach a full understanding of these processes by taking into account how each aspect affects the other.

The rate of transport of calcium relative to that of phosphate ions is a dominant consideration. These rates are likely to be controlled to a considerable degree by the permselective properties of the plaque and the outer layer of enamel acting as a very complex and variable membrane. Alteration of the properties of this membrane, therefore, becomes a potentially valuable means for preventing caries.

The thermodynamic properties of the apatite enter into the caries dissolution process in another way: the subsurface nature of the typical incipient lesion very probably relates to the variable solubility of the apatite in enamel mineral. Solubility measurements with enamel show that much of it is more soluble than synthetic preparations of pure hydroxyapatite and that its solubility changes with its composition and location.

14986. Okabe, H., **Photodissociation of acetylene and**

bromoacetylene in the vacuum ultraviolet: Production of electronically excited C_2H and C_2, *J. Chem. Phys.* **62,** No. 7, 2782-2787 (Apr. 1, 1975).

Key words: acetylene; bond dissociation energy; bromoacetylene; C_2; C_2H; fluorescence; photodissociation; vacuum ultraviolet.

The photodissociation of C_2H_2 and BrC_2H in the vacuum ultraviolet produces nearly identical quasicontinuous emissions in the region 4000 to above 5500 Å. It is concluded that the continua are most likely associated with the electronically excited C_2H (C_2H^*) in both cases. Based on this conclusion the following spectroscopic and thermochemical data are derived from the thresholds of incident wavelength to produce the continua (1305 ±3 Å and 1540±3 Å, respectively, for C_2H_2 and BrC_2H): The electronic energy of C_2H, $E_0(C_2H) \leq 4.11 \pm 0.05$ eV, $D_0(Br-C_2H) = 91 \pm 1$ kcal mol^{-1} (381±4 kJ mol^{-1}), and $\Delta H_{f0}°(BrC_2H) = 64.2 \pm 1.5$ kcal mol^{-1} (269±6 kJ mol^{-1}). The photolysis of BrC_2H yields the C_2 Swan bands in addition to the C_2H^* by the spin forbidden process. The fluorescence yield has been measured as a function of incident wavelength for C_2H_2 and BrC_2H. The fluorescence yield curves follow the absorption spectra of C_2H_2 and BrC_2H, indicating that the C_2H^* is predissociated from the initially formed electronic states. The C_2H^* yield from C_2H_2 increases rapidly below the incident wavelength, 1200 Å. Bond dissociation energies and the heats of formation of haloacetylenes are estimated in comparison with the corresponding cyanogen halides. Primary photochemical processes in C_2H_2 are discussed.

14987. Saloman, E. B., Ederer, D. L., **Absolute radiometric calibration of detectors between 200-600 Å,** *Appl. Opt.* **14,** No. 4, 1029-1034 (Apr. 1975).

Key words: calibration of detectors; corrections for second order radiation; far ultraviolet; noble gas double ionization chamber; synchrotron radiation; transfer standard detectors.

Radiometric transfer standards consisting of windowless diodes with cathodes made of anodized aluminum oxide on aluminum are now available from the National Bureau of Standards with calibrations in the 200–600-Å wavelength range. This extends the previously existing range of calibration for these diodes (600–1200 Å). For wavelengths shorter than 600 Å, synchrotron radiation at NBS-SURF is used as the source of radiant energy. A noble gas double ionization chamber is used to calibrate a secondary standard diode that is then intercompared with the transfer standards. Monitors take into account variations in the intensity of synchrotron radiation and in beam position. Methods of accounting for the effects of second-order radiation in the incident flux and secondary ionization in the double ionization chamber are discussed. Calibration uncertainties are about 10 percent.

14988. Mills, R., Yee, K., **Hand-held metal detectors for use in weapons detection,** *NILECJ-STD-0602.00,* 13 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: metal detector; weapons detection.

Performance requirements and methods of test have been established for hand-held metal detectors used for determining the location of metal weapons carried on a person. Requirements are specified which indicate a detector's suitability for use in each of specified applications.

14989. Ederer, D. L., Lucatorto, T. B., Saloman, E. B., **Photoabsorption from the 4d and 5p shells of barium,** (Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974), Chapter 3.5 in *Proceedings of the IV International Conference on VUV Radiation Physics,* E. Koch, R. Haensel, and C. Kunz, Eds., pp. 245-246 (Friedr. Vieweg Sohn Verlagsgesellschaft, mbH, Braunschweig, West Germany, 1974).

Key words: absorption spectrum; barium; heat pipe; inner shell excitation; shape resonance; two-electron excitations.

A plastic windowed heat pipe was used in conjunction with the NBS-170 MeV synchrotron and a 3-m grazing incidence spectrograph to observe transition $4d^{10}5s^25p^66s^2 \rightarrow 4d^94s^25p^66s^2$ nf,np in the spectral region 110Å-150Å. By replacing the plastic windows with tin, excitations involving transitions $5p^66s^2 \rightarrow 5p^56s^2$ nd,ns were observed in the spectral region 520Å-650Å.

14990. Jickling, R. M., Shafer, J. F., **Repeaters for law enforcement communication systems,** *LESP-RPT-0206.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: duplexer; fm transceiver; land-mobile communications; law enforcement; repeater; vertical antenna.

This report is concerned with FM repeaters used in land mobile communications systems. Repeater systems are described with emphasis on appropriate antenna site selection, signal-rejection techniques, and specialized transmission-line components for the transmission and reception of signals. Repeaters using the vehicle transceiver are mentioned. Repeaters at microwave frequencies are described to the extent that their use for control and as audio links is pertinent. Measurement techniques that are unique to land-mobile repeaters are discussed.

14991. Schwarz, F. P., Okabe, H., **Fluorescence detection of nitric oxide in nitrogen,** *Anal. Chem.* **47,** No. 4, 703-707 (Apr. 1975).

Key words: air; automotive exhaust emission; detection; fluorescence; nitric oxide; nitrogen; quencher.

An accurate, rapid, and simple technique is described for the measurement of nitric oxide in standard reference mixtures of NO in N_2. The technique investigated is based on the measurement of the fluorescence intensity emitted by NO when it absorbs 213.8-nm radiation from a Zn discharge lamp (the $A^2\Sigma$ ($\nu=1$) $\leftarrow X^2\pi_{1/2}$ ($\nu=0$) transition). The fluorescence is in the 220- to 300-nm region and its intensity is proportional to the 213.8-nm light intensity and the NO concentration. The fluorescence intensity at a constant light intensity level increases linearly with NO concentration in the 0.015- to 7-ppm range to within 1 percent error. In the 7- to 932-ppm range, the intensity increases sublinearly with NO concentration because of efficient self-quenching of the fluorescence. The signal-to-noise ratio is 1.0 at 10 ppb for a 1-minute counting time. The quenching half pressures of NO, H_2O, CO,O_2, O_2, C_2H_4, C_3H_8, and H_2 are, respectively, 0.34±0.03, 0.65±0.06, 8.3±0.6, 0.65±0.05,05, 1.1±0.1, 5.6±0.4, 56±4, and 115±8 torr. The application of this method to detect NO and SO_2 in automotive exhaust is discussed.

14992. Miller, T. R., Weikel, M. K., **Blood donor eligibility, recruitment, and retention,** *Transfusion* **14,** No. 6, 616-622 (Nov.-Dec. 1974).

Key words: blood banking; donor attitudes; donor eligibility; donor participation rates; donor recruitment; donor retention; foreign donor programs; non-donor attitudes.

To study the motivation and actions of potential and active blood donors, a literature search, a limited survey, and associated analytic efforts were undertaken. It is estimated that 61 million of the 114 million age-eligible donors meet Red Cross criteria of health-eligibility. The 1971 donor participation rate, calculated as the percentage ratio of active donors to eligible donors, was estimated to be between 8 and 9 percent. Total collections appear to be increasing at a stable rate of 1 percent per year and 15 percent of each year's collections apparently come from first-time donors. Thus, 14 percent of those who donate blood in any given year must replace other donors who have stopped donating. Roughly 25 percent of those who are health-eligible to donate blood have done so in the last ten years. Literature and survey analyses indicate that donor reaction rates are considerably underestimated by most collectors. A limited survey showed that the main reason for nonparticipation is fear, while common reasons for discontinuing participation are adverse reaction and medical disqualification.

14993. LaVilla, R. E., **The sulfur $K\beta$ emission and K-absorption spectra from gaseous H_2S, III,** *J. Chem. Phys.* **62,** No. 6, 2209-2212 (Mar. 15, 1975).

Key words: H_2S; sulfur $K\beta$ emission and K-absorption spectra; sulfur K shell binding energy; x-ray spectra.

The sulfur $K\beta$ emission in fluorescence and K absorption from gaseous H_2S were measured on a double crystal spectrometer. The sulfur $K\beta$ spectrum consists of four peaks. The three strongest peaks are shown to be single vacancy transitions of electrons from the three outer MO's to fill the single K shell vacancy. The weak fourth peak on the high energy side of the three line structure is identified as a double vacancy transition. The sulfur K-absorption spectrum consists of three peaks of decreasing intensity with increasing photon energy. The unusual breadth (FWHM of 1.50 eV) and asymmetry on the high energy side of the first peak is ascribed to the Frank-Condon factors of the transitions to the unoccupied antibonding MO's $3b_2$ and $6a_1$. The other two peaks, which are narrow, are identified as transitions to Rydberg levels. In addition, the binding energy of the sulfur K shell electron was estimated to be 2478.3 eV. The sulfur $L_{2,3}$ absorption of H_2S is also discussed briefly.

14994. Newell, A. C., Crawford, M. L., **Planar near-field measurements on phased array antennas,** Abstract only, (Proc. Int. IEEE AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper 6-7 in *1974 International IEEE/AP-S Symposium Digest,* p. 423 (IEEE Inc., New York, N.Y., June 1974).

Key words: antennas; near-field measurements; phased arrays.

The results of applying the planar near-field measurement technique to two experimental phased array antennas are described. Fast and efficient tests are used to determine the required scan area and data point spacings. The use of these tests enable one to reduce the amount of data required for some antennas without seriously increasing the errors in computed far-field parameters.

Measurements were made at different distances from the antennas, with the probe transmitting and receiving, and for both sum and monopulse difference patterns of the test antenna. Comparisons between the far-field patterns computed from the near-field data and those measured on far-field ranges are presented.

14995. Komarek, E. L., **An application of the power equation concept and automation techniques to precision bolometer unit calibration,** (Proc. 1974 IEEE S-MTT Int. Microwave Symp., Atlanta, Ga., June 12-14, 1974), Paper in *Microwave Symposium Digest,* pp. 263-265 (IEEE Inc., New York, N.Y., June 1974).

Key words: automation techniques; bolometer units; calibration; power equation concept.

The power equation concept has been implemented into a multioctave precision bolometer unit calibration system employing automation techniques in conjunction with an automatic network analyzer system. The system was qualified as a calibration transfer system operating in the 2-12.4 GHz frequency range at 1 to 10 mW with a single measurement standard deviation of 0.2 percent to 1 percent from 2-10 GHz.

14996. Rebbert, R. E., Lias, S. G., Ausloos, P., **The photolysis of neopentane and isobutane with 7.6, 8.4, and 10.0 eV photons,** *J. Photochem.* **4,** 121-137 (1975).

Key words: free radical scavenging; hydrocarbons; isobutane; neopentane; primary photochemical processes; quantum yields; vacuum ultraviolet photolysis.

The photolysis of neopentane has been studied using photons of energies 7.6, 8.4, and 10.0 eV, at pressures in the range 1-760 torr and in the liquid phase. Quantum yields of all molecular and radical products smaller than C_5 have been determined in the gas phase experiments, and have been estimated in the liquid phase. In contrast to results obtained with other alkanes studied to date, hydrogen elimination is found to be an unimportant process in the photolysis of neopentane. The two predominant primary processes are elimination of methane (neo-$C_5H_{12} \rightarrow CH_4 +$ iso-C_4H_8) and direct C-C bond cleavage (neo-$C_5H_{12} \rightarrow CH_3 +$ t-C_4H_9). A fraction of the t-C_4H_9 radicals dissociate further unless collisionally stabilized, either by loss of a H atom or by loss of a methyl radical (presumably preceded by an initial rearrangement to the isobutyl structure). With an increase in photon energy, the importance of direct bond cleavage increases at the expense of the methane elimination process. In the liquid phase, secondary decomposition processes are quenched, and the estimated quantum yields of primary processes are similar, at all energies, to those found in the 7.6 eV gas phase photolysis at high pressures.

Quantum yields of molecular and radical products formed in the 7.6 and 8.4 eV photolysis of isobutane are also reported and are discussed briefly, with particular emphasis on the effect of energy on the mechanisms of the molecular elimination processes: (iso-$C_4H_{10} \rightarrow CH_4 + C_3H_6$) and (iso-$C_4H_{10} \rightarrow$ iso-$C_4H_8 + H_2$). For both of these primary processes, the lower energy pathway, in which the olefin is formed directly, predominates at 7.6 eV, but diminishes in importance relative to the higher energy channel (presumably involving carbene formation) when the photon energy is increased.

14997. Saloman, E. B., Ederer, D. L., Madden, R. P., **Radiometry in the EUV spectral region: Standard source and detectors,** (Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974), Chapter 10.12 in *Proceedings of the IV International Conference on VUV Radiation Physics,* E. Koch, R. Haensel, and C. Kunz, Eds., pp. 798-800 (Friedr. Vieweg Sohn Verlagsgesellschaft, mbH, Braunschweig, West Germany, 1974).

Key words: continuum radiation; diodes; irradiance standard; synchrotron radiation; transfer standard detectors; vacuum ultraviolet radiation standards.

Conceptually it is straight-forward to apply the calculable continuum distribution of synchrotron radiation to problems requiring a source of known irradiance. However, in practice many factors affect the accuracy of such a calibration. These factors will be discussed with reference to the NBS 170 MeV synchrotron. The calibration facility at NBS-SURF has been utilized in the 200Å-1200Å spectral range by Air Force Cambridge Research Laboratories and the Naval Research Laboratory to calibrate rocket monochromators. Transfer radiometric standards consisting of windowless diodes with cathodes made of anodized aluminum oxide on aluminum have been developed and calibrated for wavelengths between 200Å-600Å. Diodes have been calibrated with a double ionization chamber using synchrotron radiation from NBS-SURF as a source. Methods accounting for beam motion, second order radiation in the beam, as well as multiple ionization in the double ionization chamber will be discussed.

14998. Hughes, C. E., **The general decision problem for Markov algorithms with axiom,** *Notre Dame J. Formal Logic* **XVI,** No. 2, 208-216 (Apr. 1975).

Key words: combinatorial systems with axiom; degrees of unsolvability; general decision problems; Markov algorithms; many-one reducibility; recursive functions; r.e. many-one degrees; r.e. one-one degrees; semi-Thue systems; splinters.

A constructive proof is presented which shows the existence of a Markov algorithm with axiom whose decision problem is of any prescribed r.e. many-one degree of unsolvability. This result is then shown to be best possible in that it does not hold for r.e. one-one degrees. And, finally, a theorem concerning the degree representation of splinters of recursive functions is proven as a direct corollary to the forementioned results.

14999. Bussey, H. E., **Rapport sur la comparaison internationale des mesures de permittivité complexe á 9 GHz,** (Proc. Comité Consultatif, D'Electricité Comité International des Poids et Mesures, Sèvres, France, Oct. 12-13, 1972), Paper in *Comité International Des Poids et Mesures,* pp. 124-137 (Bureau International des Poids et Mesures, Sèvres, France, 1972).

Key words: cavity method for dielectrics; dielectric constant; dielectric loss; international comparison; laboratory intercomparison; permittivity; standard dielectric.

Dielectric constant and loss measurements made by three national laboratories (of the USSR, Canada, and USA) are compared. The two materials measured were glasses. The measurements utilized cavity resonators in the H_{01n} mode. The errors in dielectric constant reported by the laboratories were usually $\pm$ 0.3 percent; actual differences between laboratories of the average corrected results were only ± 0.05 percent. The loss tangent results disagreed when multimoding occurred; however, the errors may be as low as $\pm 0.000\,02$ or ± 3 percent, whichever is the larger, if multimoding is avoided.

15000. Sams, R. L., Maki, A. G., **High-resolution infrared measurements of ν_1 and force-field calculations for thioborine (HBS),** *J. Mol. Struct.* **26,** 107-115 (1975).

Key words: absorption spectra; force constants; HBS; infrared; molecular spectra; spectra; thioborine.

The gas-phase high-resolution spectrum is reported for ν_1 of the linear molecule thioborine (HBS) from 2775 cm^{-1} to 2720 cm^{-1}. Band centers and rotational constants are given for the 10^00-00^00 transitions of $H^{11}B^{32}S$, $H^{10}B^{32}S$, $H^{11}B^{34}S$ and $H^{10}B^{34}S$ and for the 11^10-01^10 transitions of $H^{11}B^{32}S$ and $H^{10}B^{32}S$. A valence force field is determined from measured values of ν_1, D_0 (the centrifugal distortion) and q (the l-doubling constant). The remaining unobserved vibrational fundamentals are calculated from the force constants.

15001. Zuckerman, B., Turner, B. E., Johnson, D. R., Clark, F. O., Lovas, F. J., Fourikis, N., Palmer, P., Morris, M., Lilley, A. E., Ball, J. A., Gottlieb, C. A., Litvak, M. M., Penfield, H., **Detection of interstellar trans-ethyl alcohol,** *Astrophys. J.* **196,** L99-L102 (Mar. 15, 1975).

Key words: ethyl alcohol; interstellar chemistry; molecular cloud; molecular spectroscopy; radio astronomy; Sagittarius B2.

Three transitions of *trans*-ethyl alcohol (CH_3CH_2OH) were detected in emission toward the Sagittarius B2 molecular cloud. The $6_{06}-5_{15}$ transition at 85,265.46 MHz, the $4_{14}-3_{03}$ transition at 90,117.51 MHz, and the $5_{15}-4_{04}$ transition at 104,808.58 MHz were observed at $V_{lsr}\sim 60$ km s^{-1}. The abundance of ethyl alcohol in the Sgr B2 cloud is comparable to that of many molecules previously detected there. Careful comparison of the abundance of ethyl alcohol with chemically related molecules such as its isomer dimethyl ether, acetaldehyde, and methyl alcohol may provide important information about mechanisms for molecular formation in the interstellar medium.

15002. Leasure, W. A., Jr., Corley, D. M., **Truck noise-1B: Spectral and directional characteristics of noise generated by truck tires,** *Report No. DOT-TST-75-71,* 180 pages (Available from the National Technical Information Service, Springfield, Va., 22161, Sept. 1974).

Key words: acoustics; noise measurement; noise pollution; noise (sound); sound transmission; tire noise; transportation noise; truck; urban planning.

This report is the third in a series of reports published as a result of Department of Transportation sponsored truck tire noise research conducted by the National Bureau of Standards. The previous reports (OST-ONA-71-9 and OST/TST-72-1) contained details of the test design, test procedures, and an inventory of maximum A-weighted sound level data for typical rib, crossbar, and retread type truck tires. A test sample of nine tread designs, estimated to represent 70-80 percent (based on discussions with fleet owners) of the truck tire population on the road today, was investigated considering noise levels as a function of the following variables: wear, loading, speed, pavement surface, and tire location. Test vehicles included both single-chassis vehicles and tractor trailers. The existing data base is expanded in this report to include one-third octave band spectral data, directionality data in the form of equal A-weighted sound level contours and other refined analysis of the data. Such data can serve as the groundwork for understanding the generation mechanisms by which tires produce noise—the first step in developing the necessary data to design quiet tires scientifically.

15003. Jacox, M. E., **Matrix isolation study of the vibrational spectrum and structure of HC_2,** *Chem. Phys.* **7,** 424-432 (1975).

Key words: acetylene; discharge; ethynyl (HC_2); infrared spectrum; interstellar molecule; matrix isolation; structure; vacuum ultraviolet photolysis.

Detailed isotopic studies of the infrared absorptions characteristic of the products of the decomposition of C_2H_2 in a mild discharge through argon trapped at 14 K indicate that HC_2 is an important product and that an absorption at 3612 cm^{-1} can be assigned to the carbon-hydrogen stretching fundamental of this species. The data suffice for determination of the stretching and stretching-interaction force constants of HC_2, which, in turn, have permitted estimates of the bond lengths. The carbon-hydrogen bond is found to be exceptionally strong, and the carbon-carbon bond is intermediate between that characteristic of ground-state C_2 and that of C_2H_2. The estimated rotational spacing is in excellent agreement with that found for HC_2 in recent observations of the interstellar medium.

15004. Johnson, D. R., Clark, F. O., **Observations of circular polarization of the $J=2-1$, $v=1$ transition of the SiO maser.** *Astrophys. J.* **197,** L69-L72 (Apr. 15, 1975).

Key words: circular polarization; maser; orion; pumping processes; radio astronomy; silicon monoxide.

Circular polarization has been observed in the $J=2-1$, $v=1$ SiO emission from the Orion A molecular source (OMC 1). The net polarization was observed at two different times separated by three days.

15005. Crandall, D. H., Phaneuf, R. A., Dunn, G. H., **Electron impact excitation of Hg^+**, *Phys. Rev. A* **11**, No. 4, 1223-1232 (Apr. 1975).

Key words: crossed beams; cross section; electron impact; excitation; Hg^+.

Crossed beams of electrons and Hg^+ ions have been employed to measure absolute cross sections for 165.0-nm emission, corresponding to the transition $Hg^+(6p\ ^2P_{3/2}{}^0) \rightarrow Hg^+(6s\ ^2S_{1/2})$. The emission cross section, which is nearly identical to the excitation cross section for $Hg^+(6p\ ^2P_{3/2}{}^0)$ near threshold, has a value of about 1.2×10^{-16} cm^2 at the 7.51-eV threshold, rises to a maximum of 2.26×10^{-16} cm^2 at 13 eV, and falls to 0.64×10^{-16} cm^2 at 274 eV. The cross section exhibits considerable structure in the energy region from threshold to the onset of the first cascade ($7s\ ^2S_{1/2}$) at 11.9 eV; this structure is likely due to interference from autoionizing states of neutral Hg. The total uncertainty at a "good" confidence level is about 18 percent, taken as the quadrature sum of random uncertainty (5% at 90% confidence level) with systematic uncertainties (17% at a level equivalent to 90% confidence level). At threshold, the Gaunt-factor formula of Seaton predicts a value of about 3 times that measured, but the two converge to within about 15 percent for electron energies ranging from 13 to 274 eV. The results are also in reasonable agreement with a semiclassical Gryzinski-type calculation for energies above several times threshold. The data give an emission cross section of $(2.8 \pm 0.5) \times 10^{-16}$ cm^2 at 6.8 eV for 194.2 nm ($6p\ ^2P_{1/2}{}^0 \rightarrow 6s\ ^2S_{1/2}$). Analysis of data taken with some metastable $6s^2\ ^2D$ ions in the target beam indicates that the mean cross section for excitation of the $6s\ ^2P_{3/2}{}^0$ level from the $6s^2\ ^2D$ metastable states is larger than that for excitation from the $6s\ ^2S_{1/2}$ ground state. Additional measurements of 398.4-nm emission ($6p\ ^2P_{3/2}{}^0 \rightarrow 6s^2\ ^2D_{5/2}$) yield a cross section of about 6×10^{-19} cm^2 near threshold, and a branching ratio $(^2P_{3/2} \rightarrow {}^2S_{1/2})/(^2P_{3/2} \rightarrow {}^2D_{5/2})$ of 350/1.

15006. Newman, M., **Formulas and multiplicative relationships for the parameters of subgroups of the modular group**, *Math. Ann.* **212**, 173-182 (1974).

Key words: classical modular group; congruence groups; elliptic class numbers; genus; index; level; parabolic class number.

Explicit formulas in terms of coset decompositions are derived for the parabolic class number and elliptic class numbers of any subgroup of finite index of the classical modular group Γ. It is shown that these are multiplicative arithmetic functions of the level for congruence subgroups of Γ.

15007. Ekberg, J. O., **Term analysis of Fe VI**, *Phys. Scr.* **11**, No. 1, 23-30 (1975).

Key words: iron; spectra; ultraviolet; wavelengths.

The spectrum of Fe VI has been observed by using a vacuum sliding-spark discharge and the 10.7-m grazing-incidence spectrograph and the 10.7-m normal-incidence spectrograph at the National Bureau of Standards, Washington, D.C. More than 400 lines have been classified in the region 250-1 580 Å. All terms of the configurations $3d^3$, $3d^24s$ and $3d^24p$, except $3d^2(^1S)4s\ ^2S$ have been established. The estimated uncertainty of the level values is ± 0.4 cm^{-1}. The $3d^3$, $3d^24s$ and $3d^24p$ level structure has been theoretically interpreted. The energy parameters determined from a least-squares fit of the observed level values are compared with Hartree-Fock calculations. From the complete set of $3d^3$ levels all forbidden lines of Fe VI from 1 387 to 10 000 Å have been predicted. All but two lines in the spectrum of the star RR Telescopii previously identified as forbidden Fe VI lines have been confirmed and 6 of the otherwise unexplained lines have been identified as [Fe VI].

15008. Artru, M. C., Kaufman, V., **Extension of the analysis of triply ionized aluminum (Al IV)**, *J. Opt. Soc. Amer.* **65**, No. 5, 594-599 (May 1975).

Key words: aluminum; spectra; wavelengths.

A total of 225 new lines of Al IV have been observed in the wavelength range 400-4700 Å, leading to the determination of all of the levels of the $2p^54p$, $4d$, $4f$, $5s$, $5f$, and $5g$ configurations. Results of parametric calculations for the configurations are presented. An ionization energy of $967\,804 \pm 15$ cm^{-1} has been derived.

15009. Roszman, L. J., **Effects of time ordering on plasma-broadened hydrogen profiles**, *Phys. Rev. Lett.* **34**, No. 13, 785-788 (Mar. 31, 1975).

Key words: Balmer lines; four dimensional rotation group; hydrogen; plasma; plasma broadening; pressure broadening; scattering matrix; spectral line broadening; Stark broadening; symmetry group; time ordering.

The plasma-broadened H_α and H_β spectral-line profiles of hydrogen were calculated retaining the time ordering in the S matrices of the width-shift operator by diagonalizing with the O(4) group. Significant changes occur: The H_α peak is decreased 15 percent, the half-width is increased 25 percent, and the H_β relative dip is decreased 23 percent without significant alteration of the maximum intensity of half-width. Agreement with experiment is improved appreciably.

15010. Collin, G. J., Ausloos, P., **Réactions des ions moléculaires cyclohexane en phase gazeuse**, *Can. J. Chem.* **53**, No. 5, 680-687 (1975).

Key words: cyclohexane; cyclopropanes; ion-molecule reactions; olefins; photoionization.

The *cy*-$C_6H_{12}{}^+$ ions formed in the photoionization of cyclohexane (resonance lines of argon: 11.6-11.8 eV) react with cyclic (C_3 and C_4) and unsaturated hydrocarbons by H_2 transfer. This reaction is quantitative with propene, 1-butene, 1-pentene, 1,3-butadiene, and isobutene. This transfer is efficient only if there is a terminal double bond. There is ring opening with the C_3 and C_4 hydrocarbons. H atom transfer reactions are also observed between *cy*-$C_6H_{12}{}^+$ ions and several compounds and the structure of the radical formed in such a reaction is determined by chemical analysis. With *cis*-2-butene, there is only charge transfer reaction.

15011. Bennett, L. H., Cuthill, J. R., McAlister, A. J., Erickson, N. E., Watson, R. E., **Electronic and catalytic properties of tungsten carbide**, *Science* **187**, 858-859 (Mar. 7, 1975).

Key words: catalysis; electronic structure; platinum; soft x-ray appearance potential; tungsten; tungsten carbide; x-ray photoemission.

The purpose of this comment is to note that two sets of experimental data, namely x-ray photoemission and soft x-ray appearance potential, are only apparently inconsistent in their measurement of the electron distribution in tungsten carbide.

15012. Epstein, M. S., Rains, T. C., Menis, O., **Determination of cadmium and zinc in standard reference materials by atomic fluorescence spectrometry with automatic scatter correction**, *Can. J. Spectrosc.* **20**, No. 1, 22-26 (Jan.-Feb. 1975).

Key words: accuracy; atomic fluorescence; automatic scatter correction; cadmium; chemical interferences; data evaluation; precision; production of atomic vapor; zinc.

The scattering of exciting radiation by matrix components is a major physical interference for trace analysis in atomic fluorescence spectrometry (AFS), which must be eliminated before practical "real sample" analysis can be performed. Using an instrumental arrangement for automatic scatter correction, trace cadmium and zinc are analyzed in Standard Reference Materials, Coal, Bovine Liver, Orchard Leaves, and Fly Ash, without prior separation or preconcentration. The effects of scatter and chemical interferences are evaluated for premixed argon (entrained air)—hydrogen and air—acetylene flames. Precision and accuracy of the results of AFS analysis are compared with data from analysis by atomic absorption.

15013. Barton, J. A., Jr., Brauer, G. M., Antonucci, J. M., Raney, M. J., **Reinforced polycarboxylate cements,** *J. Dent. Res.* **54,** No. 2, 310-323 (1975).

Key words: base, dental; cement, dental; cement, polycarboxylate; cement, reinforced; fiber reinforcement; poly(acrylic-itaconic acid); polycarboxylate; potassium titanate.

Mechanical properties of polycarboxylate cements are greatly improved by incorporation of high modulus fibers such as potassium titanate into acrylic-itaconic acid and acrylic-itaconic-aconitic acid copolymers. Other desirable properties of the cements are not changed by the addition of fibers.

15014. Jennings, D. A., Petersen, F. R., Evenson, K. M., **Extension of absolute frequency measurements to 148 THz: Frequencies of the 2.0- and 3.5-μm Xe laser,** *Appl. Phys. Lett.* **26,** No. 9, 510-511 (May 1, 1975).

Key words: absolute frequency measurements; laser frequency synthesis; xenon laser.

Absolute infrared frequency measurement has been extended to 148 THz (the highest frequency ever directly measured) with measurement of the two strong cw laser lines of Xe. The frequencies were synthesized with stabilized CO_2 and 3.39-μm He-Ne lasers and mixed on a W-Ni point-contact diode. The measured frequencies are $\nu_{Xe(2.0\ \mu m)} = 147.915\ 850(15)$ THz and $\nu_{Xe(3.5\ \mu m)} = 85.459\ 997(3)$ THz.

15015. Fong, J. T., **Construction of a strain-energy function for an isotropic elastic material,** *Trans. Soc. Rheol.* **19,** Issue 1, 99-113 (1975).

Key words: compressibility; elasticity; finite deformation; hyperelasticity; rubbery materials; strain-energy function; volume-extension.

Experimental data on the volume changes accompanying simple tension of peroxide vulcanizates of natural gum rubber, as first reported by Penn in *Trans. Soc. Rheol.* **14,** 509 (1970), are further interpreted within the framework of the theory of a hyperelastic material. Motivated by the formal connection between a hyperelastic material and a nonlinear viscoelastic fluid (*Trans. Soc. Rheol.* **9,** 27 (1965)), and a mathematical result on the decomposition of the scalar potential of that fluid (*Z. Angew. Math. Phys.* **23,** 780 (1972)), the interpretation of Penn's data leads to an explicit construction of a strain-energy function for rubbery materials:

$$W(I_1, I_2, I_3) = C_1(I_1 - 3) + C_2(I_2 - 3) + \bar{H}(I_1, I_2)(I_3 - 1) + \frac{1}{8K}(I_3 - 1)^2.$$

15016. Swartzendruber, L. J., Evans, B. J., **Electronic structure and ^{121}Sb hyperfine fields in the Heusler alloys $Ni_{1-x}Cu_xMnSb$,** *J. Phys.* **35,** No. 12, C6-265/C6-268 (Dec. 1974).

Key words: alloys; Cu; hyperfine fields; magnetism; Mn; Mössbauer effect; Ni; Sb; Pd.

At 4.2 K the magnetic hyperfine field, H_n, at Sb in the $C1_b$ structure alloys $Ni_{1-x}Cu_xMnSb$, $0 < x < 1$, increases from 296 kG at $x = 0$ to 504 kG at $x = 0.6$. For $x < 0.7$, H_n decreases rapidly and is characterized by a broad Gaussian distribution. For example, at $x = 0.8$ the average H_n is 327 kG and the width of the distribution, σ_{Hn}, is 130 kG. Using the recent model of Blandin and Campbell based on the RKKY interaction, the increase of H_n with x for $x < 0.7$ can be shown to arise primarily from the increase in electron concentration. A similar explanation might also apply to the 600 kG H_n at Sb in Pd_2MnSb if it is assumed that Pd contributes 0.25 electron to the conduction band. The large hyperfine fields at Sb in the above alloy systems appear to be consistent with the predictions of extant theoretical models.

15017. Eisenhart, C., **A supplementary list of publications of S. S. Wilks,** *Amer. Statist.* **29,** No. 1, 25-27 (Feb. 1975).

Key words: bibliographic citations; publications; Samuel Stanley Wilks; S. S. Wilks.

Full bibliographic citations for thirty-one "other writings" of Samuel Stanley Wilks not included in "The Publications of S. S. Wilks," in February 1965 issue of the *Annals of Mathematical Statistics* (Vol. 36, No. 1, pp. 24-27), together with the observation that his writings and those of his younger brother, Syrrel Singleton Wilks, are lumped together under "S. S. Wilks" in the volumes of the *Science Citation Index*.

15018. Biedenharn, L. C., Trivedi, M., Danos, M., **Giant multipole resonances and the three-fluid hydrodynamical model of nuclei,** *Phys. Rev. C* **11,** No. 4, 1482-1484 (Apr. 1975).

Key words: collective model; giant resonances; isospin purity; nuclear charged density; nuclear models; nuclear structure.

The recently observed resonance at ~ 11 MeV in ^{208}Pb is interpreted as the miniature quadrupole resonance (associated with the giant quadrupole resonance at 22 MeV) implied by the three-fluid hydrodynamical model. A difficulty arises with the miniature dipole resonance; this may signify that the simple hydrodynamic model has reached the limits of its validity. A numerical error in a previous publication is corrected.

15019. Misra, D. N., Bowen, R. L., Wallace, B. M., **Adhesive bonding of various materials to hard tooth tissues. VIII. Nickel and copper ions on hydroxyapatite; rôle of ion exchange and surface nucleation,** *J. Colloid Interface Sci.* **51,** No. 1, 36-43 (Apr. 1975).

Key words: adsorption; hydroxyapatite; ion exchange; nucleation; reaction rate; surface.

The interaction of synthetic hydroxyapatite with nickelous [Ni(II)] or cupric [Cu(II)] ions from aqueous nitrate solutions was investigated. Nickelous ions exchange with the calcium ions of the adsorbent and follow the Langmuir adsorption isotherm; the saturation amounts of the adsorbate for two apatite samples have approximately the same ratio as their surface areas. With Cu(II), the initial uptake seems to be independent of concentration and almost equal to the saturation amount of nickelous ions for the same apatite sample. Subsequently, the apatite dissolves in concert with the growth of some form of copper phosphate as a separate phase on the apatite surface if an excess of cupric ions is present. This reaction follows a zero order rate law for dilute solutions. A phenomenological theory is developed which explains the various kinetic facets.

15020. Grundl, J. A., Gilliam, D. M., Dudey, N. D., Popek, R. J.,

Measurement of absolute fission rates, *Nucl. Technol.* **25,** 237-257 (Feb. 1975).

Key words: cross sections; fission; neptunium-237; neutron reactions; pile neutrons; plutonium-239; uranium-234; uranium-235; uranium-238.

The capability to measure absolute fission rates per nucleus at a remote laboratory site [the Coupled Fast Reactivity Measurement Facility (CFRMF) at Aerojet Nuclear Company] has been established to a precision level of better than ± 1 percent and was sustained at that level for a period of two years. Double fission ionization chambers and solid-state track recorders were used in a series of irradiations designed to calibrate fission activation detectors used for reactor fuels and materials dosimetry. The array of reference and working fissionable deposits involved in the measurements included five isotopes: ^{239}Pu, ^{235}U, ^{238}U, ^{237}Np, and ^{234}U. Isotopic masses for the fissionable deposits were determined from interrelated components of mass assay: (a) relative and absolute alpha counting, (b) fission comparison counting in thermal-neutron beams, (c) mass spectrometry, and (d) quantitative deposition employing solutions of known fissionable element concentration. Absolute accuracies for the fission rates per nucleus measured in CFRMF are in the range of ± 1.5 to ± 2.5 percent and are dominated by uncertainties in the fissionable deposit masses. Fission cross-section ratios for the CFRMF central spectrum are (1.000 : 1.145 ± 0.017 : 0.0485 ± 0.0007 : 0.354 ± 0.008) for (^{235}U:^{239}Pu:^{238}U:^{237}Np), respectively.

15021. Hust, J. G., **Low-temperature thermal conductivity of two fibre-epoxy composites,** *Cryogenics* **15,** No. 3, 126-128 (Mar. 1975).

Key words: aramid fiber; composites; cryogenic; epoxy; glass fiber; thermal conductivity.

Thermal conductivity data are presented for two fibre-epoxy composites. The fibre in one composite is glass and an aramid-class polymer in the other. Measurements were conducted on a glass-epoxy specimen in the direction perpendicular to the fibres at temperatures from 14 to 100 K. The aramid-epoxy specimen was measured parallel to the fibres at 5, 76, 196, and 276 K. Data are presented both in graphical and tabular form.

15022. Weber, L. A., **Thermodynamic and related properties of parahydrogen from the triple point to 300 K at pressures to 1000 bar,** *NASA Spec. Publ. 3088,* 100 pages (National Aeronautics and Space Administration, Washington, D.C., Mar. 1975). (Available from the National Technical Information Service, Springfield, Va. 22161).

Key words: density; enthalpy; entropy; hydrogen; properties of fluids; specific heat; velocity of sound.

NBS compressibility measurements and thermodynamic properties data for parahydrogen have been extended to higher temperatures and pressures. Results of an experimental program are presented in the form of new PVT data in the temperature range 23-300 K at pressures up to 800 bar. Also given are tables of thermodynamic properties on isobars to 1000 bar including density, internal energy, enthalpy, entropy, specific heats at constant volume and constant pressure, velocity of sound, and the surface derivatives $(\partial P/\partial T)_v$ and $(\partial P/\partial \rho)_T$. The accuracy of the data is discussed and comparisons are made with previous data.

15023. Roberts, J. R., Voigt, P. A., Czernichowski, A., **Experimentally determined absolute oscillator strengths of Ti I, Ti II, and Ti III,** *Astrophys. J.* **197,** 791-798 (May 1, 1975).

Key words: arc; experimental; oscillator strengths; Ti I; Ti II; Ti III.

Absolute oscillator strengths of Ti I, Ti II, and Ti III transitions in the wavelength region from 2440 Å to 3500 Å have been experimentally determined using a wall-stabilized arc. Titanium in the form of heated $TiCl_4$ was admixed with argon plus 5 percent H_2 and introduced into the arc, which was operated at a current of 40-60 amperes. Axis temperatures and electron densities ranged from 11,000 K to 12,500 K and 3.5×10^{16} cm^{-3} to 8.7×10^{16} cm^{-3}, respectively.

15024. Orloski, M. J., **The numbers game in stacks and drains,** (Proc. Sixty-Eighth Annual Meeting of the American Society of Sanitary Engineering, New Orleans, La., Oct. 13-16, 1974), Paper in *ASSE Yearbook* **52,** 122-136 (ASSE, Cleveland, Ohio, 1975).

Key words: National Bureau of Standards; performance of plumbing systems; plumbing code; principles of hydraulics.

This paper discusses some of the historical aspects of plumbing research and plumbing code committee work (Part I). Fundamentals of hydraulics are reviewed as they relate to the intent of plumbing codes (Part II), and current NBS programs on the evaluation of plumbing systems in the laboratory and in the field are discussed (Part III). Considerations involved in implementing the performance approach are covered briefly.

15025. Mohan, K., Schaefer, A. R., Zalewski, E. F., **Measurement of geometrically total spectral radiant power,** *Appl. Opt.* **14,** No. 4, 1035-1038 (Apr. 1975).

Key words: geometrically total spectral radiant power; gonioradiometer.

In this paper, the measurement of geometrically total spectral radiant power, i.e., the spectral radiant power emanating in all directions from a light source, is discussed. A gonioradiometer employing a silicon photodiode and a set of narrow band interference filters was used for these measurements. The experiment is described, some exploratory measurements are presented, and the uncertainties which this method introduces are estimated.

15026. Madden, R. P., Ederer, D. L., **SURF-II, a new synchrotron ultraviolet radiation facility at the NBS,** (Extended Abstract), *Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974,* No. 10.3, 774-776 (1974).

Key words: electron accelerator; new facility; radiation; storage ring; synchrotron radiation; vacuum ultraviolet.

At NBS the accelerator providing synchrotron radiation in the vacuum ultraviolet is being converted from a synchrotron to a storage ring which we anticipate will accelerate a 50 mA electron beam to a maximum energy of 240 MeV. These changes will extend the useful spectral range of the continuum vacuum ultraviolet radiation down to wavelengths somewhat below 40 Å. Increased intensity, greater spacial and temporal stability are other advantages that this conversion will provide. Even at wavelengths greater than 200 Å the intensity is expected to increase by a factor of at least 100 to a value of 4×10^{11} photons per sec per milliradian of orbit for an instrument resolution of $\Delta\lambda/\lambda = 0.001$. It should be of general interest that SURF-II is being constructed so as to be compatible with a large user group.

15027. Freund, S. M., Sweger, D. M., **Vinyl chloride detection using carbon monoxide and carbon dioxide infrared lasers,** *Anal. Chem.* **47,** No. 6, 930-932 (May 1975).

Key words: detector; laser; pollution; vinyl chloride.

Stark modulated absorption of CO and CO_2 infrared laser radiation by vinyl chloride is the basis for sensitive and selective detection of this gas. Using the P(13) line of the 20-19 band of the CO laser (1609 cm^{-1}, 6.22 μm), a 2 ppm C_2H_3Cl in air sample is observed in an extracavity absorption cell with a 5/1 signal-to-noise ratio after 50 seconds of integration. The response of the signal to concentration of C_2H_3Cl is linear over at least 3 orders of magnitude to within experimental uncertainty which is a few percent. Similar results are obtained using a CO_2 laser operating on the P(42) line of the 001-100 band (922.9 cm^{-1}, 10.84 μm).

15028. Clifton, J., Frohnsdorff, G., **Fiber-reinforced cementitious materials,** Special Review in *Cements Research Progress 1974,* F. Young, Ed., pp. 201-234 (American Ceramic Society, Columbus, Ohio, 1975).

Key words: cement; concrete; fiber-reinforced cements; fiber-reinforced concretes; glass fibers; mechanical properties; organic fibers; review; steel fibers.

This review is concerned with developments, through 1974, in the research and technology, but not applications, of fiber reinforced cementitious materials including hardened cement pastes of gypsum, portland and high alumina cement and their concretes. Essentially, only materials reinforced with short, discontinuous and discrete fibers are covered, because long rods, continuous meshes and woven fabrics are not classified as discrete fibers in this review.

15029. Gilsinn, J. F., **Validation of maximum airport throughput levels estimated by the DELCAP simulation model,** *FAA Report No. FAA-RD-75-66,* 72 pages (National Technical Information Service, Springfield, Va. 22151, Jan. 1975).

Key words: airport; airport capacity; airport simulation; models; model validation; runway capacity; simulation.

This report documents exercises of the DELCAP airport terminal area simulation model performed to validate the maximum throughput calculations of that model. DELCAP was run for five different runway configurations, with three or four appropriate operating policies chosen for each, and for three different mixes of aircraft types. Throughput estimates from DELCAP are found to be in general agreement with current values provided by the FAA. One specific instance of greater discrepancy is identified, and a remedy for it is proposed. Changes made in DELCAP since its original documentation in 1971 are described in an appendix.

15030. Yakowitz, H., **Future growth of SEM—toward super efficient microscopy,** *Proc. 8th Annual Scanning Electron Microscope Symposium, St. Louis, Mo., Apr. 7-11, 1975,* Part 1, 1-10 (IIT Research Institute, Chicago, Ill., Apr. 1975).

Key words: Auger electron spectrometry; electron probe x-ray microanalysis; energy loss spectrometry; scanning electron microscopy; scanning transmission electron microscopy.

Some predictions concerning future trends in the SEM field have been made. Economic and personnel considerations have been taken into account in arriving at these predictions. Micrographic and analytical requirements and capabilities were also considered. For electron transparent specimens, scanning transmission electron microscopy (STEM) will become a major research method. Auger and energy loss spectrometry will join x-ray emission as analytical methods used for the analysis of such samples. Greater advantages will probably arise from improvements in electron source brightness and from advantages afforded by low energy loss electron detectors. Finally, the SEM field can only profit as the quality and quantity of educational opportunities in the field expand.

15031. Hust, J. G., **Low temperature thermal conductivity measurements on longitudinal and transverse sections of a superconducting coil,** *Cryogenics* **15,** No. 1, 8-11 (Jan. 1975).

Key words: composite; cryogenics; superconducting coil; thermal conductivity.

Thermal conductivity measurements have been performed on longitudinal and transverse sections of a superconducting coil at 5, 79, 196, and 276 K. The composite coil sections are composed of copper-stabilized niobium-titanium wire embedded in epoxy. Tabular and graphical data are presented. These data are compared to values calculated on the bases of components of the coil sections. Reasonably good agreement is obtained.

15032. Livingston, R. C., Rowe, J. M., Rush, J. J., **Neutron quasielastic scattering study of the ammonium ion reorientations in a single crystal of NH_4Br at 373 K,** *J. Chem. Phys.* **60,** No. 11, 4541-4546 (June 1, 1974).

Key words: ammonium bromide; ammonium ion; neutron scattering; orientational disorder; reorientation; residence time; single crystal.

The ammonium ion reorientations in a single crystal of NH_4Br in its disordered CsCl phase have been investigated by quasielastic neutron scattering at 373 K. Neutron spectra were measured at four different crystal orientations (with the [110] planes of the crystal in the scattering plane) and data were recorded simultaneously at a variety of scattering angles providing a range of momentum transfers for elastic scattering, $0.5\ Å^{-1} \leq Q \leq 2.5\ Å^{-1}$. The experimental results were fit to models allowing instantaneous random jumps around the C_2 and C_3 axes of the $(NH_4)^+$ ions using a variety of analytical procedures that are described in some detail. The results of these fits establish conclusively that the ammonium ion reorientations are dominated by 90° jumps around the C_2 axes with an average time τ between jumps of 3.2 ± 0.4 psec at 373 K. The inelastic part of the measured neutron spectra shows a torsional vibration peak at 305 cm^{-1}, in good agreement with previous values. The results and analysis demonstrate the value of single crystal measurements in neutron studies of dynamic orientational disorder in solids.

15033. West, E. D., Schmidt, L. B., **Spectral-absorptance measurements for laser calorimetry,** *J. Opt. Soc. Amer.* **65,** No. 5, 573-578 (May 1975).

Key words: absorptance; calorimeter; cavity; laser energy measurements; laser power measurements; radiometry.

Methods used at the National Bureau of Standards for determining the power or energy in laser beams depend on calorimetric comparison of laser power or energy and the calibrating electrical power or energy. For this comparison, it is essential to know the fraction of the incident radiant energy that is converted to heat and measured by the calorimeter. This fraction, the effective spectral absorptance, is measured by adding an auxiliary calorimeter, which covers practically all of the opening in the main calorimeter. A laser beam enters the main calorimeter through a small hole in the auxiliary calorimeter. The reflected laser energy and the excess thermal radiation are measured by the auxiliary calorimeter. The data analysis is based on the theory of calorimetery derived from a linear heat-flow problem. Time-dependent functions relating the transient temperature responses of the calorimeters to various constant power inputs are determined experimentally from known electrical inputs. The effective absorptance is found by comparing transient responses for electrical and laser inputs.

15034. Jennings, D. A., **Simple, adjustable lens holder,** *Rev. Sci. Instrum.* **46,** No. 4, 487-488 (Apr. 1975).

Key words: adjustable; lens holder.

The construction of a simple, adjustable lens holder is described. This lens holder is unique in that it will firmly hold small lenses without taking up space at the edge of the lens or stopping them down.

15035. Zimmerman, J. E., Campbell, W. H., **Tests of cryogenic SQUID for geomagnetic field measurements,** *Geophysics* **40,** No. 2, 269-284 (Apr. 1975).

Key words: geomagnetism; magnetometer; SQUID; superconducting device.

A type of cryogenic SQUID (superconducting quantum interference device) magnetometer was designed for geomagnetic measurements. Field tests of the instrument including comparisons to observatory variometers, a rubidium magnetometer, an induction loop, and a flux-gate magnetometer showed the new cryogenic systems to be reliable, accurate, portable, and simple to operate. Directional measurements of natural magnetic field fluctuations as small as 0.0001 gamma with periods from 0.5 sec to several hours were demonstrated.

15036. Rowe, J. M., Rush, J. J., Smith, H. G., Mostoller, M., Flotow, H. E., **Lattice dynamics of a single crystal of $PdD_{0.63}$,** *Phys. Rev. Lett.* **33,** No. 21, 1297-1300 (Nov. 18, 1974).

Key words: coherent neutron scattering; dispersion relation; lattice dynamics; palladium deuteride; phonon frequency distribution; single crystal.

The frequency-wave-vector dispersion relations of a single crystal of $PdD_{0.63}$ have been measured by coherent neutron inelastic scattering at 78, 150, 220, and 295 K. The acoustic modes are considerably lower in frequency than the corresponding modes for pure Pd, in accord with the observed lattice expansion. The optic modes, in which D motions predominate, show considerable dispersion. In particular, the shape of the motions predominate, show considerable dispersion. In particular, the shape of the [100] LO branch shows conclusively that second-like-neighbor D-D interactions are comparable to the first-like-neighbor D-D interactions.

15037. Yakowitz, H., Newbury, D. E., **Magnetic domain structures in Fe-3.2Si revealed by scanning electron microscopy—A photo essay,** *J. Test. Eval.* **3,** No. 1, 75-78 (Jan. 1975).

Key words: iron-silicon alloys; Lorentz force; magnetic domains; photomicrography; scanning electron microscope; strain effects.

The mechanism and experimental arrangement by which magnetic contrast can be observed from materials of cubic anisotropy are indicated. Transformer alloy Fe-3.2Si is used as an example to illustrate the effects of tensile strain, magnetic field switching, residual stress, and inclusions on magnetic structure.

15038. Yakowitz, H., Newbury, D. E., Myklebust, R. L., **Approaches to particulate analysis in the SEM with the aid of a Monte Carlo program,** (Proc. 8th Annual Scanning Electron Microscope Symp., St. Louis, Mo., Apr. 7-11, 1975), Paper in *Scanning Electron Microscopy/1975,* Part 1, 93-102 (ITT Research Institute, Chicago, Ill., Apr. 1975).

Key words: backscattered electrons; electron specimen interaction; Monte Carlo simulation; particulate analysis; scanning electron microanalysis; x-ray microanalysis; x-ray source size.

Conventional quantitative electron microanalysis methods have been shown to be satisfactory when semi-infinite, planar specimens normal to the electron beam are analyzed. However, in the case of particulate analysis, the surface may be irregular, the specimen dimensions may be less than the electron beam interaction volume and the x-ray absorption path will be irregular. Currently the only tractable approach to the analysis of particulates is to use a Monte Carlo simulation of electron and x-ray interactions to predict x-ray intensity as a function of particle geometry. A program to carry out this task was devised and tested in several ways for both electron and x-ray parameters. A detailed document of results of these tests, and results on a variety of specimens including aluminum spheres, nickel cylinders, alloy steel wear particles and others show good agreement between theory and experiment.

Some practical considerations have to be taken into account when such methods are used in real analytical situations, e.g., (1) the cost of preparing a calibration curve by the Monte Carlo method, (2) analytical strategy, e.g., what specimen tilt to use in the SEM, what operating voltage and what is the effect of using either energy dispersive or wavelength dispersive detection systems, and (3) applicability to multicomponent particles. From a discussion of these we conclude that the Monte Carlo method can be employed profitably by laboratories having a need for quantitative information concerning particulate matter.

15039. Ciarlo, D. R., Schultz, P. A., Novotny, D. B., **Automated inspection of IC photomasks,** *Proc. Society of Photo-Optical Instrumentation Engineers, Seminar 8, Technological Advances in Micro and Submicro Photofabrication Imagery, San Diego, Calif., Aug. 1974,* **55,** 84-89 (May 1975).

Key words: automated inspection of photomasks; critical dimension determination; defects; detection of visual defects; integrated circuit photomasks; photomask inspection; photomasks; photoplate quality.

The results of a nationwide review of automated IC photomask inspection methods are presented. Major photomask inspection problems of detection of visual defects and registration errors, and the determination of critical dimensions and photoplate quality are discussed. This review indicates that for high-volume, large-scale integrated circuits, the greatest concern is for the detection of visual defects. Next in order of importance are the detection of registration errors, and then the accurate determination of critical dimensions. Automated inspection systems and technologies currently available for this are discussed including: microdensitometer-digital computer systems, laser beam scanning systems, spatial filtering systems and microscope-television-digital computer systems. Suggested criteria for an ideal photomask inspection system are the simultaneous inspection for 2-μm visual defects, the determination of registration tolerances to within ± 0.5 μm and the determination of the accuracy of the critical dimensions to tolerances of ± 0.5 μm on a single photomask in ten minutes.

15040. Angel, W. T., Bean, V. E., **Tracking, pulsed ultrasonic interferometer,** *Rev. Sci. Instrum.* **46,** No. 5, 533-535 (May 1975).

Key words: interferometer; phase locked loop; tracking; ultrasonic.

A pulsed ultrasonic interferometer was designed and constructed that has the ability to track changes in transit time as the ambient pressure and temperature of the sample are changed. The stability over 17 h approached one part in 10^7. This instrumentation will be incorporated into an automated high pressure transfer standard calibration system.

15041. Costrell, L., **Standardized instrumentation system for computer automated measurement and control,** *IEEE Trans. Ind. Appl.* **IA-11,** No. 3, 319-323 (May-June 1975).

Key words: CAMAC; computer interfacing; control systems; instrumentation; instrumentation standards; standards.

A standardized instrumentation system for computer automated measurement and control (CAMAC) is gaining wide international acceptance for industrial and laboratory applications. The system features a fully specified dataway together with modular functional units that are completely compatible with each other and that are available from diverse sources. The system is nonproprietary and can be freely used without license or restriction of any kind.

15042. Fuggle, J. C., Madey, T. E., Steinkilberg, M., Menzel, D., **X-ray photoelectron spectroscopy (XPS) of adsorbate valence bands,** *Phys. Lett.* **51A**, No. 3, 163-164 (Feb. 24, 1975).

Key words: chemisorption; CO; ESCA; ruthenium; x-ray photoelectron spectroscopy.

The CO valence levels for a monolayer of CO adsorbed on the basal (001) face of ruthenium have been observed by XPS. The assignment of the observed peaks is discussed.

15043. Brennan, J. A., Stokes, R. W., Kneebone, C. H., Mann, D. B., **NBS-CGA cryogenic flow measurement program,** (Proc. ISA International Instrumentation-Automation Conf. and Exhibit, New York, N.Y., Oct. 28-31, 1974), Paper in *Advances in Instrumentation* **29**, 612-1/612-13 (Instrument Society of America, Pittsburgh, Pa., 1974).

Key words: angular momentum; cryogenic; flowmeter; liquid nitrogen; measurement; positive displacement; turbine; vortex shedding.

This paper reviews the joint National Bureau of Standards-Compressed Gas Association program in which (1) all the types of flowmeters used in the U.S. for custody transfer of liquid nitrogen were tested, (2) a tentative national code on cryogenic liquid-measuring devices was adopted, (3) use of transfer standards for testing cryogenic flowmeters was started and (4) tests on some temperature and density compensation devices were completed.

Data from the test program are presented in summary form for flowmeters operating on several principles. Highlights of the code requirements and transfer standard test results are described. Densitometer and temperature compensation test data are presented.

15044. Mount, G. H., Linsky, J. L., **One- and multi-component models of the upper photosphere based on molecular spectra. IV. Non-LTE treatment of the CN violet system,** *Solar Phys.* **41**, No. 1, 17-33 (Mar. 1975).

Key words: carbon abundance; molecular spectra; non-LTE; solar model; upper photosphere.

Non-LTE synthetic spectra derived from a detailed analysis of the formation of the CN(0,0) λ3883 Å spectrum are compared with center-limb photoelectric spectra taken at Kitt Peak National Observatory. Significant non-LTE effects are found and the Kurucz, Altrock-Cannon, Mount-Linsky II, and HSRA models are compared. We derive a solar carbon abundance of log $A_c = 8.30 \pm 0.10$ for the Mount-Linsky model and log $A_c = 8.40 \pm 0.10$ for the Altrock-Cannon model, compared to the HSRA value of log $A_c = 8.55 \pm 0.10$, assuming a nitrogen abundance of log $A_N = 7.93$. In addition we specify the regions of formation for the CN(0,0) 3883.35 Å bandhead at disc center and limb.

15045. Madey, T. E., Engelhardt, H. A., Menzel, D., **Adsorption of oxygen and oxidation of CO on the ruthenium (001) surface,** *Surface Sci.* **48**, 304-328 (1975).

Key words: adsorption; carbon monoxide; catalysis; LEED; oxygen; ruthenium.

The adsorption of oxygen on the ruthenium (001) surface has been studied using a combination of techniques: LEED/Auger, Kelvin probe contact potential changes, and flash desorption mass spectrometry. Oxygen is rapidly adsorbed at 300 K, forming an ordered LEED structure having apparent (2×2) symmetry. Two binding states of oxygen are inferred from the abrupt change in surface work function as a function of oxygen coverage. LEED intensity measurements indicate that the oxygen layer undergoes an order–disorder transition at temperatures several hundred degrees below the onset of desorption. The order–disorder transition temperature is a function of the oxygen coverage, consistent with two binding states. A model involving the adsorption of atomic oxygen at $\theta < 0.5$ and the formation of complexes with higher oxygen content at $\theta > 0.5$ is proposed. The oxidation of CO to form CO_2 was found to have the maximum rate of production at a ruthenium temperature of 950 K.

15046. Lawless, W. N., **Dielectric and thermal properties of a machinable glass-ceramic at low temperatures,** *Cryogenics* **15**, No. 5, 273-277 (May 1975).

Key words: cryogenics; dielectric constant; loss tangent; machinable glass-ceramic; specific heat; thermal conductivity.

Measurements of the dielectric properties (2-300 K), specific heat (2-20 K), and thermal conductivity (2-22 K) are reported for a mica-containing glass-ceramic which has a machinability in the range from brass to low-carbon steel. The dielectric constant increases with increasing temperature and is field independent for field strengths up to at least 70 kV cm^{-1} at low temperatures. Power-supply-limited attempts to measure the dielectric breakdown strength at low temperatures are consistent with the reported strength at room temperature (1.4 MV cm^{-1}). The thermal properties are similar to fused SiO_2 with two exceptions: the thermal conductivity does not show the "knee" at ~ 10 K typical of amorphous materials, and the specific heat deviates strongly from a T^3 law below 3.5 K.

15047. Arp, V., **Thermodynamics of single-phase one-dimensional fluid flow,** *Cryogenics* **15**, No. 5, 285-289 (May 1975).

Key words: helium; hydrodynamics; one dimensional flow; single phase fluid; thermodynamics; transposed critical line.

Fluid flow processes in helium within the range 4-10 K and 10-100 N cm^{-2} pressure are similar to those of ordinary fluids near their critical points. Three thermodynamic parameters, the Gruneisen parameter, isentropic compressibility, and velocity of sound, which are weakly non-catalytic near the critical point, are used to describe fluid flow processes in fluids in the near critical range. It is found that if temperature is not used as a variable in a fluid state equation, flow profiles can be easily evaluated in a single-phase fluid region, including close to or transecting the transposed critical line.

15048. Murphey, W. M., Schleter, J. C., **Practicality of diversion path analysis,** (Proc. 15th Annual Meeting of the Institute of Nuclear Materials Management, Inc., Atlanta, Ga., June 19-21, 1974), *Nucl. Mater. Manage. Journal of the Institute of Nuclear Materials Management* **III**, No. III, 236-268 (1974).

Key words: analysis; diversion of nuclear materials; diversion path analysis; internal control system characterization; nuclear materials safeguards; safeguards.

Maintenance of effective safeguards requires a program for routine assessment of plant safeguards systems in terms of their capabilities to satisfy safeguards aims. Plant internal control systems provide capabilities for detection of unprevented diversion and can provide assurance that diversion has not occurred. A procedure called Diversion Path Analysis (DPA) enables routine assessment of the capabilities of internal control systems to indicate unprevented diversion and identification of safeguards problem areas in a plant. A framework for safeguards system design is also provided which will allow flexibility to accommodate individual plant circumstances while maintaining acceptable diversion detection capability. The steps of the procedure are described and the practicality of the analytical procedure is shown by referring to a demonstration test for a high throughput process where plant personnel were major participants. The boundary conditions for the demonstration case are given, along with some conclusions about the general procedure.

15049. Murphey, W. M., Schleter, J. C., Maltese, M. D. K., **Internal control vis-a-vis diversion path analysis,** (Proc. 14th Annual Meeting of the Institute of Nuclear Materials Management, Inc., San Diego, Calif., June 20-22, 1973), *Nucl. Mater. Manage. Journal of the Institute of Nuclear Materials Management* **II**, No. 3, 232-274 (1973).

Key words: analysis; diversion of nuclear materials; diversion path analysis; internal control system characterization; nuclear materials safeguards; safeguards.

A procedure, "diversion path analysis," has been developed for systematic analysis of diversion possibilities in plants using SNM. The procedure can be applied to diversion possibilities countered by physical protection and materials balance accounting but special emphasis is given to diversion possibilities in high throughput production areas. A parallel practicality study is discussed which used plant production data and had a working diversion indication objective of 500 grams and 24 hour response for a single diversion of attractive material by a single employee without collusion given that the employee may alter any records to which he had access. Explanation of the procedure, its relation to plant internal control, relations or internal control data monitoring techniques to existing safeguards techniques and implementation implications are presented.

15050. Wu, Y. C., **On the control of thermal impact for thermal safety,** (Proc. AIAA 10th Thermophysics Conf., Denver, Colo., May 27-29, 1975), *AIAA Paper No. 75-713,* 1-11 (American Institute of Aeronautics and Astronautics, New York, N.Y., May 1975).

Key words: contact burn; heat conduction; human tissue; thermal impact; thermal potential; thermal safety.

The thermal impact exerted by a hot surface to human tissue is the rate of thermal energy delivered from it to the tissue. If the physiological reaction to the thermal impact is beyond the limit of a cell's resistance, a burn may result. Therefore, the severity of a burn is determined by two processes: physiological and physical. Once the physiological reaction to the thermal impact is determined on the basis of the severity of the burn, the thermal potential could be controlled to a safe level by means of a physical process with the aid of modern technology to provide the materials needed. It is this process that is of interest in the area of thermal safety. In the present study we wish to minimize the thermal impact of a hot surface on human tissue. An analytical solution of the linear heat conduction equation as applied to a three layer model is obtained under a given selected set of initial and boundary conditions. The parameters derived from the solution are discussed and subjected to appropriate experiments. The results verify the assumed conditions.

15051. Roberts, R. W., Hoffman, J. D., **Reducing energy consumption in R&D labs—The NBS experience,** *Res. Manage.* **XVIII,** No. 1, 26-33 (Mar. 1975).

Key words: building energy use; conservation; energy conservation; electricity saved; fuel consumption.

The National Bureau of Standards has a major facility at Gaithersburg, Md. Over 3,000 people are housed in some 25 buildings, and rather strict temperature and humidity control must be maintained in much of the laboratory space. The climate control system uses a rather complex cool/reheat cycle to maintain proper humidity. Following a thorough analysis of the climate control system, steps were taken that reduced consumption of both electricity and fuel by 20 percent. The procedures by which these savings were realized are detailed.

15052. Schooley, J. F., Soulen, R. J., Jr., **Superconductive fixed points for cryogenic thermometry,** *Instrum. Technol.* **21,** No. 11, 35-39 (Nov. 1974).

Key words: superconductive transition temperatures; superconductivity; temperature; thermometric fixed points.

Research at NBS has shown that some elements exhibit very sharp and reproducible superconductive transitions. This research led to the development of a device, now offered through the Office of Standard Reference Materials, which permits ± 0.001 K reproducibility at the superconductive transitions of Pb ($T^c \sim 7.2$ K). In ($T^c \sim 3.4$ K), Al ($T^c \sim 1.2$ K), Zn ($T^c \sim 0.85$ K), and Cd ($T^c \sim 0.5$ K). To extend the usefulness of the device, NBS has been examining the width and reproducibility of the superconductive transitions of Nb^3Sn ($T^c \sim 18$ K), Ir ($T^c \sim 0.1$ K), Be ($T^c \sim 0.023$ K), and W ($T^c \sim 0.015$ K) with the view of establishing these materials as additional fixed points. This article describes these superconductive fixed points.

15053. Laughlin, D. E., Cahn, J. W., **Spinodal decomposition in age hardening copper-titanium alloys,** *Acta Met.* **23,** 329-339 (Mar. 1975).

Key words: age hardening; copper-titanium; *D*l*a*; metastable solvus; microstructural sequence method; nucleation; ordering; precipitation; spinodal decomposition.

The early stages of spinodal decomposition in age hardening Cu-Ti alloys have been studied by electron microscopy. The alloys (1.55, 3.08 and 5.17 w/o Ti) decomposed on the quench from solutionizing temperatures into Ti enriched and Ti lean regions. Superlattice reflections, at $1/5\{420\}^m$ positions as well as $1/2\{210\}^m$ reflections were observed in the diffraction patterns of the as quenched 5.17 w/o Ti alloy. The alloys continued to decompose when aged at elevated temperatures. A sequence of microstructures was used to show that continuous phase separation, and hence spinodal decomposition, was the mechanism of decomposition. The metastable two phase structure which formed from the spinodal process was aligned and periodic from the start of the process. The Ti enriched phase was ordered, with the $D1a$(Ni^4Mo;14/m) structure. Reversion experiments were performed to determine the position of the coherent metastable solvus. When aging treatments were performed near this solvus, heterogeneous nucleation of the metastable phase was observed.

15054. Ederer, D. L., Manalis, M., **Photoabsorption of the 4*d* electrons in xenon,** *J. Opt. Soc. Amer.* **65,** No. 6, 634-637 (June 1975).

Key words: atomic structure; inner shell; $N^{IV,V}$; resonance cross section profiles; spectroscopy; vacuum ultraviolet; xenon; 4d absorption.

In xenon, the cross section has been measured over the energy range 64-70 eV (194-177 Å) for two series of resonances that converge to the $4d^95s^25p^6(^2D_{5/2,3/2})$ limits. By a parametrization technique the cross-section amplitude and widths of these resonances have been obtained. The oscillator strength, averaged over the interval between resonances, and the widths of resonances in each series are essentially constant. The oscillator strength in these $4d^95s^25p^6(^2D_{5/2,3/2})np$ series is small (0.06) compared to the total continuum oscillator strength integrated over open p and f channels. The ratio of the cross section at the $4d^95s^25p^6(^2D_{5/2})$ limit to the cross section at the $4d^95s^25p^6(^2D_{3/2})$ limit had a value of 1.4(4), consistent with the ratio of the statistical weights of the $N_{IV,V}$ levels.

15055. Julienne, P. S., Krauss, M., **Predissociation of the Schumann-Runge bands of O_2,** *J. Mol. Spectrosc.* **56,** 270-308 (1975).

Key words: ab initio calculation; level shifts; line broadening; molecular oxygen; predissociation; spin-orbit matrix elements.

The predissociation line broadening in the Schumann-Runge bands of O_2 is interpreted through an ab initio calculation of the pertinent repulsive potential energy curves and spin-orbit matrix elements. The ab initio results provide an overall qualitative picture of the predissociation which is further refined through a detailed comparison of calculated level shifts and widths with experimental data. The position of the dominant repulsive curve is also deduced by a deperturbation of the level shift in the second vibrational difference. The predissociation is dominated by the $^5\Pi_u$ state crossing the $B\ ^3\Sigma_u^-$ state around 1.875 Å with a spin-orbit matrix element of 65 cm^{-1}. The $^1\Pi_u$ and $^3\Pi_u$ states have small spin-orbit matrix elements and play only minor roles in the predissociation. The calculated and experimental widths are in good agreement for low and high vibrational levels. The apparent experimental widths between $v=5$ and 11 are shown to be inconsistent with the theoretical analysis, the difference probably being due to line blending.

15056. Spencer, L. V., **Structure shielding against initial radiations from nuclear explosions. I. Attenuation of air secondary and fission product gamma rays,** *Nucl. Sci. Eng.* **57,** 129-154 (1975).

Key words: effects of nuclear weapons; fission product gamma rays; gamma ray penetration; initial nuclear radiations; neutron penetration; radiation shielding.

Calculations and resulting data are described which are intended for use in estimating the protection afforded by buildings against nuclear radiations emitted from a nuclear burst in the first half minute or so. The basic source configuration is that for which one assumes equal likelihood of the explosion occurring on a ring of elevation 30 deg above the horizontal, relative to a structure location on the ring axis. Source spectra and angular distributions corresponding to large distance ($\gtrsim 1$ mile) from burst point to structure are used. As sources we discuss here only gamma rays from fission products and from neutron interactions with air molecules.

15057. Hosler, W. R., Frederikse, H. P. R., **Doped ceria for MHD-materials,** (Proc. Sixth Int. Conf. on Magnetohydrodynamic Electrical Power Generation, Washington, D.C., June 9-13, 1975), Paper in *MHD Sixth International Conference on Magnetohydrodynamic Electrical Power Generation* **II,** Conf-750601-P2, 67-76 (The Energy Research and Development Administration-Fossil Energy, Washington, D.C., 1975).

Key words: conductivity; doped ceria; high temperature; MHD electrodes; mixed ceria.

A number of ceria compositions and ceria-based mixtures show promise as electrode material in MHD generators. This paper discusses the electrical conductivity and some of the chemical stability aspects of cerium oxide, cerium-zirconium oxide, Ta doped CeO_2 and Ta doped CeO_2-ZrO_2.

15058. Klose, J. Z., **Mean life of the 27 887-cm^{-1} level in U I,** *Phys. Rev. A* **11,** No. 6, 1840-1844 (June 1975).

Key words: delayed coincidence; f value; imprisonment; lifetime; mean life; resonance radiation; transition probability; U I; uranium.

Measurements of the mean life of the 27 887-cm^{-1} level in U I have been made at a single vapor density using electronic excitation and a method of delayed coincidence. The lifetime values were obtained by optically detecting the decay of the 3584.9-Å resonance transition. Using branching ratios obtained from known relative f values, the average of the measured lifetimes was corrected for imprisonment of the resonance radiation, and absolute f values were derived from the corrected lifetime giving the following results: $\tau_0=7.3\pm1.1$ nsec, $f_{3585}=0.18\pm0.03$, and $f_{4620}=0.20\pm0.03$. The error given with each quantity is the standard deviation as determined from the dispersion of the individual measurements. A systematic error of 1 percent due to possible nonlinearities in the time scale of the system is also assigned to the results. Unaccounted for systematic errors affect only the correction in the measured lifetime, which is small compared to the statistical error. The lifetime and f values are presented in comparison with the experimental results of another group of workers.

15059. Hebner, R. E., Jr., Booker, S. R., **A portable Kerr system for the measurement of high voltage pulses,** *Proc. 1975 IEEE Southeastcon, Charlotte, N.C., Apr. 6-9, 1975,* **1,** 3A-1-1/3A-5-1 (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1975).

Key words: calibration; electrical measurement; electro-optics; high voltage measurement; impulse measurement; Kerr effect; laser systems.

A portable system for the measurement of high voltage pulses based on the electro-optic Kerr effect has been constructed and tested. This system is designed to measure microsecond risetime pulses having a duration of less than one hundred microseconds and peak values from one thousand volts to more than one hundred thousand volts.

15060. Schooley, J. F., **National measurement system temperature—A micro study,** *Nat. Conf. Stand. Lab.—Newsletter* **15,** No. 1, 26-33 (Apr. 1975).

Key words: measurement accuracy; national temperature measurement system; temperature scale; thermometer calibration; thermometer production; thermometry.

The National Temperature Measurement System is briefly described. The nature of the international temperature scale and the standard thermometers are noted, along with the accuracy levels which are possible with the letter. The "commerce" of thermometry—the producers of sensors, calibrations, and measurements as well as the major users—is outlined, with particular emphasis upon the manner in which the National Bureau of Standards interacts with and contributes to the rest of the system.

15061. Kucirek, J., Melmed, A. J., **Influence of an initial (contamination) film on the determination of film properties by ellipsometry,** *J. Opt. Soc. Amer.* **65,** No. 5, 611-612 (May 1975).

Key words: ellipsometry; optics; thin films.

Computer calculations were done to evaluate the error in an ellipsometric determination of film thickness and refractive index, due to the unknown presence of a contamination film. The methods employed are described, and typical results are given.

15062. Schooley, J. F., Soulen, R. J., Jr., **Superconductive fixed points for thermometry in cryogenics,** *Instrument Society of America International Instrumentation-Automation Conference and Exhibit, New York, N.Y., Oct. 28-31, 1974,* Paper 74-620, pp. 1-5 (1974).

Key words: fixed points; SRM 767; superconductivity; transition temperatures.

Research at the National Bureau of Standards has shown that several elements exhibit very sharp and reproducible superconductive transitions. This research led to the development of a device, now offered to the cryogenics industry through the Office of Standard Reference Materials, which permits the attainment of ± 0.001 K reproducibility at the superconductive transitions of Pb ($T_c \sim 7.2$ K), In ($T_c \sim 3.4$ K), Al ($T_c \sim 1.2$ K, Zn ($T_c \sim 0.85$ K), and Cd ($T_c \sim 0.5$ K). The device is easily mounted into a cryogenic facility and the superconductive transitions are readily observed using a simple a.c. bridge circuit recently developed. Care must be taken, however, to exclude ambient magnetic fields or to correct the transitions for the field present in the laboratory. In order to extend the usefulness of the device, we have been examining the width and reproducibility of the superconductive transitions of Nb_3Sn ($T_c \sim 18$ K), Ir ($T_c \sim 0.1$ K), Be ($T_c \sim 0.023$ K), and W ($T_c \sim 0.015$ K) with the view of establishing these materials as additional fixed points.

15063. Laughlin, D. E., **On the imaging of composition modulations,** *J. Appl. Crystallogr.* **7,** Part 6, 635 (Dec. 1974).

Key words: composition modulations; contrast mechanism; electron diffraction; electron microscopy; lattice images; modulation images; satellites; spinodal decomposition.

A new interference contrast mechanism in transmission electron microscopy is presented and compared with the well known lattice imaging technique. This mechanism is termed "modulation imaging" as it may be used to study the periodic composition modulations which occur in crystalline alloys which undergo spinodal decomposition.

15064. Wiese, W. L., Kelleher, D. E., Helbig, V., **Variations in Balmer-line Stark profiles with atom-ion reduced mass,** *Phys. Rev. A* **11,** No. 6, 1854-1864 (June 1975).

Key words: Balmer; hydrogen; ion dynamics; plasma; Stark broadening.

Calculations of the Stark broadening of hydrogen lines treat the radiating atoms and the perturbing ions as quasistatic. The present experiment represents an attempt to determine whether the possible breakdown of this approximation near the center of the line can account, at least partially, for the existing discrepancies between theoretical and experimental profiles in the core of the Balmer lines. The central regions of H_α, H_β, H_γ, and H_δ profiles have been measured in a wall-stabilized arc over a range of atom-ion relative velocities by varying the atom-ion reduced mass. The cores of all four lines exhibit a significant dependence on the reduced mass. With increasing reduced mass, the experimental profiles gradually show more structure, but still less than the theories predict. Extrapolation of the results for H_α and H_β to infinite reduced mass, i.e., to the static case, gives results that agree quite well with recent calculations.

15065. Armstrong, G. T., Domalski, E. S., **Energy from wastes,** *Report of the Conference on Thermodynamics and National Energy Problems, Warrenton, Va., June 10-12, 1974,* pp. 386-400 (National Academy of Sciences, National Research Council, Washington, D.C., 1974).

Key words: fuel from waste; incinerators; organic waste conversion; thermodynamic data for incinerators; waste utilization.

Today I am your garbageman. I hope you will consider this is an honorable estate. The problem posed by accumulating wastes of all kinds can be enormous; failure to solve it effectively can be fatal to any human community. How fortunate we would be not just to prevent it from overwhelming us, but to find a simultaneous solution to another equally grave problem. There are signs that this can be done, at least in part.

15066. Voigt, P. A., **Measurement of U I and U II relative oscillator strengths,** *Phys. Rev. A* **11,** No. 6, 1845-1853 (June 1975).

Key words: flow-stabilized arc; oscillator strength; U I; U II; wall-stabilized arc.

Relative *gf* values for 49 prominent U II lines and 21 of the strongest U I lines have been measured. The U II measurements were made using a wall-stabilized arc into which the uranium was introduced in the form of UF_6. The U I values were measured with a flow-stabilized arc which is essentially a free-burning arc stabilized by streaming argon around one of the electrodes which is formed from a molten ball of uranium held in a tungsten cup. Temperatures in the wall-stabilized and flow-stabilized arc were 10 500 K and 5500 K, respectively. The U I relative *gf* values were placed on an absolute scale employing a recent lifetime determination for the 27 887-cm^{-1} level of U I. This absolute scale was extended to the U II values by measuring the relative intensity of a U I and a U II line in the wall-stabilized arc.

15067. Hougen, J. T., Radford, H. E., Evenson, K. M., Howard, C. J., **Analysis of the laser magnetic resonance spectrum of HO_2,** *J. Mol. Spectrosc.* **56,** 210-228 (1975).

Key words: asymmetric rotor levels; HO_2; laser magnetic resonance; rotational constants; spectral assignments; spin splitting; Zeeman spectrum.

An analysis of the previously detected laser magnetic resonance spectrum of HO_2 is carried out by (i) assigning M_J quantum numbers to each observed Zeeman line, (ii) determining the quantum numbers ($N'_{Ka'Kc'} - N''_{Ka''Kc''}$) and energies of the zero-field asymmetric rotor transitions involved, and (iii) determining the values of the zero-field spin-rotation doublet splittings in the upper and lower states of each asymmetric rotor transition. The rotational transitions obtained lie in the region 50-150 cm^{-1}, with quantum numbers $4 \leq N \leq 19$ and $1 \leq K_a \leq 4$. They are fit to an asymmetric rotor program to obtain the three rotational constants A, B, C and the three symmetric-top centrifugal distortion constants D_K, D_{NK}, D_N. The spin splittings are fit to an approximate theoretical expression involving two adjustable linear combinations of components of the spin-rotation interaction tensor ϵ. Because of the lack of spectra from other isotopic species, a unique molecular geometry cannot be derived.

15068. Reader, J., Epstein, G. L., **Resonance lines of Cs II, Ba III, and La IV,** *J. Opt. Soc. Amer.* **65,** No. 6, 638-641 (June 1975).

Key words: barium; cerium; cesium; ionization energy; lanthanum; wavelengths.

The resonance line spectra of ions in the Xe I isoelectronic sequence, consisting of the 5 transitions to the $5p^6\ {}^1S_0$ ground state from levels with $J = 1$ in the $5p^5 5d$ and $6s$ configurations, have been observed for Cs II, Ba III, and La IV. The observations were made with a sliding spark on the 10.7-m normal-incidence vacuum spectrograph at NBS. The resonance transitions from the $5p^5 6d$ and $7s$ configurations were also observed for these ions, except for that from $5p^56d\ ^3P_1$ of Ba III. Several resonance transitions from higher *nd* and *ns* levels were also observed. Estimated values for the $J=1$ levels of the $5p^57s$ configuration of Ce V were obtained by extrapolation. The derived ionization energies in eV are Cs II 23.17(4), Ba III 35.79(6), La IV 45.95(6), Ce V 65.55(25).

15069. Harrison, G. A., **The high-rise fire problem,** *CRC Critical Rev. Environ. Control* **4,** No. 4, 483-505 (Oct. 1974).

Key words: flame spread and smoke development; high-rise; human behavior; life safety; plastics.

This study focuses on life safety aspects of high-rise buildings located within the United States. A high-rise building is defined as one which exceeds 24.4 meters (80 feet) and is of a Light or Ordinary hazard occupancy classification as specified by the National Fire Codes, "Standard for Installation of Sprinkler Systems," Volume 6, No. 13, 1974. The purpose of this study is to identify and analyze the high-rise fire problems to formulate research recommendations to the Programmatic Center for Fire Research at the National Bureau of Standards.

A comprehensive review of the pertinent literature indicates that only a limited number of high-rise fire problems exist. These include increasing fuel loads and fire spread potential, smoke development and movement, life safety and occupant evacuation, and fire department operations. These specific problem areas relate to building evacuation and the vertical movement of smoke and toxic gases through a building.

A major finding of this study is that fire fatalities occurring within high-rise buildings have been few in number, historically. However, with changing construction techniques and materials, this fire experience record is subject to change. The future high-rise fire problem must be managed through the use of progressive engineering design which will keep pace with innovative high-rise building technology and interior design concepts.

15070. Ottinger, C., Scheps, R., York, G. W., Gallagher, A., **Broadening of the Rb resonance lines by the noble gases,** *Phys. Rev. A* **11,** No. 6, 1815-1828 (June 1975).

Key words: line broadening; rubidium.

Normalized emission spectra of the optically excited Rb resonance lines (7800 Å, 7948 Å) have been measured in the presence of He, Ne, Ar, Kr, and Xe for about 50 Å on either side of the lines. The perturber gas pressures were in the range 100-1100 torr and the temperature was 318 K. The spectra, normalized to the total emission, are shown to be due to binary collisions. Shifts and widths of the Lorentzian cores of the lines were obtained, at pressures sufficiently low for impact theory to apply. The widths are corrected for the Rb hfs and the instrument function. Various power-law fits to the near-wing intensities are presented and compared to theoretical expectations. The red satellites reported by other authors are found to be, in the low-pressure limit, mere shoulders on the line wing for Ar and Kr, while Xe barely produces an actual peak. The measured linewidths and shifts are compared to previous measurements.

15071. Cotton, I. W., **Standards for network graphics communications,** *Comput. & Graphics* **1,** 45-47 (1975).

Key words: computer graphics; computer networks; graphics; networks; protocol; standards.

Common protocols provide a means for the interchange of information between dissimilar systems in a computer network. This paper discusses the background and philosophy of the common graphics protocol currently under development for the ARPANET and outlines the details of its design. Other applications for such a protocol are suggested.

15072. Cotton, I. W., **Methodologies for the cost-benefit analysis of computer graphics systems,** *Comput. & Graphics* **1,** 33-43 (1975).

Key words: computer graphics; cost-benefit analysis; cost-effectiveness; economics; performance evaluation.

This paper assesses the state of the art in cost-benefit analyses of computer graphics systems and suggests an approach for developing improved methodology. Cost-benefit analyses are distinguished from analyses of system performance in that the latter is directed at optimizing system performance at a given level of investment, while the former is directed at justifying the investment itself.

Computer graphic system design alternatives are first outlined. Then methods of analyzing the performance and costs of computer systems in general and graphic systems in particular are discussed. With this information it is shown how cost-effectiveness analyses may be performed. The next crucial step is to conduct benefit analysis, an ill-defined art. The results of benefit analysis must be combined with cost-effectiveness analysis in order to perform the desired cost-benefit analysis.

An experimental methodology is suggested for better performing benefit analyses of computer graphics systems. A more rigorous formulation of the cost-benefit procedure is then outlined. No attempt is made in this report to actually perform such an analysis.

15073. Meshkov, S., **Current and constituent quarks,** *Proc. XVII Int. Conf. on High Energy Physics, London, England, July 1974,* pp. II-101 – II-112 (1974).

Key words: algebra of currents and quarks; constituent quarks; current quarks; hadronic structure; melosh transformation; meson spectroscopy.

In this review a summary of our attempt to establish and understand the connection between hadron spectroscopy and the algebra of currents is discussed. In addition, our present knowledge of meson structure and decays is reviewed.

15074. Hurst, W. S., **Note on the measurement of the response of oceanographic temperature sensors,** *J. Geophys. Res.* **80,** No. 18, 2663-2666 (June 20, 1975).

Key words: oceanographic temperature measurements; temperature measurement; temperature sensors; thermometry; time constant; time response.

The response times of three different types of oceanographic platinum resistance temperature sensors were measured employing the conventional rotating water container procedure. At low sensor immersion velocities (< 100 cm/s) the response was strongly dependent upon the details of the sensor insertion velocity for one sensor design. With carefully defined measurement procedures, reproducible values for the "time constant" were obtained, but their application in data analysis must be treated with caution.

15075. Bardsley, J. N., Holstein, T., Junker, B. R., Sinha, S., **Calculations of ion-atom interactions relating to resonant charge-transfer collisions,** *Phys. Rev. A* **11,** No. 6, 1911-1920 (June 1975).

Key words: atom; collision; Cs_2^+; ion; Li_2^+; low energy; Na_2^+; pseudopotential; Rb_2^+; resonant charge transfer.

The interaction between an atom and ion of the same element leads to gerade and ungerade states of the diatomic molecular ion. The energy splittings between the gerade and ungerade states determine the cross section for resonant charge transfer. Using the JWKB approach these energy splittings are derived from the asymptotic forms of the wave functions for the isolated

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atom and ion. Pseudopotential calculations of the splittings are reported for Li_2^+, Na_2^+, Rb_2^+, and Cs_2^+, and are used together with previous *ab initio* and model-potential calculations to test the JWKB method. The comparison shows that the method is sufficiently reliable to facilitate accurate calculations of the cross sections for resonant charge transfer at low energies.

15076. Vogler, M., Dunn, G. H., **Dissociative recombination of electrons and D_2^+ to yield D(2*p*)**, *Phys. Rev. A* **11**, No. 6, 1983-1987 (June 1975).

Key words: crossed beams; cross section; D_2^+; dissociative recombination; electron scattering; $L\alpha$ radiation.

Cross sections have been measured as a function of electron energy (1.4 to 7.5 eV) for production of L_α photons from the dissociative recombination of electrons and D_2^+. Ions made in a low-pressure ion source by electron bombardment and formed into a beam are reacted at right angles with a magnetically confined electron beam. Recombination was observed by detecting L_α photons from resultant excited atoms. It was demonstrated that a large fraction of the observed light arises from cascade to the 2*p* state from levels of higher principal quantum number. The measured cross section is thus presented as an upper limit for formation of D(2*p*) in the dissociative recombination process. The results, represented approximately by the expression $\sigma(2p) < (7.6 \times 10^{-17})E^{-1.25}$ cm^2, indicate that recombinations leading to formation of a D(2*p*) are a small fraction of the total recombination measured by Peart and Dolder.

15077. Cotton, I. W., Meissner, P., **Approaches to controlling personal access to computer terminals**, *Proc. 1975 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., June 18, 1975*, pp. 32-39 (IEEE Computer Society, Long Beach, Calif., 1975).

Key words: access; access control; authentication; computer networks; computer security; computer terminals; personal identification.

The advent of time-sharing and computer networking has resulted in a proliferation of computer users, many of whom are located remotely from the computer which serves them. This has been accompanied by increased opportunities for unauthorized users to gain access to computers and has focused attention on the problem of identifying and authenticating properly authorized users. The requirements of the recently-enacted Privacy Act of 1974 calls for a number of safeguards in the handling of personal information by the Federal agencies, and personal identification of personnel authorized to have access to such information is an important aspect of the implementation of this law. This paper considers the various approaches to personal identification and authentication, on the basis of things known to an individual, things possessed by an individual, and characteristics of an individual, such as appearance, handwriting, voice, fingerprints, and hand geometry.

A set of evaluation criteria is presented as a guide in selecting personal identification systems for various applications. It is pointed out that currently-available systems are vulnerable in varying degrees to erroneous recognition and circumvention, and therefore should be incorporated into a hierarchical security system which utilizes a variety of safeguards, including auditing features to provide a record of what is accessed, by whom, and for what purposes.

15078. Garfinkel, S. B., Schima, F. J., **Ionization chamber half-life measurement of the 99-minute ^{113}In isomer**, *Int. J. Appl. Radiat. Isotop.* **26**, 314-315 (May 1975).

Key words: half-life measurement; isomeric decay; isotope $^{113}In^m$; radioactivity; rate of charge measurement; $4\pi\gamma$ pressure ionization chamber.

A precise determination of the $^{113}In^m$ half-life has been made by means of a nominal $4\pi\gamma$ pressure ionization chamber. The value obtained was 99.21 min with an uncertainty of 0.13 min which is the linear sum of the component of random error at the 99 percent confidence level and the estimated systematic errors.

15079. Cooper, J. W., **Photoionization of inner-shell electrons**, Chapter 3 in *Atomic Inner-Shell Processes, Vol. 1, Ionization and Transition Probabilities*, pp. 159-199 (Academic Press, Inc., San Francisco, Calif., 1975).

Key words: atomic; inner shell; photoionization; quantum-mechanical.

This chapter of "Inner Shell Processes" (to be published by Academic Press) provides a survey of theoretical methods used in treating inner shell photoeffect. The subject is approached from a quantum-mechanical viewpoint and various approaches are related within this context.

15080. Baker, D. W., Sayre, C. L., Jr., **Decay of swirling turbulent flow of incompressible fluids in long pipes**, (Proc. 1st Symp. on Flow, Pittsburgh, Pa., May 10-14, 1971), Chapter in *Flow, Its Measurement and Control in Science and Industry. Part I. Flow Characteristics*, H. W. Stoll, Ed., **1**, 301-312 (Instrument Society of America, Pittsburgh, Pa., 1974).

Key words: decay of swirling flow; helical flow; pressure differential during swirling flow; swirling flow.

The decay of swirling flow fields in steady-state flow in cylindrical, unobstructed, smooth pipes is considered from measurements made in two pipes. With water flowing in one pipe, mean point velocities and static pressures including wall pressures were measured at several stations along the pipe. With liquid hydrocarbons flowing in the other pipe, measurements were made of wall pressure and the swirling motion of the fluid, as sensed by a vaned rotor. The investigation included the pipe Reynolds number (Re) range 12,500 to 200,000 and for the vortex flows generated, the product K/MD varied from 0 to 0.9, where K is the angular momentum flux, M is the axial momentum flux, and D is the pipe i.d. Results including those of other sources show that K decreases exponentially along the pipe at a decay rate β ranging from about 2 percent per pipe diameter at Re = 200,000 to 4 percent per pipe diameter at Re = 12,500; and that data scatter and values of β for other sources demonstrate dependence of β on the inlet geometry, and possibly on K and system turbulence characteristics. Other results show the ratio of the pressure gradient along the wall during swirling flow to nonswirling flow varies primarily with the angular momentum flux. The behavior of swirling flow fields is not well known, and these facts can aid in an improved description of swirling fields in which the performance of flow measurement and control devices might be evaluated.

15081. Ambrose, J. R., Kruger, J., **Breakdown of passive films on iron by chloride ion**, *Proc. 4th Int. Congress on Metallic Corrosion, Houston, Tex., Sept. 1969*, pp. 698-704 (National Association of Corrosion Engineers, Houston, Tex., 1972).

Key words: breakdown passivity; chloride; ellipsometry; iron; passivity; pitting.

The breakdown of passive films on iron in pH 8.4 sodium tetraborate/boric acid solution by the action of chloride ions has been studied using a combination of ellipsometric and electrochemical techniques. Two induction times associated with the breakdown process were observed. At t_1, anodic current increases due to increased ionic conduction through the film, followed at t_2 by a localized growth of thick oxide film. These induction times are influenced by chloride ion concentration, time of passive film growth, and temperature of film growth.

Growth kinetics of the passive film in the presence of chloride ion is indistinguishable from that in its absence below a potential E_a^2, that potential above which ferrous ion is not found in solution. Above this potential, breakdown occurs and film growth in the presence of chloride ion results in no limiting thickness.

The results indicate that adsorption and complete penetration by chloride ion to the metal surface is necessary to initiate pitting. When complete penetration occurs, subsequent precipitation of porous γ-FeOOH allows easy local dissolution leading to pitting. After breakdown, a lowering of potential to values below E_a^2 causes an apparent repassivation of the film as indicated by the fact that raising the potential above E_a^2 results in another incubation period before breakdown.

15082. Bartel, T. W., Schade, P. A., **Digital processing of decay rates for reverberant sound fields,** *Proc. 1974 Int. Conf. on Noise Control Engineering, Washington, D.C., Sept. 30-Oct. 2, 1974,* pp. 61-64 (Oct. 1974).

Key words: digital processing of decay rates; digital sampling; graphics display terminal; interactive program; least-squares analysis; real-time analyzer; reverberation room; spectrum shaping.

The installation of a 64K byte minicomputer to the NBS Sound Laboratory has made the capabilities of digital processing available for application to the various types of reverberation-room measurements. The present work applies this technique to reverberant field decay rate measurements. Such measurements conducted with analog equipment are limited by the amount of time and labor required to make and process the large number of decay curves necessary to achieve precise results. Reduction of these limitations is realized by interfacing the computer to digital sampling equipment capable of processing thirty 1/3-octave bands simultaneously. Through control of the reverberation room sound source and signal-processing equipment, the computer can conduct decay measurements and apply a least-squares analysis to the stored data to compute the decay rates. The software is to be expanded into an interactive program allowing the experimenter to observe the data on a display device and insert his own decisions into the data reduction process.

15083. Alberi, J. L., Wilson, R., Schröder, I. G., **Parity violation in neutron-capture gamma-rays,** *Phys. Rev. Lett.* **29,** No. 8, 518-521 (Aug. 21, 1972).

Key words: internucleon-force; parity-violation.

We have measured the circular polarization of γ rays from thermal neutron capture in ^{113}Cd and find a $P_\gamma = (6.0 \pm 1.5) \times 10^{-4}$ for the combined 8.51- and 9.04-MeV transitions. This value was measured using a transmission Compton polarimeter and pulse-counting technique. The value confirms the existence of parity-nonconserving terms in the internucleon force.

15084. Donnay, J. D. H., Ondik, H. M., **Crystal data determinative tables, Vol. 1. Organic compounds,** 999 pages (1972); **Vol. 2. Inorganic compounds,** 2106 pages (1972).

Key words: cleavage; compilation; crystal; crystal habit; crystal space group; crystal structure types; density; determination; identification; minerals; optical properties; twinning; unit cell dimensions.

This edition, which will comprise two volumes, is a thoroughly revised and updated work, containing over 24,000 entries. Some 7,500 carbon-containing crystalline compounds are given in Volume I. They are listed, within each crystal system, according to increasing values of a determinative number: *a*/*b* ratio in trimetric systems, *c*/*a* ratio in dimetric systems, cubic cell edge *a* in the isometric system. Conventional rules insure the uniqueness of crystal setting.

For each crystalline species the following properties are listed on the first line: axial ratio(s) and interaxial angles not fixed by symmetry, cell dimensions, space group or diffraction aspect, number of formula units per cell, crystal structure (whether determined), measured density, x-ray calculated density. Then come: name of the compound, synonym(s), chemical formula, literature reference, transformation matrix (when the original data had to be recast to conventional cell and setting). Additional information includes some or all of the following: crystal-structure type (if any), goniometric axial ratio(s), crystal habit, cleavages, twinning, color, optical properties, indices of refraction, optical orientation (except in the anorthic system), melting point, transition point.

Nearly all the data were obtained from original sources. "Limits of error" on numerical values are quoted from the reference. The data have been tested for self-consistency by means of computer programs. Any erratum found either in the reference or in an abstracting journal (e.g., *Structure Reports*) is specifically mentioned: erroneous values are thus identified. Editorial critical remarks point out possible errors in the literature.

Formula and name indexes enable one to learn if crystallographic information is available on any given compound, thereby providing a starting point for bibliographic searches.

15085. Piermarini, G. J., Block, S., Barnett, J. D., Forman, R. A., **Calibration of the pressure dependence of the R_1 ruby fluorescence line to 195 kbar,** *J. Appl. Phys.* **46,** No. 6, 2774-2780 (June 1975).

Key words: calibration; diamond cell; fluorescence; high pressure; hydrostatic pressures; ruby.

The pressure dependence of the R_1 ruby fluorescence line has been calibrated at 25 °C against the compression of NaCl. Pressures are determined using the Decker equation of state for NaCl. The dependence is linear to 195 kbar following the equation $P_{NaCl} = 2.746(\Delta\lambda)$, where P is in kbar and $\Delta\lambda$ in Å. The uncertainty in the value of the slope, $dp/d\lambda$, expressed in terms of a 95 percent confidence interval is 2.746 ± 0.014 kbar Å^{-1}. The coefficient of the quadratic term $(\Delta\lambda)^2$ is not significantly different from zero; and the quadratic term makes indeed a negligible contribution to the fit. Taking into account the reported uncertainty associated with the Decker equation of state for NaCl, the value of the slope is 2.740 ± 0.016 kbar Å^{-1} within a 95 percent confidence interval.

15086. Malitson, I. H., Lechner, J. A., **Refractive index variance in auto headlamp glass,** *Crime Lab. Dig.* **75,** No. 5, 8-11 (July 1975).

Key words: auto headlamp glass; population; refractive index; RI variance; statistics; temperature coefficient.

The work described in this paper was designed to evaluate the refractive index (RI) variance within and between auto headlamp glass currently manufactured in the U.S.A. The purpose is to provide the criminalist with a reliable statistical data base for decision making when confronted with this type of evidence. A precision refractometer was used to measure point-to-point RI variations within the lens components of new and used lamps. At least 13 pieces of glass from each of 46 lenses were evaluated. The spread of RI for all glasses was found to be 1.475 – 1.478. From these data it was ascertained that the headlamp glass population consists of three groups: newer and older glass made by Company A and all glass made by Company B. The newer glass significantly differs by 3×10^{-3} in RI from the other two groups whose distribution of RI values overlap. This difference is many times larger than the standard deviation within each group and within a single lens. The change in RI with temperature was determined.

15087. Baker, D. W., Koenig, A. L., **An automated prototype test system for aircraft engine fuel controls, design and operating experience,** *Proc. 13th Annual Tech. Symp., Washington, D.C., Chapter ACM, June 20, 1974,* pp. B.4.1-B.4.11 (Association for Computing Machinery, New York, N.Y., 1974).

Key words: automated test equipment; automated tests for jet engine fuel controls; computer interfacing; digital computer controlled tests; jet engine fuel control testing; minicomputer applications; minicomputer controlled tests; supervisory control; test equipment reliability.

The adjustment and calibration of the fuel control, the accessory which meters flow to the engine burners, requires long-term bench tests involving many often repeated manual operations. Minicomputer-based hardware and software systems, developed during 1968-1971, which control an existing production test stand are reviewed. The systems automating this stand, used in the rework of TF-30 engine controls, simulate engine parameters burner pressure and drive shaft speed using supervisory control. Also, metered fuel flow is measured and read out. An auxiliary panel at the test stand containing readout and input devices enables the operator to run the test. This prototype system has served as basis for two test systems, under contract and slated for production, which will automate nine stands.

15088. Freeman, D. H., Angeles, R. M., **The influence of hydrogen bonding upon gel permeation chromatography,** *J. Chromotogr. Sci.* **12,** 730-735 (Nov. 1974).

Key words: adsorption; gel permeation chromatography; hydrogen bonding; liquid chromatography.

Chloroform, methanol and benzoic acid are hydrogen bonding compounds that are simultaneously adsorbed and self-associated during liquid chromatography from carbon tetrachloride with polystyrene/divinylbenzene (Styragel). An equation is derived to treat the measured distribution coefficient dependence upon solute concentration. In dilute solution, chloroform and methanol exhibit the effect of adsorption without appreciable self-association. At higher concentrations methanol and benzoic acid show markedly less adsorption. This is the expected result as larger associated species are formed and then excluded sterically. The agreement between theory and experiment is better if one assumes that only the monomeric species is adsorbed. Experiments of this type are easily performed and they provide a helpful insight into the chromatographic mechanism.

15089. Waclawski, B. J., Vorburger, T. V., Stein, R. J., **Angular dependence of uv photoelectron distributions for oxygen adsorbed on W(100),** *J. Vac. Sci. Technol.* **12,** No. 1, 301-304 (Jan.-Feb. 1975).

Key words: angular distributions; bond geometry; chemisorption; energy distributions; oxygen on (100) tungsten; surface bonds; uv photoemission.

Recent theoretical work has suggested the possibility of determining chemisorption bond geometry by the use of uv photoemission. This possibility is being investigated experimentally in an apparatus developed at NBS. The apparatus is described, and preliminary results are presented which show energy distributions as a function of emission angle for electrons photoemitted from W(100), both clean and with adsorbed oxygen. The results obtained at $h\nu = 21.2$ eV for several emission angles indicate substantial angular dependence of the photoelectron distributions, not only for the clean (100) surface, but also, more dramatically, with an oxygen adlayer.

15090. Penn, D. R., **Determination of the spin-polarized surface density of states in strongly correlated metals by field emission: Theory,** *Phys. Rev. B* **11,** No. 8, 3208-3209 (Apr. 15, 1975).

Key words: ferromagnetic transition metals; field emission; spin polarization; strongly correlated metals; surface density of states; theory.

It is shown that the combination of spin-polarization and field-emission energy distribution measurements on ferromagnetic transition metals will provide direct information about the one-dimensional surface density of states in a direction normal to the metal surface for a given spin.

15091. Vorburger, T. V., Penn, D., Plummer, E. W., **Field emission work functions,** *Surface Sci.* **48,** 417-431 (1975).

Key words: electron energy distribution; field emission; tungsten; work function.

Field emission has proven to be a very useful technique for obtaining work function changes from single crystal planes or from the whole emitter. The inability to independently measure the electric field has limited the accuracy of field emission total current measurements for determining absolute work functions. Young and Clark's method of combining field emission energy distribution measurements and total current versus voltage measurements to eliminate the electric field as an unknown is not adequate because it does not take into account the effects of the surface density of states present in the energy distribution. In this paper we discuss a technique to overcome this problem, which involves a series of measurements taken as a function of electric field and an extrapolation to zero field. The method yields reliable values of the work function for the low index (flat) (100) and (112) planes of tungsten but not for the high index (rough) (013) and (111) faces.

15092. Bennett, A. J., Penn, D., **Optical properties of adsorbate atoms,** *Phys. Rev. B* **11,** No. 10, 3644-3657 (May 15, 1975).

Key words: adsorbate atom; dielectric function; electronic states; optical adsorption.

We calculate the dielectric response of adsorbate atoms on a metal surface assuming an Anderson model of the system. The dielectric function is then used to predict the change in the surface optical reflectance caused by the adsorbates. General results are obtained for substrates with one and two electron bands with and without the assumption of momentum conservation in the band-to-band optical transitions. A detailed analysis is carried out for the single-band momentum-conserving case. Here, the model is the same as that studied by Caroli and Kjollerstrom if the substrate density of states and various matrix elements are taken to be constants. However, we find an additional nonnegligible contribution omitted in their analysis. In other single-band cases, we show the wide variety of behavior which may be obtained for different parameter ranges and provide expressions to be used in data analyses.

15093. Abrams, M. D., **A new approach to performance evaluation of computer networks,** *Proc. 1974 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., May 23, 1974,* pp. 15-20 (Institute of Electrical and Electronic Engineers, Inc., New York, N.Y., 1974).

Key words: computer; evaluation; measurement; performance; service; utility.

Interactive conversational computing requires more appropriate measures of performance than those presently applied toward improving the efficiency of system operation. A "stimulus-acknowledgement-response" model has been conceptualized to describe the man-computer interaction. A data acquisition system called the Network Measurement Machine has been developed meeting the objective of being able to measure the delivery of computer services to any user. A set of analysis programs providing statistical summaries of workload, response, and communications utilization analysis over subsets of a conversation, such as use of specific software services, are potentially useful to systems designers and implementers. A sample application is presented with preliminary results.

15094. Armstrong, G. T., Domalski, E. S., Minor, J. I., Jr., **Standard combustion data for the fuel gas industry,** *Proc. American Gas Association Section Conf., Atlanta, Ga., May 8-10, 1972,* pp. D-74 – D-87 (1972).

Key words: enthalpy of combustion, dry basis; enthalpy of combustion, saturated basis; enthalpy of formation, hydrocarbons, heating value; hydrocarbons; International System of Units.

Equity in the sale of natural gas or other gases for fuel purposes requires that the total calorific values be accurately known and that the same values be used throughout the industry for gases of identical properties. This paper gives the total calorific values (gross heats of combustion at constant pressure) of gaseous H_2, H_2S, CO, CH_4 and 49 selected other gaseous hydrocarbons, C_1 to C_6, in the ideal gas state at standard conditions of 60 °F and 30 in. Hg (288.71 K and 101591.3 $N \cdot m^{-2}$), on a molar basis, on a dry volumetric basis and on a water-saturated volumetric basis. Units used are $kJ \cdot mol^{-1}$, $MJ \cdot m^{-3}$, $Btu_G \cdot (scf)^{-1}$.

A supplementary table is given for the total calorific values of the same substances in the ideal gas state at the slightly different standard conditions of 60 °F and 14.73 psia (288.71 K and 101559.8 $N \cdot m^{-2}$) on a dry volumetric basis and on a water-saturated volumetric basis. Units used in this table are $MJ \cdot m^{-3}$ and $Btu_{IT} \cdot (scf)^{-1}$. Total calorific values for real-gas methane are also given on the above bases. Enthalpies of combustion and molar heat capacities of crystalline carbon (graphite), and all the above named gases are given in the thermodynamic standard states at 298.15 K. Procedures for making the calculations, and necessary auxiliary data are given. Implications of the possible change of the measurement system to metric untis are discussed.

15095. Plummer, E. W., Gadzuk, J. W., Penn, D. R., **Vacuum-tunneling spectroscopy,** *Phys. Today* **28,** No. 4, 63-71 (Apr. 1975).

Key words: field emission; field ionization; ion neutralization; surface spectroscopy; tunneling.

The extension into the vacuum of the exponential tail of the wave function makes possible remarkably sensitive techniques based on field emission, ion neutralization and field ionization.

15096. Bloss, R. L., **Evaluation testing of resistance strain gages,** *Proc. Tech. Session on Strain Gaging for Accuracy Conf., Milwaukee, Wis., Oct. 19, 1971,* pp. 1-5 (Society for Experimental Stress Analysis, Westport, Conn., 1975).

Key words: bonded resistance strain gage; combined effects; evaluation tests; fatigue; high temperature; performance characteristics.

Since it is usually impossible to determine the performance characteristics of the specific resistance strain gages that will actually be used in a test program, we must depend upon their behavior being predictable from tests that have been conducted on other gages. When resistance strain gages first became available, information about their performance was limited. The situation was further complicated during World War II when a number of organizations began producing gages, usually for their own use. A similar situation arose when the need for strain measurements at elevated temperatures induced a number of organizations to produce gages for such use. User and third party evaluation testing was instrumental in the development and characterization of the gages during these times. Today most manufacturers carry out continuing testing and evaluation programs to insure that the user can rely upon their products and to maintain and enhance their competitive positions in the field. However, the user must continue to carry out such tests when special requirements or test conditions are encountered.

A brief history of evaluation testing of bonded resistance strain gages is given, and two evaluation tests are described.

15097. Danos, M., Weller, H. R., **Correlation between the (d, γ_0) and (p, γ_0) cross sections in the giant dipole resonance of ^{16}O,** *Phys. Rev. C* **10,** No. 6, 2627-2628 (Dec. 1974).

Key words: giant resonance; intermediate structure; nuclear structure; particle-hole model; quasi-bound states; two-particle two-hole states.

The reaction theory of Fano is applied to the analysis of the $^{15}N(p, \gamma_0)^{16}O$ data *vis à vis* the $^{14}N(d, \gamma_0)^{16}O$ data. The result is consistent with the Gillet model which attributes the structure near 22.9 MeV in ^{16}O to a 2p-2h quasibound state.

15098. Saylor, C. P., **Microscopical determination of refractive index with an error of about ±0.00001,** *Anal. Chem.* **47,** No. 7, 1114-1120 (June 1975).

Key words: identification of compounds by refractive index; micro determination of refractive index; microscope for accurate determination of refractive index; multiple prisms.

Steep optical-glass prisms in contact with the liquid being measured bend a collimated monochromatic beam. The deflected beam enters the microscope, and an image of the target forms at the back focal plane of the objective. The distance of the image from the center is proportional to the sine of the angle of deviation and rigorously related to determinable constants of the system and the refractive index of the liquid. Accuracy increases with steepness of prism, but the refractive index range served by any one is thereby reciprocally decreased. Sine of the angle of deflection, angle of the particular prism being used, and the refractive index of the prism are sufficient for direct calculation of the refractive index of the liquid. When the angle of the prisms is 72°, an accuracy of 10^{-5} is achieved. Each prism (with a numerical aperture of 0.11) can then serve a range of only 0.06 in index. This necessitates a series of prisms of selected optical properties, each serving 0.05 in index and providing a comfortable overlap. About 1 cubic millimeter of liquid is required for a full determination.

15099. Gump, B. H., Hertz, H. S., May, W. E., Chesler, S. N., Dyszel, S. M., Enagonio, D. P., **Drop sampler for obtaining fresh and sea water samples for organic compound analysis,** *Anal. Chem.* **47,** No. 7, 1223-1224 (June 1975).

Key words: baseline studies; fresh water sampling; sampling device; sea water sampling; trace organic analysis; water pollution.

Analytical chemists have become more involved in projects concerning water pollution, environmental impact statements and hydrocarbon baseline studies. A device for obtaining replicate and representative samples of the aquatic environment under consideration is needed. A water sampler has been designed to meet this need.

15100. Unassigned.

15101. Ball, J. J., Keller, R. A., **Quantitative determination of gaseous nitrogen dioxide concentrations over long path lengths by selective absorption of argon ion laser emission,** *J. Air Pollut. Contr. Ass.* **25,** No. 6, 631-633 (June 1975).

Key words: absorption spectroscopy; air pollution; laser; NO_2.

An argon ion laser emits several laser lines in the visible region of the optical spectrum. The absorption coefficients of NO_2 at these laser emissions were measured in a multiple pass absorption cell. A differential technique, in which the ratio of the transmitted intensities of the argon laser emissions is measured, is described to determine the concentration of NO_2 in a polluted atmosphere over path lengths of several kilometers. Measurement of ratios eliminates interferences from particle scattering and thermal index gradients. Evaluation of the data taken in the 48 meter multipass cell indicates that concentrations of NO_2 less than one part per million could be determined in a 1 km optical path.

15102. Churney, K. L., West, E. D., Armstrong, G. T., **A cell model for isoperibol calorimeters,** *Proc. 1st Natl. Conf. on Calorimetry, Zakopane, Poland, Sept. 8-18, 1973,* pp. 1-43 (Polish Academy of Science, Institute of Chemical Physics, Warszawa, Poland, 1973).

Key words: calorimetry; energy equivalents; energy measurement; heat transfer; internal energy measurement; isoperibol calorimeters; measurement theory.

A calorimeter can be modeled as a large number of volume elements or cells in each of which the temperature may be considered uniform, and each of which can store heat and exchange heat with other cells. Application of the first law of thermodynamics to this set of cells leads to representations of the usual calorimetric equations for the energy change expressed in terms of measurable or estimatable heat capacities, heat transfer coefficients, temperatures, and work terms for the individual cells. Analysis of the results yields a framework within which most of the design and measurement problems of isoperibol calorimeters can be treated.

15103. Birky, M. M., Yeh, K. N., **Calorimetric study of flammable fabrics. I. Instrumentation and measurements,** *J. Appl. Polym. Sci.* **17,** 239-253 (1973).

Key words: calorimeter; fabrics; flammability; heat of combustion; rate of combustion.

A calorimeter has been designed, calibrated, and tested to measure the total amount of heat released and the rate of heat released from the combustion of fabrics in air. Calibration of the calorimeter gave a reproducibility of ± 3 percent for total heat measurements and ± 5 percent on rate measurements. Consideration of systematic errors gives an expected accuracy of ± 7 percent for total heat and ± 10 percent for combustion rate measurements. Measurements on cotton show that 90 percent of the standard heat of combustion is released when cotton is burned in air. The rate of heat release for cotton is independent of fabric weight. The constancy of rate of heat release as determined calorimetrically confirmed the result implied by the 45° test measurements on flame spread rate. The rate and amount of heat release of other commercial fabrics and blends were also measured.

15104. Kline, F. J., Lin, C. L., Peterson, G. A., Penner, S., **Inelastic electron scattering from ^{31}P,** *Nuclear Phys. A* **241,** 299-310 (1975).

Key words: electroexcitation; electron scattering; form factors; intermediate coupling; reduced transition probability; ^{31}P.

Form factors for the electroexcitation of the $3/2^+$ (1.27 MeV), $5/2^+$ (2.23 MeV), and $3/2^+$ (3.51 MeV) states in ^{31}P have been measured for momentum transfers from 0.36 to 0.80 fm^{-1} at the NBS electron scattering facility. In addition, form factors for the 2.23 MeV state in the momentum transfer range 0.74 to 1.78 fm^{-1} have been extracted from data obtained in a previous experiment. Using the DUELS distorted-wave code the $B(E2, \omega)\downarrow$ were found to be 6.0 ± 0.9, 6.9 ± 0.3, and 2.7 ± 0.3 W.u. for the 1.27, 2.23, and 3.51 MeV states, respectively. The form factors for these states, calculated using wave functions derived in an intermediate-coupling vibrational calculation, are compared with the data.

15105. Kan, P. T., Peterson, G. A., Webb, D. V., Szalata, Z. M., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Observation of electric monopole strength in the electrodisintegration of ^{3}He,** *Phys. Rev. Lett.* **34,** No. 14, 899-901 (Apr. 7, 1975).

Key words: electrodisintegration; electron scattering; inelastic electron scattering; monopole excitation; monopole strength; ^{3}He.

A broad electric monopole excitation peaking at 6.4 MeV has been observed in the breakup of ^{3}He induced by inelastic electron scattering. The monopole cross section was obtained from the observed cross section by subtracting the electric-dipole contributions converted from photodisintegration cross sections by using the virtual photon theory, and also subtracting the magnetic multipole contributions obtained from a 180° electron-scattering experiment. The extracted monopole matrix element is 2.4 ± 0.5 fm^2.

15106. Cram, S. P., Chesler, S. N., **Analytical fluidic sampling systems,** *J. Chromatogr.* **99,** 267-279 (1974).

Key words: automated systems; fluidic logic; gas chromatography; plasma chromatography; sampling.

Fluidic logic sampling systems have been developed for analytical detectors such as the plasma chromatograph and flame ionization detector. Automated systems are reported for gases and vapor-phase samples which are rapid, quantitative and reproducible. Sample modulation systems, multiplexers, parallel-to-serial converters and sequential samplers have been developed which give no leakage or cross-talk signals. Other applications in analytical chemistry are proposed.

15107. Saloman, E. B., **Unfolding first and second order diffracted radiation when using synchrotron radiation sources: a technique,** *Appl. Opt.* **14,** No. 6, 1391-1394 (June 1975).

Key words: calibrated XUV detectors; irradiance; radiometry; second order diffracted radiation; synchrotron radiation; XUV grating monochromators.

A technique is presented of using a single calibrated XUV detector for radiometric measurements of synchrotron radiation after the radiation passes through a monochromator that produces a mixture of first and second order diffracted radiation. Irradiance measurements are made with the synchrotron source operating at two different energies for the orbiting electrons. The known change in the spectral distribution produced by the electron energy change is used to calculate the flux in both first and second order. The dependence of the precision of these determinations on the two detected currents and on the detector calibration at both first and second order wavelengths is calculated. Experimental results using the National Bureau of Standards synchrotron (SURF-I) are presented, and anticipated results for the new NBS electron storage ring (SURF-II) are calculated.

15108. Cezairliyan, A., Righini, F., **Measurements of heat capacity, electrical resistivity and hemispherical total emittance of two grades of graphite in the range 1,500 to 3,000 K by a pulse heating technique,** *Rev. Int. Hautes Temp. Refract.* **12,** No. 2, 124-131 (1975).

Key words: electrical resistivity; graphite; heat capacity; high-speed measurements; high temperature; thermal emittance; thermodynamics.

Measurements of heat capacity, electrical resistivity and hemispherical total emittance of Poco and pyrolytic graphites in the temperature range 1,500 to 3,000 K by a sub-second duration pulse heating technique are described. For a given graphite grade, heat capacities of different specimens were in agreement within 0.5 percent. The difference between the results of the two different grades was about 1.8 percent; the results of Poco being higher than those of pyrolytic. Electrical resistivity of the Poco graphite was about four times greater than that of pyrolytic graphite (parallel to basal planes). Hemispherical total emittance of Poco graphite was almost twice that of pyrolytic graphite.

15109. Prask, H. J., Trevino, S. F., Rush, J. J., **Quasielastic neutron scattering study of ammonium-ion reorientations in ammonium perchlorate,** *J. Chem. Phys.* **62,** No. 10, 4156-4160 (May 15, 1975).

Key words: activation energy; ammonium-ion dynamics; ammonium perchlorate; jump reorientations; quasi-elastic neutron scattering; residence times.

An investigation of the rotational motion of ammonium ions in NH_4ClO_4 is reported. Quasielastic neutron scattering measurements were made on a polycrystalline sample at temperatures between 66 and 150 K. The shapes and widths of the quasielastic scattering peaks as a function of momentum transfer are consistent with instantaneous reorientation about the four C_3 axes. Residence times are derived as a function of temperature yielding an activation energy of 2.3 kJ/mole and a frequency factor $1/\tau_0$ of 3.7×10^{12} s^{-1}.

15110. Jacox, M. E., Milligan, D. E., **The infrared spectrum of methylenimine,** *J. Mol. Spectrosc.* **56,** 333-356 (1975).

Key words: C=N bond; infrared spectrum; isotopic substitution; matrix isolation; methyl azide; methylenimine; normal coordinate analysis; photolysis; thermodynamic properties.

Eleven isotopic species of methylenimine have been prepared by the mercury-arc photolysis of methyl azide isolated in argon, nitrogen, and carbon dioxide matrices at 4 and at 14 K. Sufficient concentrations of methylenimine were obtained for identification of all of the vibrational fundamentals except the NH stretching mode. Using a recent ab initio structural calculation for this molecule, it has been possible to derive a set of valence-force potential constants which provide a satisfactory fit to all of the infrared spectroscopic data. The magnitude of the carbon-nitrogen stretching force constant is appropriate for a double bond. The temperature dependence of the thermodynamic properties of methylenimine has also been calculated.

15111. Bennett, S. L., Lias, S. G., Field, F. H., **Ion-molecule reactions in ethane,** *J. Phys. Chem.* **76,** No. 26, 3919-3926 (1972).

Key words: ethane; gas phase kinetics; ion-molecule reactions; mass spectrometer; product ions.

The ion-molecule reactions in ethane have been investigated in a mass spectrometer at pressures from 0.1 to 5 torr and at temperatures ranging from 189 to 410 K. The major primary ions, $C_2H_4^+$, $C_2H_5^+$, and $C_2H_6^+$, react with ethane to form the respective addition ions, $C_4H_{10}^+$, $C_4H_{11}^+$, and $(C_2H_6)_2^+$. Under these conditions, the addition ions dissociate to give all the product ions which have been attributed to reactions of these primary ions in previous studies. The major product ions resulting from these dissociation reactions are the $C_3H_7^+$ and $C_4H_9^+$ ions, formed by dissociations of the $C_4H_{10}^+$ and $C_4H_{11}^+$ ions, respectively. The rate constants for disappearance of the primary ions decrease as the temperature is raised from 189 to 410 K, from 2×10^{-10} to 0.9×10^{-10} cm^3/molecule sec for the ethylene ion, from 2.5×10^{-10} to 0.5×10^{-10} cm^3/molecule sec for the ethyl ion, and from 2×10^{-10} to 0.5×10^{-10} cm^3/molecule sec for the ethane ion. There is no evidence that any of the product ions react further with ethane to give higher molecular weight addition ions under these conditions of temperature and pressure. When H_2O is added to ethane the ethylene ion is intercepted in a rapid reaction to form the $C_2H_4 \cdot H_2O^+$ complex, which reacts further with water to add a second, a third, and a fourth molecule of water.

15112. Clifton, J. R., Beeghly, H. F., Mathey, R. G., **Protecting reinforcing bars from corrosion with epoxy coatings,** Chapter SP 49-10 in *Corrosion of Metals in Concrete,* pp. 115-132 (American Concrete Institute, Detroit, Mich., 1975).

Key words: bridge decks; chlorides; concrete; corrosion; epoxy coatings; organic coatings; steel reinforcing bars.

This study was undertaken to ascertain the feasibility of using organic coatings, especially epoxies, to protect steel reinforcing bars embedded in concrete of bridge decks from rapid corrosion. This corrosion is caused by chloride ions from the deicing salts, sodium chloride and calcium chloride. Altogether, 47 different coatings were evaluated to some extent, of which 36 were epoxy coatings.

The results of this study indicate that some epoxy coating, if properly applied, should adequately protect steel reinforcing bars from corrosion. Epoxy coated bars had acceptable bond and creep characteristics when embedded in concrete and therefore can be used in existing bridge designs. Epoxy coated bars can also be used in other concrete structures.

15113. Hunt, C. M., Burch, D. M., **Air infiltration measurements in a four-bedroom townhouse using sulfur hexafluoride as a tracer gas,** *ASHRAE Trans.* **81,** Part 1, 186-201 (1975).

Key words: air exchange measurement; air infiltration measurement; building ventilation; sulfur hexafluoride tracer.

Air infiltration measurements were made in a four-bedroom townhouse by the tracer dilution method using sulfur hexafluoride (SF_6) as the tracer gas. The house was contained in an environmental chamber with control over both the inside and outside temperature, with essentially no wind velocity. The well-known correlation between inside/outside temperature difference and infiltration rate was observed, and under conditions of negligible wind velocity the effect of sealing doors and ducts was investigated. Simultaneous use of SF_6 and He as tracer gases gave no evidence that molecular diffusion played a significant role in the measurement.

Different methods of collecting air samples for analysis were compared. SF_6 measurements were also compared with air exchange rates imposed on the house by means of a fan. Finally, the effects of poor mixing were analyzed by comparing the expected results in the case of perfect mixing with those expected in the case of air exchange without mixing and with imperfect mixing.

15114. Wang, F. W., **Viscoelasticity of dilute chain-molecule solutions: Evaluation of hydrodynamic interaction,** *J. Polym. Sci., Polym. Phys. Ed.* **13,** 1215-1231 (1975).

Key words: bead-spring model; chain molecules; chain stiffness; deoxyribonucleic acid; dilute solutions; hydrodynamic interaction; polystyrene; viscoelasticity; Zimm theory.

The viscoelastic properties of chain molecules varying in flexibility and length have been calculated by use of the bead-spring model theory of Zimm. In the evaluation of the hydrodynamic interaction parameter, the number of springs in the bead-spring model, N, has been selected from the range in which the properties predicted by the theory are insensitive to the value of N. The results for limiting viscosity number agree with those predicted by the Yamakawa-Fujii theory of the limiting viscosity number of wormlike chains. The theory also fits the experimental data of Johnson on a sample of polystyrene of molecular weight 860,000 in theta solvents at infinite dilution. The viscoelastic properties of some moderate molecular weight deoxyribonucleic acid solutions are predicted to deviate from the non-free-draining behavior toward the free-draining behavior.

15115. Howell, B. F., Velapoldi, R. A., Travis, J. C., **Fluorescence of commercial porous high silica glasses,** *Amer. Ceram. Soc. Bull.* **54,** No. 5, 503-505, 509 (May 1975).

Key words: fluorescence; Mössbauer spectroscopy; porous glass.

Fluorescence and Mössbauer spectroscopy in conjunction with elemental analysis have been used to verify that the fluorescence which develops in commercial porous glass, sintered under reducing conditions, is due to Sn(II). The fluorescence shown by in-house-formulated, porous, high silica glass impregnated with $Sn(II)Cl_2$ and sintered under various conditions is used to substantiate this conclusion. Corrected fluorescence spectra for the Sn(II) species and isomer shifts and quadrupole splitting for various tin species in glasses are also given.

15116. Frenkiel, F. N., Klebanoff, P. S., **On the lognormality of the small-scale structure of turbulence,** *Boundary-Layer Meteorol.* **8,** No. 2, 173-200 (Mar. 1975).

Key words: boundary layer; grid; intermittency, moments; statistical properties; turbulence; velocity-gradients.

Higher-order moments of turbulent velocity gradients and their behavior with Reynolds number were measured in the nearly isotropic turbulent field generated by a square-mesh grid and in a turbulent boundary layer along a flat plate with zero pressure gradient. Hot-wire anemometry and instrumentation combining analog and digital methods were used to measure moments up to the fourteenth order. Measurements of such high-order moments required that particular attention be given to their validity. Involved herein was the evaluation of such effects as nonlinearity, averaging intervals, and the adequacy of the statistics for the tails of the probability density distributions. The results obtained are compared with those of other investigators for a variety of flow configurations in the laboratory as well as in the atmosphere. The concept of the intermittency of the small-scale structure and the theoretical approach involving lognormality of the probability density distribution of the dissipation rate are evaluated.

15117. Nimeroff, I., Hall, W. A., **Instrumental colorimetry of retroreflective sign materials,** *Report No. FHWA-RD-75-4,* 89 pages (Available by purchase as PB239-633 from the National Technical Information Service, Springfield, Va. 22161, Jan. 1975).

Key words: colorimetry; highway signs; photoelectric tristimus colorimeters; photometry of retroreflective materials; retroreflective sign materials.

Because color-coded applications of highway signs increase, specification of colors and color tolerances are required. In order to assure that the requirements are met within specified regions, a measurement technique needs to be developed and described. To accomplish these goals the U.S. Department of Transportation contracted with the National Bureau of Standards to conduct the required studies and make the necessary recommendations. Having previously performed a study for daytime conditions, the National Bureau of Standards was competent to perform a study for nighttime conditions. The colorimetric properties of 126 samples of retroreflective materials of 7 different colors were measured with 3 telecolorimeters in simulated nighttime conditions. One spectrophotometer was used to measure color of 38 of the samples in simulated daytime conditions. The colors measured were: red, orange, brown, yellow, green, blue and silver (white). Differences of color measured by means of different telecolorimeters on the same samples were evaluated.

As a result of these studies procedures for making colorimetric and photometric measurements were developed and are included in this report. On the basis of the color measurements and their variability tentative recommendations for color boundaries were prepared and are also included in this report.

15118. Berger, H., **A report on the American Nuclear Society Topical Meeting "Nondestructive Testing in the Nuclear Power Industry,"** *Nucl. News* **18,** No. 1, 68, 73-74 (Jan. 1975).

Key words: electric utilities; hot cell inspection; in-service inspection; nondestructive testing; nuclear power; reactor components.

The article is a description of American Nuclear Society Topical Meeting "Nondestructive Testing in the Nuclear Power Industry" held in Columbus, Ohio, September 23-25, 1974. Key statements and key papers in the various sessions at the 2 1/2 day meeting are discussed to give readers of the ANS journal, Nuclear News, an idea of what was presented at the meeting.

15119. Beers, J. S., Tucker, C. D., **Procedures for gage block flatness and parallelism measurement,** *J. Appl. Meas.* **2,** No. 4, 82-84 (1974).

Key words: flatness; gage blocks; interferometry; length measurement; parallelism.

Geometric properties of gage blocks are important in many length measurement applications. Methods are described for measuring the flatness of gaging faces and the parallelism between opposing gaging faces. These methods, used for many years, employ interferometers and electro-mechanical gage block comparators.

15120. Klose, J. Z., **Mean life of the $5p\ ^2P_{3/2}$ resonance level in Ag I,** *Astrophys. J.* **198,** 229-233 (May 15, 1975).

Key words: Ag I; f-value; imprisonment; lifetime; mean life; resonance radiation; silver; transition probability.

The mean life of the $5p\ ^2P_{3/2}$ resonance level in Ag I has been measured at two different vapor densities using electronic excitation and a method of delayed coincidence. The lifetime values, obtained by optically detecting the decay of the $5p\ ^2P_{3/2} \rightarrow 5s\ ^2S_{1/2}$ (3280.68 Å) resonance transition, increase with increasing vapor density. This vapor density dependence was interpreted as being due to the imprisonment of the 3281 Å resonance radiation. The Holstein theory of the imprisonment of resonance radiation was applied to the lifetime-versus-vapor density data to yield the following results: $\tau_0 = 6.5 \pm 0.6$ ns, $A_{3281} = 1.53 \pm 0.14 \times 10^8$ s^{-1}, and $f_{3281} = 0.50 \pm 0.05$. The error limits were derived primarily from estimated uncertainties in the measured mean lives and possible variations in the vapor densities during the runs. Experimental results of other workers are presented for comparison with the results of the present work.

15121. Franklin, A. D., Crissman, J. M., Young, K. F., **Defect-complex reorientation processes in GdF_3-doped CaF_2,** *J. Phys. C* **8,** 1244-1266 (1975).

Key words: anelastic relaxation; calcium fluoride; defect pairs; dielectric relaxation; EPR lifetime broadening; fluorine interstitials; gadolinium ions; reorientation processes.

Measurements are reported of the temperature dependence of EPR lifetime broadening in the spectrum of Gd^{3+} ions in tetragonal sites in CaF_2 and of dielectric and anelastic relaxation in similar specimens. Concentrations ranged from 0.01 to 0.27 mol percent GdF_3, and the crystals were annealed in flowing He plus HF at various temperatures. The strongest relaxation modes (R_l) arising from pairs formed from Gd^{3+} ions plus trapped F^- interstitials could be identified in both the dielectric (T_{1u}) and the anelastic (E_g) spectra. The rate constants are $\ln \tau_0 = -32.83 \pm 0.24$ (τ_0 measured in seconds) and $Q = 0.44 \pm 0.005$ eV, and are to be associated with jumps of the F^- interstitials originating at the nearest-neighbour sites to the Gd^{3+} ions. A low-temperature relaxation ($Q \sim 0.2$ eV) was observed in the anelastic spectrum with trigonal symmetry and also in the dielectric spectrum. It was found to consist of several components. It is argued, contrary to earlier conclusions, that this relaxation is not an additional mode of the same centre giving rise to R_l. A higher temperature relaxation ($Q \sim 1.1$ eV) was seen only in the anelastic spectrum, and was approximately isotropic. It too cannot be identified on the basis of present information.

15122. Evans, A. G., Wiederhorn, S. M., Hockey, B. J., **Comments on "Dependence of Room Temperature Fracture Strength on Strain-Rate in Sapphire,"** *J. Mater. Sci. Lett.* **9**, 1367-1370 (1974).

Key words: ambient temperatures; dislocation mechanisms; fracture mechanics; sapphire; slow crack growth; thermal activation.

A recent paper attempts to explain the strain-rate dependence of the strength of sapphire filaments using a dislocation assisted slow crack growth model. We propose an alternative model which gives a quantitative prediction of the observed behavior. This model, based on fracture mechanics measurements of slow crack growth in the absence of dislocation activity, considers that the crack growth is a thermally activated bond rupture process.

15123. Wiederhorn, S. M., Roberts, D. E., **Influence of normal alcohols on the abrasive wear of glass,** *Wear* **32,** 51-72 (1975).

Key words: alcohol; glass; mechanism; silicon carbide; wear.

Normal alcohols were used as cutting fluids in a study of friction and wear of soda lime silicate glass against silicon carbide. Abrasion surfaces were 600 grit silicon carbide paper and a roughened plate of hot-pressed silicon carbide. As the alcohol chain length increased, the coefficient of friction decreased. This result was attributed in part to better lubrication of the abrading surfaces by the long chain length alcohols. The wear rate and the coefficient of friction were strongly dependent on pullout of carbide grains from the silicon carbide paper. Wear on fresh abrasive paper was independent of alcohol chain length. As the paper becomes used, long chain length alcohols were more effective cutting fluids. On the silicon carbide plate, the wear rate decreased in a non-linear fashion as the alcohol chain length increased. For all conditions, the highest wear rate and coefficient of friction were obtained in water. Data are explained in terms of classical theories of friction and wear.

15124. Rowe, J. M., Rush, J. J., Vagelatos, N., Price, D. L., Hinks, D. G., Susman, S., **Crystal dynamics of KCN and NaCN in the disordered cubic phase,** *J. Chem. Phys.* **62,** No. 11, 4551-4554 (June 1, 1975).

Key words: alkali cyanides; crystal dynamics; dispersion curves; orientation; phonons; rotational disorder; single crystal.

The lattice dynamics of KCN and NaCN in their disordered cubic phase has been studied by coherent inelastic neutron scattering and infrared reflection measurements. Acoustic phonon branches for cyanide single crystals were measured in the [001] direction, with more limited measurements taken in the [110] direction. The one-phonon scattering generally appeared as weak peaks superimposed on a large background of non-one phonon scattering, particularly as measurements were extended to higher energy. No peaks clearly assignable to optical phonons were observed in the neutron measurements but the infrared reflection spectra for polycrystalline pellets were analyzed to derive TO and LO phonon energies (at $q=0$) of 17.0 ± 0.6 and 28.5 ± 2.5 meV. These measurements (and a comparison with the rather easily measured acoustic and optical phonons in a KBr crystal of similar volume) indicate that phonons do not exist as well-characterized excitations in the cyanides at higher frequencies and finite wave vectors. The unusual character of these results is attributed to the dynamical disorder of the cyanide ions in the fcc crystal and is compared with recent phonon measurements in the analogous fcc phase of ND_4I. The [001] transverse acoustic branches of both KCN and NaCN show unusually low frequencies below $q=0.5$, which are consistent with recent elastic constant results and with the very large Debye-Waller factors derived from previous neutron diffraction results, and suggest further that the phase transitions in the cyanides are "driven" by a soft shear mode.

15125. Evans, A. G., **Analysis of strength degradation after sustained loading,** *J. Amer. Ceram. Soc.* **57,** No. 9, 410-411 (Sept. 1974).

Key words: fracture probability; slow crack growth; strength degradation; sustained loading.

The strength degradation that occurs at sustained load, due to slow crack growth, is calculated in terms of the slow crack growth parameters. It is shown that the degradation is only significant in specimens with an initial strength marginally larger than the initial strength of the last specimen that failed at the sustained load.

15126. Mielenz, K. D., Eckerle, K. L., **Averaging spheres without target,** *Appl. Opt.* **14,** No. 7, 1649-1651 (July 1975).

Key words: averaging spheres; diffusing effectiveness; efficiency; flux averaging; photometry; spectrophotometry.

The design of averaging spheres without internal target is described. The performance of such spheres is analyzed theoretically and tested experimentally. In a final design, an efficiency of 40 percent is achieved for visible and near-uv wavelengths. The averaging effectiveness is characterized by signal variations of the order of 1 part in 10^4 for beam displacements of several 0.1 mm.

15127. Hudson, R. P., Marshak, H., Soulen, R. J., Jr., Utton, D. B., **Review Paper: Recent advances in thermometry below 300 mK,** *J. Low Temp. Phys.* **20,** Nos. 1/2, 1-102 (July 1975).

Key words: cryothermometry; low temperature; thermometry.

The subject of temperature measurement below 0.3 K is reviewed, with particular attention paid to developments reported in the period 1970-1974. Sensors, measurement techniques, primary and secondary thermometers, and fixed points are discussed and attempts are made to assess the accuracy and relative merits of the various devices and methods.

15128. Melmed, A. J., Stein, R. J., **Field-ion microscopy of silicon,**

Surface Sci. (Letters to Editor) **49**, No. 2, 645-648 (Apr. 1975).

Key words: field-ion microscopy; semiconductor surface structure; silicon.

Significant advance in the state-of-the-art of silicon field-ion microscopy is described. Preliminary observations of interesting light sensitive effects are discussed. Further research is indicated.

15129. Herbst, J. F., Watson, R. E., **5f-electron excitation energies and the Coulomb term, U, in the light actinide metals,** *Phys. Rev. Lett.* **34,** No. 22, 1395-1398 (June 2, 1975).

Key words: actinides; Coulomb term; energy; excitation energy; metal; $5f$ electron.

Relativistic Hartree-Fock-Wigner-Seitz band calculations have been performed for the actinide metals Ac through Am in order to estimate $5f$ excitation energies. Our calculations predict that the tetravalent state (i.e., four s-d conduction electrons) is favored for the lighter elements with a crossover to a trivalent ground state occurring near uranium. We find the Coulomb energy, U, for $5f$ electron hopping to increase from 2-3 eV at Th to 4-5 eV at Am.

15130. Manning, J. R., Stark, J. P., **General matrix equations for diffusion drift velocity in a driving force,** *Phys. Rev. B* **12,** No. 2, 549-556 (July 15, 1975).

Key words: defects in crystals; diffusion; drift velocity; driving force; matrix equations; non-cubic crystals.

From a complete-path approach in which defects are followed from the time of their creation at defect sources to the time of their destruction at defect sinks, general matrix equations are developed which relate the atom drift velocity v_k for diffusion in a driving force to simple matrices whose elements can be written by inspection. Previous equations for v_k have been restricted either to crystals and defects having high symmetry or to cases where the x components of any atom jumps were either $\pm b$ or 0. By contrast, the present equations involve no such restrictions. They apply to diffusion by interstitialcy, divacancy, and other more complex mechanisms, independent of the presence of symmetry planes, and allow calculation of diffusion drift velocities even when the individual atom jumps provide a variety of jump distances along the diffusion direction. These equations apply, for example, even when jumps to both nearest- and next-nearest-neighbor sites are allowed and to diffusion in arbitrary crystallographic directions even in noncubic crystals. The present equations can be expressed in terms of a general matrix S. The relation of S to the less general matrices S_+ and S_- defined previously for crystals having mirror symmetry planes normal to the diffusion direction is discussed.

15131. Cotton, I. W., **Microeconomics and the market for computer services,** *Comput. Surv.* **7,** No. 2, 95-111 (June 1975).

Key words: administration of computing; computer services; management; microeconomics; pricing.

Microeconomics has much to offer the computer services manager. This article reviews some of the traditional topics in microeconomics and shows how they can be applied to the market for computer services. The topics covered include supply, demand, costs, and pricing. The most significant application of microeconomics is in setting prices—so much so that microeconomics is frequently called "price theory." Accordingly, the thrust of the article is towards providing a sound framework for the pricing of computer services.

15132. McCarty, R. D., **Determination of thermodynamic properties from the experimental p-V-T relationships,** Chapter 10 in *Experimental Thermodynamics, Vol. II—Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 501-526 (Butterworth and Co., Ltd., London, England 1975).

Key words: constraints; equation of state; fluid; least squares; parameter estimation; p-V-T; statistical weighting; thermodynamic properties.

Methods and techniques for calculating the thermodynamic properties of a fluid from a mathematical model of the p-V-T equation of state are given. Criteria for choosing a mathematical form for the equation of state are discussed. Numerical and statistical parameter estimation techniques presented include, linear and non-linear least squares; constraints; simultaneous use of different kinds of data; significance tests and statistical weighting. Formulas for many of the derived thermodynamic properties are also presented.

15133. Gadzuk, J. W., Sunjić, M., **Excitation energy dependence of core-level x-ray photoemission-spectra line shapes in metals,** *Phys. Rev. B* **12,** No. 2, 524-530 (July 15, 1975).

Key words: asymmetric lineshapes; photoelectron spectroscopy; photoemission; x-ray edge singularities.

Creation of a deep localized hole in the process of x-ray photoemission from metals is followed by a drastic rearrangement of the surrounding electrons in the Fermi sea. This rearrangement in which low-energy electron-hole pairs are produced, in analogy with gas-phase atomic shake-up processes, gives rise to a low-energy tail in the hole spectral density with an integrable (Mahan) singularity at the energy corresponding to zero-energy pair production. When the usual (symmetric) broadening of the hole is included, the resulting hole line shape becomes a skew resonance, with the asymmetry indices growing with the strength of the electron-hole interaction. The case in which the hole potential is switched on instantaneously (the sudden or impulse limit) has been treated by Doniach and Sunjić. However, the potential switching-on time is a function of the speed at which the excited electron leaves the region of the hole. In this paper we calculate the skew line shapes for finite hole-creation times, going continuously from the adiabatic to sudden limits. The photoemission line shape, for a given hole state, varies smoothly from the symmetric result given in the adiabatic approximation to the asymmetric result of Doniach and Sunjić obtained in the sudden approximation, as the photon energy is increased above the photoionization threshold value.

15134. Swanson, N., Celotta, R. J., Kuyatt, C. E., Cooper, J. W., **Resonant structure in electron impact excitation of CO near threshold,** *J. Chem. Phys.* **62,** No. 12, 4880-4888 (June 15, 1975).

Key words: CO; electron excitation; energy loss spectra; resonance decay; resonant structure; threshold.

Electron impact excitation functions of numerous states in CO have been measured at 45° scattering angle with resolutions of 16-23 meV FWHM. The decay peak of the 10.04 eV resonance can be seen in the results for the $a\ ^3\Pi$, $a'\ ^3\Sigma^+$, and $A\ ^1\Pi$ vibrational levels. There was no evidence of resonant excitation of the $a'\ ^3\Sigma^+$ state near 8 eV as suggested by Newton and Thomas. Excitation functions of the $b\ ^3\Sigma^+$, $B\ ^1\Sigma^+$, $C\ ^1\Sigma^+$, $c\ ^3\Pi$, and $E\ ^1\Pi$ states, and a previously unobserved state at 11.26 eV show numerous sharp resonances in the first few eV above threshold. Energy loss spectra in the 8-14 eV loss region show peaks corresponding to known states as well as to unidentified states. No sign of the metastable state at about 9.5 eV seen by Wells, Borst, and Zipf could be detected in direct excitation, but an indirect excitation process involving the $A\ ^1\Pi$ state is consistent with the data.

15135. Penn, D. R., **The dependence of the tunneling current on density of states in non-superconducting junctions,** *Surface Sci.* **50,** 125-136 (1975).

Key words: density of states; elastic tunneling; tunneling junctions.

The theory that the tunneling current in a non-superconducting tunnel junction depends on the densities of states of the electrodes has been known for sometime although Harrison has suggested that it is in fact not correct. In this paper Harrison's suggestion is critically discussed and the expression for the tunneling current is written in a way that emphasizes its dependence on the *surface* densities of states of the electrodes and takes into account the band structure of the oxide barrier. We find

$$J=\int_{-\infty}^{\infty} d\omega\,[f_L(\omega)-f_R(\omega)]\sum_{k_{||}} D(r_L,r_R;\omega,k_{||})\,\xi(\omega,k_{||})\,\rho_L{}^{\perp}(r_L,\omega,k_{||})\,\rho_R{}^{\perp}(r_R,\omega,k_{||})$$

where f_L, f_R are the Fermi function of the left and right hand electrodes, D is the probability that an electron tunnels from a point r_L in the barrier near the left hand electrode to a point r_R in the barrier near the right hand electrode. ξ depends on the oxide and is a slowly varying function of ω and $k_{||}$, the electron momentum parallel to the electrode surfaces. $\rho_L{}^{\perp}(r_L,\omega,k_{||})$ is the one dimensional density of states of the left hand electrode in the direction normal to the electrode at a position r_L in the barrier for electrons of energy ω and momentum $k_{||}$ and $\rho_R{}^{\perp}$ has a similar meaning. This expression for J reduces to that previously derived by Harrison if the electrodes as well as the oxide barrier are treated in a WKB approximation. In this limit J has no dependence on the densities of states due to cancellations from the factor ξ. Recent field emission experiments and theory have shown that the tunneling current is dependent on the electrode density of states so the expression for J given above must be used. It is suggested that the failure to observe such effects in tunnel junctions is due to imperfections in the junction and that tunneling in metal-vacuum-metal junctions or in perfected tunnel junctions will give density of states information.

15136. Barkley, J. F., Shoenfeld, P. S., **A central laboratory automation facility,** *Amer. Lab.* **7,** No. 2, 19-20, 22, 24-25 (Feb. 1975).

Key words: analytical chemistry; computer; data acquisition; laboratory automation operating system; teleprocessor.

The Analytical Chemistry Division at the National Bureau of Standards has developed a centralized computer facility for laboratory automation, which is described in this paper. This facility consists of two major components. These are the teleprocessor, which handles all communication between the laboratory and the computer, and the computer itself. Also described are the essential system software packages including the Operating System, the File System, and the Data Acquisition System.

15137. Olson, J. D., **The refractive index and Lorenz-Lorentz function of fluid methane,** *J. Chem. Phys.* **63,** No. 1, 474-484 (July 1, 1975).

Key words: critical refractive index; Fabry-Perot interferometer; Lorenz-Lorentz function; methane; rectilinear diameter law; refractive index; refractometric virial coefficients.

The refractive index of gaseous and liquid methane was measured between 95 and 300 K and to pressures of 225 bar (1 bar = 10^5 Pa). The measurements were performed at the ^{198}Hg vapor green line, $\lambda = 546.2$ nm, with a Fabry-Perot interferometer referred to vacuum. The refractive index data were combined with the previously measured densities of methane to calculate the Lorenz-Lorentz (LL) function. Refractometric virial coefficients were obtained from analysis of the small (~ 0.5%) maximum exhibited by the (LL) function with increasing density. B_R, the second refractometric virial coefficient, is estimated to be ~ 6.0 (cm³/mol)² and is almost independent of temperature between 220 and 300 K. The critical point refractive index, $n_c = 1.10333$, was extrapolated from a rectilinear diameter treatment of the saturated liquid and vapor results. The critical point refractive index was combined with an estimate of the critical point (LL) function to yield a critical density of methane, $\rho_c = 10.16 \pm 0.01$ mol/l.

15138. Geist, J., Steiner, B., Schaefer, R., Zalewski, E., Corrons, A., **Electrically based spectral power measurements through use of a tunable cw laser,** *Appl Phys. Lett.* **26,** No. 6, 309-311 (Mar. 15, 1975).

Key words: cw dye laser; detector spectral response; electrically calibrated pyroelectric detector; radiometry; spectral irradiance; spectral radiant power density.

A new approach to radiant power measurements is described. A continuously tunable cw dye laser was used to measure the absolute spectral response of a silicon photodiode and narrow band-pass filter by comparison with an electrically calibrated pyroelectric detector. The filtered photodetector was then used to measure the spectral power density from a standard lamp that had been calibrated by the classical technique. The agreement of better than 1 percent between the two measurements is well within the uncertainties identified with each measurement individually, of the order of 1 percent. A number of advantages in the new technique are identified.

15139. Schramm, R. E., Reed, R. P., **Stacking fault energies of seven commercial austenitic stainless steels,** *Metall. Trans. A* **6A,** 1345-1351 (July 1975).

Key words: austenite; iron alloys; stacking fault energy, stainless steel; x-ray diffraction.

The stacking fault energies of seven commercial austenitic Fe-Cr-Ni, Fe-Cr-Ni-Mn and Fe-Mn-Ni alloys have been determined by x-ray diffraction line profile analysis. From comparison with existing data on laboratory alloys with similar compositions, it is concluded that both Ni and C increase γ while Cr, Si, Mn, and N decrease γ. Regression analysis of data produced in this study provides an expression relating γ to commercial alloy composition in terms of Ni, Cr, Mn, and Mo alloy concentrations.

15140. Davis, D. D., **Calibrating crystal oscillators with TV color-reference signals,** *Electronics* **48,** No. 6, 107-112 (Mar. 20, 1975).

Key words: crystal oscillator; frequency calibrator; frequency offset; NBS traceability; phase comparison; television.

The National Bureau of Standards checks the frequency of the network television color signals and publishes the results. Here is a way to use that information to calibrate your own oscillator.

15141. Hanley, H. J. M., Haynes, W. M., **The density expansion of the viscosity coefficient,** *J. Chem. Phys.* **63,** No. 1, 358-361 (July 1, 1975).

Key words: argon; correlated molecular collisions; density expansions; fluorine; oxygen; statistical analysis; viscosity coefficient.

Experimental viscosity data for gaseous argon, oxygen, and fluorine were analyzed as a function of density and temperature. Necessary conditions were applied to investigate if a given isotherm was consistent statistically with a given density function. It was found that the low temperature isotherms were consistent with the theoretically suggested density function, which involves terms logarithmic in the density. At higher temperatures, however, these logarithmic terms did not appear to be statistically significant.

15142. Heinrich, K. F. J., Newbury, D. E., Yakowitz, H., **New techniques for the surface analysis of nonmetallic solids,** (Proc. 20th Sagamore Army Materials Research Conf., Sagamore Conference Center, Raquette Lake, New York, Sept. 11-14, 1973), Chapter 4 in *Characterization of Materials in Research Ceramics and Polymers* **20,** 73-102 (Syracuse University Press, Syracuse, N.Y., 1975).

Key words: contrast; electron probe microanalysis; electron spectroscopy for chemical analysis (ESCA); ion microprobe analysis; scanning electron microscopy; surface analysis.

Several modern techniques for the characterization and analysis of surfaces and shallow layers of nonmetallic materials are discussed, with particular emphasis on their relevance to technological problems. These include electron and ion probe microanalysis, scanning electron microscopy, ion scattering analysis, and secondary ion mass spectroscopy of surfaces.

15143. Peterlin, A., **Intrinsic stress tensor of polymer solutions in laminar flow,** *Makromol. Chem. Suppl.* **1,** 453-470 (1975).

Key words: elastic dumbbell model; flow instability; flow with longitudinal gradient; flow with transverse gradient; gradient dependence of normal stress differences; gradient dependence of viscosity; hydrodynamic interaction; intrinsic stress tensor; intrinsic viscosity.

The simplified necklace or the equivalent modified elastic dumbbell model with consideration of hydrodynamic interaction among the beads and its change with coil expansion was used for the calculation of the intrinsic stress tensor in laminar flow with transverse and parallel gradient as function of the conventional gradient γ and the dimensionless gradient parameter β. The expansion of the Gaussian coil in flow first increases and then decreases the hydrodynamic interaction. As a consequence the intrinsic viscosity $[\eta]_{tr}$ of sufficiently large macromolecules and the effective average hydrodynamic resistance coefficient Λ of the bead show first a decrease to a minimum and a subsequent gradually slower increase with the gradient. In laminar flow with parallel gradient this effect yields a deformational instability which may play some role in drag reduction of turbulent flow by polymer additives. Experimental evidence will have to conform or to refute these two interdependent phenomena. In the latter case, one suspects that the neglect of anisotropy of hydrodynamic interaction is the main cause of the unrealistic predictions of intrinsic hydrodynamic properties of polymer solutions.

15144. Bertocci, U., **Computer simulation of crystal growth on a fcc surface,** *J. Cryst. Growth* **26,** No. 2, 219-232 (Dec. 1974).

Key words: computer simulation; crystal growth; fcc

Positive and negative crystal growth has been simulated on a (100) surface of a fcc crystal. The results show considerable similarities with the behavior of simple cubic surfaces, as far as the values of the interatomic bond energy and of the free energy for crystallization at which transition from smooth to rough surfaces occur. Growth rates are smaller, reflecting the formation of a sizable area where both deposition and removal of atoms is hindered. The surface roughness at equilibrium is similar to that obtained by computer simulation by other authors on a (100) surface of a Kossel crystal and it is close to that of a two-dimensional square lattice.

15145. Lofquist, K. E., An **effect of permeability on sand transport by waves (Abstract only),** *EOS, Trans. Amer. Geophys. Union* **56,** No. 6, 370 (June 1975).

Key words: oscillatory flows; permeability; ripple; sand transport.

Permeability effects on the movement of sand in oscillatory flows are observed in laboratory experiments which approximate prototype conditions at the seabed under progressive waves. A natural sand is used, wave periods range between 3 and 14 seconds, and sand surfaces are naturally rippled. The apparatus has a symmetry which removes all effects, except those of permeability, which might cause a net movement of the sand. Onshore and offshore directions are determined by phase relationships between the horizontal flows and superposed vertical permeability flows. A positive permeability effect is found, in that the ripple profiles move in the onshore direction. The velocity of this motion is measured and described in a simple dimensionless plot. The associated net transport of sand is not observed directly but can be inferred, to an extent, form the motions of the ripple profiles. The effects of permeability sand transport are cumulative, and can be significant in coastal processes of long duration.

15146. Cezairliyan, A., **Pulse calorimetry and transient measurement of thermal properties at high temperatures,** *Faraday Symp. Chem. Soc.,* No. 8, 7-17 (1973).

Key words: high-speed measurements; high temperature; pulse calorimetry; thermodynamics; thermophysical properties.

A system is described for the transient (subsecond) measurement of selected thermal and related properties of electrically-conducting substances in the temperature range 1500 K to the melting point of the specimen. The method is based on resistive self-heating of the specimen from room temperature to any desired high temperature in less than 1 s by the passage of an electrical current pulse through it; and on measuring and recording the experimental quantities every 0.4 ms with a full-scale signal resolution of one part in 8000. The system has been used to measure heat capacity, electrical resistivity, hemispherical total emittance, normal spectral emittance, and the melting point of selected refractory elements and alloys. The results of preliminary experiments have shown the potential application of the system to measurements of temperatures and energies of solid-solid phase transformations and heat of fusion at high temperatures.

15147. Fuggle, J. C., Madey, T. E., Steinkilberg, M., Menzel, D., **X-ray photoelectron satellites from adsorbed species,** *Chem. Phys. Lett.* **33,** No. 2, 233-236 (June 1, 1975).

Key words: oxygen; ruthenium; satellite; shake-up; structure; x-ray photoelectron spectroscopy.

The O 1s XPS peaks from monolayers of CO and oxygen adsorbed on the basal (001) face of a ruthenium single crystal are observed to have satellites whose position and intensity are sensitive to the chemical environment.

15148. Berger, H., Motz, J. W., **A qualitative discussion of quantitative radiography,** (Proc. 2nd ASM Materials/Design Forum, Port St. Lucie, Fla., Apr. 8-11, 1974), Paper in *Prevention of Structural Failure,* T. D. Cooper, P. F. Packman, and B. G. W. Yee, Eds., No. 5, 37-47 (American Society for Metals, Metals Park, Ohio, 1975).

Key words: dimensional measurement; image enhancement;

imaging methods; nondestructive evaluation; radiography; serviceability.

Quantitative aspects of radiography are described and illustrated. Radiography is a widely used method for nondestructive testing. It offers the advantage of giving an image of objects as a permanent inspection record. Voids, inclusions, and cracks in homogeneous materials and welds can be detected. The size, shape and location of discontinuities are revealed if the change in density or thickness is of the order of one percent and covers a sufficient area to be resolved by the radiographic technique. The measurement of the dimensions and depth of an object can be made and, in certain circumstances, such measurements are possible to accuracies of ± 0.001 inch.

In addition, radiography can be used effectively as an accept-reject criterion, especially in conjunction with well defined specifications and reference radiographs.

Novel radiographic methods that offer advantages in improving image contrast are briefly discussed. Included are image enhancement methods and radiography employing neutrons, monoenergetic x-radiation, or charged particles.

15149. Lambropoulos, M., Moody, S. E., Smith, S. J., Lineberger, W. C., **Observation of electric quadrupole transitions in multiphoton ionization,** *Phys. Rev. Lett.* **35,** No. 3, 159-162 (July 21, 1975).

Key words: atom; dye laser; electric quadrupole; fine structure; ionization; multiphoton; sodium.

Two flashlamp-pumped, tunable, dye lasers have been utilized to study three-photon ionization in atomic sodium. The resulting ion yield shows large peaks at laser frequencies which correspond to electric quadrupole transitions. This is the first direct observation of electric quadrupole effects in multiphoton ionization. The $3p\ ^2P_{3/2} \rightarrow 4f$ matrix element is determined, and the fine-structure splitting of the $5p$ state is measured.

15150. Mountain, R. D., **A geometrical description of critical phenomena,** *J. Wash. Acad. Sci.* **64,** No. 3, 195-198 (1974).

Key words: critical phenomena; divergences at critical points; free energy surface; geometry of thermodynamic surfaces; thermodynamics.

Gibbs made extensive use of geometrical concepts in his development of thermodynamics. In this talk we examine the use of geometrical ideas to clarify our understanding of the thermodynamics of fluids in the vicinity of the critical point. The influence of Gibbs on recent developments in the study of critical phenomena is emphasized.

15151. Prosen, E. J., Cole, K. S., **Heat production of Arbacia eggs revisited (Extended Abstract),** *Biol. Bull.* **145,** No. 2, 450-451 (Oct. 1973).

Key words: Arbacia punctulata; calorimetry; cleavage of cells; development of cells; fertilization; growth of cells; heat production; marine eggs; metabolism; microcalorimetry.

Heat production is an important aspect of the thermodynamics and kinetics of the initiation and subsequent metabolic—and perhaps physical—processes of growth. Tremendous advances in speed, sensitivity, and accuracy of heat measurements have come about from the use of modern techniques and semiconductor materials. Yet little, if anything, has been done on such simple systems as marine eggs since the 1924 measurements of Rogers and Cole.

We have repeated that work with the advanced microcalorimeter of the National Bureau of Standards (Prosen, 1973) which has been developed and used in clinical studies of enzyme reactions and bacterial growth. The instrument had been modified to accommodate a larger 3.4 ml reaction vessel to adapt it for biological work. This isothermal, heat-flow instrument measures the heat production of two solutions (0.75 ml and 1.50 ml) before and after mixing with an output signal of 0.2 volt/watt an ultimate sensitivity of 0.1 μJ/sec or 90 μcal/hr (corresponding to 0.1 μk), and with a response half-time of 2 minutes.

Since a constant-temperature room was not available it was necessary to place additional insulation around the calorimeter to limit baseline drift to 3μW/hr or less. The original plan was to measure the heat production of several thousand *Arbacia* eggs and corresponding sperm in the separate compartments of the reaction vessel and to follow it—after fertilization by mixing—for a few hours or several cell divisions. This has been accomplished but not as yet satisfactorily since no greater than 90 percent fertilization has been achieved in the vessel. It was first found that no fertilization or development took place in the plastic reaction vessels used, although controls in glass gave over 95 percent. A glass vessel with ports sealed with paraffin also proved unsatisfactory. Finally the original plastic vessels operated properly (90% fertilization) after flushing them with sea water for several days. The vessel ports are closed with o-ring seals.

Egg and sperm counts are incomplete, but our preliminary results are as follows: (all measurements were made in natural sea water containing 0.0001 molar EDTA and pH 7.8). Unfertilized eggs gave about 0.3 μW/1000 eggs after 1 hour with a gradual drop with time. Prefertilized eggs gave about 0.6 μW/1000 eggs after 1 hour and with some small variations and a gradual drop with time. Sperm heat was also measured but results are not complete. Fertilization runs in the calorimeter gave similar heats for the unfertilized and the fertilized separate runs above and showed no burst of heat upon fertilization. Fluctuations suggest a possible correlation with stages of development.

There is no immediate explanation for the fact that these values are about twice as large as those of Rogers and Cole. However, different conditions were used and in one experiment with greater loading (50,000 eggs/ml in place of the usual 10,000 eggs/ml) we obtained their value. They used 100,000 eggs/ml. We conclude that it should not be difficult to extend the range of experiments to include measurements of fertilization and early development of a variety of marine eggs.

15152. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for molecular oxygen derived from electron energy-loss measurements,** *J. Chem. Phys.* **63,** No. 1, 241-248 (July 1, 1975).

Key words: electron energy-loss; oscillator strengths; oxygen.

Oscillator strengths for O_2 from 6 to 14 eV are derived from the energy-loss spectrum of 100 eV incident electrons. Integrated f values for the Schumann-Runge bands and continuum, which span four orders of magnitude in intensity, agree well with high-resolution photoabsorption measurements. Vibrational structure superimposed on the Schumann-Runge continuum, previously assigned to the $(3s\ \sigma_g)\ ^3\Pi_g$ Rydberg state, contributes less than 0.5 percent to the total oscillator strength determined for that region. These data also yield f values for discrete bands in the region between 9.5 and 14.0 eV, where line saturation problems complicate oscillator strength analysis of the optical data. An oscillator strength sum of 0.198 is obtained for all transitions below the ionization potential at 12.07 eV.

15153. Powell, C. J., **Cross sections for ionization of inner-shell**

electrons by electron impact, *Proc. 10th Annual Conf. of the Microbeam Analysis Society, Las Vegas, Nevada, Aug. 11-15, 1975,* pp. 3a-b (1975).

Key words: cross sections; electron probe microanalysis; electrons; inner-shell.

A survey has been made of available theoretical and experimental cross-section data for the ionization of inner-shell electrons by electron impact in the energy range of interest to electron probe microanalysis and to Auger-electron spectroscopy.

15154. Ludtke, P. R., **Register of specialized sources for information on selected fuels and oxidizers,** *NASA CR-134807,* 44 pages (Available from the National Technical Information Service, Springfield, Va. 22151, 1975).

Key words: chemical reactions; combustion; cryogenic fluid safety; explosions; fires; fuels; handling; hydrogen; oxidizers; oxygen; propellants; safety information; thermodynamic properties.

This Register describes thirty-eight (38) organizations that catalog and file information in their data systems on fuel and oxidizers. The fuels include hydrogen, methane (LNG) and hydrazine-type fuels (UDMH); the oxidizers include oxygen, fluorine, flox, nitrogen tetroxide and ozone. The type of available information covers thermophysical properties, propellant systems, propellant fires-control-extinguishment, propellant explosions, propellant combustion, propellant safety, and fluorine chemistry. These organizations have assembled and collated their information so that it will be useful in the solution of engineering problems.

15155. Arvidson, J. M., Brennan, J. A., **ASRDI oxygen technology survey, Vol. VIII: Pressure measurement,** *NASA Spec. Publ. 3092,* 200 pages (Available from the National Technical Information Service, Springfield, Va. 22151, 1975).

Key words: calibration; compatibility; cryogenic; liquid oxygen; measurement; oxygen; performance; pressure; survey; transducer.

This publication is part of an oxygen safety review in progress by the NASA Aerospace Safety Research and Data Institute (ASRDI). The objectives of the review include: 1. Recommendations to improve NASA oxygen handling practices by comparing NASA and contractor oxygen systems including the design, inspection, operation, to failure of oxygen equipment from a variety of sources so that hazards may be defined and remedial measures formulated. 3. Contributions to safe oxygen handling techniques through research. 4. Formulation of criteria and standards on all aspects of oxygen handling, storage, and disposal.

The special publication summarizes the current state-of-the-art in pressure measurement in the region of 50 to 150 K (the liquid state of oxygen). The report is not limited to oxygen-proved systems alone as this would have severely limited the report. The published literature available in the cyrogenic region generally is quite restricted. The survey includes information on cleaning and materials compatibility, calibration methods and descriptions of representative transducers. A summary of recommendations is presented as well as an extensive bibliography arranged by transducer type.

15156. Fano, U., Spencer, L. V., **Quasi-scaling of electron degradation spectra,** *Int. J. Radiat. Phys. Chem. Platzman Memorial Issue* **7,** 63-76 (1975).

Key words: charged particle penetration; dosimetry; electron slowing down; electron transport; scaling; *W*-value.

Douthat has found that plots of electron spectra calculated for different initial energies nearly coincide if a suitable choice of scaled variables is adopted for abscissas and ordinates. This paper provides a rationale for this choice of variables, reformulates the degradation equation in terms of the new variables, and shows how the trend of the solution of the transformed equation can be predicted semi-quantitatively by inspection.

15157. Kelly, G. E., Sengers, J. V., **Droplet growth in a dilute vapor,** *J. Chem. Phys.* **61,** No. 7, 2800-2807 (Oct. 1, 1974).

Key words: aerosols; condensation; droplets; evaporation; kinetic theory; Knudsen number expansion; nucleation.

When the mass flux Γ to a liquid droplet is expanded in terms of a parameter α which is the ratio of the droplet size to the mean free path (inverse Knudsen number), one obtains a series of the form $\Gamma=\Gamma^{(0)}+\Gamma^{(1)}\alpha+\Gamma^{(2)}\alpha^2\ln\alpha+\ldots$ As shown in a previous paper, the coefficients in this series are determined by integrals associated with sequences of successive collisions among a number of vapor molecules and the droplet. For a droplet surrounded by its pure vapor, we have calculated the coefficient $\Gamma^{(1)}$ of the first inverse Knudsen number correction to the free molecular growth rate $\Gamma^{(0)}$ assuming that the vapor molecules can be treated as hard spheres. For most nonequilibrium conditions, the ratio $\Gamma^{(1)}/\Gamma^{(0)}$ turns out to be positive, rather than negative, as heretofore was assumed in the literature. This result implies that the reduced growth rate $\Gamma/\Gamma^{(0)}$ will pass through a maximum as a function of the Knudsen number.

15158. Argentar, H., Bowen, R. L., **Colored charge-transfer complexes from *N,N*-dimethyl-*p*-toluidine,** *J. Dent. Res.* **54,** No. 3, 588-598 (May-June 1975).

Key words: aromatic amine; charge-transfer complexes; color; dental material; methacrylate, phthalate; *N,N*-dimethyl-*p*-toluidine; ultraviolet spectroscopy.

Yellow mixtures form on adding essentially colorless *N,N*-dimethyl-*p*-toluidine (DMPT) to colorless methacrylate monomers containing phthalate, isophthalate, or terephthalate diester groups. The color-causing interactions between the amines and monomers were investigated using ultraviolet spectroscopy. Equations were derived for predicting interactions between formulation ingredients and DMPT that would lead to undesired color.

15159. Bowen, R. L., Antonucci, J. M., **Dimethacrylate monomers of aromatic diethers,** *J. Dent. Res.* **54,** No. 3, 599-604 (May-June 1975).

Key words: composites, dimethacrylates; monomers; resins; synthesis.

Crystalline aromatic diether methacrylates can be prepared from dihydric phenols or their bis(2-hydroxyethyl) derivatives by simple condensation procedures. Three solid isomers form a liquid ternary eutectic when mixed in suitable proportions.

15160. Barger, R. L., West, J. B., English, T. C., **Fast frequency stabilization of a cw dye laser,** *Appl. Phys. Lett.* **27,** No. 1, 31-33 (July 1, 1975).

Key words: cw dye laser; frequency stabilization; intensity stabilization.

A system is described for stabilizing a cw dye laser frequency to a high-finesse optical cavity. The length of this optical cavity is locked to a CH_4-stabilized He-Ne laser with a tunable frequency-offset technique. A very fast servo system (using an intracavity KD*P crystal), a long dye laser cavity, and the stabilized optical cavity result in an absolute frequency stability of 1 kHz for an integration time of 10^{-4} sec and 300 Hz for 300 sec. Intensity is stabilized to one part in 10^4.

15161. Bowen, R. L., **Adhesive bonding of various materials to hard tooth tissues. VII. Metal salts as mordants for coupling agents,** (Proc. Symp. on Dental Adhesive Materials, New York, N.Y., Nov. 8-9, 1973), Paper in *Dental Adhesive Materials,* H. D. Moskowitz, G. T. Ward, and E. D. Woolridge, Eds., pp. 205-221 (Prestige Graphic Services, New York, N.Y., 1974).

Key words: adhesive bonding; chelation; comonomers; coupling agents; dental materials; hard tooth tissues; metal ions; mordant.

A number of hypothetical concepts are presented to serve as a guide for experimentation. The concepts include the combined use of etching and surface-active comonomers to obtain improved adhesive bonding between polymers and hard tooth tissues, and the use of certain metal ions to augment the interaction between the coupling agents and the tooth surfaces.

15162. Brown, W. E., Patel, P. R., Chow, L. C., **Formation of $CaHPO_4 \cdot 2H_2O$ from enamel mineral and its relationship to caries mechanism,** *J. Dent. Res.* **54,** No. 3, 475-481 (May-June 1975).

Key words: caries mechanism; dicalcium phosphate dihydrate; enamel mineral solubility; pyrophosphate formation.

Tooth enamel, when treated with dilute H_3PO_4 solutions, dissolved incongruently with formation of large $CaHPO_4 \cdot 2HO_2O$ crystals. Equilibrated solutions were saturated with respect to $CaHPO_4 \cdot 2H_2O$, and a mineral more soluble than well-crystallized, synthetic $Ca_5(PO_4)_3OH$, probably an impure, defective apatite. The $CaHPO_4 \cdot 2H_2O$ crystals formed at considerably higher pH values than expected because of enhanced solubility of the apatitic phase in enamel. Pyrolysis of carious enamel revealed the presence of acidic calcium phosphate presumed to be $CaHPO_4 \cdot 2H_2O$.

15163. Ebert, P. J., Dick, C. E., **Comments on the observation of nondivergent radiation of discrete frequencies,** *Phys. Rev. Lett. Comments* **34,** No. 24, 1537-1539 (June 16, 1975).

Key words: comment to editor; discrete; frequencies; nondivergent radiation.

A high-resolution spectroscopic study has been made of the radiation emitted in the forward direction from cylindrical targets bombarded with electrons. The discrete energy bands previously reported by Das Gupta were not observed for photon energies from 4 to 200 keV.

15164. Haas, S. S., Brauer, G. M., Dickson, G., **A characterization of polymethylmethacrylate bone cement,** *J. Bone J. Surg.* **57-A,** No. 3, 380-391 (Apr. 1975).

Key words: acrylic resin; cement; medical materials; orthopedic materials; polymethylmethacrylate, self-curing; surgical bone cement; total hip replacement, cement.

Polymethylmethacrylate cement is characterized in terms of chemical composition, handling characteristics, and physical properties; the dough time, setting time, handling time, and temperature rise were found to be most affected by environmental temperature and kneading of the dough mass. As the set material ages, the residual monomer content gradually decreases and the strength increases. A volume shrinkage of up to 5 percent was observed. The porosity, which is increased by rapid mixing, may reach 10 percent. The mechanical properties of the cement approximate those of polymethylmethacrylate denture base materials. Some variability encountered in the handling qualities of the cement could be attributed only to the variability of different batches.

15165. Meinke, W. W., **Characterization of solids-chemical composition,** Chapter 7 in *Treatise on Solid State Chemistry,* N. B. Hannay, Ed., **1,** 387-435 (Plenum Press, New York, N.Y., 1973).

Key words: activation analysis; characterization; chemical composition; chromatographic analysis; coulometry; electron probe microanalysis; ion-selective electrodes; mass spectrometry; polarography; spectrochemical analysis; thermal analysis; wet chemistry; x-ray fluorescence.

Determination of the chemical composition of solids, i.e., information on the identity and location of the atoms in a particular material, is essential if one is to have confidence that the material can be reproduced. In this chapter an integrated summary of pertinent information on many different analytical techniques is presented. Summaries of sensitivities and precisions to be expected using these techniques are given. Applications to specific characterization problems are discussed and examples are given from the literature, of detailed studies of a number of high purity materials which illustrate the present state-of-the-art for the characterization of practical samples.

15166. Marshak, H., Soulen, R. J., Jr., **The temperature scale defined by ^{60}Co γ-ray anisotropy and noise thermometry,** Paper in *Low Temperature Physics-LT* **13,** K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **4,** 498-502 (Plenum Publishing Corp., New York, N.Y., 1974).

Key words: ^{60}Co; gamma rays; Josephson junction; noise thermometer; thermometer.

In order to establish an absolute low temperature scale we are comparing a (hcp) single crystal $^{59}Co^{60}Co$ γ-ray anisotropy thermometer to a Josephson junction noise thermometer in the temperature region below 0.04 K. The temperature dependences of both thermometers are governed by independent fundamental relations. Once the parameters of each system are established, the temperatures obtained should be absolute, i.e., no previous calibration is needed, nor is any extrapolation used to determine the temperature. We have examined the possible sources of error in a single crystal Co γ-ray anisotropy thermometer. The reproducibility of the anisotropy at a fixed temperature is within the statistical uncertainty of the measurements; systematic errors arise from the uncertainty in the value of the hyperfine interaction, neglect of a possible quadrupole interaction and/or a small admixture of M3 radiation, mosaic spread of the crystal, solid angle correction factor, effects of closure domains and domain walls, variation in background radiation, and effect of scattered γ-rays. The effects of these errors can be calculated and subsidiary experiments can be performed to check these calculations.

15167. York, G., Scheps, R., Gallagher, A., **Continuum radiation and potentials of Na-noble gas molecules,** *J. Chem. Phys.* **63,** No. 3, 1052-1064 (Aug. 1, 1975).

Key words: molecules; noble gases; radiation; sodium.

The normalized emission spectra resulting from the perturbation of Na atoms by 1-1000 torr of noble gas have been measured in the range 10-150 nm about the 589 nm resonance line. This spectrum, due to the A-X and B-X transitions of the Na-noble gas molecules, was measured with 1.5 nm resolution. The Na, in a cell at a temperature of 417 ± 5 K, was optically pumped to the $3^2P_{1/2}$ and $3^2P_{3/2}$ states by resonance radiation. The resulting emission was measured at several Na densities to obtain the normalized emission spectra in the limit of zero radiation entrapment. Using the Franck-Condon principle, or equivalently the quasistatic theory of line broadening, and density factors, the $A^2\Pi_{1/2,3/2}$ and $X^2\Sigma_{1/2}$ state potentials for NaAr, NaKr, and NaXe have been obtained from the pressure dependence of the spectra.

Continuum absorption and emission coefficients for these molecules, obtained by application of the same theories, are also presented. The analysis identifies the low pressure limit of the spectrum as due to free collision states above the angular momentum barrier. The population factors corresponding to quasibound, orbiting resonances are evaluated and used in this analysis.

15168. Hanley, H. J. M., Watts, R. O., **Molecular dynamics studies of an *m*-6-8 fluid,** *Physica* **79A,** No. 4, 351-376 (Feb. 1975).

Key words: Axilrod-Teller correction; dense liquid; excess function; hydrodynamic limit; molecular dynamics; rare gases; velocity autocorrelation function; 11-6-8 potential.

The pressure, energy and self-diffusion coefficient have been calculated for an 11-6-8 fluid using the method of molecular dynamics. A comparison with data for argon, krypton and xenon is presented. It is shown that agreement between theory and experiment for the thermodynamic properties is generally within the estimated precision of the calculated and experimental values, provided three-body and quantum corrections are included in the calculation, except when the density approaches the triple-point density. Agreement between theoretical and experimental self-diffusion coefficients is satisfactory at all densities after allowance is made for the long-time behaviour of the velocity autocorrelation function. We demonstrate that three-body forces are important in the liquid and that our estimates of such forces are very close to those suggested by Barker, Fisher and Watts.

15169. Spencer, L. V., **Some comments on Fano's theorem,** *Radiat. Res.* **63,** 191-199 (1975).

Key words: cavity theory; dosimetry; Fano theorem; ionization chambers; radiation measurement; radiation transport.

Fano's proof that uniform radiation fields result when sources and interactions are strictly proportional to local density is discussed in connection with an alternative proof formulation.

15170. Kasen, M. B., **Mechanical and thermal properties of filamentary-reinforced structural composites at cryogenic temperatures. 1: Glass-reinforced composites,** *Cryogenics* **15,** No. 6, 327-349 (June 1975).

Key words: cryogenics; dynamic mechanical properties; glass-fiber composites; literature review; static mechanical properties; thermal properties.

Objective is to provide an understanding of the general magnitude of property values obtainable within the cryogenic temperature range, to provide a feel for the relative literature ranking of specific composite types with regard to a specific property, and to impart an understanding of the temperature sensitivity of the property of interest. A bibliography and bibliography-property cross-reference is included. This is Part I of a two-part series. Part II will consider advance composites.

15171. Roberts, R. W., **The national/international measurement system,** *ASTM Stand. News* **2,** No. 11, 8-13 (Nov. 1974).

Key words: international measurement; measurement system; national economy; national/international measurement system.

National and international measurements are vital to our national economy. They are vital in business transactions measuring the quality of materials and goods, vital to our citizens in measuring the performance and safety of products, and vital to government for measuring compliance with national laws. This measurement "system" must have anchor points and its quality must be monitored and improved. The National Bureau of Standards was established by Congress in 1901 to accomplish that function.

15172. Johnson, C. R., **Powers of matrices with positive definite real part,** *Proc. Am. Math. Soc.* **50,** 85-91 (July 1975).

Key words: field of values; Hermitian matrix; normal matrix; positive definite.

For n by n complex matrices A the following two facts are proven by elementary techniques: 1. If A^m is never normal, $m \in I^+$, then the equation $xA^mx^*=0$ has a solution $0 \neq x \in C^n$, $m \in I^+$; 2. If $H(A)=(A+A^*)/2$ is positive definite, then $H(A^m)$ is positive definite for all $m \in I^+$ if and only if A is Hermitian.

15173. Hanley, H. J. M., Watts, R. O., **The self-diffusion coefficient of liquid methane,** *Mol. Phys.* **29,** No. 6, 1907-1917 (June 1975).

Key words: correlation function; experimental data; hydrodynamic behavior; methane; molecular dynamics; potential function; self-diffusion coefficient; 11-6-8 potential function.

Self-diffusion coefficients of methane have been calculated over a wide density range using the method of molecular dynamics. Methane intermolecular interactions were modelled using an m-6-8 potential with coefficients determined from viscosity data for the dilute gas. After adding a contribution to the diffusion coefficient due to the long-time behaviour of the velocity autocorrelation function, agreement with experimental data is within the estimated errors given for both the calculated values and the experimental data.

15174. Goldberg, R. N., **Thermodynamics of hexokinase-catalyzed reactions,** *Biophys. Chem.* **3,** 192-205 (1975).

Key words: adenosine-5′-triphosphate; biochemistry; enzyme catalyzed reactions; glucose; heat measurements; *hexokinase*; metabolic processes; microcalorimetry; thermochemistry; thermodynamics.

The enthalpies of the *hexokinase*-catalyzed phosphorylation of glucose, mannose, and fructose by ATP to the respective hexose 6-phosphates have been measured calorimetrically in TRIS/TRIS · HCl buffer at 25.0, 28.5, and 32.0 °C. The effects on the measured enthalpy of the glucose/*hexokinase* reaction due to variation of pH (over the range 6.7 to 9.0) and ionic strength (over the range 0.02 to 0.25) have been examined. Correction for enthalpy of buffer protonation leads to $\Delta H°$ and $\Delta C_p°$ values for the processes: eq-D-hexose + ATP^{4-} = eq-D-hexose 6-phosphate^{2-} + ADP^{3-} + H^+. Results are $\Delta H° = -23.8 \pm 0.7$ kJ · mol^{-1} and $\Delta C_p° = -156 \pm 280$ J · mol^{-1} · K^{-1} for glucose, $\Delta H° = -21.9 \pm 0.7$ kJ · mol^{-1} and $\Delta C_p° = 10 \pm 140$ J · mol^{-1} · K^{-1} for mannose, and $\Delta H° = -15.0 \pm 0.9$ kJ · mol^{-1} and $\Delta C_p° = -41 \pm 160$ J · mol^{-1} · K^{-1} for fructose. Combination of these measured enthalpies with Gibbs energy data for hydrolysis of ATP^{4-} and that for the hexose 6-phosphates lead to $\Delta S°$ values for the above *hexokinase*-catalyzed reactions.

15175. Kraft, R., **Finite difference techniques for diffusion and redistribution problems with segregation-type boundary conditions,** (Proc. AICA Int. Symp. on Computer Methods for Partial Differential Equations, Bethlehem, Pa., June 17-19, 1975), Paper in *Advances in Computer Methods for Partial Differential Equations,* R. Vichnevetsky, Ed., pp. 328-333 (AICA Dept. of Computer Science, New Brunswick, N.J., 1975).

Key words: diffusion equations; finite-difference techniques; impurity redistribution; moving boundary problems; numerical methods; partial differential equations; semiconductor technology.

Finite difference techniques and a particular computer algorithm are given for a one dimensional diffusion problem in a composite domain with time dependent domain and moving interfacial boundary. The physical problem involves the redistribution of an impurity (boron) caused by the oxidation of a semiconducting crystal (silicon). The boundary conditions at the interfacial boundary express conservation of mass and the propensity of the impurity to be dissolved in one rather than the other of the two adjacent materials (the segregation condition). The novel feature of the algorithm is its employment of the integral form of the conservation of mass boundary condition instead of the conventionally used differential form.

15176. Raveché, H. J., Mountain, R. D., Streett, W. B., **Reply to the comment on "Monte Carlo studies of the fluid-solid phase transition in the Lennard-Jones system,"** *J. Chem. Phys.* **62,** No. 11, 4582-4583 (June 1, 1975).

Key words: coexisting densities; finite system; "flat" loop; fluid-solid phase transition; Lennard-Jones System; Monte Carlo Studies.

The issue between SRM and HV is shown to be the uncertainty in the coexisting densities obtained by the two methods and not the methods themselves.

15177. Reinker, R. P., Timmerhaus, K. D., Kropschot, R. H., **Thermal conductivity and diffusivity of selected porous insulations between 4 and 300 K,** Chapter I-4 in *Advances in Cryogenic Engineering* **20,** 343-354 (Plenum Press, New York, N.Y., 1975).

Key words: cryogenic insulation; powders; thermal conductivity; thermal diffusivity.

The thermal conductivity and thermal diffusivity of selected evacuated porous insulations have been measured between 4 and 300 K to better understand the heat transport mechanisms. The thermal conductivity of both perlite and uncoated microspheres can be represented by $k=bT^3$ to within the experimental error. The conductivity of aluminum coated microspheres was found to be highly dependent upon sample history.

15178. Raveché, H. J., Stuart, C. A., **Towards a molecular theory of freezing,** *J. Chem. Phys.* **63,** No. 3, 1099-1111 (Aug. 1, 1975).

Key words: branching; freezing points; metastable fluids; nonlinear operator; pair correlation function; single particle probability density.

The subject of this article is the fluid-solid transition and, in particular, an analysis of crystallization in terms of quantities which describe the average local arrangements of molecules in a fluid. We determine whether it is possible to predict the existence of crystalline solutions for the local molecular density from a Hamiltonian which is invariant under all translations and rotations. Crystallization is studied using the singlet probability density, the pair correlation function, and the intermolecular potential energy. An integral equation is obtained for these quantities, and we pursue the existence of crystalline (i.e., periodic but nonconstant) solutions for the singlet probability which branch from the fluid (i.e., constant) solution which is the number density. The phenomenon of crystallization, that is, the existence and determination of these solutions, can then be represented as a nonlinear eigenvalue problem. The analysis is applied to hard sphere systems in one, two, and three dimensions. Crystallization to close-packed lattices is found in two and three dimensions when the isotropic media are overcompressed by amounts which depend on the structures to which the fluids crystallize. That is, the fluid persists into a portion of the metastable region. The nature of the crystalline solutions is analyzed in the neighborhood of the branching eigenvalues, and the relation between these special eigenvalues and equilibrium freezing points is discussed. The stability of these crystalline solutions is determined by comparing the values of a free energylike functional on these solutions with its value for the fluid.

15179. Hudson, R. P., **Conference report: European conference on temperature measurement,** *Cryogenics* **15,** 486 (Aug. 1975).

Key words: conference; temperature; thermometry.

A short report on the European Conference on Temperature Measurement (held in Teddington, London, April 9-11, 1975 at the National Physical Laboratory).

15180. Haber, S., **Adaptive integration and improper integrals,** *Math. Comput.* **29,** No. 131, 806-809 (July 1975).

Key words: improper integrals; integrals; numerical analysis; numerical integration; numerical quadrature; quadrature; Riemann integral; singularities.

Let R be the class of all functions that are properly Riemann-integrable on $[0, 1]$, and let IR be the class of all functions that are properly Riemann-integrable on $[a, 1]$ for all $a > 0$ and for which

$$\lim_{a\to 0^+} \int_a^1 f(x)dx$$

exists and is finite. There are computational schemes that produce a convergent sequence of approximations to the integral of any function in R; the trapezoid rule is one. In this paper, it is shown that there is no computational scheme that uses only evaluations of the integrand, that is similarly effective for IR.

15181. Unassigned.

15182. Arp, V. D., Clark, A. F., Flynn, T. M., **Superconducting levitation of high speed vehicles,** *Transp. Eng. J.* **99,** No. TE4, 873-885 (Nov. 1973).

Key words: levitation; magnetic suspension; materials fatigue data; refrigeration; superconducting magnets; transportation.

The current status (December 1972) of worldwide research on high speed ground transportation techniques is reviewed. Particular attention is given to studies of magnetic levitation using superconducting magnets, including comparison with alternative magnetic techniques and with air suspension systems. Superconducting levitation appears to be a strong contender in the U.S. Department of Transportation hopes to select in the late 1970's the best of the possible levitation techniques for subsequent advanced development. Cryogenic engineering research needed in support of major development of a superconducting levitated system is identified.

15183. Cohen, J., Edelman, S., **Polymeric pyroelectric sensors for fire protection,** *Tech. Rep. AFAPL-TR-74-16,* 27 pages (Available from the National Technical Information Service, Springfield, Va. 22151, 1975).

Key words: heat detector; optical radiation sensor; poling; polymer; polyvinyl fluoride; polyvinylidene fluoride; pyroelectric effect; relative spectral response; ultraviolet detector.

This report summarizes the results of a program to develop optical radiation sensors for fire detection using polymeric pyroelectric sensing elements. Emphasis has been placed on techniques for constructing such devices, including methods of enhancing the pyroelectric response. Materials investigated included polyvinyl fluoride (PVF) and polyvinylidene fluoride

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(PVF_2). Six sensors were developed and delivered to the sponsor.

Highlights reported include achievement of a value of specific detectivity, D*, of 2×10^8 cm · $Hz^{1/2}$ · W^{-1} and the construction of a set of sensors useful over a wavelength range extending from the ultraviolet to the infrared.

Methods of characterizing the performance of sensor elements are described.

15184. Hanley, H. J. M., McCarty, R. D., Haynes, W. M., **Equations for the viscosity and thermal conductivity coefficients of methane,** *Cryogenics* **15,** No. 7, 413-417 (July 1975).

Key words: correlation; critical point; equation of state; methane; thermal conductivity; thermal conductivity coefficient; viscosity coefficient.

An equation is proposed to calculate the viscosity and thermal conductivity coefficients of methane from the dilute gas to the dense liquid. The range of validity of the equation is approximately 95-400 K for pressures up to 50 MPa (~ 500 atm). The reliabilities of the coefficients calculated are estimated at approximately 2 percent and 5 percent for the viscosity and thermal conductivity coefficients, respectively. The equation includes a contribution for the thermal conductivity enhancement in the critical region.

15185. Brauer, G. M., **Modification of soft and hard tissues,** (Proc. Symp. on Dental Adhesive Materials, New York, N.Y., Nov. 8-9, 1973), Paper in *Dental Adhesive Materials,* Moskowitz-Ward-Woolridge, Eds., pp. 180-204 (Prestige Graphic Services, New York, N.Y., Sept. 1974).

Key words: bone; chemical grafting; collagen; ratskin; surface modification; tissue surfaces.

Various techniques to modify hard and soft tissues, with the aim of enhancing adhesion, are reviewed. Treatment of enamel surfaces with acids enhances adhesion because of mechanical interlocking of resin at the enamel resin interface. Coupling agents have had some success in promoting adhesion of tooth structure to dental restoratives.

Special emphasis is given to chemical grafting techniques to obtain covalent bonding to tissue surfaces which are investigated in our laboratory.

The grafting of monomers to soft and hard tissues so that after polymerization of the monomer the proteinaceous surface is bonded covalently to the polymer side chain, offers an attractive technique for improving surface characteristics of skin, bone or dentin. Grafting monomers containing additional functional groups that are potential reactive centers for further modification of the collagenous surfaces appears feasible. Grafting to soft tissues can be conducted in the presence of various redox systems, but grafting to bone is best accomplished with persulfate-bisulfite initiator. Modification of the tissue surface is indicated by changes in wettability, decreased water sorption and improved resistance to mold growth. Surfaces with the desired degree of hydrophil to lipophil balance to suit specific applications may be prepared. The modified surfaces could be useful as adhesion promoting liners for restorative resins.

15186. Rupp, N. W., **Dental amalgam, a plea for clinical research,** *J. Am. Acad. Gold Foil Operators* **13,** No. 1, 29-31 (Spring 1975).

Key words: creep; dental amalgam; marginal ditching.

Marginal ditching of dental amalgam restorations was related to the physical property of creep in clinical studies directed by Mahler. Because of his conclusions and similar results in other studies, a recommended revision of the ADA Specification No. 1, Alloy for Dental Amalgam, includes a creep test. This effort to improve the specification and limit the certification of alloys to those having good marginal integrity is dependent upon well planned, clinical research.

15187. Weinstein, B. A., Piermarini, G. J., **Raman scattering and phonon dispersion in Si and GaP at very high pressure,** *Phys. Rev. B* **12,** No. 4, 1172-1186 (Aug. 15, 1975).

Key words: Gallium phosphides; high pressure; metallic phase transitions; phonon dispersion; Raman scattering; silicon.

One- and two-phonon Raman spectra of Si and GaP were measured at room temperature for pressures up to 135 kbar. An opposed diamond-anvil high-pressure cell was employed in the experiments, and its design and use for Raman scattering are described in detail. Mode Grüneisen parameters and quadratic pressure coefficients were measured for phonons at several zone-boundary critical points as well as at $\bar{q} \approx 0$. In addition the general effect of pressure on large portions of the phonon dispersion near the zone edge could be inferred. In both materials zone-boundary TA modes "softened" with increasing pressure, while optical phonons shifted to higher energy. Using the high-pressure Raman data a calculation of the thermal-expansion coefficient of Si as a function of temperature (negative at low temperature) achieved fair agreement with experiment. Measured and theoretically calculated mode Grüneisen parameters are compared for several tetrahedral semiconductors. The Raman spectrum of Si was measured up to the metallic (β-Sn structure) transformation at 125 ± 5 kbar. This transition is discussed within the context of the bond-charge model.

15188. Robinson, R. L., Jr., Hiza, M. J., **Solid-vapor equilibrium—A survey,** Chapter F-2 in *Advances in Cryogenic Engineering* **20,** 218-239 (Plenum Press, New York, N.Y., 1975).

Key words: binary systems; cryogenic fluids; interaction second virial coefficients; review; solid-vapor equilibria; unlike molecule interactions.

The current status of knowledge regarding solid-vapor equilibrium is reviewed. Available data are summarized for systems composed of He, Ne, Ar, Kr, Xe, H_2, N_2, O_2, F_2, CO, CO_2, CH_4, C_2H_4, C_2H_6. Currently used experimental techniques are described, including experimental difficulties. Methods for theoretical description of solid-vapor equilibrium are given. The value of solid-vapor equilibrium data is discussed, with emphasis on the information furnished regarding unlike-molecule interactions.

15189. Unassigned.

15190. Margulis, S. T., **A comparison of the opinions of Operation Breakthrough occupants and conventional housing occupants about their housing,** *Industrialization Forum* **6,** No. 1, 21-26 (1975).

Key words: architectural psychology; dwelling unit; federal building research; industrialized housing; occupant behavior; Operation Breakthrough; performance evaluation.

Occupants of Operation Breakthrough and of conventional housing were interviewed about their homes and on related topics. The opinions of these two groups of occupants were compared in order to determine comparability of the housing based on the opinions of their occupants. The matching of OBT and conventional housing, their occupants and their sites was relatively successful. The comparison of occupant opinions lead to the conclusion that OBT housing was favorably evaluated and that its evaluation was at least as good as if not superior to that of the conventional housing. The conclusion is discussed in the context of earlier research on industrialized housing and in terms of the goals of the Operation Breakthrough program.

15191. Haas, S. S., Dickson, G., Brauer, G. M., **A proposed specification for acrylic bone cement,** *J. Biomed. Mater. Res. Symp.* **9,** No. 4, 105-117 (1975).

Key words: biomaterial; bone cement; orthopaedic material; poly(methyl methacrylate); specification; surgical bone cement.

A proposed specification covering handling characteristics and physical and chemical properties of bone cement composed primarily of methyl methacrylate has been prepared on the basis of data from the authors' studies and from various other sources. Under handling characteristics, requirements included relate to dough, handling and setting time, proper plasticity for insertion and temperature rise on setting. Mechanical properties specified include compressive strength and indentation and recovery characteristics. Maximum limits are proposed for water sorption and solubility. Suggested packaging requirements are also included.

15192. Cox, J. E., Bostock, J., Waterstrat, R. M., **Superconducting properties of A15 phase V-Ir alloys,** (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT 13,* K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3,** 480-484 (Plenum Publishing Corp., New York, N.Y., 1974).

Key words: A15 phases; iridium alloys; superconductivity; vanadium alloys.

Superconducting transition temperatures, T_0, and initial slopes of the critical magnetic field curves have been determined for A15 phase V-Ir alloys. Samples investigated range from $V_{61}Ir_{39}$ to $V_{75}Ir_{25}$ in 2 at.% steps. T_0 increases with increasing Ir content, from < 15 mK for $V_{75}Ir_{25}$ to 1.85K for $V_{61}Ir_{39}$. Low temperature ordering anneals do not markedly affect the superconducting properties of these alloys. Metallurgical aspects of these materials are discussed.

15193. Ehrlich, M., **The use of pressed LiF for thermoluminescence dosimetry without furnace annealing,** *Phys. Med. Biol. Tech. Note* **19,** No. 5, 725-731 (1974).

Key words: dosimetry; fading; furnace annealing; glow curve; maximum heating temperature; peak height; reproducibility; sensitivity loss; supralinearity.

A method of LiF thermoluminescence dosimetry (TLD) requiring no furnace annealing is described which can be used with many general-purpose commercial TLD readers. With this method, one produces LiF TLD characteristics similar to those obtained after conventional annealing. Glow-curve areas following successive identical exposures of a sample reproduce to within a relative standard deviation of 1 percent, but peak heights are less reproducible. Supralinearity characteristics are similar to those of conventionally annealed samples. While fading is somewhat more pronounced, it is not prohibitive for many medical applications. Maximum nominal planchet temperatures of 300 °C during readout produce essentially complete annealing in the medical exposure range, without appreciable loss in sensitivity due to successive irradiations and readouts, while sensitivity losses sometimes amount to as much as 8-10 percent for maximum nominal readout temperatures of 400 °C.

15194. Cunitz, R. J., Galloway, W. D., Berman, C. M., **Behavioral suppression by 383-MHz radiation,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 3, 313-316 (Mar. 1975).

Key words: behavior; behavioral suppression; exposure; microwave radiation; microwaves; product safety; radiation; radiation effects; resonant cavity; rhesus; suppression.

The heads of two rhesus monkeys were irradiated in a 383-MHz resonant cavity immediately before and during performance of a four-choice forced-choice serial reaction task. CW radiation at integral dose rates of 0.001-17.5 W were delivered to the head. No effects were observed below a critical dose level ($\simeq$ 23 W/kg) derived from integral dose rate and body mass. Above this level, behavioral suppression occurred, i.e., correct response rate was profoundly altered. The effect was completely reversible and repeatable in one of the subjects – the other subject did not recover completely and was sacrificed for histological examination which revealed no gross or microscopic damage. The nature of the effect suggests a neurochemical rather than an electrical or mechanical basis for the results.

15195. Chuong, R., **Experimental study of surface and lattice effects on the solubility of hydroxyapatite,** *J. Dent. Res.* **52,** Supplement to No. 5, 911-914 (Sept.-Oct. 1973).

Key words: hydroxyapatite; nonstoichiometry; solid-to-solution ratio; solubility; surface chemistry.

Brown et al. have formulated a thermodynamic treatment for the solubility of hydroxyapatite in which recognition of a distinction between surface and lattice contributions is explicitly made. Verification of the applicability of this approach to the $Ca(OH)_2$-H_3PO_4-H_2O system has been carried out by Avnimelech et al. The purpose of the present study is to apply the theory of Brown et al. to the quaternary system $Ca(OH)_2$-H_3PO_4-H_2O-HCl. Three solution series, each involving a given HCl concentration, were prepared with solid-to-solution ratios of 0.2, 0.4, 0.5, 0.8, 1.0, and 2.0 g/100 ml. Solutions were agitated for 5 days at 25 °C, after which they were filtered. pH, Ca and P were determined and ion activity products and electroneutrality unbalances were calculated. The findings indicate that the Ca/P ratios in the final solutions varied with both the solid-to-solution ratio and the initial HCl concentration. However, the ion activity products for hydroxyapatite were essentially constant. These results indicate that the contribution of the surface to the overall dissolution reaction relative to that of the lattice must be taken into account, but in conformity with theory standard solubility product principles are applicable to the final equilibrium reaction.

15196. Jennings, D. A., Evenson, K. M., Jimenez, J. J., **New CO_2 pumped CW far-infrared laser lines,** *IEEE J. Quantum Electron.* **QE-11,** No. 8, 637 (Aug. 1975).

Key words: IR; laser, optically pumped; waveguide cavity.

A single-frequency CW CO_2 laser has been used to pump ethyl alcohol, methyl chloride, ethyl chloride, and methylene chloride, generating 8 new CW far-infrared (FIR) laser lines from 254 to 1700 μm.

15197. Chew, W. M., Xenoulis, A. C., Fink, R. W., Schima, F. J., Mann, W. B., **The L/K electron capture ratio in first-forbidden ^{81g}Kr decay,** *Nucl. Phys.* **A229,** 79-92 (1974).

Key words: deduced Q_{EC}, log ft, J^{π}; enriched ^{80}Kr target; isotope separated sources; measured L/K EC ratio; multiwire proportional counter; radioactivity ^{81g}Kr [from (n,γ)].

The L/K electron capture (EC) ratio of ^{81g}Kr was measured to be 0.146 ± 0.005 utilizing the wall-less, anticoincidence, multiwire proportional counter technique and a reactor-produced, mass separated ^{81g}Kr source. From this value, the Q_{EC} and log ft values were determined to be 305_{-29}^{+38} keV and 11.6 respectively, assuming EC decay only to the ground state. If there is 4 percent EC branching to a reported 276 keV level, Q_{EC} becomes

322_{-14}^{+31} keV from which $(L/K)_{g.s.} = 0.144 \pm 0.005$, $\log ft = 11.6$ for EC to the ground state, $(L/K)_{276} = 0.213 \pm 0.005$, and $\log ft = 11.4$ for 4 percent feeding to the 276 keV level. In order to be confident of these results, an extensive systematic comparison of experimental and theoretical L/K ratios was made for both first-forbidden non-unique and unique transitions. From this comparison, a $7/2^+$ ground state assignment for ^{81}Kr is confirmed.

15198. Davis, R. M., **Technology as a deterrent to dehumanization,** *Science* **185,** 737 (Aug. 30, 1974).

Key words: dehumanization; deterrent; technologies.

This requested editorial discusses the role of technology as one of the better deterrents to dehumanization. It cites the confusion surrounding the use of the newer technologies of computers, automation and communication in terms of their benefits or disadvantages to the public. It highlights the need for better scientific advice in these areas to senior policy makers.

15199. Davis, R., **Impermanent balance between man and computer,** *Science* **186,** 99 (Oct. 11, 1974).

Key words: artifacts; balance; computer; impermanence; intelligence; power; science; technology.

This requested editorial discussed the relative but changing balance between man and computer in the accomplishment of so-called intellectual tasks. It highlights the impermanence of the balance and emphasizes the need for people to better understand their need to define the man-computer interrelationship.

15200. Schutz, G. C., Clark, G. E., **Data communication standards,** *Computer* **7,** No. 11, 32-37 (Feb. 1974).

Key words: American National Standards Institute; Computer Society of the IEEE; Data Communication Standards; Electronics Industries Association; International Standards Organization; International Telecommunications Union.

This paper provides an overview description of a number of organizations that are involved in the development of industry, American national and international standards pertaining to data communications. The significant organizations include: the Computer Society of the Institute of Electrical and Electronic Engineers, the Electronics Industries Association, the American National Standards Institute, the International Standards Organization and the International Telecommunications Union. The functions and objectives of the pertinent committees, subcommittees and task groups sponsored by these organizations as well as various formal and informal interworking relationships among them are described. Timely information includes a discussion of presently unresolved technical issues being addressed by the data communication standards community as well as listings of the standards approved by each of the organizations described.

15201. Dresser, M. J., Madey, T. E., Yates, J. T., Jr., **The adsorption of xenon by W(111), and its interaction with preadsorbed oxygen,** *Surface Sci.* **42,** 533-551 (1974).

Key words: desorption energy; desorption kinetics; physical adsorption; tungsten (111); work function; xenon.

The physisorption of Xe on W(111) and of Xe on partial layers of oxygen chemisorbed on W(111) has been studied using flash desorption and work function methods. It has been found that xenon adsorbs up to monolayer coverages at 104 K. Xenon desorbs from W(111) as a single binding state following first order kinetics. At low coverages ($\theta_{Xe} < 0.07$) the binding energy decreases with increasing coverage possibly because of the presence of high energy adsorption sites due to crystal imperfections and edge effects. For $\theta_{Xe} > 0.07$ the desorption data fit a first order rate expression with a desorption energy of 9.3 kcal/mol and preexponential $\nu = 10^{15}$ s^{-1}. The observed work function change of -1.1 ± 0.1 eV is consistent with monolayer estimates reported in field emission studies of physisorbed xenon on tungsten. The effect of preadsorbed oxygen layers on the physisorption of xenon on this surface is very striking. The energy of desorption shifts as much as 50 percent higher for a moderate exposure of oxygen. Several physisorption models are explored along with estimates of dispersion and electrostatic interaction contributions.

15202. Snyder, J. J., **Paraxial ray analysis of a cat's-eye retroreflector,** *Appl. Opt.* **14,** No. 8, 1825-1828 (Aug. 1975).

Key words: optical devices; optics, precision; reflector, cat's-eye; retroreflector, cat's eye.

The cat's-eye retroreflector is a passive optical system consisting of a secondary mirror placed at the focal point of a primary lens. We analyze the cat's eye using the paraxial ray matrix approach. The position of the equivalent reflecting surface and the angular field of view of a realizable cat's eye are functions of the radius of curvature of the secondary mirror. The field of view is maximum for a secondary mirror with a concave radius of curvature equal to the focal length of the primary lens. We further derive the general dependence of retroreflection errors on misadjustment of the secondary mirror.

15203. Pella, P. A., Diamondstone, B. I., **Stability of aqueous ethanol solutions stored in glass ampules,** *J. Forensic Sci. Tech. Note* **20,** No. 3, 537-538 (1975).

Key words: breath alcohol analyzers; dichromate oxidimetry; performance standards; reference ethanol solutions.

Stability studies were carried out on ampules samples of ethanol-water solutions. These solutions are used to measure performance capabilities of breath alcohol detection instruments.

15204. Meyerson, M. R., **The proposed Department of Commerce "Voluntary" Labeling Program,** (Proc. 1973 Technical Seminar for College Educators of Home Equipment, Dallas, Tex., Nov. 1-3, 1973), Paper in *Proceedings 1973 Technical Seminar for College Educators of Home Equipment,* pp. 9-10 (Association of Home Appliance Manufacturers, Chicago, Ill., 1973).

Key words: education; efficiency comparison; household appliances; household equipment; label developments; labeling; label specification; monitoring priorities; product classes; test methods; voluntary.

The features of the Department of Commerce Program for the Voluntary Labeling of Major Household Appliances and Equipment to Effect Energy Conservation are presented. These procedures were published in the Federal Register on October 26. The steps involved in carrying out the program are (1) setting of priorities among products, (2) establishment of product classes where appropriate, (3) setting of test methods to be used, (4) developing a system for comparing the efficiency of similar products, (5) development of a label that is meaningful to consumers, (6) publication of a Proposed Label Specification in the Federal Register with time for comment, (7) evaluation of comments, (8) publication of the Final Label Specification, (9) education of the public as to the meaning of the program, and (10) monitoring of the program to insure compliance.

15205. Laufer, A. H., Bass, A. M., **Mechanism and rate constant of the reaction between methylene and methyl radicals,** *J. Phys. Chem.* **79,** No. 16, 1635-1638 (1975).

Key words: combination; flash photolysis-gas chromatography; methyl; methylene; radicals; rate constant.

The chemistry of the reaction between methyl and triplet methylene radicals has been examined by means of flash photolysis of azomethane and ketene followed by gas chromatographic analysis of the hydrocarbon products. Using the combination rate constant of triplet $CH_2 = 5.3 \times 10^{-11}$ cm^3 molecule^{-1} sec^{-1} and the combination of $CH_3 = 9.5 \times 10^{-11}$ cm^3 molecule^{-1} sec^{-1}, a value of $1.0 \pm 0.1 \times 10^{-10}$ cm^3 molecule^{-1} sec^{-1} for the reaction $^3CH_2 + CH_3 \rightarrow C_2H_5^* \rightarrow C_2H_4 + H$ has been determined.

15206. Leasure, W. A., Jr., Bender, E. K., **Tire-road interaction noise,** *J. Acoust. Soc. Am.* **58,** No. 1, 39-50 (July 1975).

Key words: acoustics; noise (sound); tire noise; transportation noise.

The relative importance of tire noise to overall vehicle noise is established. A general description is then given of the tire engineering process and of tire structures. The important parameters influencing tire noise are discussed, based on presently available data, followed by an identification of unknown and contradictory areas. The basic mechanisms of tire-noise generation, although not well understood, are investigated largely from a theoretical viewpoint. Areas for future research and development are identified based on gaps in the existing physical data base and a rather primitive level of understanding of noise-generating mechanisms.

15207. Copley, J. R. D., Rowe, J. M., **Short-wavelength collective excitations in liquid rubidium observed by coherent neutron scattering,** *Phys. Rev. Lett.* **32,** No. 2, 49-52 (Jan. 14, 1974).

Key words: collective excitations; liquid rubidium; neutron scattering; propagating modes; scattering function; short wavelength.

The short-wavelength collective excitations in liquid rubidium at 320 K have been studied by coherent neutron scattering. For values of $\kappa = 2\pi/\lambda$ up to 1.0 Å^{-1}, clear evidence of propagating modes was found from the shape of the scattering function $S(\kappa,\omega)$ at constant values of κ. This result shows that the existence of such modes does not depend upon either quantum effects or low thermal population of the modes.

15208. Berger, R. E., **Effect of contact lens motion on the oxygen tension distribution under the lens,** *Am. J. Optom. Physiol. Opt.* **51,** No. 7, 441-456 (July 1974).

Key words: contact lens; contact lens motion; diffusion; hydrodynamics; mathematical model; oxygen; oxygen tension; oxygen tension distribution.

A method of predicting the oxygen tension distribution under a contact lens is illustrated for some simple, but practical, lens motions. A hydrodynamic theory is used to find those regions which receive fresh tear fluid during a blink. Then a diffusion model is solved to find the oxygen tension distribution at all times between blinks. The results are compared with earlier models in which details of the fluid flow were neglected, as were variations of oxygen tension with position under the lens. Depending on the motion of the lens, the tear fluid exchange factor can be quite large without eliminating regions in which the oxygen tension is below critical levels. The results suggest that the situation can be improved if the lens is designed for large displacements, with the blink, in the direction parallel to the cornea.

15209. Mazur, J., McIntyre, D., **The determination of chain statistical parameters by light scattering measurements,** *Macromolecules* **8,** No. 4, 464-476 (July-Aug. 1975).

Key words: chain correlation; chain statistical parameters; light scattering; Monte-Carlo computations, chase transition; scattering function.

The effects of volume exclusion on polymer chain conformations can be determined from the study of the angular dependence of radiation scattered by chain molecules. It is found that useful information can be obtained only when the variable x is large, where x is the product of the square of the magnitude of the scattering vector and of the mean square radius of gyration. Hence, solutions of macromolecules of very high molecular weight are needed for these investigations. The theoretical treatment of the scattering function is based on several assumptions. The validity of these assumptions is examined by computing, using a Monte-Carlo technique, various moments of intramolecular separations and comparing the results so obtained, in the limit of a chain of infinite length, with the analytical results. The computations seem to verify the validity of the theoretical model. The scattering behavior of solutions of recently synthesized polystyrene of $M_w = 4.4 \times 10^7$ in cyclohexane at various temperatures and in benzene at 40° was investigated. From the log−log plots of the scattering function vs. x, a statistical parameter was calculated, whose value depends on the magnitude of long-range correlations between any pair of chain elements. It is found that above the Θ temperature this parameter is practically independent of temperature and that its numerical value was found to agree well with the value obtained from Monte-Carlo calculations. In the neighborhood of the Θ temperature, this parameter decreases rapidly with decreasing temperature, indicating a first-order transition in chain conformation.

15210. Buhl, D., Snyder, L. E., Lovas, F. J., Johnson, D. R., **Silicon monoxide: Detection of maser emission from the second vibrationally excited state,** *Astrophys. J.* **192,** L97-L100 (Sept. 1, 1974).

Key words: maser; M-type stars; molecular emission; Orion Nebulae; silicon monoxide; rotational transitions.

The $J = 1-0$ rotational transition of the second vibrational state ($v = 2$) of SiO has been detected in late M-type variable stars and in the center of the Orion Nebula. This transition of SiO requires 3520 K of excitation for pumping the observed maser line. The ground ($v = 0$), and third ($v = 3$) vibrational states were not detected.

15211. Casella, R. C., Robertson, B., **Direct tests for violation of *CP* invariance,** *Phys. Rev. D* **8,** No. 3, 968-970 (Aug. 1, 1973).

Key words: *CP*-violation; decays; direct tests; kaon; lepton-asymmetry; momentum-dependence; Weisskopf-Wigner.

Two tests are proposed for directly establishing violation of *CP* invariance in neutral-kaon decay. Provided that there exist only two neutral kaons, these tests rely on the principles of quantum theory and relativistic kinematics and, in particular, are independent of the Weisskopf-Wigner approximation made in the theory of Lee, Oehme, and Yang. One of these tests can be made using data that will soon be available and the other can be made with existing techniques.

15212. Howell, B. F., Simmons, J. H., Haller, W., **Loss of chemical resistance to aqueous attack in a borosilicate glass due to phase separation,** *Am. Ceram. Soc. Bull.* **54,** No. 8, 707-709 (Aug. 1975).

Key words: borosilicate glass; chemical durability; phase separation.

The chemical durability of a borosilicate glass was measured by a powder extraction test (ASTM C 225-68). It was found that a progressive decrease in chemical durability occurred during prolonged heat treatments at temperatures ranging from 29 to

84° below the immiscibility temperature. Following these extreme thermal histories, which are not normally encountered in standard forming and annealing conditions, the amount of extractable alkali increased by as much as 20 fold.

15213. Berger, H., **Summary/Conference on Emerging Techniques for Nondestructive Field Testing,** *Mater. Eval.* **XXXIII,** No. 7, 189-191 (July 1975).

Key words: airport pavements; bridge inspection; neutron testing; pipeline inspection; railroad inspection; transportation; vehicle inspection.

The Conference on Emerging Techniques for Nondestructive Field Testing held August 13-14, 1974, at the Transportation Systems Center in Cambridge, Mass., was jointly organized by the American Society for Nondestructive Testing (ASNT) and the U.S. Department of Transportation (DOT). More than 100 persons attended to learn more about the conference theme, "Opportunities for NDT in Transportation."

A primary purpose of the meeting was to make the NDT community aware of some of the nondestructive testing objectives and problems of DOT, in the expectation that organizations or individuals who had solutions, or potential solutions to such problems would make them available. The meeting itself provided the initial opportunity for this interaction.

The meeting proceedings, as contained in this issue of *Materials Evaluation,* provide a larger audience for this interaction possibility. My suggestion—read the papers and offer ideas or comments for possible solutions to NDT problems to the authors, or to the Conference Chairman, Dr. Michael Lauriente, Office of the Secretary of Transportation, U.S. Department of Transportation, Washington, D.C. 20590. We hope many readers of *Materials Evaluation* will respond and make the conference theme a reality!

15214. Berger, H., **Radiographic nondestructive testing,** *Stand. News* **3,** No. 3, 21-29 (Mar. 1975).

Key words: dimensional measurement; gamma radiography, image enhancement; neutron radiography; nondestructive testing; proton radiography; real-time techniques; three-dimensional radiography; x-radiography.

This article is a review of radiographic nondestructive testing for a planned nondestructive testing issue of Standardization News (ASTM). Several new ideas in radiographic methods are described following a brief review of conventional gamma and x-radiography. New ideas discussed include high definition radiography, xeroradiography, electron radiography, image enhancement, real-time systems, three-dimensional methods, neutron radiography, and proton radiography.

15215. Bowman, H. A., Schoonover, R. M., Carroll, C. L., **The utilization of solid objects as reference standards in density measurements,** *Metrologia* **10,** 117-121 (1974).

Key words: density; density calibration; density measurement; density standard; volume standard.

NBS has measured the densities of four single crystal silicon objects to a standard deviation of 0.26 ppm with a systematic error of 0.7 ppm. These objects will be used as working standards to which density work in the United States will be referred. A redundant hydrostatic comparison test involving two standards at a time has been devised, the use of which facilitates the efficient propagation of the density information contained in these crystals into other objects which may be used as standards by other laboratories. This article describes a method of employing this redundant comparison procedure.

15216. Casella, R. C., **Algorithm for computing the number of independent real parameters in the phonon dynamical matrix,** *Phys. Rev. B* **11,** No. 12, 4795-4800 (June 15, 1975).

Key words: counting independent parameters; phonon dynamical matrix; time reversal symmetry.

The effects of time-reversal symmetry in reducing the maximum number $\mathcal{M}$ of real parameters in the phonon dynamical matrix at fixed $\vec{k}$ are taken into account to yield the following result: either (I) $-\vec{k}$ is *not* in the star of $\vec{k}$ in which case $\mathcal{M}^{I}=\Sigma_r n_r^2$, or (II) it *is*, in which case $\mathcal{M}^{II}=\Sigma_{r\epsilon(a)} n_r(n_r+1)/2+\Sigma_{r\epsilon(b)} n_r^2/2+\Sigma_{r\epsilon(c)} n_r(n_r-1)/2$. Here, n_r denotes the number of times the rth irreducible representation of the little group $G^{\vec{k}}$ occurs in the reducible representation $\Delta^{\vec{k}}$ at wave vector $\vec{k}$. $\Delta^{\vec{k}}$ is of dimension $3n$, where n is the number of atoms per unit cell. In the expression for $\mathcal{M}^{II}$, one sums over all r in cases (a), (b), and (c), respectively, where (a) (b), and (c) refer to the three cases of Wigner in the Herring criterion. The analysis is also applied to compute a lower upper bound $\mathcal{M}'$ within the rigid-molecule model as discussed group theoretically in the context of inelastic-neutron-scattering experiments by Casella and Trevino.

15217. Lang, W. W., Flynn, D. R., **Noise power emission level for product designation,** *Noise Control Eng.* **4, No. 3, 108-113 (May-June 1975).**

Key words: acoustics; machinery noise; noise; sound; sound power.

A brief discussion is given of some of the advantages of using sound power rather than sound pressure at a particular location to describe the noise emission from a particular source. To avoid confusion between sound pressure levels and sound power levels, both of which are usually expressed in decibels, it is proposed that in communications with users, the sound power levels of stationary sources be expressed in terms of Noise Emission Number, which is numerically equal to the A-weighted sound power level expressed in bels rather than decibels.

15218. Bright, R. G., **Recent advances in residential smoke detection,** *Fire J.* **68,** No. 6, 69-77 (Nov. 1974).

Key words: detection; detectors; fire fatalities; gas detectors; ionization chamber detectors; performance standards; photoelectric detector.

The loss of life by fire in the home is a significant problem in the U.S. Had the homes been equipped with an early-warning, fire detection device between 40 and 50 percent of the people killed in these fires might have been saved. One early warning fire detection device which shows great promise is the single-station, smoke detector. This fact is being recognized by more and more code authorities in the U.S. As a consequence, an increasing number of the U.S. building codes are requiring the installation of single-station smoke detectors in all new housing.

There are problems, however, with several of the single-station, smoke detectors on the market. In addition, there is a lack of good published performance standards for these detectors, standards that would improve the quality of smoke detectors offered for sale in the marketplace and would eliminate many of the problems.

The National Bureau of Standards, in conjunction with the approvals testing laboratories and the detector manufacturers, is developing performance standards for the single-station, smoke detector. Development and publication of these standards will have a material effect on improving the quality of smoke detectors sold in the U.S.

15219. Radebaugh, R., Siegwarth, J. D., Holste, J. C., **Heat transfer between sub-micron silver powder and dilute He^3He^4 solutions,** (Proc. 5th Int. Cryogenic Engineering Conf., Kyoto, Japan, May 7, 1974), Paper H6 in *5th International Cryogenic Engineering Conference,* K. Mendelssohn, Ed., pp. 242-245 (IPC Science and Technology Press, Surrey, England, 1974).

Key words: cryogenics; dilution refrigerator; heat transfer; helium 3; helium 4; Kapitza resistance; liquid helium; powder; silver.

The thermal resistance between copper cells lined with silver powder of 0.1 – 0.2 μm diameter and a dilute stream of He^3 in He^4 was measured between 15 and 250 mK. The results show that this powder can give an order of magnitude lower thermal resistance at 15 mK than an equal volume of copper powder of 1.8 μm diameter. The scientific and engineering significance of such a low resistance in a small volume is discussed. At the higher temperatures R is proportional to T^{-1}, which can be explained by a liquid thermal resistance and a resistance at the joint between the powder and the cell walls.

15220. Chang, C. C., Dodge, W. R., Murphy, J. J. II, **$^3He(\gamma,d)^1H$ cross section from 10 to 21 MeV,** *Phys. Rev. C* 9, No. 4, 1300-1308 (Apr. 1974).

Key words: cross section structure; excitation energy distribution function; ^3He electrodisintegration; ^3He excited states; ^3He photodisintegration.

A measurement of the $^3He(e,d)^1H$ 90° differential cross section between 10 and 21 MeV was made. The $^3He(e,d)^1H$ cross section was converted into a $^3He(\gamma,d)^1H$ cross section. The shape of the $^3He(\gamma,d)^1H$ cross section agrees with recent theoretical calculations. We find no evidence for the anomalies (structure) in the $^3He(\gamma,d)^1H$ 90° differential cross section at excitation energies of 14.5 and 19.5 MeV reported in two recent experiments.

15221. Braun, W., Kurylo, M. J., Kaldor, A., **Infrared laser enhanced reactions: V → V and V → T energy transfer in the O_3-SiF_4-O_2 system,** *Chem. Phys. Lett.* **28,** No. 3, 440-444 (Oct. 1, 1974).

Key words: apparatus and methods; deactivation; energy transfer; infrared laser; luminescence; ozone.

Rapid V → V energy transfer between SiF_4 and O_3 has been observed following laser excitation of either O_3 or SiF_4. A CO_2 laser tuned to either the 9.6 μ P(30) or P(32) transitions was used to promote vibrational excitation in O_3 and SiF_4, respectively. In experiments employing the P(32) transition, the V → V transfer to O_3 and subsequent reaction of $O_3^\dagger$ with NO were used to obtain the rate constant of V → T deactivation of $SiF_4^\dagger$ by O_2.

$$SiF_4^\dagger + O_2 \xrightarrow{k_2} SiF_4 + O_2,$$

$$k_2 = (6.3 \pm 1.4) \times 10^{-13}\ \mathrm{cm^3\ molecule^{-1}\ s^{-1}}.$$

Fractional modulation measurements of the chemiluminescence generated by the $O_3 + NO$ reaction were used in experiments employing the P(30) transition to obtain a rate constant for the V → V energy transfer between $O_3^\dagger$ and SiF_4.

$$O_3^\dagger + SiF_4 \xrightarrow{k_{-3}} SiF_4^\dagger + O_3,$$

$$k_{-3} = (3.8 \pm 0.5) \times 10^{-11}\ \mathrm{cm^3\ molecule^{-1}\ s^{-1}}.$$

15222. Hruska, G. R., Koidan, W., **Free-field method for sound-attenuation measurement,** *J. Acoust. Soc. Am.* **58,** No. 2, 507-509 (Aug. 1975).

Key words: acoustic centers; attenuation of sound; sound absorption.

A free-field method is described for measuring the attenuation of sound at ultrasonic frequencies. It makes use of the systematic deviation from the inverse square law caused by attenuation when a sound receiver is drawn away from a sound source. Measurements of attenuation from 20 to 100 kHz, made in air in a small anechoic chamber under ambient environmental conditions, were in good agreement with theoretical calculations. The sum of the distances between the acoustic centers of the transducers and the vibrating elements is obtained as a by-product of the procedure.

15223. Choi, C. S., Prask, H. J., Prince, E., **Crystal structure of NH_4ClO_4 at 298, 78, and 10 K by neutron diffraction,** *J. Chem. Phys.* **61,** No. 9, 3523-3529 (Nov. 1, 1974).

Key words: crystal structure; low temperature; meta-stable compound; neutron diffraction; NH_4ClO_4; thermal motion.

The crystal structure of ammonium perchlorate has been studied at 298, 78, and 10 K by means of neutron diffraction. The NH_4ClO_4 crystal has an orthorhombic unit cell, space group *Pnma,* with four formula units per cell at all three temperatures. The unit cell dimensions at 298 K are $a = 9.20$, $b = 5.82$, $c = 7.45$ Å, as determined previously; at 78 K, $a = 9.02$, $b = 5.85$, $c = 7.39$ Å; and $a = 8.94$, $b = 5.89$, $c = 7.30$ for 10 K. Initial positions of H atoms were determined from a difference Fourier map of the room temperature data. However, a least-square refinement of these data did not converge. The thermal motions and orientations of the ammonium groups at low temperature (10 and 78 K) were determined by means of a constrained refinement which treated the ammonium group as a rigid body; these results are compared with the results obtained by the conventional least-squares method. Both refinements show that the librational motions about one of the three principal axes have particularly large rms amplitudes: 21° for the 10 K structure and 30° for the 78 K structure. Each ammonium group is surrounded by 10 oxygen atoms with short N... O distances ranging from 2.9 to 3.25 Å. The ClO_4^- group and NH_4^+ group each have essentially ideal tetrahedral structure. They are linked together by N-H... O type hydrogen bonds, one for each hydrogen, to form a three-dimensional network. Examination of the rms amplitudes for libration and the hydrogen bonding of the NH_4^+ ions indicates that two of the four hydrogens are bound identically, one hydrogen is bound more rigidly, and the fourth more weakly. These results suggest that the rotational motions of the ammoniums are quite complex even at 10 K.

15224. Piermarini, G. J., Block, S., **Ultrahigh pressure diamond-anvil cell and several semiconductor phase transition pressures in relation to the fixed point pressure scale,** *Rev. Sci. Instrum.* **46,** No. 8, 973-979 (Aug. 1975).

Key words: diamond-anvil pressure cell; fixed point pressure scale; high pressure; NaCl pressure scale; pressure measurement; ruby fluorescence; semiconductors; transition pressures.

A diamond-anvil type optical cell of improved design has produced static pressures in gasketed samples up to 500 kilobar as measured by the ruby fluorescence technique. The ruby R_1 line pressure shift is linear to 291 kilobar, and the maximum measured shift is extrapolated to 500 kilobar assuming continued linearity of the pressure dependence. The ultimate pressure capability of this diamond cell has not been established. Transition pressures in the semiconductors Si, ZnSe, ZnS, and GaP measured by the ruby method indicate that the revised 1970 fixed point scale and the ruby (NaCl) scale diverge above 135 kilobar and disagreement may be by as much as a factor of 2 in the 500 kilobar range with the ruby scale defining the lower pressure.

15225. Weston, W. F., Ledbetter, H. M., Naimon, E. R., **Dynamic low-temperature elastic properties of two austenitic nickel-chromium-iron alloys,** *Mater. Sci. Eng.* **20,** 185-194 (1975).

Key words: bulk modulus; compressibility; Debye temperature; elastic constant; nickel-chromium-iron alloys; Poisson's ratio; shear modulus; sound velocity; Young's modulus.

The zero-magnetic-field low-temperature elastic properties of two polycrystalline nickel-chromium-iron alloys were determined ultrasonically between 4 and 300 K. Results are given for: longitudinal and transverse sound velocities, Young's modulus, shear modulus, bulk modulus, Poisson's ratio and elastic Debye temperature. Effects of alloying are discussed. The elastic property changes due to additions of chromium and iron to nickel are reviewed comprehensively.

15226. Saloman, E. B., **Time response of NBS windowless XUV radiometric transfer standard detectors,** *Appl. Opt.* **14,** No. 8, 1764 (Aug. 1975).

Key words: radiometry; rise time; temporal response; transfer standard detector; XUV photodiode.

For the spectral region between 200 Å and 1200 Å the NBS radiometric standard detector is a windowless photodiode with a 2.5 cm diameter cathode made of evaporated aluminum on whose surface a 150 Å thick Al_2O_3 layer has been anodized. A study has been made of the response of these diodes to pulsed radiation. A Garton-type flashlamp was modified to provide pulses of radiation with a duration of about 1 μsec. These pulses were passed through a half-meter Seya-Namioka vacuum monochromator and the zero order radiation was allowed to fall on the cathode of the diode. The emitted cathode current of the diode across a 50Ω load was displayed by an oscilloscope. Output pulses were observed with instantaneous amplitudes as high as 1 mA with no evidence of saturation. The rise time of the diode output pulses was on the order of 300 nsec which was the expected rise time of the flashlamp. In order to confirm that the rise time was flashlamp limited, a diode with a tungsten cathode was substituted for the Al_2O_3 diode. The temporal results were identical. Thus we are able to conclude that the NBS windowless Al_2O_3 radiometric transfer standard diodes have a rise time shorter than 300 nsec.

15227. Kashiwagi, T., **A radiative ignition model of a solid fuel,** *Combust. Sci. Technol.* **8,** 225-236 (1974).

Key words: ignition; ignition boundary; solid fuel.

A theoretical model describing radiative ignition of a solid fuel is constructed and is numerically analyzed. The model includes the effects of gas phase reaction and a finite value of the absorption coefficient of the solid (in-depth absorption of incident radiation). It is found that the gas phase reaction must be included in the model in order to understand radiative ignition of a solid fuel and to find its ignition boundary. The in-depth absorption of the incident radiation by a solid fuel significantly affects the ignition delay time. The results indicate that there is a finite range of values for pyrolysis or gas phase reaction activation energy for which ignition will occur. This finding has a direct bearing on efforts to reduce material ignitability.

15228. Hasegawa, S., Stokesberry, D. P., **Automatic digital microwave hygrometer,** *Rev. Sci. Instrum.* **46,** No. 7, 867-873 (July 1975).

Key words: humidity; hygrometer; microwave refractometer.

This hygrometer is designed to measure the humidity of atmospheric air over the vapor pressure range 3-7400 Pa (0.03-74 mbar). The instrument is an adaption of a microwave refractometer using two cavities operating at 12 GHz. One cavity is exposed to the moist test air and the other is exposed to the same air sample with all the water vapor removed. Both cavities are maintained at the same fixed temperature in a thermostated oven and at the same total pressure. The difference in frequency between the cavities is automatically nulled by a tuning probe in the sampling cavity. The instrument was calibrated by two independent methods. One involved the measurement of the resonance frequency of the sampling cavity as a function probe penetration and using this in a theoretically derived equation for vapor pressure. The second involved the measurement of the probe penetration as an empirical function of known vapor pressure of a test gas. These two methods yielded results which agreed on the average to better than 0.5 percent for vapor pressures up to 3050 Pa (30.5 mbar).

15229. Buchbinder, L. B., **Human activity patterns and injury severity in fire incidents involving apparel,** *J. Fire Flammability/Consumer Product Flammability* **1,** 4-18 (Mar. 1974).

Key words: accident patterns; apparel; apparel fires; burn injury; FFACTS; fire; flammable fabrics; flammable liquids; garment fires; garment parameters; injury severity; victim's activity; victim's reactions.

Activities preceding an apparel fire accident are identified and related to age, sex, and the severity of burn injury. After age six, activity patterns were strongly related to the victim's sex, with men the primary victims of accidents involving flammable liquids, gases, or high voltage electricity, and women more susceptible to direct flame ignition. The majority of cases studied had burns over less than 20 percent of the total area of their body. When flammable liquids were involved, there tended to be fewer minor injuries and more moderately serious injuries than in accidents not involving intermediary materials. Age and defensive capability were major factors determining extent of injury, with persons over 65 and those with limited ability suffering more serious injuries than other groups. Included are recommendations for remedial action.

15230. Fung, F. C. W., Suchomel, M. R., Oglesby, P. L., **The NBS program on corridor fires,** *Fire J.* **67,** No. 3, 41-48 (May 1973).

Key words: carpets with and without underlayment; corridor fires; energy models; finished interior; full scale experiments; interaction; measurements; smoke; smoke and flame spread; temperature; with and without forced air; velocity.

This report outlines the NBS full scale experimental program to investigate the growth and spread of fire and smoke into and through a corridor when a fire is initiated in an adjoining room. The program proposes energy models to investigate both the contribution of the corridor interior finish surfaces and their interactions under the full scale fire situation. As a status report it describes in detail the experimental facilities and approaches for the program.

A summary of the tests conducted to date is presented. It is shown that flames can propagate the length of a 30 foot corridor, with a combustible floor covering as the only source of fuel in the corridor, when initiated by 2.7 psf of wood cribs in an adjacent room. Typical quantitative measurements of temperature, velocity, smoke and energy are also presented. In addition, comparative discussions are presented for tests with and without forced air draft and carpet tests with and without underlayment.

15231. Jones, F. E., **Magnetic retention of evaporation or sputtering masks (Abstract only),** *Rev. Sci. Instrum. Letter to Editor* **46,** No. 6, 793 (June 1975).

Key words: evaporation; magnetic retention; masks; sputtering; substrates; thin films.

The "use of a magnet to clamp a magnetic metal mask to the substrate during sputtering" of thin film patterns has been described by Ingle. A similar technique was described previously by Jones and Castle in this journal and in a patent.

15232. Unassigned.

15233. Iverson, W. P., **Anaerobic corrosion: Metals and microbes in two worlds,** *Dev. Ind. Microbiol.* **16,** 1-10 (1975).

Key words: anaerobic corrosion; cathodic depolarization theory; Charles Thom Award; *Desulfovibrio desulfuricans*; hollow whiskers; mechanism; microbial corrosion; mild steel; oxidizing agent; Schreibersite; sulfate-reducing bacteria; Vivianite.

Charles Thom Award address presented by the author at the General Meeting of the Society for Industrial Microbiology held at Memphis State University, 11-16 August 1974. (The Thom Award honors the first president of the Society for Industrial Microbiology. The later Charles Thom was a noted microbiologist who worked for the U.S. Department of Agriculture and his research on molds helped to produce many of today's antibiotics).

The author's investigations of the mechanism of anaerobic corrosion by sulfate-reducing bacteria, which led to the observation that a marine strain produced extracellularly, a strong oxidizing agent which caused extensive corrosion of mild steel under anaerobic conditions, are detailed. The formation of hollow whiskers, structures which resemble fungal mycelium, by the reaction of ferrocyanide or ferricyanide on metals are described.

15234. Herron, J. T., Huie, R. E., **Rate constants for the reactions of ozone with ethene and propene, from 235.0 to 362.0 K,** *J. Phys. Chem.* **78,** No. 21, 2085-2088 (1974).

Key words: air pollution; ethene; kinetics; mass spectrometry; ozone; propene; rate constant.

The rate constants for the reactions of ozone with ethene and propene have been measured over the temperature range 235.0-362.0 K, using a stopped-flow system coupled to a beam-sampling mass spectrometer. The rate constants found, at a total pressure of about 500 N m^{-2}, in the presence of molecular oxygen, were $k(C_2H_4) = (5.42 \pm 3.19) \times 10^9 \exp(-2557 \pm 167/T)$ $cm^3\ mol^{-1}\ sec^{-1}$ and $k(C_3H_6) = (3.70 \pm 1.42) \times 10^9 \exp(-1897 \pm 109/T)$ $cm^3\ mol^{-1}\ sec^{-1}$.

15235. Ito, J., **Synthetic indium silicate and indium hydrogarnet,** *Am. Mineral.* **53,** 1663-1673 (Sept.-Oct. 1968).

Key words: crystal chemistry; flux growth; garnet; hydrogarnet; indium silicates; inorganic synthesis; solid solubility silicates; x-ray powder analysis.

The following indium silicates were synthesized hydrothermally and in air: indium grossular, $Ca_3In_2Si_3O_{12}$; indium aegirine, $NaInSi_2O_6$; indium beryl, $Be_3In_2Si_6O_{18}$; indium thortveitite, $In_2Si_2O_7$; indium melanotekite, $Pb_2In_2Si_2O_9$; and strontium indium hydrogarnet, $Sr_3In_2(OH)_{12}$.

Complete solid solubility was found between ferric iron and indium silicates and hydrogarnet end members. Single crystals of indium aegirine up to 2 cm in length were grown in a Na_2WO_4 flux by slow cooling.

The crystal chemical and geochemical behavior of trivalent indium is similar to that of scandium. The ionic radius of trivalent indium of 0.81 Å given by Pauling is confirmed.

15236. Coxon, B., **Preliminary communication: Nitrogen-15 n.m.r. spectroscopy of amino sugars,** *Carbohydr. Res.* **35,** C1-C3 (1974).

Key words: amino sugars; chemical shifts; magnitude spectra; nitrogen-15 nuclear magnetic resonance spectroscopy; nuclear Overhauser effects.

Derivatives of 6-amino-6-deoxy-D-galactose-6-^{15}N and -D-glucose-6^{15}N and the corresponding unlabeled compounds have been synthesized via reactions of appropriate 6-*O*-tolyl-*p*-sulfonyl or 6-deoxy-6-iodo derivatives with potassium phthalimide-^{15}N (or ^{14}N), followed by hydrazinolysis of the phthaloyl group. ^{15}N n.m.r. spectra of the amino sugar derivatives have been measured directly at 9 MHz by pulse-Fourier transform techniques. The recording of spectra of ^{15}N in natural abundance in the amino sugar derivatives was aided by proton irradiation which caused a substantial negative, nuclear Overhauser effect (NOE), even for derivatives in which the ^{15}N nucleus is not directly bonded to a proton. For example, irradiation of the protons of 6-deoxyl-1,2:3,4-di-*O*-isopropylidene-6-phthalimido-α-D-galactopyranose (1) -6-^{15}N at 90 MHz inverted the ^{15}N signal and enhanced its intensity by a factor of 3.4, which indicates a NOE of -4.4. One half gram of this derivative (^{15}N enrichment, 99%) yielded a ^{15}N spectrum with a signal:noise ratio of 36:1 when excited by a single pulse. With ^{15}N at natural abundance in 0.75 g of **1**, 8,192 pulses (112 min) were required to give a ^{15}N signal:noise ratio of 13:1. The negative NOE on the ^{15}N signal of **1**-6-^{15}N was removed (with reinversion of the signal, but no shift) by addition of the relaxation reagent, chromium (III) acetylacetonate to a concentration of 0.02M.

15237. Peterlin, A., **Dependence of diffusive transport on morphology of crystalline polymers,** *J. Macromol. Sci. Phys.* **B-11,** No. 1, 57-87 (1975).

Key words: crazing; crystalline polymer solid; diffusion; elastic deformation; permeability; plastic deformation; sorption.

The sorption and diffusion of low molecular weight penetrants proceeds almost exclusively through the amorphous component of the semicrystalline polymer solid. The diffusive transport properties and geometrical distribution of the amorphous component are substantially modified by mechanical and thermal treatment. Deformation of spherulitic material first loosens the structure and then transforms it into a densely packed fibrous structure with a great many taut tie molecules in the amorphous component. Annealing lets the crystals grow in thickness, removes crystal defects, sharpens the boundaries between crystalline and amorphous component, and relaxes the taut tie molecules. The resulting changes of transport properties cannot be described in a satisfactory manner by crystallinity and orientation but require a detailed consideration of morphology. The elastic tensile deformation enhances sorption and diffusion by reducing the density of amorphous component. The high anisotropy of diffusion and the drastic reduction of sorption and diffusion of fibrous material are the consequence of the microfibrillar morphology with the large fraction of highly aligned and closely packed taut tie molecules which eliminate many sorption sites, enormously reduce the diffusivity, and increase its concentration dependence. The anisotropy may be reduced during plastic deformation of the fibrous material by the increased number of interfibrillar tie molecules.

15238. Radebaugh, R., Siegwarth, J. D., Oda, Y., Nagano, H., **Experiments with miniature heat exchangers for dilution refrigerators,** (Proc. 5th Int. Cryogenic Engineering Conf., Kyoto, Japan, May 7, 1974), Paper H3 in *5th International Cryogenic Engineering Conference, K. Mendelssohn, Ed., pp. 235-237 (IPC Science and Technology Press, Surrey, England, 1974).*

Key words: copper alloy; copper; cryogenics; dilution refrigerator; heat exchanger; Kapitza resistance; liquid helium; powder; silver.

This paper describes experiments done on three types of miniature heat exchanger for dilution refrigerators. These have liquid volumes on the order of 0.1 cm^3. The first is a continuous exchanger incorporating Cu(Cr) powder, the second is a continuous exchanger incorporating sub-micron silver powder, and the third is a discrete exchanger incorporating 1.8 μm copper powder. The first two were not successful and the reasons are not entirely clear. The third exchanger performed about as calculated and permits an order of magnitude reduction in liquid volumes from that normally used.

15239. Grundl, J. A., Dudey, N. D., Popek, R. J., **Measurement of absolute fission rates,** *Trans. Amer. Nucl. Soc.* **17,** 516-517 (1973).

Key words: absolute fission rates; neutron dosimetry; reactor fuels; reactor materials.

Recently, the accuracy requirements for fast reactor fuels and materials dosimetry surpassed the existing capabilities of fission foil activation measurements. In order to improve this capability by direct calibration of activation detectors, absolute fission rates per nucleus have been measured in fast neutron fluxes suitable for both fission activation foils and for fission fragment detectors. This paper presents results for absolute fission fragment emission rates from ^{239}Pu, ^{235}U, ^{238}U, and ^{237}Np exposed to the first of these fast neutron fluxes, the spectrum of the CFRMF Reactor at ANC.

15240. Huie, R. E., Herron, J. T., **Reactions of atomic oxygen (O^3P) with organic compounds,** Paper in *Progress in Reaction Kinetics,* K. R. Jennings and R. B. Cundall, Eds., **8,** No. 1, Part 1, 1-80 (Pergamon Press, Great Britain, 1975).

Key words: atomic oxygen; gas phase; kinetics; mechanism; organic compounds; rate constants.

The reactions of atomic oxygen (O^3P), in the gas phase, with organic compounds are reviewed. The various techniques used in these studies are discussed critically. The kinetics and mechanisms of the reactions of atomic oxygen with organic compounds are discussed in detail.

15241. Geller, S. B., **Archival data storage,** *Datamation* **20,** No. 10, 72, 75-76, 80 (Oct. 1974).

Key words: archival language; archival quality; content decay; content density; content lifetimes; storage media.

This paper develops some archival language and discusses factors which must be considered when an archival data storage system is designed. These include types of contents, content decay rates, content and medium lieftimes, content density and system costs. Other archival storage quality factors such as information security and recovery are considered.

15242. Davis, G. T., Eby, R. K., **Low-temperature x-ray attachment,** *Rev. Sci. Instrum.* **46,** No. 9, 1285-1286 (Sept. 1975).

Key words: attachment, low-temperature; radiation shield; temperature gradient; x-ray.

A commercial high-temperature, high-vacuum diffractometer attachment, which was originally designed for heating samples from ambient temperatures to 2600 K using metal ribbon heaters, has been modified for low-temperature use. This has been accomplished simply by the construction of a new sample holder and a change of the port used for evacuation. With these modifications, controlled temperatures down to 100 K can be achieved easily.

15243. Hastie, J. W., **Sampling reactive species from flames by mass spectrometry,** *Int. J. Mass Spectrom. Ion Phys.* **16,** No. 1/2, 89-100 (Jan. 1975).

Key words: flames; laser excitation; mass spectrometry; radicals.

Recent studies on sampling reactive species from flames and related laser-excited systems are described. Consideration is given to the possible effect of probe-related perturbations on the experimental data. It is concluded that such perturbations are not significant under the present experimental conditions.

15244. Finkel, P. W., Miller, T. R., Weikel, M. K., **Reply to clinical chemistry article,** *Clin. Chem.* **20,** No. 4, 521, 523-524 (1974).

Key words: chemistry; clinical laboratory capability; critique; hematology; microbiology; sampling.

The February 1974 issue of CLINICAL CHEMISTRY published a critique of two NBS Interagency Reports. The Bureau has prepared a reply, written by the senior author of both NBS reports, and coordinated through the Institutes for Applied Technology and Materials Research.

15245. Newbury, D. E., Yakowitz, H., **Specimen preparation, special techniques, and applications of the scanning electron microscope,** Chapter VI in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 211-262 (Plenum Press, New York, N.Y., 1975).

Key words: scanning electron microscope; SEM applications; SEM dynamic experiments; SEM specimen preparation; SEM stroboscopy; stereomicroscopy.

Techniques of specimen preparation for scanning electron microscopy, including degreasing, electropolishing, and deposition of conductive coatings, are discussed. Stereomicroscopy, the technique of obtaining images with depth information, is described. Dynamic experiments conducted *in situ* in the scanning electron microscope (SEM) are considered. Examples of dynamic experiments, including tensile straining and the application of magnetic fields, are given. Stroboscopy, the imaging of high frequency, cyclical events is described. Practical applications of the SEM to a range of materials science problems are described in detail. The problems include: (1) examination of fractured metals and composites; (2) investigation of lunar soil; (3) failure analysis of a corroded steam boiler; (4) recognition of mineral phases; (5) characterization of wear particles; (6) examination of human teeth; (7) orientation and crystal perfection analysis with electron channeling effects; (8) examination of magnetic recordings; (9) examination of magnetic domain structures; (10) operation of an integrated circuit; and (11) observation of ferroelectric domains.

15246. Yakowitz, H., **Methods of quantitative x-ray analysis used in electron probe microanalysis and scanning electron microscopy,** Chapter IX in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 327-372 (Plenum Press, New York, N.Y., 1975).

Key words: electron probe microanalysis; empirical methods; Fe-Si alloys; Monte Carlo methods; quantitative analysis; scanning electron microscopy.

Quantitative microprobe analysis is considered from the classical point of view as well as the so-called empirical approach. The relations used to convert raw data to mass fractions are discussed and scrutinized with respect to sources of error in the final analysis. Histograms depicting the typical spread of results are used to show what can be expected. By way of illustration, the complete planning and execution of the analysis of binary silicon-iron alloy is described in detail. Brief mention is made of special specimen geometries such as thin films or fracture surfaces and means to obtain analyses from them. An extensive reference list is appended.

15247. Yakowitz, H., Goldstein, J. I., **Practical aspects of x-ray microanalysis,** Chapter XI in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 401-434 (Plenum Press, New York, N.Y., 1975).

Key words: crystal spectrometers; elemental distribution; elemental identification; energy dispersive spectrometers; microanalysis; specimen preparation.

Element identification and distribution as determined by electron probe microanalytical techniques is explained. Both energy dispersive systems and curved crystal spectrometers are considered from the point of view of ease and accuracy of identification and distribution determination. A series of examples including minerals, meteorites, composite materials, superalloys and tool steel is discussed in terms of solution of practical problems by elemental identification and distribution.

For accurate quantitative electron probe microanalysis, specimen preparation plays a crucial role. Therefore, effects of specimen preparation are evaluated in terms of surface roughness, instrumental design and nature of the specimen. The role of standards in the analysis is outlined. Finally a series of examples involving compositional analysis is presented.

15248. Yakowitz, H., **Computational schemes for quantitative x-ray analysis: On-line analysis with small computers,** Chapter X in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 373-400 (Plenum Press, New York, N.Y., 1975).

Key words: empirical methods; minicomputers; on-line analysis; quantitative electron probe microanalysis; scanning electron microscopy; SRM-480.

This chapter deals with rapid means to perform data reduction for quantitative electron probe microanalysis with the aid of small computational devices (desk calculator to 8K machine). Included will be a complete discussion of a ZAF program packaged for on-line data reduction and the basis for use of the hyperbolic approximation on-line. For the laboratory which only does occasional quantitative analysis, a brief discussion is given of how to obtain an analysis with a desk calculator in a reasonable time—about two hours for a six component system or 30 minutes for a binary starting from scratch is needed. Solved examples are included.

15249. Goldstein, J. I., Yakowitz, H., Newbury, D. E., **Introduction to practical scanning electron microscopy,** Chapter I in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 1-19 (Plenum Press, New York, N.Y., 1975).

Key words: contrast; electron beam instrumentation; electron probe microanalyzer; instrumental development; scanning electron microscope; signal processing.

This chapter traces the evolution of the scanning electron microscope and the electron probe microanalyzer from birth to the present. A number of major developments both instrumental and methodological are outlined. The purpose is to familiarize the novice with these developments; for the experienced SEM user, the chapter aim is to remind one of the significant stages of instrumental development. Points touched upon include the discovery and exploitation of various SEM contrast mechanisms such as topographic, voltage and magnetic contrast as well as stages in the development of signal and image processing.

15250. Newbury, D. E., **Image formation in the scanning electron microscope,** Chapter IV in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 95-148 (Plenum Press, New York, N.Y., 1975).

Key words: scanning electron microscope; SEM contrast formation; SEM image defects; SEM image formation; SEM image quality; signal processing.

The image formation process in the scanning electron microscope (SEM) is described in detail. The major components of the image formation system are the scan coils, scan generator, signal detectors, amplifiers, and the cathode ray tube display. Various types of signal detectors are described: the Everhard-Thornley detector for back-scattered and secondary electrons, the solid state detector for backscattered electrons, specimen (absorbed) current detection, x-ray detectors, and cathodoluminescence detectors. Contrast formation is explained. The relationship between the image quality and the characteristics of the signal is detailed. For a given contrast level, a threshold beam current exists which must be exceeded to obtain a useful image. Various types of signal processing for image enhancement are described: black level suppression (differential amplification); gamma processing (non-linear amplification); time derivative signal transformation; and Y-modulation. The application of these signal processing techniques renders image details more readily visible to the human eye. Image defects are considered. Moiré effects can be obtained in images of periodic objects. If two contrast mechanisms are present in an image, one may dominate, requiring special signal processing techniques for detection of the weaker contrast.

15251. Newbury, D. E., Yakowitz, H., **Contrast mechanisms of special interest in materials science,** Chapter V in *Practical Scanning Electron Microscopy,* J. I. Goldstein and H. Yakowitz, Eds., pp. 149-210 (Plenum Press, New York, N.Y., 1975).

Key words: cathodoluminescence; electron beam induced conductivity contrast; electron channeling contrast; magnetic domain contrast; scanning electron microscope; voltage contrast.

This chapter considers several mechanisms of contrast formation in the scanning electron microscope (SEM). The physical origin of each mechanism is considered in detail. Electron channeling contrast results from effects of the periodic arrangement of atoms in a crystal on the penetration of the incident electrons. Type I magnetic contrast arises from effects of leakage fields outside the specimen on emitted secondary electrons. Type II magnetic contrast is related to effects of the internal magnetic field on the primary electrons as they undergo scattering in the specimen. Voltage contrast arises from the effect of surface potentials on the collection of emitted secondary electrons. Electron beam induced conductivity contrast (EBIC) occurs in certain semiconductors through the formation of electron-hole pairs, locally changing the conductivity from the interaction of the primary electrons. Cathodoluminescence results due to the emission of visible light when electron-hole pairs recombine. The characteristics of each contrast mechanism are related to the SEM operating parameters required for successful image formation.

15252. Johnson, C. R., ***D*-stability and real and complex quadratic forms,** *Linear Algebra and Appl.* **9,** 89-94 (1974).

Key words: *D*-stable matrix; positive diagonal matrix; quadratic forms; spectrum.

The problem of characterizing the class of *D*-stable matrices has remained unsolved since its suggestion in a paper by Arrow and McManus [1] in 1958. In this note we present a necessary condition involving real quadratic forms which is not sufficient and a sufficient condition involving complex quadratic forms which is not necessary.

15253. Sams, R. L., Lafferty, W. J., **High-resolution infrared spectrum of the $\nu_2+\nu_3$ band of $^{14}N^{16}O_2$,** *J. Mol. Spectrosc.* **56,** 399-410 (1975).

Key words: anharmonic constant; Coriolis resonance; high resolution; infrared spectrum; nitrogen dioxide; spin splitting.

The $\nu_2+\nu_3$ band of $^{14}N^{16}O_2$ has been recorded with resolution of 0.028 cm^{-1}. Ground state and upper state rotational constants have been obtained. The band center obtained, $\nu_0 = 2355.1517 \pm 0.0011$ cm^{-1} (error cited is 3σ), has been combined with the band centers recently determined for ν_3 and ν_2 to calculate $X_{23} = -11.348 \pm 0.020$ cm^{-1} where the uncertainty cited is based on reasonable estimates of the absolute frequency error.

15254. Fatiadi, A. J., **Symmetrical phenylosotriazoles from inositols,** *Carbohydr. Res. Note* **35,** 280-287 (1974).

Key words: conformation; half-chair; inositol; mercuric acetate; phenylosotriazole; p.m.r.; symmetrical.

The application of mercuric acetate reagent to conversion of inosose phenylosazones into phenylosotriazoles in 40–47 percent yield is described. Analysis of p.m.r. spectra of inositol phenylosotriazole esters (e.g., acetates, propionates, benzoates) and of their parent compounds on "decoupling" of their hydroxyl groups (by protonation, or deuterium exchange) showed a symmetrical pattern (presence of a simple, two-fold axis of symmetry in an AA′BB′ system); a half-chair conformation of these phenylosotriazole esters in solution was deduced from the p.m.r. spectra. Free inositol phenylosotriazoles in solution exist exclusively in a half-chair conformation.

15255. Reader, J., **Spectrum of Rb III observed with a pulsed-rf light source,** *J. Opt. Soc. Am.* **65,** No. 9, 988-990 (Sept. 1975).

Key words: rubidium; spectra; ultraviolet; wavelengths.

The spectrum of doubly ionized rubidium, Rb III, was observed with a pulsed-rf light source on two 10.7 m normal-incidence spectrographs at NBS. Wavelengths and classifications were obtained for 103 Rb III lines, 90 of which were newly observed. The three missing levels of the $4p^44d$ configuration, $(^3P)^4F_{9/2}$ and $(^1D)^2G_{7/2,9/2}$, and the one missing level of the $4p^45p$ configuration, $(^1S_0)[1]_{1/2}$, were located. The $4p^4(^1D)5d\,^2G_{9/2}$ level was also located. Improved values were determined for 13 excited levels.

15256. LaVilla, R. E., **The O $K\alpha$ and C $K\alpha$ emission and O K absorption spectra from O_2 and CO_2. IV,** *J. Chem. Phys.* **63,** No. 6, 2733-2737 (Sept. 15, 1975).

Key words: molecular CO_2; molecular oxygen; O and C $K\alpha$ x-ray emission spectra; O K absorption spectra.

The oxygen and carbon $K\alpha$ emission and oxygen K absorption spectra of the molecular gases O_2 and CO_2 are reported. The spectra were obtained on two different spectrometers, both with single flat crystal configurations. All the emission spectra were excited by direct electron bombardment and are in fair agreement with an interpretation based on allowed electric dipole transitions between single vacancy states and molecular orbital theory for the molecules. The oxygen K absorption of O_2 and CO_2 is dominated by a strong resonance peak before the K-shell threshold which is interpreted as being due to the transition of oxygen K electrons to the first unoccupied valence orbital of the respective molecules.

15257. Sugar, J., Kaufman, V., **Seventh spectrum of tungsten (W VII); resonance lines of Hf V,** *Phys. Rev. A* **12,** No. 3, 994-1012 (Sept. 1975).

Key words: hafnium; levels; spectra; tungsten; wavelengths.

Observations of W VII were carried out in the spectral range 100 to 2000 Å utilizing normal- and grazing-incidence spectrographs. The light source was a sliding spark operated at peak currents of 1000 to 3000 A. Eighty-five energy levels of $4f^{13}nl$ and $5p^5nl$ configurations were deduced for $nl = 5d, 6s, 6p, 6d$, and $7s$. These are based on the classification of 310 lines in the range 130 to 1436 Å. Calculations of all observed configurations were carried out with configuration interaction (CI) for the purpose of fitting radial integrals and confirming the analysis. The strong CI between p^5nl and $f^{13}nl$ configurations where $nl = 5d$, $6p$, $6d$ provided well-defined CI integrals in good agreement with Hartree-Fock values. A value of 984100 ± 500 cm^{-1} was derived for the ionization energy from the $4f^{13}ns$ series. The resonance lines of Hf V for $5p^6$-$5p^55d,6s$ are given. A revised value for the ionization energy of W VI is given.

15258. Lovas, F. J., Clark, F. O., Tiemann, E., **Pyrolysis of ethylamine. I. Microwave spectrum and molecular constants of vinylamine,** *J. Chem. Phys.* **62,** No. 5, 1925-1931 (Mar. 1, 1975).

Key words: dipole moment; ethylamine; pyrolysis reactions; rotational spectrum; structure; vinylamine.

Microwave rotational spectra assignable to gas phase vinylamine ($CH_2{=}CHNH_2$) have been detected in the pyrolysis decomposition products of ethylamine. Stark effect and hyperfine structure measurements have aided the assignment of the spectrum and allow the determination of the ^{14}N nuclear electric quadrupole coupling constants and the electric dipole moment for vinylamine. The spectrum of the first excited inversion vibrational state has been assigned. Relative intensity measurements indicate that the inversion state lies about 65 ± 25 cm^{-1} above the ground state. The spectral evidence suggests that vinylamine has a nonplanar equilibrium structure with $r_0(C-N) = 1.40$ Å and $\angle CCN = 125°$.

15259. Lewis, D. C., **On the determination of the minority carrier lifetime from the reverse recovery transient of *pn*R diodes,** *Solid-State Electron.* **18,** 87-91 (1975).

Key words: carrier lifetime; reverse recovery; semiconductor diodes.

The determination of the minority carrier lifetime of *pn* diodes with abrupt junctions and recombination (R) contacts is discussed. It is confirmed that the base transit time of diodes with sufficiently small base widths (less than approximately three minority carrier diffusion lengths) affects the reverse recovery transient and that large error can be introduced if the minority carrier lifetime of a diode with a small base width is computed using an expression which was derived for diodes with an infinite base width. Approximations to the general expression for the minority carrier lifetime as a function of the storage time and base width are developed, and the errors associated with their use are analyzed. In addition the effect of measurement errors on the determination of lifetime in short base diodes is discussed.

A procedure is described which can be used to compute the minority carrier lifetime of *pn*R diodes in which the ratio of the base width to the minority carrier diffusion length is larger than some small number. The applicability of the procedure and the approximations which are developed are a function of the ratio of the diode base width to the minority carrier diffusion length (W/L), and the forward to reverse current ratio (I_f/I_r) at which the experimental measurements are made. An example is given which shows that less than 1 percent error is introduced in the computed lifetime by the approximations if the lifetime is computed from measurements made at $I_f/I_r = 4$ and 8 for diodes such that $W/L > 2 \times 10^{-2}$.

15260. Hagan, L., **Reports of observatories for 1973/74, National Bureau of Standards, Washington, D.C.,** *Bull. Am. Astron. Soc.* **7**, No. 1, 165-169 (1975).

Key words: atomic energy levels; atomic line shapes; atomic spectra; atomic transition probabilities; bands, molecular; energy levels, atomic; line shapes, atomic; molecular bands; molecular spectra; rotational constants.

Research at the National Bureau of Standards in spectroscopy pertinent to astronomy is summarized. Publications on atomic spectra, atomic transition probabilities and line broadening, and molecular spectra are referenced and work in progress is discussed.

15261. Lovas, F. J., **Application of microwave spectroscopy to chemical analysis,** *Anal. Instrum.* **12**, 103-109 (1974).

Key words: applications; chemical analysis; microwave; qualitative analysis; quantitative analysis; rotational spectra.

Traditional analytical techniques have been successfully employed on a great variety of systems for identifying stable reaction products as well as for purity analysis and reaction efficiency. However, most analytical techniques generally can only be applied to "well behaved" chemical systems. Since gas phase reaction products do not always follow the "well behaved" guideline, an alternate analytical tool, such as microwave spectroscopy, could prove beneficial for analyzing such systems and may well provide some new routes to synthetic chemistry. A general review of the present state-of-the-art for applications of microwave techniques to analytical studies will be presented. An attempt will be made to describe the limitations and advantages of microwave spectroscopy for probing chemical systems for product identification and for optimization of the efficiency of gas phase chemical reactions. As an illustration, some recent results obtained in our laboratory on the complex pyrolytic decomposition reactions of ethylamine will be described. Further examples of possible applications will be taken from typical industrial processes which employ vapor phase chemical synthesis techniques.

15262. Giguere, P. T., Clark, F. O., **Radio search for HC_3N, HCN, OH, and detection of U8.19 in comet Kohoutek (1973f),** *Astrophys. J.* **198**, 761-764 (June 15, 1975).

Key words: comet; HCN; HC_3N; Kohoutek; OH; radio; search.

Comet Kohoutek (1973f) was observed with the NRAO 140-foot (43 m) radio telescope in the period 1974 January 4-7 in an attempt to detect the following molecular transitions: HC_3N, $J=1\text{-}0$, $v=0$; HC_3N, $J=1\text{-}0,2\nu_7$, $l=0$; HCN, $J=6,1\nu_2$; and OH, $^2\Pi_{1/2}$, $J=5/2$, $F=3\text{-}3$. All results for these lines were negative. An unidentified line was possibly detected at 8189 MHz.

15263. Rowe, J. M., Price, D. L., Ostrowski, G. E., **Inelastic neutron scattering from a liquid $^3He\text{-}^4He$ mixture,** *Phys. Rev. Lett.* **31**, No. 8, 510-513 (Aug. 20, 1973).

Key words: lifetime of excitations; neutron scattering; perturbation of elementary excitations; quantum liquids; roton minimum; $^3He\ ^4He$ solutions.

We report inelastic-neutron-scattering measurements on liquid $^3He_{0.05}{}^4He_{0.95}$ in the Q region from 0.8 to 2.3 Å^{-1} at 1.6 K. The shifts and increases in natural linewidth of the single excitation peaks relative to pure ^4He at the same temperature were determined by a least-squares fitting procedure. The shifts vary from a small, possibly negative, value at the roton minimum to positive values around 0.5 K at both ends of the Q range. The full widths at half-maximum of the extra broadening vary from 0.5 to 1.5 K over the same range.

15264. Rush, J. J., Livingston, R. C., de Graaf, L. A., Flotow, H. E., Rowe, J. M., **Study of hydrogen diffusion in tantalum hydrides by inelastic neutron scattering,** *J. Chem. Phys.* **59**, No. 12, 6570-6576 (Dec. 15, 1973).

Key words: activation energy; hydrogen diffusion; neutron scattering; quasielastic scattering; resonance time; tantalum hydrides; vibrational amplitude.

Neutron inelastic scattering spectra have been measured as a function of temperature and scattering angle for α-$TaH_{0.15}$ and for Ta_2H in its α and β_1 phases. The widths of the quasielastic peaks vs momentum transfer (Q) have been derived and compared with several models for hydrogen diffusion. The results suggest the dominance of tetrahedral jumps in the diffusion process, although no completely satisfactory theoretical fit was obtained. Residence times τ between 1.6 (340 °C) and 4.0 (148 °C) psec for $TaH_{0.15}$ and between 2.4 (300 °C) and 7 (153 °C) psec for Ta_2H were derived from the fit of the observed widths to the tetrahedral model. These results indicate a significant concentration dependence of the diffusion rates in α-TaH_x, with activation energies for diffusion of 10.4 ± 1.2 kJ/mol in $TaH_{0.15}$ and 15 ± 1.2 kJ/mol for Ta_2H. "Effective" mean square amplitudes of proton vibration of 0.02-0.04 Å^2 were obtained from the Q dependence of the quasielastic peak intensities, in reasonable agreement with the values predicted from relatively crude vibration frequency distributions obtained from our inelastic scattering spectra in the α phase. Our results are compared in detail with previous neutron results on VH_x and NbH_x. On the basis of this comparison it is tentatively concluded that the very high "Debye-Waller factors" obtained for VH_x and some other hydrides are related to high hydrogen diffusion rates.

15265. Cali, J. P., Stanley, C. L., **Measurement compatibility and Standard Reference Materials,** Chapter in *Annual Review of Materials Science* **5**, 329-343 (Annual Reviews Inc., Palo Alto, Calif., 1975).

Key words: measurement; measurement compatibility; reference methods; Standard Reference Materials.

The role of Standard Reference Materials (SRM's) in helping to provide measurement compatibility is explored. Measurement compatibility is simply the ability of elements within a measurement infrastructure to achieve the same measurement values. It is shown that measurement compatibility results when measurements are made on the basis of accuracy. SRM's are well-characterized materials whose properties are certified on the basis of accuracy. Therefore, laboratories within a measurement infrastructure become compatible when SRM's are used.

Sections cover these topics: (a) sources of information concerning the current availability and types of SRM's produced; (b) two examples of the impact of SRM's are given; and, (c) a discussion of future directions and needs is expounded.

15266. Hilsenrath, J., **The utility and economics of an on-line reference data network,** (Proc. Conf. on Mechanism of Explosions and Blast Waves, Naval Weapons Station, Yorktown, Va., Nov. 13-15, 1973), Paper in *Proceedings of the Conference on Mechanism of Explosions and Blast Waves,* Section XVII, 1-21 (Picatinny Arsenal, Dover, N.J., 1973).

Key words: data files; data network; data on-line; international data service; on-line data; reference data service; standard reference data.

This paper describes a prototype on-line data retrieval and data computation system and discusses the scientific, technical and organizational characteristics required to make such a system an economically viable reality.

The general characteristics of the envisioned system are: 1. Authoritative data collections and well documented sources stored on a reliable time-shared computer system; 2. Extended precision representation and computing where required; 3. Efficient programs to generate data not explicitly stored; 4. Easy to use conversational on-line access from inexpensive terminals; 5. A reliable and extensive communication network to eliminate or reduce toll charges; 6. Low user charges.

As envisioned, the charges for connect time should cover the communications costs, the computer costs, and the monthly cost of keeping the data and programs stored on the disc. The economics of the situation argue for building up the data files from small self-contained segments so as to expedite the collection, validation and maintenance of the data base; and to minimize the search time for the user. Of equal importance is the fact that the more compact a particular file is, the fewer uses of it will be required to cover its monthly storage cost.

Examples are given of the use of the system for solving a number of problems in thermodynamics and thermochemistry and in chemical kinetics.

15267. Lee, T. G., Huggett, C., **Interlaboratory evaluation of ASTM E 84-70 tunnel test applied to floor coverings,** *J. Test. Eval.* **3,** No. 1, 3-14 (1975).

Key words: ASTM E84; building materials; carpets; fire tests; flame spread tests; floor coverings; interlaboratory evaluation; smoke measurement; tunnel test.

Results of an interlaboratory evaluation of the American Society for Testing and Materials (ASTM) Test for Surface Burning Characteristics of Building Materials (E 84-70), involving eleven laboratories and nine materials including four carpets, are reported. Data on flame spread, smoke, and fuel contribution were analyzed statistically to determine the reproducibility and repeatability of the test method. Selected physical characteristics of each tunnel are tabulated and compared relative to specifications in the test method. The between-laboratory coefficient of variation (reproducibility) in flame spread classification (FSC) was found to range from 7 to 29 percent for the four carpets and from 18 to 43 percent for the other materials tested. The between-laboratory coefficients of variation for smoke developed and fuel contribution ranged from 34 to 85 percent and from 22 to 117 percent, respectively, for all materials tested. The causes of higher variability in smoke and fuel contribution measurement between laboratories are not definitely known but may reasonably be attributed to variations in tunnel construction, instrumentation, and operation in different laboratories.

15268. Coxon, B., Tipson, R. S., Alexander, M., Deferrari, J. O., **Conformational analysis of acylated 1,1-bis(acylamido)-1-deoxypentitols by Fourier-transform, p.m.r. spectroscopy,** *Carbohydr. Res.* **35,** 15-31 (1974).

Key words: acylated 1,1-bis(acylamido)-1-deoxypentitols; conformational analysis; conformational nomenclature; exponential filtering; Fourier transform; p.m.r. spectroscopy.

The conformations of eight acylated 1,1-bis(acylamido)-1-deoxypentitols in solution have been studied by pulse, Fourier-transform, p.m.r. spectroscopy at 90 MHz. The *arabino* and *lyxo* derivatives adopt the zigzag conformation, whereas the *ribo* and *xylo* derivatives favor different sickle conformations. The validity of the conformational assignments of these derivatives by the p.m.r. method is discussed. The relative merits and accuracy of the continuous-wave and pulse-Fourier p.m.r. spectroscopic methods in the conformational analysis of carbohydrates are appraised, and the applicability of the exponential filtering technique to enhancement of either the sensitivity or the resolution of their spectra is demonstrated.

15269. Kashiwagi, T., **Experimental observation of flame spread characteristics over selected carpets,** *J. Fire Flammability/Consumer Product Flammability* **1,** 367-389 (Dec. 1974).

Key words: flame spread; floor covering material; heat release rate; ignition.

A small laboratory size experiment was used to observe the characteristics of flame spread over various carpets under various constant external radiant fluxes ($0.10 \sim 0.27$ cal/cm^2 sec or $0.4 \sim 1.15$ w/cm^2). The results indicate that a minimum radiant flux is necessary to sustain flame spread over a carpet surface for the carpets tested. By increasing radiant flux, the flame spread velocity increases sharply and can reach several sm/sec. At a high external radiant flux, preheating time is the controlling factor for flame spread velocity. Ignitability, weight loss, and net heat release rate were also measured under various radiant fluxes. The effect of an underlayment on ignitability, flame spread speed, weight loss, and net heat release rate, was also observed for various carpets.

15270. Freund, S. M., Ritter, J. J., **CO_2 TEA laser-induced photochemical enrichment of boron isotopes,** *Chem. Phys. Lett.* **32,** No. 2, 255-260 (Apr. 15, 1975).

Key words: BCl_3 (boron trichloride); boron; CO_2 (carbon dioxide); enrichment; infrared; isotopes; TEA laser.

Mixtures of BCl_3 and H_2S are irradiated with 10.55 μm radiation (P(16)line of the 001-100 band of CO_2) from a TEA laser. After several hours of irradiation it is found that the maximum ^{10}B to ^{11}B ratio of recovered gaseous boron containing material (primarily unreacted BCl_3) is 0.413 ± 0.004. The corresponding ratio of the BCl_3 starting material is 0.242 ± 0.002. The ^{10}B concentration has therefore been increased from 19.5 to 29.2 percent. Further, by irradiating similar mixtures with 10.18 μm radiation (R(30) line of the same CO_2 vibrational band) this ratio changes to 0.169 ± 0.002, the ^{10}B concentration being lowered to 14.4 percent. All experiments are performed in a small static system and chemical procedures for recovering milligram quantities of BCl_3 selectively enriched in either isotope are described.

15271. Prince, E., Trevino, S. F., Choi, C. S., Farr, M. K., **A refinement of the structure of deuterium peroxide,** *J. Chem. Phys.* **63,** No. 6, 2620-2624 (Sept. 15, 1975).

Key words: crystal structure; deuterium peroxide; hydrogen bonds; hydrogen peroxide; neutron diffraction; structure refinement; thermal motion.

The structure of deuterated hydrogen peroxide, D_2O_2, at -15 °C was refined by least-squares methods from three dimensional neutron diffraction data. The data were fitted to two models, one with conventional anisotropic temperature factors and the other with the molecule treated as a rigid body except for torsional oscillations of the O–D groups about the O–O bond. The weighted agreement indices were 0.030 over 106 observed reflections for the conventional model and 0.032 over 102 reflections for the rigid body model. The structure is tetragonal, space group $P4_12_12$ or $P4_32_12$, with $a = 4.035$ Å, $c = 7.97$ Å, $Z = 4$. Position parameters for the two models are essentially the same. The O–O distance in the molecule, 1.455(2) Å, is identical to that found in H_2O_2, but the O–D bond is about 0.015 Å shorter than the O–H bond, 0.993 Å as compared with 1.008 Å when corrected for thermal motion by the riding model. The O–O distance corrected for thermal motion in the rigid body model is

1.49 Å, in fair agreement with the value 1.48 Å found in the vapor phase.

15272. Johnson, C. R., **The Hadamard product of A and A^*,** *Pacific J. Math.* **51,** No. 2, 477-481 (1974).

Key words: angular field of values; diagonal; diagonally dominant; field of values; Gersgorin; Hadamard product; Hermitian; positive definite; spectrum.

Coefficient-wise multiplication was introduced by Hadamard and has been studied for certain square matrices by I. Schur and later authors. For $A \epsilon M_n(C)$, the n by n complex matrices, this paper examines the Hadamard product of A and A^*. Upper estimates are given for the largest characteristic root of this necessarily Hermitian product, and three conditions on A sufficient for the product to be positive definite are presented.

15273. Finkel, P. W., Miller, T. R., Weikel, M. K., **NBS replies to Dr. Barnett's critique,** *Lab World* **25,** No. 4, 6 and 16 (Apr. 1974).

Key words: chemistry; clinical laboratory capability; critique; hematology; microbiology; sampling.

The December 1973 issue of LAB WORLD published a critique of two NBS Interagency Reports. The Bureau has prepared a reply, written by the senior author of both NBS reports, and coordinated through the Institutes for Applied Technology and Materials Research.

15274. Lashof, T. W., **A calibration check service for paper and board test instruments,** *TAPPI* **57,** No. 1, 5 (Jan. 1974).

Key words: collaborative reference program; interlaboratory testing; laboratory performance; paper test methods.

Brief editorial description of NBS-TAPPI Collaborative Reference Program, including participants, advantages, methods included, procedure, and related programs.

15275. Karo, A., Krauss, M., Wahl, A. C., **Recent applications of the multiconfiguration self-consistent field method to polarizabilities, excited states, Van der Waals forces, and triatomic surfaces,** (Proc. Int. Symp. on Atomic, Molecular and Solid-State Theory and Quantum Biology, Sanibel Island, Fla., Jan. 21-27, 1973), *Int. J. Quantum Chem. Symp.* No. 7, 143-159 (John Wiley & Sons, New York, N.Y., 1973).

Key words: CO; energy surface; F_2; hydrides; LiH_2; MC-SCF; O_2^-; O_3; polarizability; Van der Waals.

In this brief presentation recent and new applications of the multiconfiguration self-consistent field (MCSCF) method to the direct calculation of atomic polarizabilities, excited states of the same symmetry, Van der Waals forces, and triatomic energy surfaces are presented.

These calculations utilizing the BISON system, have been carried out over the past several years as part of collaborative research between Argonne National Laboratory, the National Bureau of Standards, and the Lawrence Livermore Laboratory.

15276. Motz, J. W., Dick, C. E., **X-ray scatter background signals in transmission radiography,** *Med. Phys.* **2,** No. 5, 259-267 (Sept.-Oct. 1975).

Key words: image contrast; monoenergetic x-ray beams; optimum radiographic systems; transmission radiography; x-ray image signals; x-ray scatter.

With monoenergetic x-ray beams incident on polystyrene phantoms, the spectra of the transmitted x rays were measured with a scintillation spectrometer. The scattered and unscattered components of the transmitted x-ray fluence at a point on the beam axis were determined as a function of (i) the incident x-ray energy (18, 22, 32, 49, 58, 69, and 660 keV), (ii) the phantom thickness (5.3, 10, and 21 cm), (iii) the scatter solid angle determined by the exposed area of the phantom and the separation distance of the image plane (0.090, 0.31, 0.66, 1.8, 3.5, 4.3, 4.8, and 5.1 sr), and (iv) the beam diameter at the image plane (25, 17, and 10 cm). The results indicate that, as the incident x-ray energy *decreases* from 660 to 30 keV, the contribution of the scattered component to the transmitted fluence *increases* from approximately 50 to 90 percent for the 21-cm phantom and from 21 to 50 percent for the 5.3-cm phantom. For typical cases, the data show the effect of the scatter component on the ratio of the image to the background signals. In addition, the examples show that optimum conditions for maximizing this signal ratio may be obtained by a careful selection of the incident x-ray energy for low-, medium-, and high-contrast objects.

15277. Miller, A., McLaughlin, W. L., **Absorbed dose distribution in a pulse radiolysis optical cell,** *Int. J. Radiat. Phys. Chem.* **7,** No. 5, 661-666 (1975).

Key words: absorbed dose rate; depth dose; dose distribution; dye films; electron beams; optical cell; pulse radiolysis; radiation dosimetry; radiochromic dyes.

When a liquid solution in an optical cell is irradiated by an intense pulsed electron beam, it may be important in the chemical analysis of the solution to know the distribution of energy deposited throughout the cell. For the present work, absorbed dose distributions were measured by thin radiochromic dye film dosimeters placed at various depths in a quartz glass pulse radiolysis cell. The cell was irradiated with 30 ns pulses from a field-emission electron accelerator having a broad spectrum with a maximum energy of ≈ 2 MeV. The measured three-dimensional dose distributions showed sharp gradients in dose at the largest penetration depths in the cell and at the extreme lateral edges of the cell interior near the optical windows. This method of measurement was convenient because of the high spatial resolution capability of the detector and the linearity and absence of dose-rate dependence of its response.

15278. Miller, A., Bjergbakke, E., McLaughlin, W. L., **Some limitations in the use of plastic and dyed plastic dosimeters,** *Int. J. Appl. Radiat. Isotop.* **26,** No. 10, 611-620 (Oct. 1975).

Key words: absorbed dose rate; cellulose triacetate; dosimetry; dyed cellophane; dyed plastics; electron beams; gamma radiation; plastic films; polymethyl methacrylate; polyvinyl chloride; radiation processing; radiochromic dyes.

Several practical plastic and dyed plastic dosimeters were examined under irradiation conditions similar to those used for radiation processing of materials. Cellulose triacetate, polymethyl methacrylate, polyvinyl chloride, dyed polymethyl methacrylate, dyed cellophane and dyed nylon were given fractionated and uninterrupted absorbed doses in the megarad range with ^{60}Co γ-rays and 10 MeV electron beams. It was found that with some systems, differences in radiation response due to dose-rate and temperature dependence can cause large systematic errors in dose interpretation. Poor reproducibility of response may result from batch-to-batch differences or intrabatch variations in thickness, distribution of sensitizers and background optical density. When using these routine dosimeters, careful calibration of the response and monitoring of factors contributing to poor reproducibility are essential.

15279. Lechner, J. A., **Applying statistics in criminalistics,** (Proc. 8th Annual Crime Countermeasures Conf., Lexington, Ky., April 16-19, 1974), Paper in *Proc. 1974 Carnahan and Int.*

Crime Countermeasures Conf., UKY BU **105,** 113-123 (Aug. 1974).

Key words: acceptance tests; confidence intervals; criminalistics; errors; goodness of fit; normal distribution; significance tests; standards; statistics.

This paper is intended to tell "why-we-do-it-this-way." After preliminary remarks on randomness, errors, and distribution functions, various techniques of statistical analysis are discussed. These include significance tests, confidence intervals, and goodness of fit test. Finally, several examples will be discussed: 1) Performance requirements for breath alcohol testers; 2) bivariate discrimination for gunshot residue detection; and 3) Matching "profiles," e.g., trace element analyses or the output of a speech frequency analyzer.

15280. Prince, E., Mighell, A. D., Reimann, C. W., Santoro, A., **Hexakis(imidazole)cobalt(II) nitrate, $[Co(C_3H_4N_2)_6](NO_3)_2$,** *Cryst. Struct. Commun.* **1,** 247-252 (1972).

Key words: cobalt; complexes; hexakis(imidazole)cobalt(II) nitrate; imidazole, neutron; structure; x ray.

The structure of the title compound was determined by x-ray and neutron diffraction techniques. The hydrogen bonding in the structure was uniquely determined from the neutron data. Bond distances and angles obtained with the two techniques are compared.

15281. Brown, D. W., Lowry, R. E., **Radiation-induced polymerization of tetrafluoroethylene and 1,2,3,4,5-pentafluorostyrene at high pressure,** *J. Polym. Sci. Polym. Chem. Ed.* **13,** No. 7, 1677-1689 (July 1975).

Key words: copolymerization; pentafluorostyrene; polymerization; pressure radiation; reactivity ratios; tetrafluoroethylene.

Tetrafluoroethylene (A) and 1,2,3,4,5-pentafluorostyrene (B) were irradiated at 15 °C at autogenous pressure by use of 30-92 mole-percent A and at 5000 atm by use of 42-99.9 mole-percent A. The high-pressure results indicate that the reactivity ratio r_A for monomer addition to A-ended radicals is 0.005; the other reactivity ratio r_B appears to vary from 15 to 60 generally increasing with the A content of the charge. At autogenous pressure r_A is small, but a precise determination is not possible because of the very low polymerization rate when the A content of the charge is high. However, if r_A is less than 0.01, then values of r_B vary from 15 to 50, again generally increasing with the A content of the charge. Mixtures of A and B exhibit positive deviations from Raoult's Law. Activity coefficients were measured at autogeneous pressure and used in an attempt to correct r_B for the nonideality of solution. The range of r_B was reduced only slightly to 8-27, and charges with high A contents now generally gave low values of r_B; consequently, this approach was not regarded as a success. Another attempt was made to account for the apparent variation in r_B by ascribing influence to the penultimate units of the radicals. Improved agreement between theoretical and observed compositions resulted, but significant discrepancies remained unexplained. Rate data agreed well with those calculated from a theoretical copolymer rate equation using values of r_A and r_B of 0.0045 and 40, respectively. The equation predicts an almost proportional decrease in rate with increasing proportions of A in the charge from 0 to 99 mole-percent A.

15282. Zahn, J. P., **The dynamical tide in close binaries,** *Astron. Astrophys.* **41,** No. 314, 329-344 (July 1975).

Key words: binary; gravity modes; nonadiabatic; oscillations; resonances; stellar.

The nonadiabatic oscillations of a star, driven by an outer rotating gravitational field, have been studied by the use of matched asymptotic expansions. The interior and envelope solutions in this procedure are derived in Sections 2 and 3. The results apply to stars which have a convective core and a radiative envelope, and they are discussed in Section 4.

We find that the resonances of the free gravity modes are damped by radiative dissipation, which operates in a relatively thin region below the surface of the star. Due to that dissipation, some properties of the dynamical tide have observable consequences in close binary systems: i) A torque is applied to a binary component; this serves to make it corotate with its companion in a time which can be short compared to its nuclear life. ii) Before that synchronization is achieved, the brightness distribution over the surface of the star is in general phase shifted relative to the external driving potential.

15283. Wyatt, D. M., Gray, R. C., Carver, J. C., Hercules, D. M., Masters, L. W., **Studies of polymeric bond failure on aluminum surfaces by x-ray photoelectron spectroscopy (ESCA),** *Appl. Spectrosc.* **28,** No. 5, 439-445 (Sept.-Oct. 1974).

Key words: adhesion failure; cohesive failure; polymeric bond failure; scanning electron microscopy (SEM); x-ray photoelectron spectroscopy (ESCA).

X-ray photoelectron spectroscopy (ESCA) has been used to identify very thin layers of polymeric species remaining on aluminum plates after the polymer was cured and stripped from the aluminum. Two polymers were studied. In one, the residual polymeric carbon was used as the tracing signal; in the other, the polymeric silicon was used. In both cases, the polymeric species was partially sputtered from the aluminum surface by an argon ion gun. A reduction in the polymeric signal relative to a standard signal was noted. The results of this study show that, when the polymers studied were mechanically pulled from the aluminum substrate, the failure was a cohesive separation within the polymer, rather than failure at the polymer-aluminum interface. Scanning electron microscopy was used to show that the residual polymer does not remain on the surface as "clumps" or "islands," but rather as a smooth surface a few atomic layers thick.

15284. Choi, C. S., Abel, J. E., Dickens, B., Stewart, J. M., **The crystal structure of 1,3,5,7-tetraceto-1,3,5,7-tetrazacyclo-octane,** *Acta Crystallogr.* **B29,** Part 4, 651-656 (Apr. 1973).

Key words: crystal structure; organic crystal; x-ray diffraction.

The crystal of 1,3,5,7-tetraceto-1,3,5,7-tetrazacyclo-octane, $C^{12}N^4O^4H^{20}$, is tetragonal, $a=b=10.540(2)$ and $c=12.137(3)$ Å, with 4 molecules per unit cell. Systematic absences are consistent with space group $P4^12^12$ (enantiomorphous to $P4^32^12$). The structure was solved by direct methods and refined to a final R index $R^w=0.037$ and $R=0.039$ for 1244 observed reflections. The molecule consists of alternate CH^2 and $N-CO-CH^3$ groups in a puckered $C-N$ ring, having a boat shape conformation with a twofold rotation axis through the center of the $C-N$ ring and perpendicular to the mean plane of the puckered ring. The heavy atoms of each acetyl group are essentially coplanar with its neighbouring nitrogen atom. The molecular thermal motion may be represented chiefly by three motions; a libration about the twofold rotation axis and two intramolecular bending motions about the $C-C$ diagonal of the $C-N$ ring.

15285. Marzetta, L. A., **A thermesthesiometer — An instrument for burn hazard measurement,** *IEEE Trans. Biomed. Eng.* **BME-21,** No. 5, 425-427 (Sept. 1974).

Key words: burn hazard; consumer products; contact temperature; thermesthesiometer; thermometry.

Surface temperature measurement alone is insufficent to establish the hazard to the human of contact with a hot or cold object. A metal surface is more likely to cause thermal injury than a plastic surface at the same temperature. An instrument equipped with a measuring probe has been developed for indicating the temperature that would be experienced if human contact were made with the hot surface in question. The correct value of interface contact temperature can be read for a selected contact time without knowing the composition or temperature of the heated material under test.

15286. Machado, M. E., Linsky, J. L., **Flare model chromospheres and photospheres,** *Sol. Phys.* **42,** No. 2, 395-420 (June 1975).

Key words: chromosphere, sun; photosphere, sun; radiative transfer; solar flares.

Homogeneous plane-parallel model atmospheres for solar flares have been constructed to approximately simulate observations of flares. The wings of the Ca II lines have been used to derive flare upper photosphere models, which indicate temperature increases of ~ 100 K over the temperature distribution in the pre-existing facula at a height of 300 km above $\tau^{5000} = 1$. In the case of flares covering sunspots the temperature rise seems to occur much higher in the atmosphere. We solve the transfer and statistical equilibrium equations for a three-level hydrogen atom and a five-level calcium atom in order to obtain the chromospheric flare models. The general properties of flares, including n^e, N^2, linear thickness, and Lyman continuum intensity are approximately reproduced. We find that with increasing flare importance the height of the upper chromosphere and transition region occur lower in the solar atmosphere, accounting for the factor of 60-600 increase in pressure in these regions relative to the quiet Sun. The Ca II line profiles agree with observations only by assuming a macrovelocity distribution that increases with height. Also the chromospheric parts of flares appear to be highly inhomogeneous. We show that shock and particle heated flare models do not agree with the observations and propose a thermal response model for flares. In particular, it appears that heating in the photosphere is an essential aspect of flares.

15287. Albus, J. S., **Data storage in the cerebellar model articulation controller (CMAC),** *Trans. ASME Series G, J. Dyn. Syst. Meas. Control* **97,** No. 3, 228-233 (Sept. 1975).

Key words: cerebellar model; control theory; data storage; distribution memory; hierarchical control; manipulator control.

The storage of manipulator control functions in the CMAC memory is accomplished by an iterative process which, if the control function is sufficiently smooth, will converge. There are several different techniques for loading the CMAC memory depending on the amount of data which has already been stored and the degree of accuracy which is desired. The CMAC system lends itself to a "natural" partitioning of the control problem into manageable subproblems. At each level the CMAC controller translates commands from the next higher level into sequences of instructions to the next lower level. Data storage, or training, is accomplished first at the lowest level and must be completed, or nearly so, at each level before it can be initiated at the next higher level.

15288. Bishop, M., Dimarzio, E. A., **Models of diffusion in lyotropic liquid crystals,** *Mol. Cryst. Liq. Cryst.* **28,** 311-333 (1975).

Key words: asymmetric diffusion coefficients; diffusion in liquid crystals; lyotropic liquid crystal.

The asymmetric diffusion of small molecules in a liquid crystal host is examined via three models. The small molecules are represented by spheres and the liquid crystal host by aligned cylinders. DASH is a continuum model which allows one to use the results of electrical conductivity problems to calculate the diffusion coefficient. LASH is an extension of polymer lattice counting models. CASH is a molecular dynamics computer simulation which provides experimental data to check the analytical models. It is found that DASH is a better representation of the diffusion asymmetry than LASH for the low liquid crystal densities examined on the computer. The cylinder sphere pair correlation function is also calculated in CASH and this gives evidence for liquid order around the liquid crystals.

15289. Scheps, R., Ottinger, C., York, G., Gallagher, A., **Continuum spectra and potentials of Li-noble gas molecules,** *J. Chem. Phys.* **63,** No. 6, 2581-2590 (Sept. 15, 1975).

Key words: lithium; molecules; noble gases.

The normalized emission spectrum of the Li($2p - 2s$) resonance transition has been measured in the presence of 10-1000 torr of noble gas. Fluorescence at 100-3000 Å from the atomic line, due to the A-X and B-X bands of Li-noble gas molecules, has been measured as a continuum with 1.5 nm resolution. The lithium is optically excited in a 670 K cell. The lithium is optically thin ($\sim 10^{-6}$ torr) so that the continuum emission per excited lithium atom is obtained from the normalized emission. The attractive A-state potentials for Li-Ar, Kr, and Xe have been constructed by analysis of the A-X band spectra in the limit of high and low noble-gas densities. At high densities each spectrum is due to an equilibrated vibrational distribution of A-state molecules, whereas at low densities only free collision states contribute. The ratio of the two spectra thus depends on the excited state potential and has been used to determine this potential where it is attractive. Absorption and stimulated emission coefficients for Li-noble gas vapors are also deduced from the data.

15290. Nyyssonen, D., **Partial coherence in imaging systems,** *Opt. Eng.* **13,** No. 4, 362-367 (July-Aug. 1974).

Key words: coherence measurement; microdensitometry; optical imaging; partial coherence.

An improved method of measuring spatial coherence is described and some sources of measurement errors are discussed. Partial coherence in the image plane of an optical system is discussed and results of coherence measurements are given that demonstrate the scaling of the coherence function for coherence intervals large compared to the diameter of the Airy disk and the limiting value for the coherence interval equal to the diameter of the Airy disk. The application of these results to microdensitometry is discussed and results of coherence measurements in the source plane of currently-used classical microdensitometers are given.

15291. Ott, W. R., Behringer, K., Gieres, G., **Vacuum ultraviolet radiometry with hydrogen arcs. 2: The high power arc as an absolute standard of spectral radiance from 124 nm to 360 nm,** *Appl. Opt.* **14,** No. 9, 2121-2128 (Sept. 1975).

Key words: arc; calibrations; hydrogen; plasma; radiometry; spectral radiance; vacuum ultraviolet; wall-stabilized.

A wall-stabilized hydrogen arc can be utilized as a standard source of spectral radiance since the continuum emission coefficient is calculable to within a few percent. Previous efforts to apply this concept have been impeded by relatively large uncertainties associated with the plasma diagnostics. The present approach yields absolute intensities independent of other radiometric standards or the accuracy of any plasma diagnostics. The

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hydrogen arc is operated at high temperatures where the continuum emission coefficient reaches a broad, unique, and calculable maximum. Comparisons with other primary standards are consistent with the estimated uncertainty in the arc continuum intensities.

15292. McCarter, R. J., **A new technique for thermal analysis of vapor-producing reactions,** *J. Appl. Polym. Sci.* **17,** No. 6, 1833-1846 (1973).

Key words: differential thermal analysis; DTA; kinetics; pyrolysis; TGA; thermal analysis; thermal degradation; thermogravimetric analysis.

An apparatus was developed for measuring the rate at which vapors are evolved during the thermal degradation of materials and thereby deriving the kinetics of such reactions. Requisite to the operating scheme of the apparatus is the provision of a high-temperature zone to convert condensable or tarry vapors into noncondensable form. The apparatus yields a direct measure of reaction velocity, rather than the integrated indication obtained with thermogravimetric analysis. This simplifies the identification and calculation of kinetic parameters. Increases in sensitivity and operating range are also achieved. Flexibility in operation is obtained that permits the separate recording of reactions that tend to overlap. Although the apparatus principally has been operated using a combustible gas indicator to meter the evolved vapors, a number of options are available for the latter function, including flowmeters and various continuous gas analyzers. The applicability of the method appears promising.

15293. Mulholland, G. W., Zollweg, J. A., Sengers, J. M. H. L., **Liquid-vapor asymmetries in pure fluids,** *J. Chem. Phys.* **62,** No. 7, 2535-2549 (Apr. 1, 1975).

Key words: asymmetry; coexistence curve; compressibility; critical exponents; critical point; decorated lattice gas; hole-particle symmetry; law of corresponding states; liquid; Padé approximant; power law; slope of the coexistence curve diameter.

The coexistence curve and the compressibility-like quantity $(\partial\rho/\partial\mu)_T$ at the coexistence curve are calculated for Mermin's decorated lattice gas. We tabulate the Padé approximants to the Ising model properties which were used in these calculations. It is shown that for the proper choice of the adjustable parameter in the model the asymmetries in the coexistence curve and in $(\partial\rho/\partial\mu)_T$ over a large temperature range, $T_c/2 < T < T_c$, are qualitatively similar to those in real fluids. Also, similar correlations between the overall coexistence curve asymmetry and the amplitudes of divergences for the critical region occur in the model and in real fluids. Based on our model calculations, several predictions for fluid behavior near the critical point are listed: (1) The *asymptotic* asymmetry in the coexistence curve and in $(\partial\rho/\partial\mu)_T$ at the coexistence curve should be most observable for fluids with large overall asymmetry such as SF_6, NH_3, and H_2O; (2) the range of the asymptotic asymmetry for $(\partial\rho/\partial\mu)_T$ is expected to extend somewhat beyond $t=1-(T/T_c)=0.1$ for such fluids; (3) in order to obtain an estimate for the compressibility exponent γ' that is within a few percent of the true asymptotic value, experiments will have to be confined to the range $t < 10^{-2}$. Recent experimental data for $(\partial\rho/\partial\mu)_T$ at the coexistence curve are found to be consistent with the model for $t > 10^{-2}$, but are inconclusive closer to the critical point.

15294. Deslattes, R. D., Henins, A., Bowman, H. A., Schoonover, R. M., Carroll, C. L., Barnes, I. L., Machlan, L. A., Moore, L. J., Shields, W. R., **Determination of the Avogadro constant,** *Phys. Rev. Lett.* **33,** No. 8, 463-466 (Aug. 19, 1974).

Key words: Avogadro number; crystal repeat distance; density; isotopic abundance; silicon.

Measurements are reported on the densities and isotopic-abundance ratios of nearly perfect Si single crystals. These, when combined with optical interferometry of the crystal repeat distance, yield a new value for the Avogadro constant. This result, $N_A = 6.022\,0943 \times 10^{23}$ mol^{-1} (1.05 ppm), represents a more than thirty-fold reduction in the uncertainty of previous direct measurements.

15295. McCormick, P. G., Burke, R. W., Doumas, B. T., **Precautions in use of soft-glass disposable pipets in clinical analyses,** *Clin. Chem. Scientific Note* **18,** No. 8, 854-856 (1972).

Key words: clinical; contamination; errors; soft glass pipets; unwashed soft glass pipets.

Soft-glass, Pasteur-type pipets are widely used as disposable transfer pipets, especially in clinical and biochemical laboratories. These pipets possess an alkaline surface contamination that can affect the accuracy of chemical analyses if proper precautions are not taken. Microtitrations of aqueous rinsings from these pipets have consistently yielded values of 0.1 to 0.2 μmol of hydroxide equivalent per pipet. A possible detrimental effect of this residue was demonstrated, using chloroform solutions of bilirubin. Absorbance was diminished by as much as 5 percent when unwashed, soft-glass pipets were used to transfer these solutions to spectrophotometric cells. Absorption and fluorescence characteristics of other unidentified surface contaminants are also described. The effect of multiple rinsings is discussed and several ways are suggested for cleaning these pipets. Oven drying must be avoided, however, since it enhances alkali release.

15296. Maximon, L. C., O'Connell, J. S., **Sum rules for forward elastic pion-nucleon scattering,** *Phys. Lett.* **51B,** No. 1, 31-34 (July 8, 1974).

Key words: dispersion relations; pion-nucleon amplitudes; pion-nucleon cross section; pion-nucleon scattering; pion-nucleus scattering; sum rules.

A number of energy weighted sum rules relating amplitudes and differential cross sections for forward elastic and charge exchange scattering to the total pion-nucleon cross section are derived from dispersion relations.

15297. Pickart, S., Rhyne, J., Alperin, H., Savage, H., **Neutron diffraction study of sputtered and annealed Tb-Fe alloys,** *Phys. Lett.* **47A,** No. 1, 73-74 (Feb. 25, 1974).

Key words: amorphous alloys; amorphous magnetism; coercine magnetic force; magnetic structure; neutron diffraction; recrystallization; terbium-iron.

Sputtered alloys of composition $Tb_x\,Fe_{1-x}$, with $x=0.118$, 0.45 and 0.75 were shown by neutron diffraction to be amorphous. Line-width measurements of an annealed sputtered sample with $x=0.333$ indicate microcrystallinity with a particle size of ≈ 100 Å.

15298. Van Brunt, R. J., Kieffer, L. J., **Angular distribution of N^+ from dissociative ionization of N_2 near threshold,** *J. Chem. Phys.* **63,** No. 8, 3216-3221 (Oct. 15, 1975).

Key words: electrons, ions; molecules; nitrogen.

Translational kinetic energy and angular distributions of N^+ from dissociative ionization of N_2 have been measured at electron energies close to threshold. For electron energies above 50 eV the energy distributions agree favorably with earlier measurements of Kieffer and Van Brunt. The ion energy distributions at electron energies below 50 eV are dominated by a feature peaked at a kinetic energy below 1 eV in agreement with recent measurements of Locht *et al.* For electron energies closest to threshold the angular distribution of N^+ associated with this feature is consistent with the previously proposed mechanism involving excitation of the $C^2\Sigma_u^+$ state followed by predissociation. At higher electron energies the degree of anisotropy increases and then rapidly decreases suggesting a significant contribution from direct excitation to the $^4\Sigma_g^+$ repulsive state of N_2^+ leading to fragments in their ground states.

15299. Manson, S. T., Cooper, J. W., **Angular distribution of photoelectrons: Outer shells of noble gases,** *Phys. Rev. A* **2,** No. 5, 2170-2171 (Nov. 1970).

Key words: angular distribution; asymmetry; photoionization; rare gases.

Results of calculations of angular distributions of photoelectrons from the outer *p* subshells of Ne, Ar, Kr, and Xe are presented for electron energies between 0 and 2 Ry (27.2 eV).

15300. Martin, W. C., **Atomic spectroscopy—Some data centers and compilations,** (Proc. 4th Int. CODATA Conf. on Generation, Compilation, Evaluation and Dissemination of Data for Science and Technology, Tsakhcadzor, U.S.S.R., June 24-27, 1974), *CODATA Bull.* **14,** 112-115 (CODATA Secretariat, Paris, France, 1974).

Key words: atomic data; atomic energy levels; atomic line shapes; atomic spectra; data compilations; gas lasers; transition probabilities.

The operation and current work of the NBS Atomic Energy Levels Data Center is reviewed briefly, and some of the other activities of this type, at NBS and elsewhere, are noted. The data include atomic wavelengths, energy levels, transition probabilities and line shapes and shifts, and gas laser transition data. References to some recent and forthcoming compilations of atomic spectral data are included.

15301. Lide, D. R., Jr., **The NSRDS experience,** (Proc. 4th Int. CODATA Conf. on Generation, Compilation, Evaluation and Dissemination of Data for Science and Technology, Tsakhcadzor, U.S.S.R., June 24-27, 1974), *CODATA Bull.* **14,** 6-9 (CODATA Secretariat, Paris, France, 1974).

Key words: data; Standard Reference Data Program; well-defined, measurable properties.

The Standard Reference Data Program deals primarily with physical and chemical property data. The properties covered are well-defined, measurable properties and the systems include pure substances and mixtures that can be adequately characdata by experienced scientists. The program is managed by the National Bureau of Standards under a mandate from the Congress of the United States to make critically evaluated reference data readily available to scientists, engineers and the general public.

15302. Simpson, J. A., **Modernizing gage block calibrations: A case study in measurement assurance,** *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974,* pp. 153-157 (Instrument Society of America, Pittsburgh, Pa., 1975).

Key words: calibration; gage blocks; measurement assurance.

Recently the Optical Physics Division of the National Bureau of Standards was faced with a potentially serious set of problems in the gage block calibration laboratory; labor costs were escalating, metrication threatened to greatly increase the workload, and the system in use (interferometry) did not lend itself to providing a desired Measurement Assurance Program. The introduction of a new system that provides better accuracy, lower cost and the possibility of a MAP was undertaken. The methods used to insure compatibility, maintain performance, and to be economic both for the Bureau and its customers, provide an interesting case study which is applicable to many other situations in metrology.

15303. Marzetta, L. A., **Some measurement engineering innovations in consumer products,** *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974,* pp. 41-44 (Instrument Society of America, Pittsburgh, Pa., 1975).

Key words: consumer products; contact temperature; thermesthesiometer; thermometry.

Exploration of the problem concerning hazards in consumer products has shown that laboratory engineers can usefully apply basic measurement practices towards improving safety and developing new measuring tools. Some novel and relatively simple redesign features will be presented concerning a common household appliance that can significantly reduce its electrical and thermal hazards. Included in the paper are details of an instrument which tests for burn hazard by simulating the human response to contact with a hot surface. The advantage of the new instrumentation is that a thermal safety standard can be written around one specified contact temperature for nearly any material regardless of its composition or surface temperature.

15304. Andrews, J. R., Lawton, R. A., **Picosecond pulse research at NBS,** *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974,* 123-140 (Instrument Society of America, Pittsburgh, Pa., 1975).

Key words: oscilloscopes; pulse; pulse generators; pulse measurement; transmission lines.

A general review of pulse measurement research at the National Bureau of Standards is described which includes work with electrical pulse generators using mechanical switches, avalanche transistors, snap off diodes, tunnel diodes, and laser pulses. Pulse transmission studies which include skin effect, nonuniform dielectric, lossy liquid dielectric and superconductivity are also mentioned together with pulse measurement techniques which include oscillographic techniques and pulse autocorrelation. The interfacing of picosecond pulse measurement instruments with a minicomputer is also described. This has resulted in an Automatic Pulse Measurement System (APMS) which has already been used to measure transmission coefficient, S_{21}, of some microwave networks.

15305. Lide, D. R., Jr., **The Standard Reference Data System,** *Chem. Eng. Prog.* **67,** No. 11, 77-78 (Nov. 1971).

Key words: critically evaluated numerical data; National Standard Reference Data System; physical sciences.

The National Standard Reference Data System (NSRDS) represents an effort to provide critically evaluated numerical data in the physical sciences. It is a decentralized program coordinated from the National Bureau of Standards, but enlisting the help of experts throughout the country. Activities of interest to chemical engineers are discussed.

15306. Mills, R. M., **A performance standard for walk-through metal detectors,** (Proc. 8th Annual Crime Countermeasures Conf., Lexington, Ky., Apr. 16-19, 1974), Paper in *Proc. 1974 Carnahan and Int. Crime Countermeasures Conf., UKY BU* **105,** 78-82 (Aug. 1974).

Key words: handgun detection; metal detector; performance standard; security; weapon detection.

The Law Enforcement Standards Laboratory at the National

Bureau of Standards (NBS) is developing performance standards for equipment used in the criminal justice system. They will be promulgated primarily by the National Institute of Law Enforcement and Criminal Justice, Department of Justice. This paper discussed the development of a standard for walk-through metal weapon detectors. The standard contains requirements and test methods for such things as detection performance, effects of walking speed and throughput rate, alarm indicator, controls, stability, ambient and generated magnetic field, and interference with other detectors.

15307. Newman, M., Pierce, S., **Bounded matrix groups,** *Linear and Multilinear Algebra* **1,** No. 3, 251-256 (1973).

Key words: associated matrices; Burnside theorem; irreducible representations; matrix groups.

The principal result is that if G is any irreducible subgroup of $GL(n, C)$ (C the complex field) such that $|\mathrm{tr}(TA)|$ is uniformly bounded for all A in G and some fixed $n \times n$ nonzero matrix T, then G is equivalent to a unitary group. Similar results are proved for certain associated representations of G.

15308. Marcus, M., Newman, M., **Some results on unitary matrix groups,** *Linear Algebra and Appl.* **3,** 173-178 (1970).

Key words: bounded representations; Burnside; irreducibility; unitary groups; Weyl.

It is shown that an irreducible matrix group with uniformly bounded trace is itself uniformly bounded, and so equivalent to a unitary group. This result is used to prove that certain matrix groups preserving certain scalar valued functions are unitary.

15309. McCrackin, F. L., Chang, S. S., **Simple calibration procedures for platinum resistance thermometers from 2.5 to 14 K,** *Rev. Sci. Instrum.* **46,** No. 5, 550-553 (May 1975).

Key words: calibration of thermometers; low-temperature calibration of thermometers; platinum resistance thermometers; resistance thermometers; two-way structural analysis.

Calibration procedures are developed for platinum resistance thermometers in the temperature range 2.5-14 K. Two recommended methods require calibration points at the boiling point of liquid helium (4.215 K) and the triple point of hydrogen (13.81 K); in addition, the first method requires a point at 7.201 K while the second method requires the slope of the calibration curve at 13.81 K. For temperatures from 3.5 to 14 K, the calibrations are accurate to within 0.01 K for the first method and 0.025 K for the second method. For temperatures from 2.5 to 3.5 K, the calibrations are somewhat less accurate. Therefore, if a thermometer has been calibrated for temperatures of 13.81 K and above, its calibration may be easily extended to lower temperatures with sufficient accuracy for many applications. These calibration procedures were developed from two-way structural analysis of the accurate calibrations of 12 platinum resistance thermometers.

15310. Hanley, H. J. M., Watts, R. O., **Molecular dynamic calculation of the thermodynamic properties of methane,** *Aust. J. Phys.* **28,** 315-324 (1975).

Key words: methane; molecular dynamics; potential function; specific heat; statistical mechanical ensembles; thermodynamic properties; three body forces.

Thermodynamic properties of methane in the dense gas and liquid states have been calculated by the method of molecular dynamics. The methane pair interactions were modelled using a spherically symmetric m-6-8 potential, and the most significant three-body and quantum effects were included. Agreement between calculated and experimental values for the energy and pressure is generally good except at low temperatures and high densities. The specific heat at constant volume is also briefly discussed.

15311. Maki, A. G., **High-resolution infrared spectrum of the $\nu_1 + \nu_3$ band of ozone,** *J. Mol. Spectrosc.* **57,** No. 3, 416-427 (1975).

Key words: absorption spectra; infrared; molecular energy levels; ozone; pollution; spectra.

The $\nu_1 + \nu_3$ band of ozone (O_3) near 2110 cm^{-1} has been measured and analyzed using a Watson-type Hamiltonian including all seven sextic centrifugal distortion terms. Two weak perturbations have been found between $K=n$ of $\nu_1 + \nu_3$ and $K=n+3$ of $2\nu_3$. Those perturbations locate the band center for $2\nu_3$ at about 2058 cm^{-1}. Aside from those perturbations the interactions of $\nu_1 + \nu_3$ with $2\nu_1$ and $2\nu_3$ have not been taken into account in the analysis. Effective band constants and an atlas listing line wavenumbers and assignments are given.

15312. Leasure, W. A., Jr., Mathews, D. E., Cadoff, M. A., **Automobile tire noise: Results of a pilot study and review of the open literature,** *Report DOT/TST-76-4,* 75 pages (Office of Noise Abatement, Department of Transportation, Washington, D.C., Aug. 1975). (Available from the National Technical Information Service, Springfield, Va. 22161.)

Key words: acoustics; automombile; noise (sound); tire noise; transportation noise.

Automobiles, the primary mode of transportation in the United States, contribute significantly to the noise environment due to the large number in operation. In this report, one aspect of automobile noise is discussed; namely, the contribution to overall vehicle noise resulting from the interaction of the tires with the road surface. The results of this pilot study, which investigated the influence of selected parameters on automobile tire noise levels, in conjunction with a review of the open literature, serve as the basis for comparison of parametric trends between truck (for which an extensive noise data base exists) and automobile tires. As was the case with trucks, vehicle speed, road surface characteristics and tread design are major factors affecting automobile tire noise. The effect of pavement surface is more significant for automobile tires than for trucks since the texture within the tire-road interaction zone is on the same scale as the tread element spacing typical of passenger car tires. Load and wear, significant factors for truck tires, do not affect automobile tires as much due to the fact that the majority of automobile tires utilize rib tread designs. On the basis of the limited data available in the literature, factors such as inflation pressure, number of plies, tire dimensions, tire cord material, etc., do not appear to be significant factors affecting automobile tire noise.

15313. Bowman, C. D., **A shelf in the "subthreshold" photofission cross section,** *Phys. Rev. C* **12,** No. 3, 856-862 (Sept. 1975).

Key words: bremsstrahlung beams; cross section; fission barrier shape; fission isomer; photofission.

The influence of a double-humped fission barrier on the photofission cross section far below the top of the barrier is considered. In the region about 2 MeV below the top of the outer barrier and at a cross section in the region of $10^{-9} - 10^{-6}$ b the photofission is expected to become almost entirely isomeric or delayed fission. When this occurs a "shelf" should appear in the photofission cross section where the cross section changes with energy far more slowly than at higher γ-ray energy. The cross section on the shelf can therefore be orders of magnitude higher than otherwise expected. While the angular distribution near the top of the barrier is expected to have a well-defined and nonisotropic angular dependence, the angular distribution on the shelf is expected to be isotropic. The cross sections, although small, appear to be measurable with bremsstrahlung beams in the

3- to 5-MeV range using a several hundred μA electron beam. Successful experiments of this type should provide information on the shape of the inner and outer barriers at much lower excitation energies than possible by other techniques.

15314. Marcus, M., Merris, R., **A relation between the permanental and determinantal adjoints,** *J. Aust. Math. Soc.* **15,** Part 3, 270-271 (May 1973).

Key words: permanental adjoint; positive semidefinite hermitian matrix; symmetry class of tensors.

In this note an inequality is proved for generalized matrix functions. When specialized to the permanent, the inequality suggests a conjecture concerning a relation between the permanental and determinantal adjoints. The general inequality extends a conjectured inequality of Doković to another class of matrices.

15315. Thomson, R. M., **A review of nondestructive evaluation opportunities,** *ASTM Stand. News* **3,** No. 3, 8-14 (Mar. 1975).

Key words: materials reliability; nondestructive evaluation.

This paper is an abridged version of a recent report by a federal ad hoc working group on NDE. In the report, the NDE field is surveyed in order to foresee probable future growth areas and the technical developments which will be required to support this growth. Major NDE involvement is expected to continue in aerospace, to grow enormously along with the nuclear power industry, and to become a more important factor in ground transportation, general manufacturing, maintenance of machinery, and medical diagnosis. Technical issues and challenges are reviewed.

15316. Yonemura, G. T., **An image quality criterion for the identification of faces,** *Photogr. Sci. Eng.* **19,** No. 4, 223-227 (July-Aug. 1975).

Key words: acutance; identification (faces); image quality; Modulation Transfer Functions.

The performance required of imaging devices should be based on the needs of the user. In analyzing these needs, three psychophysical levels of visual task performance must be considered; detection, recognition, and identification. The experimental data base for these levels of performance is very uneven. Many detection studies have been performed, fewer have addressed problems of recognition, and rarer still are investigations associated with identification. This study determined experimentally the observer's perception of the image quality required for the identification of faces, as determined by two criteria: (1) the average observer and (2) 90 percent of the population. The subjective response from the human observer was then transformed into a physical descriptor amenable to direct measurement by instruments. The Modulation Transfer Function is recommended as the physical correlate for subjective facial identification.

15317. Young, J. P., **Codeposition of particulate matter with chromium,** *Plat. Surf. Finish. Tech. Brief* **62,** No. 4, 348-349 (Apr. 1975).

Key words: cermet; chromium plating; codeposition, composite coating; dispersion plating; electroplating; hard particles; wear-resistance; wear-tests.

Particles were included in a chromium deposit with the addition of a monovalent cation, e.g., thallium nitrate, in a small amount to the sulfate chromic acid bath. Using these additives, hard particles, lubricating particles, and metal powders were incorporated in a chromium matrix on vertical surfaces. When even less than 1 wt % of hard particles such as diamond, boron carbide or silicon carbide were codeposited with the chromium, resistance to wear was increased up to threefold over that of a hard, bright chromium deposit as measured by an abraser type wear-testing device.

15318. Yates, J. T., Jr., **Catalysis,** *Chem. Eng. News* **52,** No. 34, 19-22, 24-29 (Aug. 26, 1974).

Key words: adsorption; Auger spectroscopy; catalysis; infrared spectroscopy; kinetics; photoelectron spectroscopy.

A survey of a number of modern methods of surface science is given. The objective is to provide the reader with a general appreciation of the new advances in surface science which relate to fundamental thinking about heterogeneous catalysis.

15319. Goldberg, R. N., Prosen, E. J., Staples, B. R., Boyd, R. N., Armstrong, G. T., Berger, R. L., Young, D. S., **Heat measurements applied to biochemical analysis: Glucose in human serum,** *Anal. Biochem.* **64,** No. 1, 68-73 (Mar. 1975).

Key words: analysis; clinical chemistry; glucose; microcalorimetric; thermochemistry.

Microcalorimetric measurement of enthalpy change for the hexokinase catalyzed reaction of ATP with glucose (in TRIS/HCl buffer containing $MgCl_2$) was carried out with glucose concentrations from zero to 1350 mg · liter^{-1}. A linear relationship between measured heat and glucose concentration was found, from which the reaction enthalpy was calculated to be − 61.4 kJ · mole^{-1}. This linear relation, combined with calorimetric measurements of the same process carried out with 0.15 ml samples of human serum, was used to calculate glucose concentrations in the serum. For 45 samples containing glucose levels ranging from 420 to about 4000 mg · liter^{-1} the results show only slight systematic differences from measurements made by the glucose oxidase procedure of Gochman and Schmitz.

15320. Mopsik, F. I., Broadhurst, M. G., **Molecular dipole electrets,** *J. Appl. Phys.* **46,** No. 10, 4204-4208 (Oct. 1975).

Key words: electret; dipoles; glass; piezoelectric; polarization; polyvinyl chloride; pyroelectric.

The total polarization due to molecular dipoles in a glassy electret is computed using an Onsager cavity approach. From this result, all the possible contributions to the piezoelectric and pyroelectric coefficients are considered. It is shown that there are major contributions from the variation in dielectric constant and, for pyroelectricity, from thermal motion. These results account well for experimental data for polyvinyl chloride.

15321. Velapoldi, R. A., Travis, J. C., Cassatt, W. A., Yap, W. T., **Inorganic ion-doped glass fibres as microspectrofluorimetric standards,** *J. Microsc.* **103,** Part 3, 293-303 (Apr. 1975).

Key words: europium ions; fluorescence; fluorescence standards; inorganic ion-doped fibers; microspectrofluorimetry; uranyl ions.

Uranyl and europium ion-doped fibres of 5-45 μm diameter were prepared which emit in the green and red spectral regions, respectively. Measurements were made of fluorescence flux as a function of fibre length, dopant concentration, slit shape and fibre diameter. The flux was found to be proportional to fibre length and fluorophor concentration and proportional to the square of the fibre radius. In addition, the fluorescence flux as a function of aperture size and shape and fibre position has been measured experimentally and compared to computer generated fluorescence flux envelopes. It is suggested that inorganic ion-doped fibres are suitable for use as microspectrofluorimetric standards.

15322. Wiederhorn, S. M., Evans, A. G., **A new method for the design of structural ceramic components,** *Nav. Res. Rev.* **XXVII,** No. 2, 18-25 (Feb. 1974).

Key words: crack growth; fracture; fracture mechanics; porcelain; strength; structural ceramics.

A new method in design of structural ceramic components is discussed. The method is based on an understanding of crack growth in these materials and provides a means of estimating the time to failure under load.

15323. Unassigned.

15324. VanderHart, D. L., **Study of molecular reorientation: Pressure and temperature dependence of deuterium relaxation in liquid $CDCl_3$,** *J. Chem. Phys.* **60,** No. 5, 1858-1870 (Mar. 1, 1974).

Key words: chloroform; deuterium; NMR; pressure dependence; relaxation; reorientation; temperature dependence.

Deuterium NMR spin-lattice relaxation measurements have been performed on the neat liquid $CDCl_3$ over the range 28 °C < T < 165 °C and at pressures up to 5 kbar (5×10^8 N/m^2). These measurements enable one to determine $\tau_{\theta,2}$, the correlation time for molecular reorientation about the axes perpendicular to the symmetry axis. The data are presented as a function of all three state variables, P, V, and T. An attempt is made to describe the data in terms of various simple models for reorientation including activation and free volume models. Each of these models predicts certain aspects of the data but fails in other areas. In particular, the activation model fails to predict the correct behavior at constant temperature and the free volume theories generally fail to predict the constant volume experiments. Deviations from the Debye and microviscosity theories were also noted. The mean time between collisions τ_{coll} was calculated from $\tau_{\theta,2}$ assuming both Gordon's J-diffusion model and the equivalence of τ_{coll} and τ_J, the angular momentum correlation time. These values of τ_{coll} were then compared with the predictions of the cell model for liquids in which τ_{coll} is simply the mean free path divided by the mean velocity. Generally, the data did not fit the cell model; however, at constant pressure, the cell model did predict the changes in τ_{coll} quite well. Qualitative suggestions are made to account for the discrepancies. Finally, the possibility that H-bonding exists in $CHCl_3$ and affects the generality of these results by changing the quadrupole coupling constant and disturbing the dynamics of the system is discussed. It is concluded that these effects are small if they exist at all.

15325. Collard, J. J., **U.S. law enforcement receives scientific support,** *Int. Crim. Police Rev. No. 262,* 261 (Nov. 1972).

Key words: building systems; communications equipment; concealed objects detectors; emergency equipment; Law guidelines; protective equipment; security systems vehicles; voluntary standards; weapons.

In January 1971, at the request of the U.S. Department of Justice, the National Bureau of Standards established a new organization, the "Law Enforcement Standards Laboratory." This Laboratory, which is presently funded entirely by the National Institute of Law Enforcement and Criminal Justice, the research arm of the Law Enforcement Assistance Administration, has been given the task of developing voluntary performance standards, specifications, and guidelines for equipment used by U.S. law enforcement and criminal justice agencies. The objective of this program is to assist Federal, state and local law enforcement organizations in the selection and procurement of equipment used by these agencies. In addition to standards development, the Laboratory is developing the methods for measuring the actual performance levels of the equipment.

15326. Swing, R. E., **The sampling aperture for linear microdensitometry,** *Opt. Eng.* **13,** No. 5, 460-470 (Sept.-Oct. 1974).

Key words: impulse response; linear microdensitometry; microdensitometry; optics; slit imagery; transfer function.

In the development of modern linear microdensitometry, the underfilling the efflux optics, with total collection of light after it passes through the sample. The system transfer function is therefore attributable to the influx optics, and the sampling aperture is the light distribution impinging on the sample, reduced from an illuminated slit or circular aperture through the influx optical system. The maximum frequency response of the system is obtained when the sample is illuminated with the impulse response of the influx optics. However, the theoretical impulse response can only be realized by imaging a delta-function and this is photometrically impossible. Similarly, because the system images an illuminated aperture onto the sample, scanning with a pure, geometrically-characterized slit or spot is not possible due to lens response and diffraction. These two problems are investigated, for both coherent and incoherent illumination.

For both impulse response and slit image, the MTF is investigated, and its deviation from the ideal is calculated. The results are characterized in terms of RMS-MTF differences over the spectrum for 10, 5, 2, and 1 percent levels. The controlling parameter is the ratio N/R, where R is the reduction factor employed for the influx optics, and N is the number of resolution elements contained within the nominal object slit width. The study shows that there are significant differences in these values for the same RMS difference level, with coherent and incoherent illumination, and that there are compromises to be made with both kinds of illumination. The results of this study facilitate calculation of system response for any configuration of object slit and influx optics (within the linear microdensitometer system), and defines limits on slit sizes for operation with impulse response and geometrically characterized slit images for the sampling aperture. The effects expected with the linear polarization associated with laser illumination (the most common source of high-energy, coherent radiation) is discussed, but not included in this scalar treatment.

15327. Cox, J. E., Waterstrat, R. M., **Anticorrelation of atomic ordering with superconductivity in vanadium-based transition metal A15 alloys,** *Phys. Lett.* **46A,** No. 1, 21-22 (Nov. 19, 1973).

Key words: annealing temperature; atoms; stoichiometry; superconducting; transition temperature.

Measurements of the superconducting transition temperature (T_o) of V-Rh A15 alloys reveal that long range order induced by low temperature annealing may cause T_o to decrease rather than increase. The behavior of T_o with ordering is discussed for the systems V-Au, V-Pt, V-Ir, V-Os and V-Rh.

15328. Laufer, A. H., Bass, A. M., **Rate constants of the combination of methyl radicals with nitric oxide and oxygen,** *Int. J. Chem. Kinet.* **VII,** No. 5, 639-648 (1975).

Key words: combination; kinetics; methyl; nitric oxide; oxygen; rate constants.

Rate constants for the combination of methyl radicals with NO and O_2 have been measured by flash photolysis of azomethane coupled with product analysis by gas chromatography. Values of the rate constants have been obtained over the pressure region from 50 to 700 torr with He, N_2, and Ar as quenching molecules.

The high-pressure limits were obtained through an RRKM model calculation and were found to be

$$CH_3 + NO + M \rightarrow CH_3NO + M$$

$$k_\infty = 3.2 \times 10^{-11}\ \mathrm{cm^3/molec \cdot sec}$$

$$CH_3 + O_2 + M \rightarrow CH_3O_2 + M$$

$$k_\infty = 1.7 \times 10^{-12}\ cm^3/molec \cdot sec$$

The rate constants were measured relative to the methyl combination reaction k_1 with $k_1 = 9.5 \times 10^{-11}$ cm³/molec · sec. The RRKM model suggests $D_0(CH_3 - O_2) = 32 \pm 3$ kcal/mole.

15329. Farmer, B. L., Eby, R. K., **Methyl branches in hydrocarbon crystals: Calculation of relaxation parameters,** *J. Appl. Phys.* **46,** No. 10, 4209-4217 (Oct. 1975).

Key words: mechanical relaxation; methyl branches; paraffins; polyethylene; potential energy calculations; relaxation mechanism; relaxation strength; site model.

A site model has been used in conjunction with potential-energy calculations to examine the role of isolated molecules with methyl branches in the mechanical relaxations of a linear hydrocarbon host crystal. The results indicate that there are two possible relaxation modes and that the one involving molecular rotation is energetically favorable over the one involving rotation and translation. For some modes of deformation, the calculated relaxation strengths are comparable to the experimentally measured ones. Furthermore, the barriers determined in this work yield calculated curves of the logarithmic decrement as a function of temperature which are comparable to the experimental ones. The relaxation is much weaker for unbranched chains in the planar zigzag conformation.

15330. Torchia, D. A., Lyerla, J. R., Jr., Quattrone, A. J., **Molecular dynamics and structure of the random coil and helical states of the collagen peptide, α1-CB2, as determined by ¹³C magnetic resonance,** *Biochemistry* **14,** No. 5, 887-900 (1975).

Key words: C-13 magnetic resonance; collagen; polymers; polypeptides; protein structure; relaxation times.

Carbon-13 chemical shifts, spin-lattice (T_1) and spin-spin (T_2) relaxation times, and ^{13}C-$\{^1H\}$ nuclear Overhauser enhancements (NOE) have been determined for the random coil and triple helical states of the α1-CB2 fragment of rat skin collagen. Assignment of all aliphatic resonances of this 36 residue peptide in the random coil state (30°) has been achieved with the aid of model polypeptides containing pyrrolidine residues. The chemical shifts and intensities of the Pro and Hyp C^γ resonances show that $\geqslant$ 90 percent of the X-Pro and X-Hyp bonds are trans in both helix and coil conformations. From T_1 measurements rotational correlation times (τ_{eff}) of *ca.* 0.45 nsec are calculated for interior C^α carbons in the coil, while τ_{eff} values of the side chain and near terminal carbons are found to be 2-9 times smaller. These results along with the narrow natural line widths (3-5 Hz) and maximal NOE values (2.8 ± 0.3) demonstrate the high degree of backbone mobility, due to segmental motion, in the unordered state of the peptide. By contrast, the broad lines (50-90 Hz) and small NOE values (1.3 ± 0.3) for the α carbons in the helical state (2°) suggest much slower motion. The line widths and NOE values together with the $C^\alpha T_1$ values (0.025-0.040 sec) correspond to correlation times which are in reasonable agreement with those calculated for an axially symmetric rigid ellipsoid, undergoing rotational diffusion, having dimensions approximating those of a collagen-type triple helical aggregate of three α1-CB2 chains. A satisfactory computer simulation of the experimental 2° spectrum is obtained by assigning the narrow aliphatic resonances in the spectrum (line widths 5-40 Hz) to (a) carbons in the small amounts of α1-CB2 (3 mol %) and α1-CB1 (2.5 mol %) random coil conformations, (b) carbons in the flexible terminal triplets of the helix, and (c) Ala, Leu, and Phe methyl and phenyl carbons. The side chain carbon line widths obtained from the simulation—when compared with side chain line widths calculated for a rotating rigid ellipsoid with internal motion—indicate rapid axial reorientation of methyl and phenyl groups. With the exception of the Hyp residue the line widths suggest local motion for at least some carbons in most other side chain moieties. The Hyp C^β and C^γ line widths indicate the presence of little if any rapid Hyp ring motion.

15331. Scheide, E. P., Taylor, J. K., **Piezoelectric sensor for mercury in air,** *Environ. Sci. Technol.* **8,** No. 13, 1097-1099 (Dec. 1974).

Key words: air pollution; chemical analysis; industrial hygiene; mercury; piezoelectric detector; trace analysis.

A quartz piezoelectric crystal detector with gold evaporated onto the electrode as the sensor substrate has been developed for the detection of small mass changes caused by the selective adsorption of mercury vapor from an air sample. Incorporation of the crystal into a variable oscillator circuit and measurement of the change in frequency of the crystal due to the increase in mass allows a highly sensitive indication of the amount of mercury present in the air sample down to the subpart-per-billion level. Thus, the selectivity of mercury adsorption onto gold films and the sensitivity of the piezoelectric sensor are combined in this instrument. Calibration curves are obtained from part-per-million to subpart-per-billion concentrations of mercury. Reversibility is achieved by placing the sensor in an oven, raising the temperature to 150 °C, and flow switching a stream of clean, dry air over the detector. This detector has potential use both as an air pollution sensor and in industrial hygiene applications.

15332. Stampfl, P. P., Travis, J. C., Bielefeld, M. J., **Mössbauer spectroscopic studies of iron-doped rutile,** *Phys. Status Solidi A* **15,** No. 1, 181-189 (1973).

Key words: diffusion; doping; Fe-57; iron-doped; lattice distortion; Mössbauer spectroscopy; quadrupole splitting; temperature dependence.

Iron-57 Mössbauer spectra have been obtained of single crystal and powdered samples of rutile (TiO_2) doped to about one percent by weight in isotopically enriched iron. Spectral patterns found for powdered samples are consistent with theoretical expectations for substitutional doping with a uniform distribution of oxygen vacancies and impurity ions. The temperature dependence of the ferrous pattern indicates a slight shift in position of the neighboring oxygen ions to accommodate the relatively large size of the dopant ion. Spectral parameters from the single crystal samples differ radically from those of the powdered samples or the "ideal lattice" theory. Variations in stoichiometry, charge compensation mechanisms, or other diffusion-related phenomena are assumed to be responsible. Single crystal results do, however, furnish graphic evidence that trivalent iron diffuses faster in rutile than the larger divalent species.

15333. Paule, R. C., **Calculation of complex equilibria involving vaporization into vacuum,** *High Temp. Sci.* **6,** No. 4, 267-275 (Dec. 1974).

Key words: Al^2O^3; chemical doping; complex equilibria; purification (evaporative); vacuum vaporization.

A simplified, direct approach is presented to the description of complex equilibria involving vaporization into vacuum. Emphasis is on the basic problem-solving process and on modification of existing techniques. Sequential solutions are presented to problems involving purification of a melt by vaporization into vacuum. The effects of concentration of melt and oxygen partial pressures on vaporization rates are demonstrated.

15334. Jacox, M. E., Milligan, D. E., **Matrix isolation study of the infrared spectrum of thioformaldehyde,** *J. Mol. Spectrosc.* **58,** No. 1, 142-157 (1975).

Key words: CH_3S; CH_3SH; dimethyldisulfide; infrared spectrum; matrix isolation; pyrolysis; *s*-trithiane; thioformaldehyde; ultraviolet photolysis; vacuum ultraviolet photolysis.

H_2CS has been trapped in argon and nitrogen matrices at 14 K as a product of the pyrolysis of *s*-trithiane or $(CH_3S)_2$ and of the ultraviolet or vacuum ultraviolet photolysis of CH_3SH. A small concentration of H_2CS has also been observed upon vacuum ultraviolet photolysis of a mixture of CH_4 and H_2S in an argon matrix. The isotopic data support the assignment of absorptions at 993 and at 1063 cm^{-1} to the out-of-plane deformation and the C=S stretching fundamentals of H_2CS. Absorptions in the CH stretching region which were assigned to H_2CS in an earlier gas-phase study were confirmed in the matrix experiments. Studies of the vacuum ultraviolet photolysis of CD_3SH have provided information on the mechanism of the photolysis process.

15335. Tomuta, L., Mizushima, M., Howard, C. J., Evenson, K. M., **Rotational structure and magnetic *g* factors of $O_2(X_3\Sigma^g_-, \nu = 0)$ from laser-magnetic-resonance spectra,** *Phys. Rev. A* **12**, No. 3, 974-979 (Sept. 1975).

Key words: effect; laser; magnetic resonance; oxygen; rotational structure; Zeeman.

Using the 108- and 84-μm D_2O laser lines, new laser-magnetic-resonance (LMR) spectra of the oxygen molecule in its ground state $(X_3\Sigma^g_-, \nu=0)$ are observed and analyzed. The corresponding transitions are $n=15\rightarrow 17$ and $n=19\rightarrow 21$, respectively. Bauer, Kamper, and Lustig's values of the *g* factors are consistent with our results, but Hendrie and Kusch's values are not. Combining all LMR results with other results, we obtain rotational parameters $B^0=43.1004608(75)$ GHz and $B^1=0.14520(20)$ MHz.

15336. Gillispie, G. D., Khan, A. U., Wahl, A. C., Hosteny, R. P., Krauss, M., **The electronic structure of nitrogen dioxide. I. Multiconfiguration self-consistent-field calculation of the low-lying electronic states,** *J. Chem. Phys.* **63**, No. 8, 3425-3444 (Oct. 15, 1975).

Key words: dipole moment; excited states; MC-SCF; molecular geometry; NO_2; spectra.

Traditional spectroscopic analysis of the complex and irregular absorption spectrum of NO_2 has provided a relatively small amount of information concerning the nature of the excited states. An extensive *ab initio* investigation has been undertaken, therefore, to provide a basis for interpretation of the experimental results. Multiconfiguration self-consistent-field (MC-SCF) wavefunctions have been computed for the low-lying

$$\overline{X}^2A_1, \overline{A}^2B_2, \overline{B}^2B_1, \overline{C}^2A_2, {}^4B_2, {}^4A_2, \text{ and } {}^2\Sigma_g^+$$

electronic states of NO_2. The minima of the $\overline{A}^2B_2$, $\overline{B}^2B_1$, and $\overline{C}^2A_2$ states have all been found to be within 2 eV of the minimum of the $\overline{X}^2A_1$ ground state; for these states, C_{2v} potential surfaces have been constructed for purposes of a spectral interpretation. The ${}^4B_2$, ${}^4A_2$, and ${}^2\Sigma_g^+$ states are all more than 4 eV above the minimum of the ground state and have been examined in less detail. The study described here significantly improves on previous NO_2 *ab initio* calculations in three important areas: (1) The double-zeta-plus-polarization quality basis set is larger and more flexible; (2) the treatment of molecular correlation is more extensive; and (3) the electronic energies have been calculated for several different bond lengths and bond angles in each state. For the four lowest doublet states the following spectral data have been obtained:

	T_e(eV)	R_e(Å)	θ_e(deg)
$\overline{C}^2A_2$	1.84	1.27	110
$\overline{B}^2B_1$	1.66	1.20	180
$\overline{A}^2B_2$	1.18	1.26	102
$\overline{X}^2A_1$	0.00	1.20	134
	(0.00)	(1.1934)	(134.1).

	ω_1(cm^{-1})	ω_2(cm^{-1})	μ(D)
$\overline{C}^2A_2$	1360	798	0.05
$\overline{B}^2B_1$	1192	960	0.00
$\overline{A}^2B_2$	1461	739	0.46
$\overline{X}^2A_1$	1351	758	0.37
	(1358)	(757)	(0.32)

The ground state experimental constants are included in parentheses. The estimated accuracy of the various parameters is ± 0.02 Å for bond length, $\pm 2°$ for bond angle, ± 10 percent for the vibrational frequencies, ± 0.10 D for dipole moments, and $\pm$ 0.3 eV for the adiabatic excitation energies. An unusual feature has been found for the ${}^2\Sigma_g^+$ state. The equilibrium geometry of this linear state has two unequal bond lengths of 1.20 and 1.42 Å and the inversion barrier is approximately 800 cm^{-1}.

15337. Furukawa, G. T., Bigge, W. R., Riddle, J. L., Reilly, M. L., **The freezing point of aluminium as a temperature standard,** *Inst. Phys. Conf. Ser. No.* **26**, Chapter 7, 389-397 (1975).

Key words: aluminium point; calibration; freezing point; freezing-point cell; platinum resistance thermometer; tin point; zinc point.

Six platinum resistance thermometers were "calibrated" at the triple point of water and at the freezing points of tin, zinc and aluminium. By extrapolating the "quadratic relation" the freezing point of pure aluminium was found to be 660.407 ± 0.005 "degrees C." The advantages of having a platinum resistance thermometer calibrated at a fixed point (e.g., aluminium point) near the upper temperature limit are demonstrated.

15338. Merris, R., Pierce, S., **Elementary divisors of higher degree associated tranformations,** *Linear and Multilinear Algebra* **1**, No. 3, 241-250 (1973).

Key words: elementary divisors; irreducible character; symmetry class of tensors.

Let V be a complex inner product space of dimension n and let $\overset{m}{\otimes} V$ be the space of m contravariant tensors over V. Given a subgroup G of S_m and an irreducible character χ on G, we define a subspace $V_\chi{}^m(G)$ in $\overset{m}{\otimes} V$. If $T:V\rightarrow V$ is linear, let $\Pi \cdot T: \overset{m}{\otimes} V \rightarrow \overset{m}{\otimes} V$ be the mth Kronecker product of T. Then $V_\chi{}^m(G)$ is invariant under $\Pi \cdot T$ and we let $K(T)$ be the restriction of $\Pi \cdot T$ to $V_\chi{}^m(G)$. In this paper we prove that if the rank of T is large enough, then the elementary divisors of $K(T)$ are linear if and only if the elementary divisors of T are linear. This result has previously been proved only for the case that χ is linear.

15339. Soulen, R. J., Jr., Gubser, D. U., **Superconducting properties of iridium,** (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT* **13**, K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3**, 498-502 (Plenum Publishing Corp., New York, N.Y., 1974).

Key words: critical field, fixed point; iridium; transition temperature.

The residual resistivity ratio, superconductive transition temperature, magnetization curves, and critical magnetic field data of several samples of iridium have been measured. It is found that the magnetic properties of superconducting iridium are highly dependent on the metallurgical state of the sample, whereas the transition temperature is relatively less sensitive.

The use of iridium as a superconductive thermometric fixed point at 0.1 K is critically examined.

15340. Shih, A., **van der Waals forces between a Cs atom or a CsCl molecule and metal or dielectric surfaces,** *Phys. Rev. A* **9**, No. 4, 1507-1514 (Apr. 1974).

Key words: cesium beam; cesium chloride beam; gold surfaces; van der Waals forces.

The interaction potentials between a spherically symmetric atom (Cs) and a highly conducting surface (gold) or a dielectric surface (glass) are investigated by the atomic-beam-deflection technique. The observed beam profile is least-squares fitted to an r^{-3} potential. The derived interaction constant for the gold surface is 0.59 and 0.67 of the values predicted by Bardeen and Mavroyannis, respectively. A glass surface is found to have an interaction constant 0.65 that of gold. The measurements have also been obtained for a polar molecule (CsCl). With a gold surface the observed beam profile is almost identical to that for stainless steel (reported earlier) in spite of their difference in dc conductivity. Further, the observed constant for an insulator (glass surface) is 0.86 that of gold. With gold, the interaction constant obtained for a cesium-halide molecule, with a strong permanent dipole moment, is smaller than that for a Cs atom with zero dipole moment.

15341. Johnson, C. R., **Inequalities for a complex matrix whose real part is positive definite,** *Trans. Amer. Math. Soc.* **212**, 149-154 (1975).

Key words: eigenvalues; Hadamard inequality; positive definite; real part.

Denote the real part $A \in M_n(C)$ by $H(A) = 1/2(A + A^*)$. We provide dual inequalities relating $H(A^{-1})$ and $H(A)^{-1}$ and an identity between two functions of A when A satisfies $H(A) > 0$. As an application we give an inequality (for matrices A satisfying $H(A) > 0$) which generalizes Hadamard's determinantal inequality for positive definite matrices.

15342. Schooley, J. F., **The superconductive transition in cadmium,** (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT 13*, K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3**, 382-386 (Plenum Publishing Corp., New York, N.Y., 1974).

Key words: OSRM; pure cadmium; superconductive transition temperature; superconductive transition width; thermometric fixed point.

We have examined the superconductive transition of a single crystal of cadmium at temperatures from 0.1 K to its transition temperature, T_c, and in magnetic fields from 0-27 gauss. We have measured T_c as $0.515 \pm 0.002_5$ K on the T-62 scale. We have compared its transition width and its T_c with polycrystalline samples prepared for thermometric fixed-point devices. The single-crystal transition width is ~ 250 μK at H=0, compared to 2-6 mK for the polycrystalline samples. However, the T_c's of the polycrystalline samples agree within 0.5 mK with that of the single crystal. We have examined the width of the single-crystal transition as a function of applied field, and find a minimum width of about 25 μK for 0.5 gauss. These data will be discussed in terms of transition temperature theory.

15343. Ledbetter, H. M., Weston, W. F., Naimon, E. R., **Low temperature elastic properties of four austenitic stainless steels,** *J. Appl. Phys.* **46**, No. 9, 3855-3860 (Sept. 1975).

Key words: bulk modulus; chromium alloys; compressibility; Debye temperature; Doring effect; elastic constants; iron alloys; magnetic transition; nickel alloys; Poisson's ratio; pulse-echo method; sound velocity; Young's modulus.

The elastic properties of four austenitic stainless steels—AISI 304, AISI 310, AISI 316, and A286—are reported over the temperature range 300-4 K. These properties include longitudinal (reciprocal compressibility), Poisson's ratio, and elastic Debye temperature. Elastic constants were determined from measurements of longitudinal and transverse soundwave velocities using an ultrasonic (10 MHz) pulse-superposition method. Measurements were made in the absence of a magnetic field; these alloys undergo paramagnetic-to-antiferromagnetic transitions at low temperatures. For all four alloys, the shear modulus behaves regularly with respect to temperature. The other elastic constants, all of which have a dilatational component, decrease anomalously at temperatures below 80 K. The largest anomaly, about 3 percent, is in the bulk modulus of the 304 alloy; this modulus is lower at 0 than at 300 K. Results are interpreted on the basis of the Döring effect, which results from a large volume magnetostriction in the magnetic phase. This may be the first report of a Döring effect in antiferromagnetic materials.

15344. Maienthal, E. J., **Analysis of botanical standard reference materials by cathode ray polarography,** *J. Assoc. Off. Anal. Chem.* **55**, No. 5, 1109-1113 (1972).

Key words: aluminum; analysis; business; differential cathode ray polarography; iron; lead; nickel; orchard leaves.

The need for certified botanical and biological standards both in research and in industrial and field applications is leading to the development and production of a number of new Standard Reference Materials by the National Bureau of Standards. The first of these to be produced and certified is an orchard leaf standard. The determination of a number of important trace elements by cathode ray polarography was investigated and found to offer considerable advantages in sensitivity and accuracy over many other techniques. In addition, several elements may be determined simultaneously in the same solution. The methods were developed and applied to the analysis and certification of nickel, lead, bismuth, and iron in the orchard leaves. Results were also obtained for aluminum which has not yet been certified. Nickel was determined on 1 g samples after extraction with dimethylglyoxime and $CHCl_3$. Lead and bismuth were determined concurrently on 1 g samples after a sodium diethyldithiocarbamate separation. Iron and aluminum were determined on 0.25 g samples after cupferron separations. Details of the methods are given and the results are compared with those obtained by other techniques.

15345. Clark, A. F., Moulder, J. C., Runyan, C. C., **Combustion of bulk titanium in oxygen,** (Proc. 15th Int. Symp. on Combustion, Tokyo, Japan, Aug. 25-31, 1974), Paper in *Fifteenth Symposium (International) on Combustion*, pp. 489-499 (The Combustion Institute, Pittsburgh, Pa., 1974).

Key words: combustion; Hilbert transform; laser ignition; oxygen; titanium.

The combustion of bulk titanium in one atmosphere oxygen is studied using laser ignition and several analytical techniques. These were high-speed color cinematography, time and space resolved spectra in the visible region, metallography (including SEM) of specimens quenched in argon gas, x-ray and chemical product analyses, and a new optical technique, the Hilbert transform method. The cinematographic application of this technique for visualizing phase objects in the combustion zone is described. The results indicate an initial vapor phase reaction immediately adjacent to the molten surface but as the oxygen uptake progresses the evaporation approaches the point of congruency and a much reduced evaporation rate. This and the accumulation of the various soluble oxides soon drive the reaction zone below the surface where gas formation causes boiling and ejection of particles. The buildup of rutile cuts off the oxygen supply and the reaction ceases.

15346. Yakowitz, H., **Use of divergent-beam x-ray diffraction to measure lattice expansion in LiF as a function of thermal-neutron dose up to 6×10^{16} nvt,** *J. Appl. Phys.* **43,** No. 11, 4793-4794 (Nov. 1972).

Key words: Kossel diffraction; lattice expansion; LiF; NBS reactor; radiation damage; thermal neutrons.

The lattice expansion of LiF was measured by means of the divergent-beam (Kossel) x-ray diffraction method at three levels of thermal-neutron dose, 0.45, 2, and 6×10^{16} nvt, respectively. The lattice parameter of LiF increases due to the production of Frenkel defects resulting from the $Li^6(n,\alpha)H^3$ reaction. At 6×10^{16} nvt, the lattice expansion was found to be 0.13 ± 0.02 percent which is in good agreement with previously reported values.

15347. Yates, J. T., Jr., Erickson, N. E., **X-ray photoelectron spectroscopic study of the physical adsorption of xenon and the chemisorption of oxygen on tungsten (111),** *Surface Sci.* **44,** No. 2, 489-514 (1974).

Key words: chemisorption; ESCA; oxygen; physical adsorption; tungsten; xenon.

X-ray photoelectron spectroscopy (ESCA) has been used to study the physical adsorption of Xe and the chemisorption of oxygen by W (111). An ultrahigh vacuum ESCA spectrometer has been modified such that thermal desorption behavior from the W (111) crystal can be directly compared with ESCA spectra of the adsorbed species. In addition, since the work function of a W (111) crystal covered with one monolayer of Xe is accurately known from previous work, the binding energy of the $Xe(3d_{5/2})$ adsorbate level can be accurately compared to the gaseous $Xe(3d_{5/2})$ level.

When Xe is physisorbed to 1 monolayer the Xe $(3d_{5/2})$ level exhibits a binding energy (relative to the vacuum level) which is 2.1 eV below that found for Xe (g). At lower Xe coverages the shift becomes monotonically greater, approaching 2.6 eV at a Xe coverage of 0.05. This 0.5 eV shift downward is accompanied by an increase of only 0.05 eV in adsorption energy as coverage decreases, and may be partially caused by the presence of ~ 10-20 percent of extraneous adsorption sites other than W (111) which adsorb Xe with higher adsorption energy. The adsorption energy of Xe may also be increased by coadsorption of oxygen and the Xe $(3d_{5/2})$ binding energy exhibits a corresponding shift downward as adsorbed oxygen coverage is increased to $\theta_o = 0.5$. Electronic relaxation processes affecting the final state are dominant factors in determining the magnitude of the chemical shift upon adsorption, in agreement with the predictions of Shirley. The magnitude of the relaxation effect seems to be very sensitive to small changes in Xe adsorption energy. Similar effects have been seen for chemisorption of CO.

The adsorption of O_2 at 120 K by W (111) yields a single broad O(1s) peak whose linewidth decreases with increasing coverage. The final spectra at $\theta_o = 1$ monolayer are very similar to those obtained at temperatures of 300 K or above on polycrystalline tungsten.

15348. Lyon, G., Stillman, R. B., **Simple transforms for instrumenting FORTRAN decks,** *Software—Pract. Exper.* **5,** No. 4, 347-358 (Oct.-Dec. 1975).

Key words: computation and flow analysis; FORTRAN use; programming aids; syntax analysis.

A recent revival of interest in measuring program execution behaviour has led to a number of distinct approaches. Arguments are given for a fairly simple method of modifying FORTRAN source code to collect frequency counts. No symbol table is necessary and only a single reserved name is introduced into the

15349. Gallagher, A., **The spectra of colliding atoms,** (Proc. 4th Int. Conf. on Atomic Physics, Heidelberg, Germany, July 1974), Paper in *Atomic Physics* **4,** G. zu Putlitz, E. W. Weber, and A. Winnacker, Eds., pp. 559-574 (Plenum Publ. Corp. New York, N.Y., 1975).

Key words: line broadening; rubidium; sodium.

We discuss what can be learned from line shapes and the basic ideas of how they are interpreted with theoretical approximations. Only "pressure" or neutral-gas broadening will be considered, not "Stark" or plasma broadening. We will give examples of recent theoretical and experimental work, but this is not intended as a review and we will concentrate on our measurements in the far wings of the lines.

15350. Bowman, C. D., Schröder, I. G., Dick, C. E., Jackson, H. E., **Very low energy photofission of ^{238}U,** *Phys. Rev. C* **12,** No. 3, 863-870 (Sept. 1975).

Key words: bremsstrahlung beam; cross section; fission barrier shapes; γ-ray strength; isomeric fission; level density; photofission.

The photofission cross section of ^{238}U was measured in the 2.75- to 5.75-MeV range. Cross sections as small as 2×10^{-11} b were detected. A shelf was observed which had been predicted to occur in the cross section owing to the dominance of radiative decay of levels in the second well. Barrier penetrabilities for both inner and outer barriers were determined from these measurements and together with penetrabilities from other measurements were used to infer a potential shape for ^{238}U. The total γ-ray strength function in the second well at 4.25 MeV was found to be 1.3×10^{-5}. From comparison of expected and measured cross sections at the lowest energies, the density of levels effective in photofission at 3 MeV was found to be greater than 4 per MeV.

15351. Dibeler, V. H., McCulloh, K. E., **Enthalpy of formation of methyl and methylene radicals by photoionization studies of methane and ketene,** (Proc. IV Int. Conf. on Vacuum-UV Radiation Physics, Hamburg, Germany, July 22-26, 1974), Paper in *Vacuum-UV Radiation Physics,* E. E. Koch, R. Haensel, and C. Kunz, Eds., pp. 191-194 (Pergamon-Vieweg, Braunschweig, Germany, 1974).

Key words: enthalpy of formation; ions; mass spectrometry; methyl; methylene; photoionization; radicals; vacuum ultraviolet.

Photoion yield curves for CH_3^+ and CH_2^+ from methane have been remeasured near threshold at 298 and 115 K and the curve for CH_2^+ from ketene has been measured at 298, 215, and 130 K. For methane there is no evidence for the ion-pair process yielding $CH_3^+ + H^-$. The temperature shift of the CH_3^+ curve is $k\Delta T$, indicating only two available rotational degrees of freedom in the dissociation process. Including a negligible kinetic energy release at threshold, the estimated threshold at $T = 0$ results in $\Delta Hf_0^o\ (CH_3) = 35.6 \pm 0.2$ kcal mol^{-1}. No temperature shift is observed for the CH_2^+ curve from methane. Assuming zero kinetic energy release, the result $\Delta Hf_0^o\ (CH_2) = 93.7 \pm 0.5$ kcal mol^{-1} is obtained. The CH_2^+ curve from ketene exhibits a shift of $k\Delta T$ with temperature. Neglecting kinetic energy release, the estimated threshold at $T = 0$ results in $\Delta Hf_0^o\ (CH_2) = 93.5 \pm 0.4$ kcal mol^{-1}.

15352. McCulloh, K. E., **Threshold energies for formation of OH^+ and NH_2^+ by dissociative photoionization of water and ammonia,** (Proc. IV Int. Conf. on Vacuum-UV Radiation Physics, Hamburg, Germany, July 22-26, 1974), Paper in *Vacuum-UV Radiation Physics*, E. E. Koch, R. Haensel, and C. Kunz, Eds., pp. 195-197 (Pergamon-Vieweg, Braunschweig, Germany, 1974).

Key words: ammonia; dissociative photoionization; NH_2^+, OH^+; photoionization; threshold energies; water.

A photoionization mass spectrometer incorporating a monochromator of 0.5 Å resolution has been employed to remeasure photoion yield curves near threshold for OH^+ from water vapor at temperatures of 215 and 298 and for NH_2^+ from ammonia at 160 and 298 K. From the observed temperature shifts of these curves it is inferred for both molecules that essentially the entire rotational energy is available for dissociative ionization. On this basis the threshold energies for formation of the fragment ions are corrected for the effect of rotationally excited molecules. The enthalpies of formation of OH^+ and NH_2^+ are discussed in relation to thermochemical quantities for the neutral OH and NH_2 radicals. Similar results are reported for OD^+, ND_2^+, and NHD^+ fragment ions.

15353. Schooley, J. F., **Solid state phase transitions as thermometric fixed points,** *Inst. Phys. Conf. Ser. No.* **26,** Chapter 2, 49-56 (1975).

Key words: antiferromagnetism; ferroelectricity; solid-state transitions; superconducting temperature calibration; thermometric fixed points.

The general question of the usefulness of thermometric fixed-point devices based upon phase transitions in solids is examined. It appears that both the method of detection and the intrinsic character of the transition relate to thermometric precision and practical utility of such devices. Promising systems which are discussed are the AC mutual inductance detection of superconductive transitions and the AC heat capacity detection of antiferromagnetic and ferroelectric transitions.

15354. Beers, Y., **A simplified discussion of energy storage associated with an electrostatic field,** *Am. J. Phys.* **43,** No. 8, 739-740 (Aug. 1975).

Key words: electrostatic; energy.

This note gives a simplified derivation for the energy associated with an electrostatic field by extended use of the expression for the energy of a parallel plate capacitor.

15355. Huie, R. E., Herron, J. T., **Temperature dependence of the rate constants for reactions of ozone with some olefins,** (Proc. Symp. on Chemical Kinetics Data for the Upper and Lower Atmosphere, Warrenton, Va., Sept. 15-18, 1974), *Int. J. Chem. Kinet. Symp.*, No. 1, 165-181 (John Wiley & Sons, Inc., New York, N.Y., 1975).

Key words: air pollution; kinetics; mass spectrometry; olefin; ozone; photochemical smog; rate constant.

The temperature dependence of the rate constants for the reactions of ozone with some olefins has been studied using a stopped-flow reactor in conjunction with a beam sampling mass spectrometer. The effect of molecular oxygen on the measured rate constants was studied, and it was concluded that molecular oxygen scavenges free radical species which could further react with ozone. Rate constants, measured in the presence of molecular oxygen, are as follows (in units of $cm^3\ mol^{-1}\ s^{-1}$): log k (1-butene) = $(9.247 \pm 0.033 - (1686 \pm 20)/2.303T$; log k (2-methylpropene) = $(9.281 \pm 0.026) - (1671 \pm 23)/2.303T$; log k (*cis*-2-butene) = $(9.272 \pm 0.087) - (956 \pm 54)/2.303T$; log k (*trans*-2-butene) = $(9.555 \pm 0.069) - (1051 \pm 43)/2.303T$; log k (2-methyl-2-butene) = $(9.582 \pm 0.119) - (826 \pm 78)/2.303T$; and log k (2, 3-dimethyl-2-butene) = $(9.230 \pm 0.237) - (294 \pm 196)/2.303T$.

A good linear correlation is found between the activation energy for the reaction and the ionization potential of the olefin.

15356. Klein, W., **Behavior of distribution functions in the thermodynamic limit,** *J. Math. Phys.* **15,** No. 8, 1181-1185 (Aug. 1974).

Key words: distribution functions; finite volumes; Kirkwood Salsburg equation; perturbation expansion; strip operator; thermodynamic limit.

Ruelle has proven that the solutions of the Kirkwood-Salsburg equation for a finite volume Λ become, in the limit as $\Lambda \to \infty$, the solutions to the Kirkwood-Salsburg equation for an infinite volume, i.e.,

$$\lim_{\Lambda\to\infty}\rho_\Lambda \to \rho + \lim_{\Lambda\to\infty}\epsilon(\Lambda), \lim_{\Lambda\to\infty}\epsilon(\Lambda) \to 0.$$

The form of ϵ is not obtained. We show that for the first order contribution to the solution of the Kirkwood-Salsburg equations obtained via a perturbation scheme developed in an earlier paper that

$$\epsilon(\Lambda) \leq \lim_{R\to\infty}\epsilon^{-k'aR},$$

where k'_a is a positive real constant which can be specified and R is the minimum distance from the container walls to the particles of the system.

15357. Phillips, J. C., Wall, L. A., Aldridge, M. H., **Liquid (melt) heat capacities and heats of vaporization of oligomers of poly(hexamethylene sebacate),** *Polym. Eng. Sci.* **15,** No. 2, 73-78 (Feb. 1975).

Key words: alkanes; esters; heat capacity; heats of vaporization; oligomers; rates.

The liquid heat capacities and heats of vaporization of three linear esters of poly(hexamethylene sebacate) with hexyl-capped end groups (M(mol.wt.) = 370, 655, and 939) have been determined. The heats of vaporization of the oligomers measured at a mean temperature were corrected to 323.15 to 523.15 K by use of the experimental liquid (melt) heat capacities and the calculated gas heat capacities. The corrected heats of vaporization were fitted to the equation $\Delta H_v = S(T)M^\alpha + I(T)$, where the temperature dependence of the slope and intercept are represented, respectively, as $S(T) = C\ln T + K_0$ and $I(T) = aT + b_0$, and α is an exponent. The results indicate (at corresponding molecular weights and constant temperature) that the ratio of the liquid heat capacities of the oligomer ester and the n-alkane, and similarly the ratio of the heats of vaporization, depend on the number of carboxyl groups in the oligomer ester chain.

15358. Pella, P. A., DeVoe, J. R., **Systematic error in tin ore assay by Mössbauer spectrometry,** *J. Radioanal. Chem. Short Commun.* **25,** No. 1, 185-188 (1975).

Key words: Mössbauer spectrometry; quantitative analysis; Stannic oxide; tin ores.

In this work, Mössbauer spectrometry was applied to the nondestructive, quantitative analysis of tin oxide in two NBS-SRM tin ore concentrates. Systematic errors of 10 to 25 percent were observed when these ore samples were measured versus calibrant samples prepared from A.R. tin oxide. The effect of heat treatment of the ores on the resonant absorption intensity is also discussed.

15359. Reneker, D. H., Martin, G. M., Broadhurst, M. G., **Search for correlations between dielectric relaxation and polymerization in trioxane crystals,** *J. Appl. Phys.* **45,** No. 10, 4172-4174 (Oct. 1974).

Key words: dielectric loss; dielectric relaxation; molecular motions; nuclear magnetic resonance absorption; polyoxymethylene crystals; solid state polymerization; trioxane crystals.

After exposure to ionizing radiation, trioxane polymerizes rapidly at temperatures between 50 and 60 °C. The nature of the molecular motions involved in this solid-state reaction is not clear. Line narrowing in nuclear magnetic resonance absorption has been reported as one indication of such motions. No related dielectric loss peaks were found in trioxane at temperatures from − 180 to 55 °C and frequencies from 1 to 10 000 Hz. Ionic conductivity is large above room temperature and it may play an important role in this polymerization reaction.

15360. O'Brien, J. T., Crannell, H., Kline, F. J., Penner, S., **Ionization loss for high-energy electrons in thin targets,** *Phys. Rev. C* **9,** No. 4, 1418-1429 (Apr. 1974).

Key words: energy loss; ionization loss; most-probable energy loss; target thickness.

The most-probable ionization loss has been measured for relativistic electrons passing through thin absorbers of carbon, aluminum, and copper. Incident energies of 50 and 100 MeV were used. Target thicknesses ranged from 48 to 614 mg/cm^2 and encompass the range of thicknesses most frequently used in electron scattering experiments at these energies. The measured values of the most-probable ionization losses are in good agreement with the theoretical predictions of Sternheimer. The techniques for using values of the ionization loss to determine the target thickness in electron scattering experiments are presented.

15361. Ekin, J. W., Clem, J. R., **Magnetic coupling force of the superconducting dc transformer,** *Phys. Rev. B* **12,** No. 5, 1753-1765 (Sept. 1, 1975).

Key words: dc transformer; granular aluminum films; magnetic coupling; superconducting dc transformer; type II superconducting films; vortex coupling.

The temperature dependence and magnetic field dependence of the coupling force have been measured in two transformer systems, one with primary and secondary film thicknesses d_p and d_s comparable with the superconducting penetration depth λ ($d_p/\lambda_p \sim d_s/\lambda_s \sim 1$) and one with film thicknesses small compared with the penetration depth ($d_p/\lambda_p \sim d_s/\lambda_s \sim 10^{-1}$). The results show that (i) the coupling force is nearly two orders of magnitude greater in the thick-film transformer than in the thin-film transformer; (ii) there exists a transition field above which the coupling force decreases very rapidly, typical values for the transition field being quite low ($\sim$ 0.5 G); and (iii) the temperature dependence of the coupling force over much of the range investigated is simply proportional to the temperature dependence of $\lambda_p^{-2}\lambda_s^{-2}$. A Gibbs free-energy theory describing the coupling force has been numerically evaluated and compared with these data. The results show that the theory can be used to predict accurately both the absolute magnitude and the field and temperature dependences of the coupling force for wide-ranging values of the operating parameters.

15362. Rosasco, G. J., Etz, E. S., Cassatt, W. A., **The analysis of discrete fine particles by Raman spectroscopy,** *Appl. Spectrosc.* **29,** No. 5, 396-404 (Sept.-Oct. 1975).

Key words: fine particles; laser Raman; micro-Raman; particle analysis; particulates; Raman spectroscopy.

A conventional laser Raman spectrometer has been modified and used to obtain useful Raman spectra from discrete solid particles as small as 0.7 μm in linear dimensions. Spectra obtained from single, micrometer-sized particles of several inorganic and organic compounds are reported. Simplified calculations are discussed which provide an estimate of detectability levels and other problems associated with these measurements. Certain parameters that must be considered in the design of an instrument especially intended for use in the chemical characterization of single fine particles are reviewed in the light of this work.

15363. Marshall, H. E., **"Cost sharing for recreation: Efficiency and equity:" Comment,** *Land Economics* **LI,** No. 3, 300-303 (Aug. 1975).

Key words: cost sharing; efficiency; equity; recreation; redistribution of income; water resources.

This comment critiques an article in *Land Economics* entitled "Cost Sharing for Recreation: Efficiency and Equity," by William Miller and Bruce Scherr. These authors presented in their article a general set of policy conclusions regarding cost sharing for recreation that were based on a case study they made of a Soil Conservation Service project and on theoretical work by Harold Marshall. This comment questions the validity of the conclusions and policy implications for the general case, clarifies the relationship of Marshall's work to that of Miller and Scherr, and suggests an alternative approach to measuring the redistribution of income effects of a recreation project.

15364. Parkinson, J. S., **Studies of human factors in building design,** *Constr. Specifier* **27,** No. 11, 41-43 (Nov. 1974).

Key words: acoustics; human factors; human occupancy; illumination; interdisciplinary approach; physiology; psychology.

The human factors which affect design are not always known or understood. The Center for Building Technology of the National Bureau of Standards has mobilized an unusual aggregation of experts to study the human factors involved in building design and physical occupancy.

This interdisciplinary approach looks, for example, at the need for windows, the optimum level of illumination, individual's reactions to noise levels and human behavior during fires. They are also trying to find out how much can be learned from the occupants of the housing built under Operation Breakthrough by conducting interviews with the tenants, interrogating visitors, studying work orders, and asking for comments from those moving out of the developments.

The human factors approach is not new but psychological and physiological test techniques have improved a great deal in the past couple of decades so that designers and builders should now be able to provide more pleasant, comfortable and efficient environments for human occupancy.

15365. Snyder, L. E., Buhl, D., Schwartz, P. R., Clark, F. O., Johnson, D. R., Lovas, F. J., Giguere, P. T., **Radio detection of interstellar dimethyl ether,** *Astrophys. J.* **191,** No. 2, Part 2, L79-L82 (July 15, 1974).

Key words: dimethyl ether; internal motion; interstellar molecules; Orion; radio astronomy.

Interstellar dimethyl ether, $(CH_3)_2O$, has been detected in emission from the direction of the Orion Nebula molecular cloud. The observed velocity of the $6_{06} \rightarrow 5_{15}$ transition 90.9 GHz is in excellent agreement with other molecules observed toward Orion. Observations of the $2_{20} \rightarrow 2_{11}$ transition at 86.2 GHz and the $2_{11} \rightarrow 2_{02}$ at 31.1 GHz support the dimethyl ether detection and indicate that either $(CH_3)_2O$ has two distinct velocity components in Orion or certain internal motion states are preferentially populated. This molecule has a large collisional cross-section and C_{2V} symmetry; hence it should be useful for future studies of molecular pumping models.

15366. Sheingorn, M., **Poincaré series of polynomials bounded away from zero on a fundamental region,** *Amer. J. Math.* XCV, No. 4, 729-749 (Winter, 1973).

Key words: automorphic functions; Poincaré series; polynomial approximation.

The purpose of the present paper is to extend Knopp's Main Lemma to the case $q > 1$. Knopp's proof involves substantial use of the Bers' spaces of automorphic forms. Since the character of these spaces in the cases $q \geqslant 2$ and $1 < q < 2$ is vastly different, our proof bears only superficial resemblance to Knopp's. Indeed, the situation is this: If one replaces $q \geqslant 2$ by $q > 1$ at every stage of Knopp's proof, the proof turns out to be valid. However, verification of two of the resulting statements is quite hard and requires techniques far outside Knopp's paper.

15367. Stark, J. P., Manning, J. R., **Correlated complete-path equations for diffusion in an electric field,** *Phys. Rev. B* 9, No. 2, 425-434 (Jan. 15, 1974).

Key words: correlation factor; diffusion; drift mobility; electric field; random walk; symmetry plane; vacancy.

Diffusion of a substitutional solute in a face-centered-cubic metal is discussed in terms of the complete path of the defect giving rise to mass transport. For diffusion in the absence of an applied field, these results are equivalent to the matrix method of Howard for the calculation of the correlation factor. In an applied field, however, the possibility that during the lifetime of a defect it may cause a tracer atom to make a series of successive jumps in the positive field direction or alternatively a series of successive jumps antiparallel to the field can appreciably influence the form of the equations. The tracer can, with decreasing probability, find itself several or many jump distances from its original position. Previous descriptions of this process restricted the tracer to two adjacent planes perpendicular to the applied field. In the present paper, generalized equations are derived for diffusion in an applied field with successive jumps by the tracer in one direction being explicitly allowed. To illustrate the use of these equations, the diffusion of an isolated tracer by a single vacancy is evaluated for a case where successive jumps in one direction are allowed, and also for comparison it is evaluated with the assumption that arrival of the vacancy at the symmetry plane passing through the tracer normal to the diffusion direction returns the vacancy to equilibrium. The latter approach restricts the tracer to two adjacent planes in a sequence of correlated jumps but is shown to give the same mobility. Thus use of the symmetry plane does not affect the results. In contrast to previous equations, the present treatment is applicable to situations where symmetry planes are not present. Thus, it will allow calculation of drift mobilities when the defect or crystal symmetry is more complex, as for diffusion via divacancies which can dissociate.

15368. Young, R. D., Teague, E. C., **The measurement and characterization of surface finish,** Chapter 2 in *Properties of Electrodeposits Their Measurement and Significance,* R. Sard, H. Leidheiser, and F. Ogburn, Eds., pp. 22-49 (Electrochemical Society, Princeton, N.J., 1975).

Key words: characterization; instruments; measurement, statistical surface parameters; surface finish; surface parameters.

The surface microtopography of an electrodeposit is determined by a variety of parameters, particularly the physical and chemical character of the initial substrate. Modern instrumentation for quantitative measurement of substrate and electrodeposit surface microtopography are reviewed. Statistical parameters associated with measured surface profiles which permit concise geometrical characterization of height distributions, periodicities along the surface, etc., are defined and discussed. Illustrative examples based on measurements of electrodeposited surfaces are reported together with appropriate characterizing parameters.

15369. Yokel, F. Y., **Reply to a question on connections between bearing walls and precast floor panels,** *Civ. Engr. Engineers' inquiry box,* 60-61 (Dec. 1974).

Key words: design standards; earthquake load; masonry construction; precast concrete construction; progressive collapse; structural connection; structural design; wind load.

The design of ties between masonry bearing walls and precast concrete floor panels is discussed.

15370. Bernstein, L. S., Kim, J. J., Pitzer, K. S., Abramowitz, S., Levin, I. W., **Potential function for the ν_7 vibration of phosphorus pentafluoride,** *J. Chem. Phys.* **62**, No. 9, 3671-3675 (May 1, 1975).

Key words: high amplitude; internal rotation; PF_5; pseudorotation; Raman; vibration.

The gas phase Raman spectrum of the ν_7 fundamental of PF_5 has been observed under spectral resolutions approaching 1 cm^{-1}. With the use of a two dimensional harmonic oscillator basis set and a potential function of the form $V(\rho,\phi) = (1/2)a\rho^2 - b\cos(3\phi)\rho^3 + c\rho^4$, an adequate fit to the ν_7 region was obtained. The barrier to axial-equatorial fluorine atom interchange was estimated to be 1371 cm^{-1} (3.92 kcal/mole).

15371. Treu, S., **Interactive command language design based on required mental work,** *Int. J. Man-Mach. Stud.* **7**, No. 1, 135-149 (1975).

Key words: association links; command language design; interactive user; language transformation; mental work.

Although the definition of "mental work" remains elusive, systematic means/methods should be considered for gaining evidence about interactive language features requiring more/less effort of the human mind. The suggested approach employs a structuring of the user's conceptual reference spaces into sets of "action primitives," peculiar to the type of computer-aided task involved. An interactive command language can then be regarded as the range of some transformation on the user's set of action primitives. The nature and efficiency of that transformation, in conjunction with the inherent number of mental association links, are hypothesized to have direct relationships to the level of required mental work. The user's delay or "think time," expended immediately preceding command utilization, is one measurable quantity that should be useful as a work level indicator.

15372. Yokel, F. Y., **The Operation Breakthrough evaluation, an experience in the application of performance criteria,** *Industrialization Forum* **6**, No. 1, 27-33 (1975).

Key words: building codes; building standards; housing; performance criteria.

The testing and evaluation of Operation Breakthrough housing systems relied heavily on a special set of performance criteria developed especially for the program. Valuable experience was gained in this application of performance criteria.

The Breakthrough program is assessed with respect to how effectively the criteria were formulated, the level of guidance and information provided, whether all the criteria were used and implemented, and the problems and difficulties encountered. The experience indicates that performance criteria should not be used as a substitute for specific standards and should be reserved for guiding and evaluating innovative schemes. Performance criteria are rarely simple and can be successfully implemented only in situations where compliance can be objectively measured. Particular difficulties arise in the assessment of durability. Performance criteria can provide valuable guidance in areas outside the domain properly regulated by codes and standards. Inflexible application in such areas, however, could inhibit the evolution of new concepts.

15373. Wang, F. W., **Dynamics of block-copolymer molecules in dilute solution,** *Macromolecules* **8,** No. 3, 364-371 (May-June 1975).

Key words: bead-spring model; block-copolymers; dilute solutions; dynamics; limiting viscosity number; solution properties; viscoelasticity; Zimm theory.

A theory for the dynamics of block-copolymer molecules in dilute solution has been developed by modifying the bead-spring model theory of Zimm to take into account the existence of dissimilar segments in block copolymers. The eigenvalue equation encountered in the theory has been solved numerically by extending the method of Lodge and Wu. The applications of the theory have been illustrated with calculations for the viscoelastic properties of poly(styrene-*b*-methyl methacrylate) solutions and poly(styrene-*b-cis*-1,4-isoprene) solutions. It is found that, for some block copolymers in solution, the calculated values of the viscoelastic properties deviate significantly from the values for the parent homopolymers toward the values predicted by the free-draining case.

15374. Bowen, R. L., **Adhesive bonding of various materials to hard tooth tissues. IX. The concept of polyfunctional surface-active comonomers,** *J. Biomed. Mater. Res.* **9,** No. 5, 501-510 (Sept. 1975).

Key words: adhesion; bonding; composites; coupling agents; monomers; polymers; primers; sealants.

The concept of surface-active comonomers of higher functionality is proposed as a means of increasing reliability of the bonding between preventive and restorative dental materials and tooth structures.

15375. Cali, J. P., **Tying methodology to standards,** *Lab World* **25,** No. 7, 22-24 (July 1974).

Key words: clinical chemistry; standard reference materials.

This is an interview of Mr. Cali by one of the editors of *Lab World* concerning the status of our NBS Clinical Standard Reference Materials Program. Topics discussed were the financing of the program, the technical output of the program, the goals of the program, the problems of accuracy in clinical chemistry, and how reference methods and SRM's are used to bring and to improve the accuracy in this field. Future possibilities and directions are also discussed as well as interactions between NBS and other government agencies and professional societies.

15376. Harrison, S. H., LaFleur, P. D., Zoller, W. H., **Evaluation of lyophilization for the preconcentration of natural water samples prior to neutron activation analysis,** *Anal. Chem.* **47,** No. 9, 1685-1688 (Aug. 1975).

Key words: freeze drying; instrumental neutron activation analysis; lyophilization; neutron activation analysis; preconcentration; radioactive tracers; river water; trace elements; tracers; water.

A method for the concentration of trace elements in water by lyophilization is described. This method has important applications in the multielement analysis of natural water samples by neutron activation. The results of the evaluation of trace element retention yields, using radioactive tracers, indicate that at least Na, Sc, V, Cr, Fe, Co, Zn, As, Se, Br, Rb, Sr, Ag, Cd, Sb, Cs, Ba, Tb and Ce are retained quantitatively (greater than 95%) in the freeze dried residue of a river water sample. Hg and I were found to be lost substantially and Au was retained at almost the 95 percent level. A bag made from linear polyethylene film is used as the sample container for freeze drying and neutron irradiation and is the only measurable blank in the preconcentration process. The results of a typical analysis of a freeze dried estuarine sample with the determined sample/blank ratios for each element are presented.

15377. McCamy, C. S., Derr, A. J., **Microdensitometry,** Article 15.6 in *SPSE Handbook of Photographic Science and Engineering,* W. Thomas, Jr., Ed., pp. 871-877 (John Wiley & Sons, New York, N.Y., 1973).

Key words: microdensitometry; microphotometry; optical density.

Microdensitometry is the science of measuring the optical densities of very small areas. Microdensitometers are usually equipped to scan along a line and continuously record the varying density with respect to distance. The principal application of microdensitometry is in the field of image structure analysis. The maximum resolving power of a transmission instrument is the quotient of the sum of the numerical apertures of the illuminating and sensing objectives to the wavelength of the light. With high numerical apertures, 1800 cycles/mm has been recorded.

Since microdensitometers measure optical density as a function of position, the principal calibrations are the photometric calibration and the length calibration. The photometric scales of microdensitometers are most often calibrated by placing a step tablet of known densities in the sample position. The length scale of a microdensitometer may be calibrated by scanning a glass scale or stage micrometer.

15378. Brown, C. P., Yeates, E. J., Van Hoesen, M. J., **Use and cost of on-line systems at the National Bureau of Standards Library,** *Proc. Am. Soc. Inf. Sci. Annual Meeting, Boston, Mass., Oct. 26-30, 1975,* **12,** 132-133 (Oct. 1975).

Key words: evaluation; National Bureau of Standards; on-line information retrieval systems; use statistics.

The National Bureau of Standards Library has had a year of experience in offering on-line information retrieval systems to users. Users were encouraged and assisted to access systems directly if they wished. Cost and use statistics for selected data bases are given.

15379. Wagner, G. A., Reimer, G. M., Carpenter, B. S., Faul, H., Van der Linden, R., Gijbels, R., **The spontaneous fission rate of U-238 and fission track dating,** *Geochim. Cosmochim. Acta* **39,** No. 9, 1279-1286 (1975).

Key words: fission track dating; neutron flux; neutron irradiation; plateau annealing; uranium glasses; U-238 fission decay constant.

The rate of spontaneous fission decay of uranium-238 (λ_f^{238}) was determined in 4π-geometry by the fission track method. Uranium glasses of known age of manufacture were used. Spontaneous tracks have accumulated since the time of manufacture and induced tracks to determine the uranium content were produced by thermal neutron irradiations. Spontaneous tracks in all glasses were found to be partially annealed. By correcting for this annealing effect, a $\lambda_f^{238} = 8.7 \pm 0.6 \times 10^{-17}$ yr^{-1} was obtained. Uncertainty in the neutron dose is the largest source of error.

15380. Kaufman, V., Sugar, J., **Spectrum of six-times ionized rhenium (Re VII),** *Phys. Rev. A* **12,** No. 4, 1402-1403 (Oct. 1975).

Key words: energy levels; rhenium; spectrum.

Six terms of the $4f^{14}5s^25p^6(^1S_0)nl$ doublet system of Re VII have been found, including $nl = 5d$, $5f$, $6s$, $6p$, $6d$, and $7s$. Thirteen spectral lines were classified in this system of levels. The partially resolved hfs of the $6s$-$6p$ multiplet was used to derive a value for the hyperfine splitting of the $6s$ level in agreement with a predicted value. The ionization energy of Re VII derived from the ns series is 82.74 ± 0.06 eV.

15381. Sugar, J., Kaufman, V., **Nuclear magnetic dipole moment of ^{181}Ta,** *Phys. Rev. C* **12,** No. 4, 1336-1339 (Oct. 1975).

Key words: ionization energy; nuclear moment; spectrum; tantalum.

The hyperfine structure of the $6s^2S_{1/2}$-$6p^2P_{1/2}$ line of Ta V at 1708 Å has been resolved using a 150 A sliding spark discharge. The $6p$-$8s$ multiplet was identified and the ionization energy was redetermined. With these new data a value for the nuclear dipole moment of ^{181}Ta of $(2.36 \pm 0.02)\mu_N$ is derived. New wavelengths are given for all previously classified lines.

15382. McCarty, R. D., **Hydrogen technological survey-thermophysical properties,** *NASA Spec. Publ.* **3089,** 530 pages (National Aeronautics and Space Administration, Washington, D.C., 1975).

Key words: computer programs; gaseous hydrogen; graphs; handbook thermophysical properties; hydrogen; liquid hydrogen; ortho-para modifications; property value uncertainties; solid; solid hydrogen; tables.

This handbook is the result of an extensive survey of the thermophysical properties of hydrogen, including densities and the thermodynamic, transport, electrical, optical, and molecular properties for the gaseous and fluid states. A thorough bibliography of published work on each property is given. Recommended references are cited for those properties which have been critically surveyed. Other references are listed which were reviewed but not considered as basic source material. Each property is described and defined; selected values are presented for the more common properties; and where appropriate, graphical presentations are also made. The major tables cover the range 25-5000 K with pressures to 15,000 psia (14-3000 K to 100 MPu). In addition, for property values beyond this range, recommended references are given, where available.

15383. Prince, E., **Dimethyl sulfone diimine, a neutron study,** *Acta Crystallogr. Short Structural Papers* **B31,** Part 10, 2536-2537 (1975).

Key words: alkyl sulfone; crystal structures; dimethyl sulfone diimine; hydrogen bonds; neutron diffraction; sulfone.

$(CH_3)_2S(NH)_2$, orthorhombic, $F2dd$ (No. 43), $a = 5.44$, $b = 10.59$, $c = 16.13$ Å, $Z = 8$. The structure was refined from neutron diffraction data. The molecules lie on twofold axes, and are linked together by a three-dimensional network of N–H...N hydrogen bonds. The methyl groups are in an eclipsed conformation.

15384. Ausloos, P., Lias, S. G., Eyler, J. R., **Reactions of halomethyl ions with carbonyl-containing compounds,** *Int. J. Mass Spectrom. Ion Phys.* **18,** No. 3, 261-271 (1975).

Key words: carbonyl compound; four-center reactions; halocarbon ions; ion cyclotron resonance; ion-molecule reaction; rate constants.

The mechanisms of the reactions of CF_3^+, CF_2Cl^+, CCl_2F^+, and CCl_3^+ with aldehydes, ketones, esters, acids, and acetic anhydride have been examined, and rate constant determinations have been made. Both four-center reactions and displacement reactions are observed. For aldehyde and ketone reactants, a four-center reaction resulting in the formation of a monohalogenated carbonium ion predominates; the importance of this reaction vis-a-vis more exothermic displacement processes is explained in terms of a preference for attack by the ion at the carbonyl oxygen atom. In the case of reactions of CX_3^+ (X = F, Cl) ions with esters or acids, the most commonly observed reactions are displacements and four-center reactions resulting from attack by the ion at the acyl oxygen. The displacements result in the formation of acylium ions, and the four-center reactions, in the formation of CX_2OR^+ ions (R = alkyl group). The competition between these two reactions is examined in terms of the relative exothermicities of the two channels and the time required for reaction to occur in the ion–molecule complex. The results indicate that, for ion–molecule reactant pairs which react through only one channel, the probability that an ion–molecule collision will lead to reaction is influenced by the exothermicity of reaction.

15385. Gladney, E. S., Rook, H. L., **Simultaneous determination of tellurium and uranium by neutron activation analysis,** *Anal. Chem.* **47,** No. 9, 1554-1557 (Aug. 1975).

Key words: environmental samples; neutron activation analysis; tellurium; uranium.

A procedure for the simultaneous determination of tellurium and uranium is described. The procedure utilizes thermal neutron activation followed by sample combustion and a gas phase separation of the volatile radionuclides of interest. This method is sensitive enough to permit the measurement of tellurium and uranium at their naturally occurring levels in materials of biological and environmental origin. The procedure has been successfully employed to determine the tellurium and uranium concentrations in three Standard Reference Materials (SRM's) currently being offered by the National Bureau of Standards, and in atmospheric particulate material collected in rural Maryland.

15386. Simmons, J. D., Tilford, S. G., **Evidence for an accidental predissociation of CO,** *J. Mol. Spectrosc. Note* **49,** No. 1, 167-168 (Jan. 1974).

Key words: absorption spectrum; accidental predissociation; carbon monoxide; emission spectrum; perturbation; Rydberg state.

The perturbation in the $E-X(0-0)$ band of the CO absorption spectrum has been shown to be due to an unusual accidental predissociation. The intermediate predissociated state has not yet been identified.

15387. Speller, L. C., Mendlowitz, H., **Characteristic electron energy losses in germanium,** *J. Phys. Chem. Solids* **36,** No. 11, 1229-1232 (1975).

Key words: electron energy loss; germanium; material structure; optical properties; scattering.

The characteristic electron energy loss spectrum of germanium was studied in a transmission type experiment as a function of the changes in structure due to electron bombardment. The structure of the material was characterized by electron micrograph and diffraction techniques. The electron energy loss spectrum of germanium was studied up to 45 eV, and loss peaks were observed at 15.7 eV and 31.6 eV as well as a 6 eV carbon loss. The positions of the most intense characteristic energy loss peak at 15.7 eV and its first multiple were constant for a large variation in the lattice parameters for the individual films.

15388. Rhyne, J. J., Pickart, S. J., Alperin, H. A., **Magnetism in amorphous terbium-iron,** (Proc. 19th AIP Conf. on Magnetism and Magnetic Materials, Boston, Mass., Nov. 13-16, 1973), Chapter in *Magnetism and Magnetic Materials*, C. D. Graham, Jr., and J. J. Rhyne, Eds., pp. 563-577 (American Institute of Physics, New York, N.Y., 1974).

Key words: amorphous materials; magnetic materials; neutron diffraction; rare earths.

Neutron diffraction and magnetization measurements on a sputtered specimen of 33 percent terbium, 66 percent iron have confirmed the existence of long range magnetic order and an amorphous spatial distribution of atoms and spin sites. Elastic diffraction data taken above and below the 409 K Curie temperature have enabled the separation of nuclear and magnetic scattering contributions. The magnetic spin density function contains a very broad major peak, dominated by the Tb-Tb pair distribution function, with a maximum near 3.6 A. Longer range correlations are very much weaker. The principal features of the atomic structure can be accounted for by considering only near neighbor correlations between terbium and iron atoms in a random close-packed arrangement.

Inelastic scattering studies have revealed a significant shift in the magnetic density of states to lower energy in the amorphous material relative to the crystalline $TbFe_2$ counterpart. No discrete spin-wave excitations or critical scattering near T_c could be observed.

15389. Rowe, J. M., Vagelatos, N., Rush, J. J., Flotow, H. E., **Acoustic modes of the phonon dispersion relation of NbD_x alloys,** *Phys. Rev. B* **12,** No. 8, 2959-2964 (Oct. 15, 1975).

Key words: alloy; electronic structure; interstitial; lattice dynamics; niobium deuteride; phonons.

The acoustic modes of the phonon dispersion relation in Nb, $NbD_{0.15}$, and $NbD_{0.45}$ have been measured at 473 K for phonons with wave vectors along the [100], [110], and [111] axes by coherent neutron scattering. The observed neutron groups for both alloys were well defined, with little or no apparent broadening. The results are compared to similar data for Nb-Mo alloys and with previous lattice-dynamics results for $PdD_{0.63}$. This comparison shows that despite differences in detail, the general features of the dispersion relations of NbD_x and Nb-Mo are similar after allowing for the differences in lattice parameters for the two alloys. The measured dispersion curves and derived phonon frequency distributions for the Nb-D alloys are quite different from the analogous results for $PdD_{0.63}$ in that the average acoustic phonon frequencies *increase* with increasing deuterium concentration and lattice parameter.

15390. Carpenter, B. S., Samuel, D., Wassermann, I., **The location of lithium in the brain,** *ANS Trans.* **18,** 85-86 (1974).

15391. Tighe, N. J., **Examination of fracture interfaces in silicon nitride,** *Proc. 33d Annual Electron Microscopy Society of America, Las Vegas, Nev., Aug. 10-14, 1975*, G. W. Bailey, Ed., pp. 60-61 (Claitor's Publ. Div., Baton Rouge, La., 1975).

15392. Carpenter, B. S., Gilliam, D. M., Reimer, G. M., **Induced fission tracks in glass from monoenergetic and thermal neutrons,** *ANS Trans.* **18,** 90 (1974).

15393. Wassermann, I., Samuel, D., Yuwiler, A., Carpenter, B. S., **Location of catecholamines in the brain using the $^{17}O(n, \alpha)^{14}C$ reaction,** *ANS Trans.* **18,** 85 (1974).

15394. Swyt, D. A., **National Measurement System: Microstudy of optics,** *Nat. Conf. Stand. Lab. (NCSL) Newsletter* **15,** No. 2, 13-17 (June 1975).

Key words: densitometry; lens evaluation; microdensitometry; microscopy resolution charts; National Measurement System.

Studies of the National Measurement System are currently in progress at the National Bureau of Standards. These studies are an attempt to understand the infrastructure and impact of measurement throughout our economy. One particular microstudy is entitled Optics. This brief article gives an overview of the developments to date; i.e., description of the infrastructure, identification of various users and the techniques of the study.

15395. Young, R. D., **National Measurement System micro study,** *Natl. Conf. Stand. Lab. (NCSL) Newsletter* **13,** No. 2, 20-21 (Aug. 1973).

Key words: calibration; economic dimensions; National Measurement System; surface finish; surface roughness.

A brief description of the National Measurement System for Surface Finish is given together with a descriptive block diagram. The economic dimensions of the measurement system are discussed briefly. A biographical sketch of the author is included.

15396. Swing, R. E., **The case for the pupil function,** (Proc. SPIE Seminar on Image Assessment, Rochester, N.Y., May 20-22, 1974), Paper in *Image Assessment and Specification*, D. Dutton, Ed., **46,** 104-113 (Society of Photo-Optical Instrumentation Engineers, Palos Verdes Estates, Calif., 1974).

Key words: impulse response; lens aberrations; optical transfer function; partial coherence; pupil function; wavefront shearing interferometry.

The pupil function, a description of the wavefront errors associated with a lens (in terms of a phase distribution over its exit pupil), has long been used by lens designers since it is implicit in the determination of aberrations. Pupil functions require interferometry for measurement. The analysis of interferograms has been facilitated in modern times by the development of high-speed digital computers, automatic fringe scanners and laser sources and can be put on a routine, low-cost basis. When the theory of partial coherence is applied to the analysis of imaging systems, the pupil function is seen to be the fundamental measure of lens performance, because from this one description, the other measures of system behavior can be derived. Further, since the pupil function can be determined with great precision, a polynomial expansion can be curve-fitted in the computer to list the aberration coefficients out to orders whose height is a function of the size of the available computer core. It is thus practicable to provide not only transfer function but also a diagnosis of the lens ills, quantitatively. However, white-light response cannot be measured directly and must be synthesized from measurements at several wavelengths; the techniques for accomplishing this are well-known but are presently not implemented at NBS, where wave-front shearing interferometry has been utilized for measurement of the pupil function. Among the problems for which pupil function measurement is a solution are the cascading of lenses in imaging systems and the evaluation of microscope objective/eyepiece response.

15397. Dzubay, T. G., Rook, H. L., Stevens, R. K., **A chemiluminescent approach to measurement of strong acid aerosols,** Chapter 4 in *Analytical Methods Applied to Air Pollution Measurements*, R. K. Stevens and W. F. Herget, Eds., pp. 71-83 (Ann Arbor Science Publishers, Inc., Ann Arbor, Mich., 1974).

Key words: ambient concentration; chemiluminescent measurement; continuous monitor; strong acid aerosols.

The deleterious effect of sulfuric acid aerosol on human health has been demonstrated. Currently, no real time monitors for strong acid aerosols are available. This work represents an effort to develop an instrument for monitoring strong acid aerosols in real time without going through collection and extractions procedures.

15398. Franklin, A. D., Dragoo, A. L., **Calculation of defect-formation energies in alkaline-earth oxides: Interionic forces,** Paper in *Defects and Transport in Oxides,* M. S. Seltzer and R. I. Jaffee, Eds., pp. 141-158 (Plenum Press, New York, N.Y., 1974).

Key words: alkaline earth oxides; Born-Mayer potential; first-neighbor interactions; ionicity; Lundquist three-body potential; second-neighbor interactions; shell model.

A model potential for the alkaline-earth oxides was developed and tested. The interionic potential contains the usual Coulombic and two-body short-range terms, such as those which have been used in previous alkali halide calculations, plus many-body terms which are incorporated by means of the Lundquist three-body approximation in which only the spherically symmetric term in the overlap-charge-density expansion is retained. The three-body interactions contribute to both the long-range and the short-range forces. Additional short-range central-force interactions between nearest-neighbor ions and next-nearest-neighbor ions are included; these are modeled by means of a Born-Mayer plus van der Waals potential. The electronic polarizabilities of the ions are described by a shell model. Parameters in the model potential and in the shell model are evaluated using the elastic constants and their pressure derivatives, the low- and high-frequency dielectric constants, the infrared dispersion frequency, and the equilibrium interionic separation. Three constraints on the shell model are required. The model does not give satisfactory results in that (1) the trend in an effective charge parameter, χ_o, through this family of oxides runs counter to that for the Phillips ionicities and (2) the Born-Mayer potential parameters appear to be highly anomalous compared with those for other ionic crystals. The principal weakness of the model apparently resides in its neglect of bond-bending (noncentral force) terms, which results in an overestimate of the overlap contribution to the bond-stretching terms, in excessive deviations in the effective charges from the classical valences, and in departures of the Born-Mayer potential parameters from the values found in alkali halide and alkaline-earth fluorides.

15399. Mitchell, R. A., Woolley, R. M., Halsey, N., **High-strength end fittings for FRP rod and rope,** *J. Eng. Mech. Div. ASCE* **100,** No. EM4, 687-706 (Aug. 1974).

Key words: axisymmetric analysis; cables (ropes); composite materials; contour plotting; end fittings for FRP rod and rope; finite element analysis; FRP rod; FRP rope; materials testing; nonlinear analysis (shear); potted end fittings; structural engineering; tensile strength; transversely isotropic materials.

Improved structural end fittings of two basic types were developed for use with fiber-reinforced-plastic (FRP) rod and rope materials. Each type of end fitting is essentially a metal sleeve that is attached to the FRP material by a thick layer of potting material. Tensile tests demonstrated that the new end fittings can equal or approach the full tensile strength of E-glass-reinforced-plastic rod and rope. In tensile strength, the new fittings are superior to commercially available end fittings. An axisymmetric finite element analysis was developed to study the transfer of load from a rod or rope, through the potting material, to the metal fitting. In the analysis the FRP material and the potting material are assumed to be transversely isotropic. The results of both the analytical study and the laboratory tests indicate the importance of using a relatively thick layer of low-stiffness potting material with these fittings.

15400. Hockey, B. J., Lawn, B. R., **Electron microscopy of microcracking about indentations in aluminium oxide and silicon carbide,** *J. Mater. Sci.* **10,** 1275-1284 (1975).

Key words: brittle solids; dislocation networks; electron microscopy; healing; indentations; microcracking; moiré patterns.

Transmission electron microscopy is used to examine the nature of microcracking about small-scale indentations in two highly brittle solids, sapphire and carborundum. The observed crack geometry is discussed in terms of an earlier model of indentation fracture beneath a point force, in which both loading and unloading half-cycles contribute to the crack growth. The residual interfaces are generally found to exhibit moiré fringe contrast, and occasionally to contain dislocation networks. These observations are discussed in relation to spontaneous closure and healing mechanisms, and the associated "lattice mismatch" is estimated at about one part in a thousand. It is suggested that cleavage steps comprise the main source of obstruction to lattice restoration across the interfaces. Mechanical and thermal treatments of the indented specimens are found to influence the extent of the residual cracking. Some practical implications concerning the strength degradation of brittle solids are discussed.

15401. Evans, A. G., **The role of inclusions in the fracture of ceramic materials,** *J. Mater. Sci.* **9,** 1145-1152 (1974).

Key words: ceramics; failure prediction; fracture; inclusions; nondestructive inspection.

The stress concentrations that occur at inclusions due to thermal expansion and elastic modulus mismatch are discussed and the stress intensity factors at interface cracks that result from these stresses are calculated. It is shown that conservative failure prediction based on an equivalence between inclusion size and crack size is usually acceptable if the shear modulus μ or thermal expansion coefficient α for the inclusion is larger than the matrix values. If, however, μ and α are smaller for the inclusion than the matrix, extensive cracking can develop at the inclusions which may lead to premature failure. For this case the only effective methods for failure prediction are techniques which give directly the maximum stress intensity factor, i.e., proof testing and/or acoustic emission.

15402. Frederikse, H. P. R., Hosler, W. R., **High temperature electrical conductivity of aluminum oxide,** Chapter in *Mass Transport Phenomena in Ceramics,* A. R. Cooper and A. H. Heuer, Eds., **9,** 233-251 (Plenum Press, New York, N.Y., March 1975).

Key words: aluminum oxide; electrical conductivity; high temperature; ionic charge transport.

The electrical conductivity of polycrystalline and single crystal Al_2O_3 has been determined between 1000 and 1650 °C. Measuring the conductivity between the outside and inside surface of a thin-walled, hollow tube eliminates the adverse effects of gas or surface conduction. An analysis of possible electronic and ionic charge transport mechanisms shows that none of these processes fully accounts for the magnitude of the observed conductivity. Migration of Al^{3+} ions (or Al^{3+} vacancies) yields the largest values and offers at present the best explanation for electrical conduction in Al_2O_3.

15403. Hill, J. E., Kusuda, T., **Dynamic characteristics of air infiltration,** *ASHRAE Trans.* **81,** Part 1, 168-185 (1975).

Key words: air infiltration; dynamic pressure differential; wind velocity.

Currently available methodology for estimating air leakage into and out of buildings does not directly take into account the

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fluctuating nature of the outdoor wind conditions. The air leakage into and out of commercial building offices was studied with particular attention to the time history of outdoor wind velocity and pressure differential across the window. It was found that the air leakage measured was generally quite different from that which could be calculated. The reason for this discrepancy was postulated to be due to a complex process caused by the dynamically varying pressure differential across the window, flow occurring through the window in both directions simultaneously, and finally to the particular experimental configuration used.

15404. Yokel, F. Y., **Reply to question on the design of unreinforced masonry load-bearing walls,** *Civ. Engr. Engineers' inquiry box,* p. 79 (Nov. 1973).

Key words: codes; masonry; standards; structural design.

Provisions of present U.S. Code and Design Standards are clarified and interpreted in response to a question by a reader of *Civil Engineering* magazine.

15405. Compton, P. R., **National Measurement System study,** *Natl. Conf. Stand. Lab. (NCSL) Newsletter* **13,** No. 3, 10-14 (Nov. 1973).

Key words: flow measurement study; fluid flow measurement system; measurement system identity; technology assessment.

A technological assessment of gas and liquid flow measurements, excluding cryogenics, is being conducted. A description is being prepared of the interrelationships that exist within and between the identifiable parts of the fluid flow measurement system which is identified as an important component of the overall National Measurement System. The approach of this study is to gather pertinent information from contacts throughout the system. The technology assessment has identified many attributes that can be used to quantify this system. A data base is being developed which will be helpful in recognizing major trends of future applications of fluid flow measurement.

15406. Harrison, J. O., Jr., **Computer program characteristics,** (Proc. Seminar on Metric Conversion Engineering and Manufacturing, Gaithersburg, Md., Dec. 12-13, 1974), Appendix B in *ANMC-74-1, Metric Conversion in Engineering and Manufacturing,* L. Perica, Ed., pp. 133-136 (American National Metric Council, Washington, D.C., May 1974).

Key words: computer program; metric conversion; round off.

At least six computer programs to assist manufacturing companies in metric conversion are now available. The principal characteristics of these programs and the requirements for programs for metric conversion are discussed. NBS' plans to issue a metric conversion package are described.

15407. Caswell, R. S., Coyne, J. J., Randolph, M. L., **Studies of energy deposition by neutrons,** (Proc. 2d Symp. on Neutron Dosimetry in Biology and Medicine, Neuherberg/Munich, Germany, Sept. 30-Oct. 4, 1974), Paper in *Proc. 2d Symp. on Neutron Dosimetry in Biology and Medicine,* B. G. Berger and H. G. Ebert, Eds., **1,** 29-47 EUR 5273 d-e-f (Mar. 1975).

Key words: fluence; kerma; kerma factors; microdosimetry; neutron dosimetry; neutron energy deposition.

Neutrons generate secondary particles (p, α, C, N, O, etc.) when they interact with tissue. It is through these secondary particles that nearly all of the energy deposition and biological effects occur. It is therefore of interest to determine the total energy transferred to the charged particles (kerma), the initial spectrum of the secondary particles, the slowing-down spectrum, and the details of the energy deposition by these secondary charged particles. We are continuing to study all of these quantities. Further along in the energy deposition process, one is interested in the delta-ray production cross sections and absorbed dose distributions due to the delta rays. We have not yet focused on this problem. In this report we shall discuss kerma calculations and some studies of the energy deposition in spherical volumes.

15408. Gills, T. E., McClendon, L. T., Maienthal, E. J., Becker, D. A., Durst, R. A., LaFleur, P. D., **Determination of toxic trace elements in body fluid reference samples,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 273-280 (1974).

Key words: body fluids; fluorine; lead; mercury; reference samples; trace elements.

The measurement of elemental concentration in body fluids has been widely used to give indication of exposure to certain toxic materials and/or a measure of body burden. To understand fully the toxicological effect of these trace elements on our physiological system, meaningful analytical data are required along with accurate standards or reference samples. The National Bureau of Standards has prepared for the National Institute for Occupational Safety and Health (NIOSH) a number of reference samples containing selected toxic trace elements in body fluids. The reference samples produced include mercury in urine at three concentration levels, five elements (Se, Cu, As, Ni and Cr) in freeze-dried urine at two levels, fluorine in freeze-dried urine at two levels and lead in blood at two concentration levels. These reference samples have been found to be extremely useful for the evaluation of field and laboratory analytical methods for the analysis of toxic trace elements. In particular the use of at least two calibration points (i.e. "normal" and "elevated" levels) for a given matrix provides a more positive calibration for most analytical techniques over the range of interest for occupational toxicological levels of exposure.

15409. McClendon, L. T., **Selective determination of chromium in biological and environmental matrices,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 255-257 (1974).

Key words: analysis; biological materials; chloroform; chromium; environmental materials; neutron activation; radiochemical separation; solvent extraction; tribenzylamine.

Chromium occurs in many biological and environmental materials but only in trace amounts (ppm level), which makes the determination by usual chemical methods very difficult and sometimes impossible. Destructive neutron activation analysis, utilizing the reaction ^{50}Cr (n, γ) ^{51}Cr, can eliminate many of the difficulties encountered with other techniques. A detailed description of chromium determination in various biological (e.g. liver and urine) and environmental (e.g. coal and fly ash) samples using the NBS Reactor, coupled with a very selective radiochemical separation procedure, will be discussed.

15410. Quintiere, J., **Some observations on building corridor fires,** *Proc. Fifteenth Symp. (International) on Combustion, Tokyo, Japan, Aug. 25-31, 1974,* pp. 163-174 (The Combustion Institute, Pittsburgh, Pa., 1974).

Key words: corridor; fire spread; flashover; floor covering; radiative heat transfer.

Full-scale corridor fire experiments designed to evaluate the potential fire hazard of floor covering materials exposed to a room fire are described. A phenomenological account of events leading to rapid fire propagation along the corridor is presented for one experiment. Mechanisms responsible for the rapid fire propagation, termed flameover, are explored through measurements and analysis of the data. Before flameover the corridor floor is heated by radiation which enables flames to spread into the corridor. On the wood floor considered, flame spread velocity accelerates from $\sim 10^{-2}$ ft/sec to ~ 1 ft/sec following flameover. Causative factors of flameover appear to be the increase in flame height of the floor fire, and a reduction of air supply to the burn room due to a change in flow pattern between the corridor and burn room. Calculations show that air flow to the burn room steadily drops as the corridor fire develops resulting in incomplete combustion for the room fire.

15411. Bridges, J. M., **Arc measurements of Fe II oscillator strengths,** *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.3.5*, p. 418 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

Key words: arc plasma; iron; lifetimes; oscillator strength; transition probabilities; wall-stabilized arc.

Fe I and Fe II lines were measured in emission from a wall-stabilized arc, which was operated in argon with an admixture of $FeCl_3$. Lines were selected for measurement which would permit a check on the consistency of several previously reported data. These include oscillator strength measurements of Fe II lines as well as lifetime values for several atomic levels of Fe I and Fe II. Overall, good consistency was found among most of the data.

15412. Ott, W. R., Behringer, K., **Absolute vuv radiometry with hydrogen arcs—comparisons with blackbody calibrations,** *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.2.7*, p. 412 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

Key words: blackbody calibrations; hydrogen continuum; primary standard; radiometry; vacuum ultraviolet; wall-stabilized arc.

A hydrogen arc has been applied for the purpose of making spectral radiance calibrations in the wavelength region 1450 to 3600 Å. Absolute calibrations using the hydrogen continuum as a primary standard are presently possible with an estimated uncertainty of ± 5 percent. Such accuracies are much better than can be obtained presently by any other source calibration method in the vuv. The hydrogen arc standard has been compared with two other calibration methods. Agreement with tungsten strip lamp calibrations in the visible and near uv and with the blackbody ceiling calibration in the vuv is within the combined experimental uncertainties associated with the various methods.

15413. Behringer, K., Ott, W. R., **Measurement of the Ly-α Stark profile in a pure hydrogen arc,** *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.1.1*, p. 396 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

Key words: high temperature; hydrogen arc; line broadening; Lyman alpha; optically thin; Stark profile.

The Stark profile of the hydrogen line Ly-α requires the least elaborate theoretical treatment of all hydrogen lines, reflected in the fact that all calculations reported so far show very similar results. Yet one of the two different type published experiments, even after reexamination, shows significant deviations from the theoretical profile. From the available data, it is not clear whether a physical effect went undetected in the experiments or whether the calculations should be revised. An investigation on the Ly-α profile under very different experimental conditions is reported here. While self-absorption in the previous experiments has been lowered by greatly diluting the hydrogen plasma with inert gases like Ar or He, in this investigation thin line wings are achieved in a pure plasma by operating at very high temperatures. Above 17,000 K the emission coefficient of Ly-α in a constant pressure, almost completely ionized plasma decreases rapidly with increasing temperature. The absorption coefficient does even more so because the blackbody radiation at the wavelength of Ly-α increases drastically. The properties of a pure hydrogen plasma are very well known and allow very accurate diagnostic measurements. The electron density at these high temperatures is close to 1.8×10^{17} cm^{-3} and almost independent of the temperature, certainly an advantage in a line broadening experiment. The high temperature arc plasma has been shown to be very close to local thermodynamic equilibrium.

15414. Olver, F. W. J., **Recent error analysis of asymptotic solutions of linear differential equations,** *Proc. Int. Conf. on Differential Equations, Los Angeles, Calif., Sept. 4-7, 1974*, pp. 636-645 (Academic Press, Inc., New York, N.Y., 1975).

Key words: approximation; asymptotics; asymptotic theory; error analysis; ordinary differential equations; turning points.

Considerable progress has been made during the past fifteen years in the error analysis of asymptotic solutions of linear ordinary differential equations. In addition to computational applications, realistic error bounds provide insight into the doubly asymptotic nature of many of the approximations, thereby avoiding the need for the somewhat unsatisfactory concept of generalized asymptotic expansions. The methods that have been developed for constructing error bounds have also led to the solution of some recalcitrant problems involving two or more turning points.

15415. Robertson, B., **Evaluation of automotive fuel flowmeters,** *Proc. Automotive Energy Efficiency Program, Cambridge, Mass., Jan. 15-17, 1975, DOT-TSC-OST-75-31*, pp. 121-134 (National Technical Information Service, Springfield, Va., June 1975).

Key words: automotive fuel flowmeter environment; automotive fuel flowmeters; flowmeter evaluation; flowmeter evaluation test setup; flowmeters; gasoline flowmeter.

Fuel economy measurement procedures are being developed by the Transportation Systems Center. Flowmeters will be used to measure the gasoline consumed by the engine of an automobile either on the road or on a dynamometer. The role played by NBS in this work is to survey commercially available meters and find which ones might be suitable, to determine the environment in which they will be ultimately used, and to measure their accuracy in a laboratory simulation of that environment.

A discussion will be given of: (1) the different kinds of possibly suitable flowmeters to measure gasoline flow to the carburetor, (2) the environment of the flowmeter in an automobile (flowmeter temperature; fuel temperature, pressure, density, viscosity, color, opacity, flow pulsations, backflow, and swirl due to elbows; line voltage fluctuations; electromagnetic radiation from ignition; vehicle attitude with respect to the vertical; and vibration), and (3) plans for a test setup for evaluating and calibrating these meters in the laboratory under conditions simulating the automotive environment.

15416. Parrish, W. R., **An economic study of electrical peaking alternatives,** (Proc. Conf. Hydrogen Economy Energy, Miami

Beach, Fla., Mar. 18-20, 1974), Paper R-889 in *Hydrogen Energy*, pp. 949-968 (Plenum Press, New York, N.Y., 1975).

Key words: energy storage; hydrogen utilization; power generation; synthetic fuels.

Results are given of a feasibility study of alternatives for producing peak power. Fuel cells, batteries, and superconducting magnetic storage are considered as well as gas turbines and pumped storage. The fuels considered are hydrogen, from coal or electrolysis, synthetic natural gas, and methanol. Fuel storage alternatives include liquid, compressed gas, and for hydrogen, metallic hydride.

15417. Unassigned.

15418. Mount, G. H., Ayres, T. R., Linsky, J. L., **A non-LTE analysis of the CN 3883 Å band head in the upper photosphere of Arcturus,** *Astrophys. J.* **200,** 383-391 (Sept. 1, 1975).

Key words: atomic abundances; CN spectra; non-LTE molecular spectra; photospheres, stellar; radiative transfer.

A detailed non-LTE study of the CN(0,0) 3883 Å band-head spectrum of Arcturus (K2 III) provides an accurate determination of the carbon, nitrogen, and oxygen abundances in Arcturus. Non-LTE effects are significant, and we find that the Ayres-Linsky model provides an adequate fit to the observations for $[C,N]_*=1/3\ [C,N]_{\odot}$ and $[O]_*=0.60\,[O]_{\odot}$, or for $[C,N,O]_*=1/6\,[C,N,O]_{\odot}$, but the latter abundances are unlikely. The upper photospheric microturbulence is found to be 2.5 ± 0.2 km s^{-1}.

15419. Wiederhorn, S. M., **Reliability, life prediction and proof testing of ceramics,** (Proc. Second Army Materials Technology Conf., Hyannis, Mass., Nov. 13-16, 1973), Chapter 29 in *Ceramics for High-Performance Applications,* pp. 633-663 (Army Materials and Mechanics Research Center, Watertown, Mass., 1974).

Key words: ceramics; crack propagation; delayed failure; fracture; proof testing; Weibull analysis.

Proof testing is discussed as a design method for assuring the reliability of structural components. The advantages of proof testing over the statistical approach used for design lies in the insensitivity of the proof testing method to the detailed history of handling or processing of structural components. Methods are presented for developing and using proof test diagrams that assure minimum lifetime after proof testing. Procedures of proof testing and precautions that must be followed during proof testing are discussed. Provided these precautions are followed, proof testing offers a general method for assuring the reliability of structural components under stress.

15420. Flynn, D. R., Blomquist, D. S., **Environmental noise measurement,** (Proc. Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 6-8, 1973), Paper in *NEREM (of the IEEE) 1973 Record,* pp. 40-43 (1973).

Key words: acoustics; noise; sound.

This paper is a digest of a paper to be given orally at the Northeast Electronics Research and Engineering Meeting (NEREM) of the IEEE in November 1973. Since its length was severely limited, the paper can only describe the subject matter to be covered in the oral presentation. A discussion will be given of current instrumentation for measurement of environmental noise and noise emission from machinery and equipment—in both occupational and community situations. Emphasis will be placed on available measurement standards, problem areas, and trends in sound measurement instrumentation.

15421. Manning, J. R., **Diffusion kinetics and mechanisms in simple crystals,** (Proc. Conf. Geochemical Transport and Kinetics, Warrenton, Va., June 4-6, 1973), Chapter in *Geochemical Transport and Kinetics,* pp. 3-13 (Academic Press Inc., New York, N.Y., 1974).

Key words: atom transport; diffusion in crystals; kinetic diffusion equations; mechanism for diffusion; random walk; vacancies.

The kinetic-atomic theory of diffusion is discussed and reviewed. Any such theory must involve a model providing a detailed picture of the paths as the atoms move through the material. Diffusion paths and diffusion mechanisms therefore are important in this theory and are discussed first. Both short-circuit diffusion mechanisms along easy diffusion paths and possible volume-diffusion mechanisms through regions of regular crystal structure are described. Simple random-walk diffusion equations are derived which yield expressions for the tracer diffusion coefficient D^* and the atom drift velocity v_F in terms of atom jump frequencies. It is noted that diffusion frequently occurs by a vacancy mechanism. When this is the case, the random-walk equations must be modified to include both correlation-factor effects and vacancy-wind effects. The origin and influence of these effects are discussed. A comparison is made between the kinetic-atomic diffusion equations and the thermodynamic-continuum diffusion equations. It is noted that cross terms which yield a dependence of the atom flux of species i on the concentration gradients or chemical potential gradients of other species k appear in these equations.

15422. Evans, A. G., **High-temperature slow crack growth in ceramic materials,** (Proc. Second Army Materials Technology Conf., Hyannis, Mass., Nov. 13-16, 1973), Chapter 17 in *Ceramics for High-Performance Applications,* pp. 373-396 (Army Materials and Mechanics Research Center, Watertown, Mass., 1974).

Key words: ceramics; crack healing; crack propagation; cyclic fatigue; failure prediction; high temperature; static fatigue.

High temperature slow crack growth processes in several ceramic materials are examined under static and cyclic loading conditions. Data obtained at temperatures up to 1400 °C are used for purposes of failure prediction and for analysis of the slow crack growth phenomena. It is shown that purity plays a major role in slow crack growth resistance particularly in the hot-pressed materials, and that cycling in the low frequency regime does not significantly enhance the rate of slow crack growth. The slow crack growth mechanisms appear to be primarily plasticity related, and some discussion of these is presented.

15423. Kuyatt, C. E., **Electron energy analyzer design,** *Proc. 31st Annual Meeting Electron Microscope Society of America, New Orleans, La., Aug. 13-17, 1973,* C. J. Arceneaux, Ed., pp. 280-281 (Claitor's Publ. Div., Baton Rouge, La., 1973).

Key words: angular aperture; computer optimization of electron optics; electron beam transport; electron energy analyzers; field aperture.

The design of electron energy analyzers is discussed, with special emphasis on the electron optical system used to transport electrons from the source to the energy dispersing element.

15424. McLaughlin, W. L., **Radiation dosimetry with thin films,** (Proc. Third Conf. on Application of Small Accelerators, North Texas State Univ., Denton, Tex., Oct. 21-23, 1974), Paper in *Application of Small Accelerators. Vol.* **II. Industrial Applications of Small Accelerators,** I. L., Morgan and J. L. Duggan, Eds., pp. 65-85 (U.S. Energy Research and Development Admin. Office of Public Affairs and Technical Information Center, Springfield, Va., 1975).

Key words: cavity theory; depth dose; dose distributions; dosimetry; dyes; electron beams; radiochromic dyes; thin films.

A thin self-supported or laminated layer of radiation-sensing material is useful for measuring or monitoring the energy deposited by a radiation beam passing through that layer. If (1) the film is thin enough in relation to the range of the incident radiation particles in the absorbing material and (2) the incident radiation spectrum can be approximated sufficiently, the absorbed dose or dose rate in materials surrounding the thin layer can be determined by applying fairly simple cavity-theory considerations (i.e. factoring by stopping power ratios in the case of charged-particle beams). Some sensing materials that may be used as dosimeters in accelerator beams are thin calorimetric bodies, solid-state detectors, and ceramic, plastic, or dyed plastic layers. Major sources of error that must be accounted for are instabilities, nonlinearities, variations of response with dose-rate and spectral changes, environmental factors, inconsistencies in the quality of the sensing material, and imprecisions in the analysis of the radiation effect. A primary advantage afforded by thin-film dosimetry is its capability of supplying dose distribution data near interfaces of different materials.

15425. Newbury, D. E., **Techniques of signal processing in the scanning electron microscope,** *Proc. 8th Symp. on Scanning Electron Microscopy, St. Louis, Mo., Apr. 7, 1975*, pp. 727-736 (IIT Research Institute, Chicago, Ill., Apr. 1975).

Key words: black level suppression; nonlinear amplification; scanning electron microscope; signal differentiation; signal processing; Y-modulation.

Signal processing applied during the formation of SEM images can greatly aid the microscopist in obtaining a maximum amount of information from a specimen. Signal processing is necessary in order to overcome basic limitations of the eye in extracting information from the SEM cathode ray tube display or from photographs of the display. The four most commonly encountered forms of signal processing are black level suppression (differential amplification), nonlinear amplification (gamma), signal differentiation, and Y-modulation. Black level suppression and gamma processing are useful in producing enhanced image contrast over a small range of input signal. Signal differentiation preferentially enhances high frequency components of the image and is therefore effective for emphasizing edges. Y-modulation is particularly sensitive to fine detail and enhances the effect of surface texture.

15426. Wiederhorn, S. M., Johnson, H., **Effect of zeta potential on crack propagation in glass in aqueous solutions,** *J. Am. Ceram. Soc.* **58,** No. 7-8, 342 (July-Aug. 1975).

Key words: crack propagation; fracture; glass; zeta potential.

In this paper the effect of zeta potential on crack propagation in glass is studied. Results indicate that in aqueous environments the zeta potential has no effect on crack growth. Reasons for this null effect are discussed.

15427. Maienthal, E. J., **The application of linear sweep voltammetry to the determination of trace elements in biological and environmental materials,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 243-246 (1974).

Key words: analysis; biological and botanical samples; differential linear sweep voltammetry; environmental samples; fossil fuels; lunar samples.

The application of differential linear sweep voltammetry to the analysis of many types of environmental samples is described. The methods are applicable to the determination of many trace elements in almost any matrix. Results will be given and compared with those obtained by other techniques.

15428. Albus, J. S., **A new approach to manipulator control: The cerebellar model articulation controller (CMAC),** *Trans. ASME—J. Dyn. Syst. Meas. Control* **97,** No. 3, 220-227 (Sept. 1975).

Key words: adaptive control; cerebellum model; control theory; manipulator control; Perceptron.

CMAC is an adaptive system by which control functions for many degrees of freedom operating simultaneously by referring to a table rather than by mathematical solution of simultaneous equations. CMAC combines input commands and feedback variables into an input vector which is used to address a memory where the appropriate output variables are stored. Each address consists of a set of physical memory locations, the arithmetic sum of whose contents is the value of the stored variable. The CMAC memory addressing algorithm takes advantage of the continuous nature of the control function in a way which promises to make it possible to store the necessary data in a physical memory of practical size.

15429. McLaughlin, W. L., Rosenstein, M., Levine, H., **Bone-and-muscle-equivalent solid chemical dose meters for photon and electron doses above one kilorad,** (Proc. Symp. on Biomedical Dosimetry, IAEA, Vienna, Austria, 1975), Chapter in *Biomedical Dosimetry,* pp. 267-281 (Int. Atomic Energy Agency, Vienna, Austria, 1975).

Key words: bone; dosimetry; dyes; electron dosimetry; energy dependence; gamma rays; muscle; radiochromic dosimeters; x-ray spectra.

Conventional solid dose meters, such as plastic films, powders, emulsions, glasses, ceramics and gels, have a response to ionizing photons and electrons that varies markedly over a broad spectrum when compared with the absorption characteristics of biological tissues. New radiochromic dyed plastic dose meters have been developed with x- and gamma-ray and electron energy absorption cross-sections (calculated) and radiation energy responses (experimental) corresponding approximately to those for human muscle and bone, for a spectrum from a few keV to at least 10 MeV. Three-dimensional solid dose meters useful over the absorbed dose range of 10^3 to 10^6 rad are formed by thermosetting a selected combination of monomers containing the radiochromic dye in solution. Thin-film dose meters for the dose range 10^5 to 10^7 rad are formed by casting on optically flat surfaces strippable layers of special combinations of polymers and dyes in solution. The response of these systems to x and gamma rays and electrons has been studied over various radiation spectra, dose-rates and temperatures during irradiation.

15430. Harman, G. G., **A metallurgical basis for the nondestructive wire-bond pull-test,** *12th Annual Proc. IEEE Reliability Physics, Las Vegas, Nev., April 2-4, 1974,* pp. 205-210 (Nov. 15, 1974).

Key words: bond pull test (nondestructive); metallurgical; reliability (microelectronic); transistors; wire bond.

Nondestructive wire-bond pull tests are often specified by high-reliability electronic device users in order to eliminate weak, poorly made wire bonds. The main problem with the test has been in establishing a pull-force level which will assure that the bonds are adequately strong but will not damage them during the test. In the present work, factors affecting the nondestructive wire-bond pull-test are examined. The variables, such as wire and bond-loop elongation, bond geometry, bond deformation, and the mean and standard deviation of the destructive bond pull test are studied to determine their influence on the nondestructive test. Different pull-force criteria are derived for wire with high elongation, such as is used in power devices, and for wire with low elongation, typically used for bonding integrated circuits.

15431. Harman, G. G., **Metallurgical failure modes of wire bonds,** *12th Annual Proc. IEEE Reliability Physics, Las Vegas, Nev., April 2-4, 1974,* pp. 131-141 (Nov. 15, 1974).

Key words: bonds (wire); failure modes; metallurgical failure modes; microelectronic; thermocompression bonds; ultrasonic bonds.

Various metallurgical failure modes of gold and aluminum wire bonds are described. Examples are taken from both low and high power devices. Whenever possible, known methods of avoiding these failure modes are given.

Wire bond failure modes can be divided into two categories. The first is comprised of those failure modes that are caused by poorly controlled or poorly designed manufacturing processes that result in lower product yield or higher per unit bonding cost, as well as those processes that predispose the device to early field failure. The second category is comprised of the failure modes of adequately made bonds that are caused to fail by environmental stresses during the operating life of the device.

The most frequent causes of failures are discussed in detail. These include nonoptimized bonding schedules, cracks in the heels of ultrasonic bonds, intermetallic formation, poor metallization, and inadequate glassivation removal. Assuming that the package is hermetic, or for plastic devices that humidity and other corrosion producers are not present, then the primary wire bond failure modes in the second category result from environmental temperature exposure and the number of power or thermal cycles experienced by the device during operation. Both of these can induce intermetallic formation. The latter can cause metallurgical flexure-fatigue at the bond heel or in the wire.

15432. Wiederhorn, S. M., **Strength of glass—A fracture mechanics approach,** (Proc. 10th Int. Congress on Glass, Kyoto, Japan, July 8-13, 1974), Paper in *Tenth International Congress on Glass,* pp. 11-1/11-15 (The Ceramic Society of Japan, Kyoto, Japan, July 1974).

Key words: crack growth; fracture; glass; static fatigue; strength.

After a brief review of those factors that determine the strength of glass (brittleness, surface flaws, susceptibility to stress corrosion cracking), a discussion will be given of how fracture mechanics techniques can be used to understand the physics and chemistry of glass strength. In this paper we assume that the strength of glass is limited by the growth of cracks that are always present in normal glass surfaces. Fracture mechanics techniques can be used to characterize the crack growth and to relate the growth to experimental parameters such as temperature, environment, and glass composition. Crack growth data obtained in this manner can be used to develop a deeper understanding of fracture mechanisms, and to develop charts that can be used for the design of glass structural components. Examples of both applications are given in the paper.

15433. Green, R. E., Jr., Farabaugh, E. N., Crissman, J. M., **X-ray topographic examination of large paraffin single crystals,** *J. Appl. Phys.* **46,** No. 10, 4173-4180 (Oct. 1975).

Key words: microstructure; paraffin crystals; plastic deformation; polymer crystals; radiation damage; x-ray topography.

The internal microstructure of large melt-grown paraffin (*n*-eicosane, $C_{20}H_{42}$) single crystals was examined by the Lang x-ray diffraction projection topographic technique. Crystal selection was facilitated by use of an electro-optical system which permitted instantaneous display of Laue transmission x-ray diffraction patterns on a television monitor. The crystals were oriented and topographic diffraction planes were selected by the use of a standard (001) stereographic projection plotted from computed angles between crystallographic planes. A second electro-optical system which permitted direct viewing of the topographic images was used for rapid alignment of the Lang camera and ensured uniformly exposed topographs. X-ray topographs were obtained from crystals in the as-grown, plastically deformed, and γ-irradiated states. The results indicate that both plastic deformation and γ irradiation caused marked changes in the microstructure of the crystals, and that x-ray topography can be successfully exploited to determine such changes in hydrocarbon crystals.

15434. Prask, H., Trevino, S., Tsai, D. H., MacDonald, R. A., Kemmey, P., Yip, S., **Computer simulation studies of the microscopic behavior of shocked solids,** *Proc. Conf. on Mechanisms of Explosion and Blast Waves, Naval Weapons Station, Yorktown, Va., Nov. 13-15, 1973,* 1-21 (1974).

Key words: blast waves; computer simulation; interatomic potentials; lattice dynamics; molecular dynamics; shock waves.

The application of computer molecular dynamics (CMD) techniques to the understanding of blast wave phenomena in solids is discussed. Examples of CMD studies of simple systems undergoing plane shock waves are reviewed and the inadequacy of some of the assumptions made in the conventional continuum approach examined. Recent advances made in obtaining approximate interatomic potentials for complex solids from conventional lattice-dynamical studies are reviewed for NaN_3 and KN_3. These results are discussed in the context of extending the scope of CMD calculations.

15435. McLaughlin, W. L., **Radiation sources and dosimetry,** *Food Irradiation Information* **4,** 44-45, 58 (Mar. 1975).

Key words: accelerators; dose distributions; dosimetry; electron beams; food irradiation; food preservation; gamma rays.

The program at the NBS Center for Radiation Research contributing to food preservation by irradiation includes measurement studies with several high-energy electron accelerators and radionuclide sources such as cobalt-60. Investigations are made on large-dose measurement systems, chemical dosimeters, and thin-film imaging systems used for high-resolution dose-distribution studies.

15436. Maki, A. G., **High-temperature infrared spectrum of HCN near 3300 cm^{-1},** *J. Mol. Spectrosc.* **58,** 308-315 (1975).

Key words: high temperature; hydrogen cyanide; infrared; molecular term values; spectra; spectroscopy.

The infrared absorption of HCN near the fundamental band at 3311 cm^{-1} has been measured at temperatures up to 1200 K. Transitions involving high rotational states (up to $J=62$) have been measured. These give an improved value for the sextic centrifugal distortion term H_0. Many hot-band transitions have been observed and assigned to transitions originating in vibrationally excited states up to 4000 cm^{-1} above the ground state. These measurements give new data on vibrational states involving moderately high bending quantum numbers and indicate that new terms are needed to fit the ro-vibrational energy levels.

15437. Bender, P. L., **Laser measurements of the lunar distance,** *Rev. Geophys. Space Phys.* **13,** No. 3, 271-272, 291 (July 1975).

Key words: crustal movements; earth rotation; geophysics; lasers; lunar cartography; lunar gravity; moon; plate tectonics.

Progress since 1971 on laser measurements of the lunar distance is reported. The current status of analysis work based on lunar distance data is described. New lunar and geophysical results which have been obtained by the joint efforts of a number of different institutions are discussed briefly.

15438. Buchbinder, L. B., **Human behavioral patterns vs. injury severity for apparel fire victims,** *Proc. Seventh Annual Meeting, Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1973,* pp. 236-253 (Information Council on Fabric Flammability, New York, N.Y., July 1, 1974).

Key words: apparel; apparel fires; burn injury; defensive capability; FFACTS; fire; flammable fabrics; garment fires; garment parameters; injury severity; reaction patterns; victims.

This study is based on information from 1,126 fire accident cases in the NBS computerized data base, FFACTS. The defensive actions taken by persons involved in apparel fires are described and the effect of these reactions on the severity of the resultant burn injuries is discussed. In general, "running" was the most frequent first reaction with "beating flames with hands" and "trying to remove clothing" ranking second and third in frequency. However, the relative frequency of reactions varied with age, sex and type of accident. The effectiveness of various reactions was analyzed considering both the extent of injury incurred, measured by the percent total area of body burned, and the number of additional reactions required to extinguish the fire. The victim's defensive capability (i.e., his ability to recognize danger and take appropriate action) was also found to have an effect on the level of injury severity.

15439. Roth, R. S., Brower, W. S., Parker, H. S., Minor, D. B., Waring, J. L., **Alkali oxide-tantalum, niobium and antimony oxide ionic conductors,** *NASA CR-134869,* 76 pages (National Technical Information Service, Springfield, Va., 1975).

Key words: ionic conductivity; nonstoichiometry; potassium antimonate; rubidium niobate; rubidium tantalate; sodium antimonate; sodium antimonate fluoride.

The phase equilibrium relations of four systems were investigated in detail. These consisted of sodium and potassium antimonates with antimony oxide and tantalum and niobium oxide with rubidium oxide as far as the ratio $4Rb_2O:11B_2O_5$ (B = Nb, Ta). The ternary system $NaSbO_3$-Sb_2O_4-NaF was also investigated extensively to determine the actual composition of the body centered cubic sodium antimonate. In addition, various other binary and ternary oxide systems involving alkali oxides were examined in lesser detail. The phases synthesized were screened by ion exchange methods to determine mobility of the alkali ion within the niobium, tantalum or antimony oxide (fluoride) structural framework. Five structure types were found to be of sufficient interest to warrant further investigation. These structure types are (1) hexagonal tungsten bronze (HTB), (2) pyrochlore, (3) the hybrid HTB-pyrochlore hexagonal ordered phases, (4) body centered cubic antimonates and (5) $2K_2O:3Nb_2O_5$. Although all of these phases exhibit good ion exchange properties only the pyrochlore has so far been prepared with Na^+ ions as an equilibrium phase and as a low porosity ceramic. Unfortunately Sb^{+3} in the channel apparently interferes with ionic conductivity in this case, although relatively good ionic conductivity was found for the metastable Na^+ ion exchanged analogs of $RbTa_2O_5F$ and $KTaWO_6$ pyrochlore phases. Small crystals of the other phases can generally be prepared by flux techniques and ion exchanged with Na^+. However, in the one case where congruency allows large crystals to be pulled from the melt ($4Rb_2O:11Nb_2O_5$) ion exchange techniques up to ~450 °C are not sufficient to accomplish complete replacement with Na^+ ions.

15440. Kashiwagi, T., **A study of flame spread over a porous material under external radiation fluxes,** *Proc. Fifteenth Symp. (International) on Combustion, Tokyo, Japan, Aug. 25-31, 1974,* pp. 255-265 (The Combustion Institute, Pittsburgh, Pa., 1974).

Key words: flame spread; floor covering materials; ignition.

Characteristics of horizontal flame spread over the surface of a porous material, a carpet in this study, are studied experimentally and theoretically under various external radiant fluxes (0.1 – 0.27 cal/cm²sec). It is observed that the size of flame is increased significantly by increasing the external radiant flux. This increases the radiative heat feedback from the flame so that it becomes comparable to or greater than the convective heat feedback. The external radiation can also cause an unstable motion of the flame front. This effect is probably due to the production of volatile pyrolysis products ahead of the flame front instead of under it. The theoretical calculation indicates that the thermal emission loss from the heated sample is significant and the internal radiation in the porous material must be included in the model.

15441. Armstrong, G. T., Johnson, W. H., **Standard reference materials for combustion calorimetry,** *Proc. Third Int. Conf. on Chemical Thermodynamics, Baden near Vienna, Austria, Sept. 3-7, 1973,* **VIII,** 55-72 (International Union of Pure and Applied Chemistry, Oxford, England, 1974). (Abstract is found in Vol. I, page 148 (1973)).

Key words: acetanilide; bomb calorimetry; calorimetry; chlorobenzoic acid; combustion; creatinine; fluorobenzoic acid; nicotinic acid; reference materials; thermochemical; thermochemical standards; thianthrene; urea.

Combustion measurements using a rotating bomb adiabatic aneroid calorimeter have been used to make a preliminary evaluation of ten substances as potential thermochemical reference materials for combustion of organic compounds containing N, S, Cl and F. p-chlorobenzoic acid, p-fluorobenzoic acid, and urea are recommended for acquisition, certification, and distribution. Thianthrene may also be suitable. For the ten substances including in addition to the above: o- and m-chlorobenzoic acids, o-fluorobenzoic acid, nicotinic acid, acetanilide, and creatinine, typical combustion data are given, showing corrections applied; and mean thermodynamic functions at 25 °C are given together with error estimates. The results are compared with other work. Recommendations and a discussion of the role of standard reference materials for thermochemistry are given.

15442. Swanson, N., Celotta, R. J., Kuyatt, C. E., **Electron excitation of xenon near threshold,** (Proc. Int. Symp. on Electron and Photon Interactions w/Atoms, Univ. of Stirling, Stirling, Scotland, July 16-19, 1974), Chapter in *Electron and Photon Interactions with Atoms,* pp. 661-667 (Oct. 1975).

Key words: autoionizing states; electron excitation; energy loss; resonances; threshold; xenon.

An electron energy-loss spectrum and excitation functions for the four lowest excited states in Xe have been measured at a scattering angle of 45° in the near-threshold region (8 – 14 eV). Four peaks in the energy-loss spectrum above the $^2P_{3/2}$ ionization limit can be fitted to a $5p^5np'$ Rydberg series. The excitation functions for the two lowest states at 8.32 and 8.44 eV show large peaks due to decay of the $5p^56s^2(^2P_{1/2})$ resonance, as well as other resonance peaks which correlate well with previous transmission measurements.

15443. Huebner, R. H., Ferguson, C. H., Celotta, R. J., Mielczarek, S. R., **Apparent oscillator-strength distributions derived from electron energy-loss measurement: Methane and *n*-hexane,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 41-44 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

Key words: electron; energy loss; methane; *n*-hexane; oscillator strengths; spectra.

The derivation of oscillator strengths from electron energy loss spectra are discussed and results obtained for methane and *n*-hexane are compared to optical data.

15444. Huebner, R. H., Ferguson, C. H., Celotta, R. J., Mielczarek, S. R., **Apparent oscillator strength distributions derived from electron energy-loss measurements: Methane and *n*-hexane,** *Proc. IVth Int. Conf. on Vacuum-Ultraviolet Radiation Physics, Hamburg, Germany, July 22-26, 1974,* Article 111, 4 pages (1974).

Key words: electron; electron scattering; energy loss; methane; *n*-hexane; oscillator strength.

Electron energy loss spectra were obtained for methane from 8.0 to 14.0 eV and for *n*-hexane from 0–20 eV with the NBS Model AN-1 electron impact spectrometer. These data were obtained for 100 eV incident electrons scattered within about 20 milliradians of the forward direction. Relative oscillator strengths were derived from the data by correcting for the finite angular acceptance of the apparatus with the assumption that the generalized oscillator strength can be approximated by its optical oscillator strength limit. The apparent oscillator strength distributions are placed on an absolute scale by normalization at one energy to a df/dE value determined optically. Comparisons of these results with available photoabsorption and other electron impact measurements will be presented.

15445. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Dipole oscillator-strength distributions derived for several hydrocarbons from electron energy-loss spectra,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 45-48 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

Key words: electron; energy loss; oscillator strengths; spectra.

A summary is presented of the technique used to determine dipole oscillator strength values from electron energy loss spectra. Data on benzene is presented as an example.

15446. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for molecular oxygen,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 49-52 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

Key words: electron; energy loss; molecular oxygen; oscillator strengths; spectra.

The oscillator strengths for molecular oxygen are determined from electron energy loss measurements and are compared to the available optical data.

15447. Hughes, E. E., **Development of standard reference materials for air quality measurement,** (Proc. Int. Instrumentation-Automation Conf. & Exhibit, New York, N.Y., Oct. 28-31), *ISA Reprint 74-704,* 13 pages (Instrument Society of America, Pittsburgh, Pa., 1974).

Key words: air pollution; carbon monoxide; gas analysis; gas standards; nitric oxide; nitrogen dioxide; sulfur dioxide.

The National Bureau of Standards is engaged in a continuing program involving gaseous Standard Reference Materials for air pollution measurements. Preparation of such materials requires definition of the stability, homogeneity and accuracy of the samples. This information is obtained by long-term studies of the gas systems, by development of absolute methods of analysis and by analysis of large numbers of samples prepared in bulk. The results of studies, extending over several years, of low concentration of carbon monoxide in nitrogen and nitric oxide in nitrogen are reported. Over one thousand samples of these materials have been analyzed and the stability with time and the within-batch homogeneity have been characterized. Accuracy is achieved by use of gravimetric standards and with dynamic dilution systems. Accuracy attainable by either method is described.

The use of permeation tubes of sulfur dioxide and nitrogen dioxide is necessary in some situations because of the reactivity of the gases. Data covering the stability and accuracy of these devices has been collected over a period of several years.

15448. Fife, D. W., **Primary issues in user needs,** (Proc. EDUCOM Working Seminar on the National Science Computer Network, Warrenton, Va., Nov. 1972), Chapter 10 in *Networks for Research and Education,* pp. 89-95 (The Massachusetts Institute of Technology, Cambridge, Mass., 1974).

Key words: computer networks; National Science Computer Network; network management.

The Institute for Computer Sciences and Technology of the National Bureau of Standards is assisting the National Science Foundation in technical planning to delineate major approaches and to derive guidelines for the trial experiments that may lead to a National Science Computer Network. The primary efforts of NBS are in network management requirements and application criteria for communications technology. User characteristics are being briefly studied for perspective on the objectives for the network and on the types of service it may provide. The goal of the NBS project is to describe by mid-1973 the basic types of experiments which address the central issues, together with appropriate evaluation criteria, so that NSF may use this technical framework in selecting an approach to the trial network.

15449. Hosler, W. R., Capps, W., Plante, E. R., **Some physical and chemical properties of coal slags,** *Proc. 14th Symp. on Engineering Aspects of Magnetohydrodynamics, The Univ. of Tennessee Space Institute, Tullahoma, Tenn., April 8-10, 1974,* pp. IV.7.1-IV.7.5 (1974).

Key words: coal slags; MHD; thermionic emission; vaporization; viscosity.

Thermionic emission, viscosity and vaporization studies of molten synthetic coal slags are described. Thermionic emission of a combustor type slag was determined in 1 atm air, 1 atm O_2, and 0.01 atm O_2 in N_2. Sizeable flows of electrons and positive ions were detected at temperatures as low as 1200-1300 °C. Viscosities of one real and several synthetic slags are shown between 1585 °C and their liquidus temperature (1250-1350 °C). These melts are quite fluid in this temperature range. From the modulated-beam mass spectrometer studies it appears that initial stages of evaporation of some synthetic melts are characterized by a nonequilibrium process involving a slower than expected decomposition of Fe_3O_4. SiO evaporation from the slag solution proceeds at a rate consistent with the SiO_2 in solution having an activity near unity.

15450. Armstrong, G. T., **The infrastructure of the thermochemical measurement system,** (Proc. Quatrieme Conf. Int. de Thermodynamique Chimique, Montpellier, France, Aug. 26-30, 1975), Chapter in *Thermochimie* **I,** 11-18 (Centre de Recherches de Microcalorimétrie et de Thermochimie du C.N.R.S., Marseille, France, 1975).

Key words: calorimetry; chemical energy; chemical thermodynamic data; energy scale (chemical); equilibrium measurements; mass spectrometry; measurement system; spectroscopy; state measurements; thermochemistry.

The thermochemical measurement system outlined here is an extension of the concept of a measurement system in that it deals with a class of physicochemical information, rather than with a metrology. Thermochemical quantities are defined, classified as archival thermochemical data, and thermochemical laboratory test data, and their source methodologies are categorized as calorimetry, equilibrium and state measurements, optical and mass spectrometry and theory. The relationship of thermochemical to nonthermochemical calorimetry is outlined. The propagation of measurements from standards laboratory to ultimate user is described for archival and for test laboratory thermochemical data.

15451. Meyerson, M., **The Department of Commerce voluntary labeling program for household appliances and equipment to effect energy conservation,** *Proc. Conf. on Improving Efficiency in HVAC Equipment and Components for Residential and Small Commercial Buildings, Purdue Univ., West Lafayette, Ind., Oct. 7-8, 1974,* pp. 222-225 (1974).

Key words: consumer information; efficiency; energy; label; refrigerator/freezers; room air conditioning.

The purpose and legal/administrative authority for the Department of Commerce Voluntary Labeling Program for Household Appliances and Equipment to Effect Energy Conservation are described. The procedures for executing this program are outlined, with examples of experience in developing labels for room air conditioners and refrigerator/freezers.

15452. Tighe, N., **Microstructure of oxidized silicon nitride,** (Proc. 32d Annual Proc. Electron Microscopy Society of America, St. Louis, Mo., 1974), Paper in *32d Annual Proc. Electron Microscopy Society of America,* C. J. Arceneaux, Ed., pp. 470-471 (Claitor's Publ. Div., Baton Rouge, La., 1974).

Key words: β-cristobalite; electron microscopy; oxidation; silicon nitride; silicon oxynitride; Si_3N_4.

The reaction product layer produced on hot-pressed silicon nitride, Si_3N_4, during oxidation at temperatures from 1000 to 1400 °C was examined by transmission electron microscopy. The oxide was found to have at least two crystalline phases—silicon oxynitride Si_2ON_2 and β-cristobalite SiO_2, and two amorphous phases. The microstructure of the phases and of the silicon nitride near the reaction interface is discussed.

15453. Simmons, G. L., Eisenhauer, C., Spencer, L. V., **Moments method calculations of neutron and gamma-ray penetration in bulk media,** *Proc. IVth Int. Conf. on Reactor Shielding, Paris, France, Oct. 9-13, 1972,* **2,** 268-283 (Oct. 1972).

Key words: adjoint; concrete; gamma-ray penetration; moments; neutron penetration; secondary gamma rays.

A system of computer codes using the moments method to calculate penetration of neutrons and gamma rays in bulk media is described. Results are presented for the penetration of fission neutrons incident at various angles on concrete. The use of adjoint procedures for calculating gamma-ray buildup factor data are also described and results are presented for the penetration of gamma rays from point sources emitting at various conical angles in a concrete medium. Finally, the two types of calculations are combined to produce data for penetration of gamma rays produced in concrete by a neutron source.

15454. Wehrli, R., **Metrication and the construction industry: Potential problems and promising opportunities,** *AIA J.,* pp. 50-54 (May 1974).

Key words: building industry; conversion; engineering; human and modular standards; metrication; product-dimensions.

Conversion to the metric system, now nationally underway but still unorganized, challenges the building industry especially to plan promptly for hard conversion (metrication's approaching later stages). Why planning now is needed to accomplish competent hard conversion is examined in relation to standards. Because the building industry will need new dimensional standards for products to achieve a successful, final conversion, three types of hard conversion standards should be fixed upon to avoid haphazard pitfalls as conversion advances. The three standards briefly examined are engineering, modular, and human and their possible interrelationships.

15455. Strobridge, T. R., **Feasibility study of a multipurpose refrigerator for a superconducting cable test facility,** *Paper EPRI* **282,** 52 pages (Electric Power Research Institute, Palo Alto, Calif., July 1975).

Key words: cryogenics; helium pump; power transmission; refrigeration; superconducting cables.

A major problem in simultaneously cooling a number of test sections of superconducting power transmission cables is the wide variation in cable operating pressures and temperatures. It is feasible to couple a single large refrigerator to the cables with individual pumped helium circulation circuits. The system is flexible in both pressure and temperature and in the temperature rise along the length of the cable. The total refrigeration capacity required for a test facility is derived from current estimates of cable characteristics. A single refrigerator is shown to be less expensive than individual refrigerators for each cable even when the penalties for pump work and heat transfer through large temperature differences are included. Sufficient process calculations are included to show that the system is practical, and a draft specification for the refrigerator is given.

15456. Rook, H. L., Suddueth, J. E., Becker, D. A., **Determination of iodine-129 at natural levels using neutron activation and isotopic separation,** *Anal. Chem.* **47,** No. 9, 1557-1562 (Aug. 1975).

Key words: improved limits of detection; iodine-129; isotopic separation; neutron activation.

Iodine-129 levels have been published for biological matrices that naturally accumulate iodine such as animal thyroid and kelp. However, published procedures have insufficient sensitivity to determine ^{129}I in other environmental and biological species. A unique procedure has been developed for the determination of ^{129}I which couples neutron activation with mass separation. The procedure results in a significant improvement in sensitivity, thus allowing analyses to be performed on a variety of matrices which heretofore had not been investigated. Method development and analytical procedures are presented and analytical results at the $10^{-13}-10^{-14}$ gram ^{129}I level are given.

15457. Carpenter, B. S., Reimer, G. M., **Fission track technique for uranium determination in coal and fly ash standard reference materials,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 141-143 (Available from the National Technical Information Service, Springfield, Va., 1974).

Key words: coal; fission track technique; fly ash; mica detector; polycarbonate detector; rapid analysis; uranium.

The analysis of coal and combustion waste products for uranium will become increasingly important with the greater use of coal for supplying energy needs. A fission track technique, as demonstrated with NBS Standard Reference Material Trace Elements in Coal (SRM 1632) and Trace Elements in Fly Ash (SRM 1633), provides a rapid and inexpensive method for U analysis.

15458. Rook, H. L., Moody, J. R., **Stabilization and determination of nanogram quantities of mercury in water,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 44-53 (Available from the National Technical Information Service, Springfield, Va., 1974).

Key words: mercury; stabilization; standard reference material; trace element; water standard.

The National Bureau of Standards has completed development work and analytical certification on two Mercury in Water Standard Reference Materials (SRM). SRM 1641 has a mercury content of 1.52 ± 0.05 μg Hg^{++} per gram of water and is intended as a "spike" standard for natural waters. SRM 1642 has a mercury content of 1.20 ± 0.05 ng Hg^{++} per gram of water and is intended as a benchmark trace standard used for analytical methods development.

These Standards have been stabilized using a new technique developed at NBS. Shelf life of the trace solutions has been demonstrated to be greater than one year with expectation of an even longer storage capability.

15459. Gills, T. E., LaFleur, P. D., **The determination of hafnium in standard reference materials using bis(2-ethylhexyl) phosphate (HDEHP) with neutron activation analysis,** (Proc. Int. Meeting on Activation Analysis, Saclay, France, Oct. 1-6, 1972), *J. Radioanal. Chem.* **19,** 235-237 (1974).

Key words: activation analysis; Ge(Li) detector; solvent extraction.

The method for the determination of hafnium in standard reference steels is described. The method combines neutron activation analysis with a solvent extraction procedure using bis(2-ethylhexyl) phosphate as the extractant. A subsequent back extraction into 2N hydrofluoric acid is done finally before counting. The samples were counted on a 60cc Ge(Li) in configuration with a 2048 channel analyzer. Using this method of analysis as described fast determination of hafnium can be made with routine 3-4 percent precision and accuracy.

15460. Heydemann, P. L. M., **Pressure measurement and calibration,** *Proc. ASME Pressure Vessels and Piping Materials Nuclear Conf., Miami, Fla., June 24-28, 1974,* Paper 74-PVP-43, pp. 1-8 (American Society of Mechanical Engineers, New York, N.Y., 1974).

Key words: calibration; pressure measurement; primary pressure standards.

The National Bureau of Standards maintains a group of primary pressure standards in its laboratories in Gaithersburg, Md. These standards are dead weight piston gages with controlled clearance. Special experimental and computational methods have been developed for the calibration of these primary standards. From this group of standards calibrations are disseminated to industry by means of transfer standards, which are calibrated against the primary standards with the cross float method. Specialized computer programs are used for the evaluation of the cross float in order to obtain best sets of characteristic gage coefficients. Pressure calibration services available from NBS presently cover the range from 2 kPa (0.3 psi) to 400 MPa (60,000 psi) and an expansion to 2.5 GPa (375,000 psi) is in preparation. In addition NBS provides training courses, data evaluation service and extensive, free consultations. Facilities exist for long term performance testing of transducers and for research and development work under contract. This report is written to make petroleum engineers aware of the availability of these services.

15461. Marvin, R. S., Hogenboom, D. L., **Viscosity of liquids,** Paper 2m in the *American Institute of Physics Handbook Third Edition,* pp. 2-187—2-202 (McGraw-Hill Book Co., New York, N.Y., 1972).

Key words: handbook article; liquids; viscosity.

Existing tabulations of the viscosity of liquids are described with selected examples from some of the more recent tabulations.

15462. Pallett, D. S., **Force platform instr entation system for the study of impact forces,** *Proc. Inter-Noise Conf., Sept. 30-Oct. 2, 1974,* J. C. Snowdon, Ed., pp. 89-92 (Noise Control Foundation, Poughkeepsie, N.Y., 1974).

Key words: building acoustics; force platforms; impact noise; instrumentation; mechanical impedance; noise.

Human footfall has long been recognized as an important source of impact noise in buildings, which in turn has been recognized as an important source of occupant dissatisfaction in multifamily dwellings. Very little is known of the dynamic characteristics of the footfall event. The instrumentation system described in this paper is intended for use in research dealing with the dynamic characteristics of footfall impact events. The data obtained in this research is directed toward the question of whether it is possible to reliably specify live walkers for use in impact noise studies. Force platform design considerations and description of related signal processing are presented. Preliminary calibration data indicate that the usable response of the force platform may extend from DC to nearly 2 kHz.

15463. Wiese, W. L., **Experimental progress on plasma broadening of hydrogen lines,** *Proc. Invited Lectures given at the 7th Yugoslav Symp. and Summer School on the Physics of Ionized Gases, Rovinj, Yugoslavia, Sept. 16-21, 1974,* V. Vujnovic, Ed., pp. 637-673 (Institute of Physics, University of Zagreb, Yugoslavia, 1974).

Key words: Balmer lines; hydrogen plasma; ion motion; line shapes; reduced mass; Stark broadening.

Recent experimental investigations on the Stark broadening of hydrogen Balmer lines in high density plasmas are described. The review is principally devoted to the finer details of the line shapes, such as their central structure, asymmetries, shifts, and the decay in the line wings. Recently detected variations in the line shapes with the reduced mass of the radiator-perturber system are discussed, comparisons with theory are presented, and some preliminary conclusions are drawn.

15464. Kahles, J. F., Field, M., Young, R. D., Whitehouse, D. J., **Survey on surface roughness and surface integrity requirements for machined components,** *CIRP Annals* **23,** No. 1, 185-186 (1974).

Key words: CIRP; surface; surface finish; surface integrity; surface questionnaire; surface survey.

CIRP Committee "S" has developed a survey to determine surface roughness and surface integrity requirements for machined components. Specifically, the survey is designed to develop a comprehensive international response concerning the status of surface technology as related to all types of material removal processes, and the surface conditions produced which affect parts performance. The design of the survey is discussed, the status is outlined, and a partial list of survey questions is presented.

15465. Ayres, T. R., Linsky, J. L., **Stellar model chromospheres. III. Arcturus (K2 III),** *Astrophys. J.* **200,** No. 3, 660-674 (Sept. 15, 1975).

Key words: Ca II emission; chromospheres, stellar; photospheres, stellar.

We construct models for the upper photosphere and chromosphere of Arcturus based on the H, K, and IR triplet lines of Ca II and the *h* and *k* lines of Mg II. The chromosphere model is derived from complete redistribution solutions for a five-level Ca II ion and a two-level Mg II ion. A photospheric model is derived from the Ca II wings using first the "traditional" complete redistribution limit and then the more realistic partial redistribution approximation. In particular, the temperature and mass column densities for the temperature minimum region and the chromosphere-transition region boundary are computed and the pressure P_0 in the transition region and corona estimated. We find $T_{min}/T_{eff} \approx 0.77$ for Arcturus, Procyon, and the Sun and a trend of increasing mass at the temperature minimum with decreasing gravity. We find P_0 to be about 1 percent of the solar value, and on this basis estimate the surface brightness of the Arcturus transition region and coronal spectrum to be much less than for the Sun. Finally, the partial redistribution calculation for the Ca II K line indicates that the emission width is at least partially determined by damping rather than Doppler broadening, suggesting a reexamination of previous explanations for the Wilson-Bappu effect.

15466. Menis, O., Garn, P. D., Diamondstone, B. I., **The application of thermoanalytical methods to the environmental health problems,** (Proc. Fourth ICTA Conf., Budapest, Hungary, July 8-13, 1974), Chapter in *Thermal Analysis,* I. Buzas, Ed., **3,** 127-139 (Akademiai, Kiado, Budapest, Hungary, 1975).

Key words: calibration filters; chrysotile; environmental health; improved methodologies; particulates; quartz; self-generated atmosphere.

Differential thermoanalysis methods provided an independent measurement of quartz and chrysotile asbestos in the preparation of calibration standards needed by environmental control agencies. In this study it was found that 30-500 μg of chrysotile asbestos could be measured with a relative standard deviation of 15 percent. Sealed silver containers were used to provide a self-generating atmosphere which reduced the spread of the dehydroxylation peak and improved both selectivity and sensitivity. A repeat-measurement of the thermal curve, after the dehydroxylation, provided a correction for the matrix baseline. Under similar experimental conditions, microgram quantities of quartz were determined with a relative standard deviation of ~ 2 percent. However, there was a 50 percent difference between the NBS-ICTA SRM 759 and commercially prepared material. It was shown that this difference could be eliminated by thermally treating the commercial product.

15467. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for nitrous oxide,** (Proc. IX Int. Conf. on Physics of Electronic and Atomic Collisions, Seattle, Wash., July 24-30, 1975), Abstract in *Electronic and Atomic Collisions,* J. S. Risley and R. Geballe, Eds., **2,** 1043-1044 (University of Washington Press, Seattle, Wash., 1974).

Key words: electron energy loss; low energy electron impact; N_2O; oscillator strengths.

The apparent oscillator strengths for N_2O in the energy loss range of 4.5 to 14 eV are presented at 0.01 eV intervals. Measurements were made with an incident energy of 100 eV and at a scattering angle of within 20 milliradians of the incident direction.

15468. Sarkes, L. A., Mann, D. B., **A survey of LNG technological needs in the U.S.A. – 1974 to beyond 2000,** *Proc. 4th Int. Conf. on Liquefied Natural Gas, Algiers, Algeria, June 24-27, 1974, Session VII,* Paper 1, pp. 1-21 (Institute of Gas Technology, Chicago, Ill., 1974).

Key words: cryogenic; gas industry; liquefied natural gas; research; survey; technology.

A comprehensive analysis of near and long term research needs has been conducted by the U.S. Gas Industry covering operational areas of Production and Exploration, Synthetic Supply, Transmission, Distribution, Utilization, and LNG.

Identifiable research needs are reported for the area of LNG encompassing time frames of: 1974-1978 (in detail, year by year); 1979-1985 (in 5 year period); 1986-2000 (as specific as possible); beyond 2000 (as believed necessary).

A year by year examination of LNG research priorities for the first five years are considered vital to overcome the potential suppression of growth in the LNG industry that could result from lack of available technology. Assessments of technical LNG needs beyond 1978 cannot, of course, be too well defined and must be examined annually for purposes of updating.

The National Bureau of Standards Cryogenics Division has become the governmental focal point for LNG research. A survey of NBS LNG research and how these relate to the future technological growth of the LNG industry are discussed.

15469. Heimbach, C. R., O'Connell, J. S., **Influence on the neutron's charge distribution on nuclear Coulomb energies,** (Proc. Conf. Int. Few Body Problems in Nuclear and Particle Physics, Laval Univ., Quebec City, Canada, Aug. 27-31, 1974), Paper in *Few Body Problems in Nuclear and Particle Physics,* R. J. Slobodrian, B. Cujec, and K. Ramavataram, Eds., pp. 94-95 (Les Presses de L'Université Laval, Quebec, Canada, 1974).

Key words: charge distribution; Coulomb energy; deuteron; electrostatic; interaction potential; neutron.

The electrostatic interaction energy of a deuteron was computed for a model in which the neutron charge distribution was taken as a superposition of two exponentials of total charge + e and − e. Because the interaction potential is of short range the result is sensitive to the interior deuteron wave function. For a Reid hard-core wave function the computed energy is 1 keV.

15470. Krasny, J. F., Winger, J. H., **Current status of flammability test development at the National Bureau of Standards,** *Proc. 8th Annual Meeting Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1974,* 5 pages (1974).

Key words: apparel; carpets; curtains; draperies; fabrics; flammability; garments; test methods; textiles; upholstered furniture.

Tests for the flammability of textile items, that are presently under development at NBS, are described.

15471. Loevinger, R., **Dosimetry standards for fast electrons,** (Proc. XIII Int. Congress of Radiology, Madrid, Spain, Oct. 15-20, 1973), *International Congress Series No. 339,* **2,** 467-471 (Excerpta Medica, Amsterdam, The Netherlands, 1973).

Key words: absorbed dose; calorimeter; dosimetry; electrons; ionization chamber; radiation standard.

Graphite calorimeters are being developed at several national standards laboratories to serve as absorbed-dose standards for fast electron beams for radiation therapy. Two such calorimeters have been constructed at the National Bureau of Standards, and compared to ionization chambers of the same size and shape by determining the quotient of the calorimeter response by the ionization chamber response. That quotient will be the factor used to convert the response of an ionization chamber calibrated in absorbed-dose units in a cobalt-60 beam to absorbed-dose units in high-energy electron beams.

15472. Becker, D. A. **Accuracy and precision in activation analysis—counting,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 69-80 (Available from the National Technical Information Service, Springfield, Va., 1974).

Key words: accuracy; errors in activation analysis; precision; radiation detection.

Accuracy and precision in activation analysis was investigated with regard to counting of induced radioactivity. The various parameters discussed include configuration, positioning, density, homogeneity, intensity, radioisotopic purity, peak integration, and nuclear constants. Experimental results are presented for many of these parameters. The results obtained indicate that counting errors often contribute significantly to the inaccuracy and imprecision of analyses. The magnitude of these errors ranges from less than 1 percent to 10 percent or more in many cases.

15473. Swanson, N., Celotta, R. J., Kuyatt, C. E., **Excitation of low-lying triplet states in ozone by electron impact,** (Proc. IX Int. Conf. on Physics of Electronic and Atomic Collisions, Seattle, Wash., July 24-30, 1975), Abstract in *Electronic and Atomic Collisions,* J. S. Risley, Ed., **2,** 128-129 (University of Washington Press, Seattle, Wash., 1974).

Key words: electron impact; energy loss spectra; oxygen; ozone; triplet states.

Energy loss spectra of ozone were measured at scattering angles of 45, 75, and 90° and incident energies below 10 eV to look for previously unobserved triplet states. A broad continuum between 1.3 and 2 eV energy loss was seen which we believe is due to excitation of these states.

15474. Wiese, W. L., Martin, G. A., **Oscillator strength distributions in the lithium isoelectronic sequence,** (Proc. Invited Lectures 7th Yugoslav Symp. and Summer School on the Physics of Ionized Gases, Rovinj, Yugoslavia, Sept. 16-21, 1974), Paper in *Physics of Ionized Gases,* V. Vujnovic, Ed., pp. 675-700 (Institute of Physics, University of Zagreb, Zagreb, Yugoslavia, 1974).

Key words: f-sum rule; f-values; lithium sequence; oscillator strength distribution; oscillator strengths; systematic trends.

A recent study on the oscillator strength distributions of several spectral series throughout the lithium isoelectronic sequence is described. In this work critically compiled oscillator strength data for discrete and continuum transitions have been subjected to four principal constraints: (a) to fit into systematic trends along the lithium isoelectronic sequence, (b) to fit into systematic trends within spectral series, (c) to comply with the requirement of continuity across the spectral series limit, and (d) to adhere to f-sum rules. The best available data require only minor modifications to adhere closely to all these constraints, which gives these data—for which several illustrative examples are presented—a very high degree of reliability.

15475. Utton, D. B., **Nonchemical applications of NQR,** *Proc. Second Int. Symp. on Nuclear Quadrupole Resonances Spectroscopy, Viareggio, Italy, Sept. 3-7, 1973,* pp. 341-350 (A. Vallerini, Pisa, Italy, 1975).

Key words: applications; material detection; nuclear quadrupole resonance; piezometry; thermometry.

Since the early work on NQR over twenty years ago it has been suggested that the temperature dependence of NQR frequencies can be used as a thermometer. A natural extension of this idea is to use an NQR frequency to measure pressure. A review is given of the work that has been done to investigate these applications of NQR. The criteria for the choice of material and measurement technique are discussed with emphasis on chlorine compounds since they have received the most attention. As an example, the accuracy and precision obtainable with the Cl^{35} NQR in $KClO_3$ (for which accurate measurements are available) will be described.

There has been some renewed interest in using characteristic NQR frequencies to detect the presence of specific materials. As an example, estimates are given for the signal to noise ratio to be expected for nitrogen compounds when the material is not located within the detector coil.

15476. Peterlin, A., **ESR investigation of chain rupture in mechanically strained crystalline polymer solids,** (Proc. Sixth Southeastern Magnetic Resonance Conf., Clemson, S.C., Oct. 1974), *J. Magn. Reson.* **19,** 83-98 (1975).

Key words: chain rupture; crystalline polymer; ESR investigation of radicals; fibrous structure; mechanical breakdown; microfibrillar structure; radical formation; tie molecules.

ESR detects radicals formed in a strained polymer sample as a consequence of chain rupture and, hence, for a while was considered the best method for investigation of molecular effects during tensile straining. It turned out that a sufficiently high number of radicals for ESR detection is only obtained in highly oriented material with well developed fibrous structure.

The primary end-of-chain radicals are too reactive and unstable so that, as a rule, they are not observable by ESR except at cryogenic temperatures. By proton transfer, more stable center-of-chain radicals are formed which are normally measured. They yield information about primary chain rupture. The much more easy rupture of bonds adjacent to center-of-chain radicals breaks less strained chains (secondary rupture), but does not produce any new radicals. Hence, the ESR information about chain rupture is rather incomplete and has to be supplemented by other methods as for instance IR which detects the unsaturated end groups formed during radical transfer and secondary chain rupture.

Since the broken chains are not exactly the same chains which before rupture were responsible for elastic modulus and tensile strength one has no direct correlation between the radical population and the load-elongation curve of the sample even if no secondary rupture is involved. It turns out that the specific morphology, in particular the presence of point defects of fibrous structure caused by the ends of microfibrils, is responsible for crack nucleation and growth to critical size which finally leads to sample failure. The chain rupture partially monitored by the radical population is a moderately reliable indicator of the effects leading to failure but not the cause of it.

15477. Marshall, H. E., **Cost sharing and efficiency in salinity control,** (Proc. 15th Annual Western Resources Conf. on Salinity in Water Resources, Boulder, Colo., July 9-10, 1974), Chapter 8 in *Salinity in Water Resources,* J. E. Flack and C. W. Howe, Eds., pp. 139-152 (Merriman Publ. Co., Boulder, Colo., 1974).

Key words: Colorado River; cost sharing; efficiency; equity; salinity control.

The increase in salinity concentrations in the southwestern United States and Mexico imposes economic costs on water users. Cost-sharing rules influence the selection of techniques and of scales for salinity control projects, yet there is no established Federal policy for sharing the costs of salinity control. Based on efficiency and equity criteria, a package of rules is suggested. Charging salt polluters and salinity control beneficiaries are potential policies, the final choice being constrained by legal and political institutions. Two specific rules are for the Federal government to share in the same proportion costs of all techniques (structural and nonstructural) used to provide salinity control, and to share costs in proportion to benefits received at the margin. Implications are that nonfederal interests, especially irrigators, would bear most of the costs of salinity control.

15478. Cosby, P. C., Bennett, R. A., Peterson, J. R., Moseley, J. T., **Photodissociation and photodetachment of molecular negative ions. II. Ions formed in oxygen,** *J. Chem. Phys.* **63,** No. 4, 1612-1620 (Aug. 15, 1975).

Key words: cross section; drift tube; experimental; molecule; negative ion; O_2^-; O_3^-; O_4^-; photodetachment; photodissociation.

Total photodestruction cross sections for O_2^-, O_3^-, and O_4^- ions have been measured over a photon energy range of 1.93-2.71 eV using a drift tube mass spectrometer coupled with an argon ion laser and a tunable dye laser. The O_2^- ion is found to photodetach at these photon energies with a cross section which varies from 1.2 to 2.2×10^{-18} cm^2. The O_3^- ion photodissociates to form O^- over this energy range with a cross section which varies from 0.1 to 7.3×10^{-18} cm^2 and exhibits structure indicative of the vibrational levels of a predissociating excited state. Structure is also observed in the O_4^- photodestruction cross section which varies from 1.0 to 2.2×10^{-18} cm^2, and in the O_2^- photodetachment cross section.

15479. Taylor, J. K., **Electrochemical analysis,** *Med. Electron. Data,* pp. 39-42 (May-June 1972).

Key words: chemical analysis; coulometry; electrochemical analysis; ion-selective electrodes; polarography.

A brief review is presented, in popular style, of the various electrochemical techniques that are applicable to chemical analysis. Techniques described include polarography, coulometry and potentiometry employing ion-selective electrodes. The use of electrochemical sensors in titrimetry is also pointed out.

15480. Harvey, W. W., Kruger, J., **The passivity of gallium arsenide,** (Proc. 3d Int. Conf. on Passivity of Metals, Cambridge, England, July 1970), Paper in *Electrochim. Acta* **16,** 2017-2037 (1971).

Key words: electrochemistry; ellipsometry; gallium arsenide; passivity.

Both p- and n-type gallium arsenide in aqueous electrolytes display the phenomenon of passivity once sufficiently high prepassive cds are attained. This can be achieved for the n-type by illumination, whereby a transition is observed from hole-limited anodic dissolution to passive film formation as the light intensity is increased. Ellipsometric studies reveal that the passive film on either n- or p-GaAs dissolves at a comparatively high rate, and so reaches a steady-state thickness in a rather short time.

Coulometric measurements indicate that the passive film contains gallium and arsenic in their +3 oxidation states. The ionization of Ga and As at the GaAs/film interface is shown to require holes, in like manner to anodic dissolution in the absence of a passive film. The electrical and optical properties of the passive film suggest uniformity of composition for thickness greater than about 50 Å, whereas thinner films show higher conductivity and refractive index.

The passive film on GaAs supports typically large electric fields and exhibits negligible electronic conductivity and porosity. Under proper conditions a nonpassive anodic film can be formed at potentials in the active region. It is much less soluble than the passive film, continues to thicken indefinitely and therefore appears to be porous.

15481. Stiehler, R. D., **Measurement units in engineering and SI,** *Proc. Symp. on Standardization and Metric Conversion for Tunneling, Underground Construction, and Mining, Washington, D.C., May 21, 1974,* pp. 42-48 (Available from the National Technical Information Service, Springfield, Va., 1975).

Key words: International System of Units; measurement units; metric units; SI; systems of units; units of measurement.

Several systems of measurement units used in engineering are discussed. The multiplicity of units for the same quantity and the use of the same name for units of different quantities led to the adoption of the International System of Units (SI) in 1960. This system is *one* of the many metric systems that have been introduced since 1793. SI is a single, rational, coherent system consisting of seven base units, two supplementary units, and units derived from them, always with a factor of one relating them. In this sense, SI is a unitary rather than a decimal system. SI provides one and only one unit for each quantity and does not use the same name for units of two different quantities. Prefixes are provided for convenience in expressing decimal multiples and submultiples of SI units, but they are not essential to SI. The present confusion existing in units for quantities which relate to rotation or vectors is discussed. The inclusion of the radian in such units as moment of inertia, angular momentum, and torque is necessary. Some improvements needed in SI are mentioned. The simplicity and rational nature of SI should relieve the engineer from memorizing equations cluttered with conversion factors dependent on irrational units seldom understood.

15482. Radak, B. B., Kosanić, M. M., Šešić, M. B., McLaughlin, W. L., **A calorimetric approach to the calibration of liquid dose meters in high-intensity electron beams,** (Proc. Symp. on Biomedical Dosimetry, IAEA, Vienna, Austria, 1975), Chapter in *Biomedical Dosimetry,* pp. 633-641 (Int. Atomic Energy Agency, Vienna, Austria, 1975).

Key words: absorbed dose rate; calorimetry; chemical dosimetry; electron beams; gamma radiation; radiation dosimetry; radiochromic dyes.

A procedure for calibrating liquid dose meter systems in pulsed high-intensity electron beams is presented. The chemical change produced in solution by a totally absorbed collimated beam has been compared with the heat deposited in a calorimeter exposed to the same beam under identical conditions. Thin film dose meters containing radiochromic dyes, which were known to have a response that does not vary with absorbed dose-rate, were used to monitor the energy absorbed during irradiations. A quasi-adiabatic calorimeter and a cell of the same geometry for containment of the dosimetry solutions are described. The G-value for dye formation in 2-mmol/litre pararosaniline cyanide in 2-methoxy ethanol (O_2-saturated) has been determined in the range of dose-rates from 10^{12} to 10^{13} rad/s.

15483. Lide, D. R., Jr., **Preface,** *Proc. Conf. Critical Evaluation of Chemical and Physical Structural Information, Dartmouth College, Hanover, N.H., June 24-29, 1973,* D. R. Lide, Jr. and M. A. Paul, Eds., pp. iii-vii (National Academy of Sciences, Washington, D.C., 1974).

Key words: critical evaluation; crystal structure; data analysis; molecular structure.

The motivations for holding a conference on structural information are discussed. The use of structural data in chemistry, physics and related disciplines is reviewed. The major points brought out during the conference are summarized.

15484. Vickers, A., Krasny, J., Tovey, H., **Some apparel fire hazard parameters,** *Proc. Seventh Annual Meeting of the Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1973,* pp. 205-226 (1975).

Key words: apparel fires; burn injury severity; fabric flammability; FFACTS; garments.

The effect of three parameters, fiber content, fabric content, fabric burn time (a function of ease of ignition and rate of flame spread), and garment configuration and fit, on frequency of involvement in accidental garment fires and on the extent of resulting injury was investigated using fabrics and data from the National Bureau of Standards Flammable Fabric Accident Case and Testing System (FFACTS). Cellulose-containing fabrics are overrepresented in FFACTS though this may be, in part, the result of biases in the data base. The extent of injury appears to be more closely related to garment configuration and fit than to fiber content and fabric burn time.

15485. Cotton, I. W., **Computer networks: Capabilities and limitations,** (Proc. Int. Symp. on Structural Mechanics Software, Univ. of Maryland, College Park, Md., June 12-14, 1974), Paper in *Structural Mechanics Computer Programs,* W. Pilkey, K. Sczalski, H. Schaeffer, Eds., pp. 1043-1055 (University Press of Virginia, Charlottesville, Va., 1974).

Key words: computer networks; networks.

This paper is intended to provide an introduction to the capabilities and limitations involved with the use of today's computer networks. While the treatment is at times brisk, this is intentional, in order to emphasize the applicability of networks for a wide range of applications—and the equally wide range of problems.

15486. Grum, F., Cameron, J., **Detector intercomparison results,** *Electro-Opt. Systems Design,* pp. 82-84 (Nov. 1974).

Key words: interlaboratory test; photodiode detectors; photometry.

The results of an intercomparison of measurement of spectral sensitivity of two silicon photodiodes are presented. The comparison was part of the activities of CORM (Council for Optical Radiation Measurement). The manufacturer, nine industrial laboratories, and NBS measured the two cells. The results were statistically analyzed and are presented here in tabular and graphical form.

15487. Ayres, T. R., Linsky, J. L., **Stellar model chromospheres. IV. The formation of the Hϵ feature in the sun (G2 V) and Arcturus (K2 III),** *Astrophys. J.* **201,** No. 1, 212-221 (Oct. 1, 1975).

Key words: chromospheres, stellar; Hϵ emission; photospheres, stellar.

The formation of the Balmer series member Hϵ in the near red wing of the Ca II H line is discussed for two cases: the Sun (Hϵ absorption profile) and Arcturus (Hϵ emission profile). It is shown that although the Hϵ source functions in both stars are dominated by the Balmer continuum radiation field through photoionizations, the line formation problems in the two stars are quantitatively different, owing to a substantial difference in the relative importance of the stellar chromosphere temperature inversion compared with the stellar photosphere.

15488. Cotton, I. W., **Some trade-offs in the design of minicomputer-based graphic systems,** *Proc. Compcon 74, Washington, D.C., Sept. 1974,* pp. 47-52 (1974).

Key words: computer graphics; cost-benefit analysis; economic analysis; graphics; minicomputers.

This report surveys the evolution of satellite graphics systems from closely coupled display channels to free-standing, minicomputer-based systems. Particular attention is paid to the assignment of functions to the host and satellite systems. Some intuitive types of analysis in support of this assignment are presented, followed by the description of an economic analysis which may be universally applied.

15489. Rybicki, G. B., Hummer, D. G., **A note on the "peaking effect" in spherical-geometry transfer problems,** *Mon. Not. Roy. Astr. Soc.* **170,** 423-427 (1975).

Key words: astrophysics; energy loss; radiative transfer; spectral line formation; stellar atmospheres.

This note presents evidence that the claims advanced by Wilson, Tung & Sen regarding the adequacy of Wilson & Sen's half-range moment method for treating the outward peaking of the radiation field in a spherical system are unjustified. In particular, the emergent intensity obtained by Wilson *et al.* is shown to be negative for $0 \leq \mu \lesssim 0.5$ and greatly in error for larger values of μ. A discussion is presented of the essential indeterminacy of the Wilson-Sen half-range method. It is suggested that the good values obtained by Wilson *et al.* for the mean intensity and the Eddington factor arise from their choice of the arbitrary function $A(r)$ to include the known asymptotic forms of the source function.

15490. Harrison, J. O., Jr., **Metric conversion and the COMMON computers,** *Proc. COMMON Users Group, Hollywood, Fla., Oct. 14-16, 1974,* 22 pages (1974).

Key words: conversion; FORTRAN; Metric System.

The NBS Computer Program Package for Metric Conversion is written in American National Standard FORTRAN and is designed to compile and run on a wide variety of large scale computers with little or no modification. This paper consists largely of a description of the package and a discussion of its applicability to the COMMON Computers consisting of the IBM System 370, System 360, the 1130, 1800, System 3, and System 7.

The package has been satisfactorily tested on a System 370 Model 165. It may be expected to compile and run satisfactorily on any 370 or on any 360 Model 22.195 of adequate configuration when one of the available AMERICAN NATIONAL STANDARD FORTRAN Compilers is used.

It will probably not run on the 1130, the 1800, the System 3, or System 7 with any IBM supplied FORTRAN compiler due to the extensive use made of features contained in ANS FORTRAN but not in ANS BASIC FORTRAN.

The package should compile and run on a 1130 of adequate configuration with a DNA 1130 ANS FORTRAN Computer with little or no modification.

15491. Radebaugh, R., Lawless, W. N., Siegwarth, J. D., **Semiannual technical report on electrocaloric refrigeration for superconductors,** *ARPA Order 2535,* 17 pages (Available as AD-A008-852 from the National Technical Information Service, Springfield, Va., 1974).

Key words: cryogenics; dielectrics; electrocaloric; heat switches; polarization; refrigeration.

The most significant development in the project for the last six months was the discovery that $SrTiO_3$ glass ceramics showed only heating effects at 4 K for both polarization and depolarization. At the same time, the pitting problem for ceramming temperatures above 1100 °C was partially solved.

Several electrothermal measurements have been done on the $SrTiO_3$ glass-ceramic samples to try to understand why they behave as they do. In addition an apparatus for measurement of DC polarization and hysteresis was completed. The results from those measurements are consistent with the electrothermal measurements. Studies of several new materials have begun in order to better understand the electrocaloric effect near 4 K and in hopes of finding a satisfactory refrigerant material.

The gold-plated multiple leaf heat switch was shown to be useful for heat loads up to about 1 watt at 4 K. The magnetothermal conductivity measurements on single crystal beryllium indicate that it could be used for both the upper and lower switch. Further work on some details of the heat switches has been temporarily suspended in order to concentrate fully on solving the refrigerant material problem.

15492. Holmer, C. I., **Estimation of sound power in the free field over a reflecting plane. Errors associated with far field and near field measurements,** *Proc. Noise-Con 75, Gaithersburg, Md., Sept. 15-17, 1975,* pp. 429-438 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

Key words: error of sound power; far-field power; near-field power; sound power estimation.

A review is presented of several sound power estimation procedures for free field above a reflecting plane condition. Particular emphasis is placed on potential sources of measurement error. Both near field and far field procedures are included in the discussion. Estimates of magnitudes of individual sources of error are discussed.

15493. Blackburn, D. L., **An electrical technique for the measurement of the peak junction temperature of power transistors,** *Proc. 13th Annual Reliability Physics Conf., Las Vegas, Nev., Apr. 1-3, 1975* pp. 142-150 (Electron Devices and Reliability Groups, IEEE, New York, N.Y., July 1975).

Key words: method of measurement, electrical; semiconductor devices; temperature, peak; thermal properties; transistors, power, safe-operating area.

A technique is described which uses straightforward electrical measurement procedures to determine the peak junction temperature of power transistors. To determine the peak temperature, standard electrical measurement techniques are altered to account for the difference between the distributions of the calibration and measurement currents in the active area of the device. For relatively uniform temperature distributions, the electrically determined peak junction temperature is only about 6 percent or less below the infrared measured peak temperature whereas the standard electrically measured temperature is about 10 to 25 percent below the infrared measured peak temperature. For severely nonuniform temperature distributions, when only about 20 percent of the total active area of the device is dissipating power at steady state, the electrically determined peak temperature is within 11 percent of the infrared measured peak temperature while the standard electrically measured temperature is more than 40 percent below the infrared measured peak temperature. Device operating conditions for which the junction temperature as determined by standard electrical methods, infrared techniques, and the electrical peak temperature technique equals the manufacturer's specified maximum safe operating temperature are compared with one another and with the manufacturer's specified safe operating limits. It is suggested that the electrical peak temperature technique can be used to generate more realistic safe operating area limits and to determine the validity of specified safe operating limits of power transistors. Devices used in this study include TO-66 and TO-3 encased devices, of both mesa and planar structure, with clip and wire leads, manufactured by a variety of techniques (epi-base, single-diffused, and multiple-diffused).

15494. Stenbakken, G. N., Phillips, W. E., Bergsman, S. E., **Terms and definitions for intrusion alarm systems,** *LESP-RPT-0305.00,* 16 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

Key words: alarms; burglar alarms; intrusion alarms; intrusion detection.

This document provides definitions in layman language of terms commonly used in the commercial intrusion alarm field.

15495. Davis, R. M., **Quality software can change the computer industry,** (Proc. Symp. on Computer Program Test Methods, Chapel Hill, N.C., June 21-23, 1972), Paper in *Program Test Methods,* W. C. Hetzel, Ed., pp. 303-311 (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1973).

Key words: buyer; computer software; marketplace; performance measurement; quality; seller; specifications; validation.

There is probably no more elusive commodity bought and sold today than computer software. We have the almost ludicrous situation of a marketplace where the buyer does not know how to describe his product. The software market practices now existing in software transactions can be displaced by imposing quality control procedures during software production, by demanding specifications or documentation at the time of software transaction and by utilizing validation services and performance measurement services to support the buyer of software.

15496. Cali, J. P., **Meaningful measurement in clinical chemistry,** *Proc. San Diego Biomedical Symp., San Diego, Calif., Feb. 6-8, 1974,* **13,** 499-505 (1974).

Key words: accuracy; clinical chemistry; measurement; reference methods; standard reference materials.

Compatibility of measurement in clinical chemistry is of utmost importance if results are to be comparable between laboratories and across time and distance. It is shown that compatibility may most easily be brought about on a measurement system based on accuracy. Five components are required to bring about meaningful measurement in clinical chemistry: (1) A rational, self-consistent system of units of measurement; (2) The materials to realize in practice the defined units and their derivatives; (3) The availability of accurate methods of measurement, analysis, or test based on the well-characterized materials (SRM) of 2; (4) The transfer method; (5) The assurance of the long-term integrity of the measurement process.

The National Bureau of Standards (NBS) is now providing a comprehensive supply of SRM's for the clinical chemistry laboratory. In addition, it is cooperating with professional societies and other government agencies to help develop reference methods.

15497. Meyerson, M. R., **The role of the National Bureau of Standards in consumer product safety,** *Proc. Product Liability Prevention Conf., Newark College of Engineering, Newark, N.J., Aug. 22, 1974, IEEE Catalog 74CHO911-8R*, pp. 149-152 (1974).

Key words: consumer; product safety; regulation; standards.

A short history of NBS contributions to consumer product safety is presented. The role of NBS in providing technical support to Federal regulatory agencies, including the Consumer Product Safety Commission, is discussed; several safety-related research projects are described.

15498. Davis, R. M., **National Bureau of Standards: Its role in computer security,** *Proc. IBM Data Security Symp., Cambridge, Mass., Apr. 10-11, 1973*, Paper G-520-2838, 11 pages (1973).

Key words: Brooks Bill; computer security; congressional concern; controlled accessibility; data sensitivity; measures of risk; standards; user identification.

Problems of computer security are a major impediment to effective computer utilization today. These problems have technological, legal, moral and ethical aspects. The National Bureau of Standards is concentrating its efforts on the technological aspects of computer security. This NBS project is entitled "Controlled Accessibility to Computer Systems." There is considerable national concern over computer security expressed by Congress, Federal, state and local governments, private groups and citizen committees. The NBS efforts are aimed at meeting these concerns through the development and issuance of guidelines, quantitative measures of risk and effectiveness and standards. These mechanisms for resolving the problem are intended principally for government use although they should be of nearly equivalent utility in the private sector.

15499. Miller, G. K., **Shirley Highway Bus-On-Freeway Project evaluation study,** (Proc. Social Experiments & Social Program Evaluation Symp., Gaithersburg, Md., May 22, 1972), Paper in *Social Experiments and Social Program Evaluation*, pp. 40-53 (Ballinger Publ. Co., 1974).

Key words: bus-on-freeway demonstration project; bus rider surveys; bus system evaluation; bus transit; traffic monitoring.

The Shirley Highway Bus-on-Freeway Demonstration Project seeks to ease traffic congestion and shorten travel times for bus and auto travelers commuting during rush hour periods via the Shirley Highway Corridor from Northern Virginia suburbs to employment centers in Washington, D.C. This and other project goals, which include reducing vehicle-caused air pollution and improving bus service, can be attained by effecting an auto-to-bus modal shift by persons commuting via the Corridor area. Three project elements—(1) an exclusive bus lane on the Shirley Highway and bus priority lanes within the District of Columbia; (2) improved bus service including new-look/new-feature buses; and (3) park-and-ride facilities will, according to the premise under which the project was conceived, effect this modal shift and achieve a substantially increased bus market share. The demonstration project is sponsored by the Department of Transportation.

The Technical Analysis Division, National Bureau of Standards, is evaluating project performance with emphasis on the effectiveness of the three project elements. This paper describes evaluation procedures used during the first year and identifies difficulties encountered with various monitoring procedures, as well as presenting preliminary conclusions and plans for future activities.

15500. Pallett, D. S., **Noise and the national measurement system,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975*, W. W. Lang, Ed., pp. 157-182 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

Key words: acoustical measurements; acoustics; national measurement system; noise; noise control; noise emission; sound.

This paper indicates the relationship of the acoustical measurements required for the effective implementation of noise abatement and control to the social system termed the National Measurement System. The relevant physical quantities being measured are described, and the infrastructure of the relevant acoustical standardization institutions is indicated. The interactions occurring between the participants in the system are specified, and the impacts, status and trends of the system in adapting to changing technology are discussed. Finally, the interactive role of NBS in the National Measurement System is briefly outlined.

15501. Pallett, D. S., **INCE laboratory measurements survey,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975*, W. W. Lang, Ed., pp. 313-316 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

Key words: acoustical measurements; acoustics; impact noise; noise emission; reverberation rooms; sound transmission.

A detailed (eight-page) questionnaire dealing with "Laboratory Measurements of Noise Emission and of Acoustical Properties of Building Elements and Materials" was developed by an INCE Measurement Survey Task Group. Copies of this questionnaire were distributed to more than 120 organizations believed to possess acoustical laboratory facilities. Since acoustical measurements are an integral element in the conduct of acoustical research, it is believed that the results of this survey will be important in the development of research priorities. This paper provides a qualitative description of the questionnaire in order to indicate its scope.

15502. Magrab, E. B., Leasure, W. A., Jr., **Research in acoustics and noise measurements at the National Bureau of Standards,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975*, W. W. Lang, Ed., pp. 191-200 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

Key words: audiometric standards; building acoustics; community noise; earphones; environmental noise; instrumentation; measurement methodologies; microphones; psychoacoustics; reverberation room; sound level meters.

A brief description of the National Bureau of Standards' recent research activities in acoustics and noise measurements is presented.

15503. Somes, N. F., **Factors influencing structural safety,** Paper 48-7 in *Industrialization in Concrete Building Construction, ACI Publ. SP48,* pp. 177-189 (American Concrete Institute, Detroit, Mich., 1975).

Key words: buildings; codes; design criteria; regulatory system; safety; standards; structural loading.

The paper identifies and briefly discusses the factors that collectively influence the structural safety of a building. These include the probability of occurrence of extreme loading, the factors of design and construction process that determine the building's response, and the function of the building that influences both its design and the consequences of an extensive structural failure. Those factors within the sphere of influence and concern of individuals responsible for the design and supervision or regulation of construction are then discussed in further detail to point out deficiencies in current knowledge or practice. Finally, conclusions and recommendations are made with respect to these deficiencies.

15504. Troy, T. N., **Working hand in hand with government,** (Proc. 36th Annual National Packaging Forum, Chicago, Ill., Oct. 7-9, 1974), *Packaging Report F-7432,* 10 pages (The Packaging Institute, U.S.A., New York, N.Y., 1974).

Key words: consumer activism; control proliferation; industry; interaction; package quantity standards; voluntary standards; working with government.

Consumer activism and concomitant opening-up of agency activities means industries must reevaluate their strategies for working with government. NBS, short on regulatory authority but holding a strong suit in technology, is sensitized to economic realities and encourages interaction. Getting your story told early and often, can lead to effective voluntary standards and perhaps draw praise from enlightened consumer advocates. Since inflation and metrication portend another effort to control the proliferation of the number of package sizes, industry may want to reconsider their package quantity standards.

15505. McDaniel, C. L., Plante, E. R., **Phase relations involving seed-electrode-insulator materials in MHD,** *Proc. 14th Symp. on Engineering Aspects of Magnetohydrodynamics, Tullahoma, Tenn., Apr. 8-10, 1974,* pp. IV.6.1-IV.6.4 (University of Tennessee, Tullahoma, Tenn., 1974).

Key words: K_2SO_4-$LaCrO_3$ system; K_2SO_4-MgO system; phase relations; vapor pressure; vaporization equilibria.

The phase relations for the K_2SO_4-MgO and K_2SO_4-$LaCrO_3$ systems were determined using quenching techniques along with x-ray diffraction and DTA data. The systems were studied in open and closed Pt containers. The K_2SO_4-MgO system is a simple eutectic-type with the eutectic located at 1067 °C and ~2 mol percent MgO. A vaporization equilibria diagram was determined from calculations based on data from the condensed state phase diagram and thermodynamic data for pure K_2SO_4 assuming ideal behavior. Temperatures at which vapor-liquid equilibria occur were calculated for total pressures of 0.01, 0.1, and 1 atm. Similar principles were applied to predict condensation temperatures when combustion gases are present. Condensed state phase relations for the system K_2SO_4-$LaCrO_3$ were determined utilizing sealed Pt tubes for specimen containers. The K_2SO_4-$LaCrO_3$ system is a simple eutectic-type with the eutectic located at 1063 °C and ~2 mol percent $LaCrO_3$. The K_2SO_4-$LaCrO_3$ system in air (open system) is more complex and can not be represented by a binary-type system.

15506. DeGraaf, L. A., Rush, J. J., Livingston, R. C., **Neutron scattering study of the rotational motions and phase transitions in sodium- and caesium-hydrosulfides,** (Proc. IAEA 5th Symp. on Neutron Inelastic Scattering, Grenoble, France, March 1972), Paper IAEA-SM-155/B-6 in *Neutron Inelastic Scattering,* pp. 247-258 (International Atomic Energy Agency, Vienna, Austria, 1972).

Key words: hydrosulfides; libration; neutron scattering; phase transition; quasi-elastic scattering.

The atomic motions in sodium- and caesium-hydrosulfide have been studied with inelastic neutron scattering using a hybrid time-of-flight spectrometer at the NBS reactor. The incident neutron wavelength was 2.43 Å, the time-of-flight resolution 3.7 percent, and the momentum transfer range for elastic scattering covered in this experiment was 0.4-3.5 $Å^{-1}$. NaSH and CsSH are members of a broad group of compounds $M^+(XY)^-$ which have cubic symmetry in the crystalline phase just below the melting point, and a lower symmetry at temperatures below a crystal phase transition point. The measured inelastic neutron scattering spectra above and below the phase transition showed that librational motions about equilibrium orientations persist in passing through the transition. A temperature- and momentum-transfer(Q)-dependent broadening of the quasi-elastic scattering peaks, however, indicates a rapid reorientation of the SH^- ions in the high-temperature cubic phases. The experimentally obtained quasi-elastic scattering peaks have been compared with predictions for the shape of the quasi-elastic scattering as derived from different models, in which the SH^- ions were assumed to reorient with rapid jumps between a limited number of quasi-equilibrium orientations. Plots of the experimental full width at half maximum of the quasi-elastic peaks versus Q show oscillations as predicted by the theoretical calculations. The differences in the rotational disorder in the two compounds studied are discussed and relaxation times τ and activation energies for the SH^- motions are given. The τ values derived for fcc NaSH vary from 0.4 to 0.2 ps between T=103 °C and T=212 °C, while the values for bcc CsSH vary from 2 ps (T=23 °C) to 0.90 ps (T=140 °C).

15507. Yokel, F. Y., Dikkers, R. D., Fattal, S. G., **Strength of load-bearing masonry walls,** *J. Structural Div. Proc. ASCE ST5,* 948-950 (May 1973).

Key words: bricks; buckling; deflection; loads (forces); masonry; moments; slenderness ratio; stability; structural engineering; walls.

This is a closure of the American Society of Civil Engineers Proceedings Paper 8143, published in May 1971.

15508. Mitchell, R. A., Woolley, R. M., Chwirut, D. J., **Analysis of composite-reinforced cutouts and cracks,** *AIAA J.* **13,** No. 6, 744-749 (June 1975).

Key words: adhesively bonded joints; composite materials; composite-overlay reinforcement; contour plotting; cracks, reinforcement of; cutouts, reinforcement of; finite element analysis; joints, adhesively bonded; reinforcement, composite overlay; reinforcement, cutouts and cracks.

Finite element computer analyses of the reinforcement of cutouts and cracks in metal sheet, by bonded overlays of composite material, are described. The analyses articulate the separate responses of the sheet, the overlays, and the adhesive. Contour plots of computed stress and strain fields are automatically generated by the computer programs. Strains measured on the

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surfaces of several reinforced-sheet tensile specimens were, for the most part, in good agreement with strains predicted by the analyses. Qualitative correlations between certain failure modes observed in the test specimens and the stress distributions given by finite element analysis are apparent. The same analytical approach is currently being used to study weld/bond and fastener/bond joints, and it could be used to study other problems such as hole repair in metal or composite sheet and embedded defects in laminar material.

15509. Reneker, D. H., Martin, G. M., Rubin, R. J., Colson, J. P., **Effect of polymeric structure on the permeation rate in standard reference material sulfur dioxide permeation tubes,** (Proc. Society of Plastics Engineers ANTEC Conf., San Francisco, Calif., May 1974), *Polym. Eng. Sci.* **15,** No. 1, 11-15 (Jan. 1975).

Key words: density; fluorocarbon copolymer; morphology; permeation; permeation tubes; polymer structure; sulfur dioxide.

Liquid SO_2 sealed into tubes made of a fluorocarbon copolymer permeates the walls of the tube at a temperature-dependent but accurately reproducible rate. Sulfur dioxide dispensers made in this way are called permeation tubes and are useful for calibrating instruments that measure SO_2 concentrations in air. The National Bureau of Standards calibrates SO_2 permeation tubes and makes them available as Standard Reference Materials. The permeation rate in a batch of nominally identical tubes varies enough that each Standard Reference Material tube must be individually calibrated. Changes in the length or radial dimensions of the tubes are much too small to explain most of this variation. An excellent (negative) correlation is found between the measured permeation rate and the density of the polymer (or weight per unit length). Since both the measured density and the permeation rate for this semi-crystalline polymer depend upon morphological factors, but in different ways, x-ray diffraction measurements of the thickness and orientation of the lamellar crystals were made and a mathematical model was set up to identify the morphological factors which can cause variations in the permeation rate.

15510. Schneider, S. J., Capps, W., Frederikse, H. P. R., Hosler, W. R., McDaniel, C. L., Plante, E. R., *Proc. US-USSR Colloquium on MHD Power Generation, Moscow, USSR, Feb. 25-27, 1974,* pp. 350-367 (Institute of High Temperatures, Moscow, USSR, 1975).

Key words: electrical conductivity; MHD materials; phase equilibrium; slag; vaporization; viscosity.

The National Bureau of Standards, under sponsorship of the Office of Coal Research, has initiated a program of materials research appropriate to open cycle, coal fired MHD. The program consists of several interrelated projects in the areas of vaporization, viscosity, electrical conductivity and phase equilibria. This paper is intended as a review of the progress achieved thus far. Initial work has concentrated on the behavior of coal slag in MHD environment since there is definite lack of data in this area. Slag specimens have been obtained under real MHD conditions and analyzed by a variety of techniques. For the most part slags are composed largely of Al_2O_3-FeO-Fe_2O_3-SiO_2 mixtures. The portions of each as well as the amount of glassy (liquid) or crystalline material vary depending upon the location sampled in the MHD system. From the data obtained on real slags, synthetic model slags were prepared for more systematic study. Viscosity-temperature relationships of both real and model slags indicate similar temperature coefficients but large differences in viscosity values at one given temperature (e.g, at 1500 °C viscosity range between 1.0 to 2.1 $\log_{10}$ poises). The electrical conductivity of a number of slags have also been determined to 1700 K in various environments. Electrical conduction is apparently caused by the transfer of electrons between Fe^{2+} and Fe^{3+} and is largely electronic rather than ionic. Vaporization studies have concentrated on the evaporation behavior of synthetic slags under their own vapor pressure. These data indicate the initial stages of evaporation are governed by a nonequilibrium process involving the decomposition of Fe_3O_4. Equilibrium, however, is achieved with respect to the evaporation of SiO_2 from the slag solution (activity of SiO_2 is near unity). Important also to MHD is the effect of seed reactions on insulators and electrodes. In this respect the phase equilibrium diagrams for the K_2SO_4-MgO and the K_2SO_4-$LaCrO_3$ system have been determined. Both systems (under their own vapor pressure) behave in a similar manner with melting beginning a few degrees below the melting point of K_2SO_4 (1069 °C).

15511. Whittaker, J. K., **A signal processing system for a semiconductor detector ladder,** *Proc. IEEE Thirteenth Scintillation and Semiconductor Counter Symp., Washington, D.C., Mar. 1-3, 1972,* pp. 444-452 (June 1972).

Key words: computer; detector-ray; discriminator; emitter-couple; integrated circuit; signal processor.

The resolution of the NBS high resolution electron spectrometer has been improved recently by installing a new 48 channel detector array at its focal plane, in place of the original channel array that has been in use for some time. This has necessitated the design and construction of a new electronics system to accommodate the increased amount of information from the detectors. The new detector system digitally processes the signals from the detectors after amplification and discrimination. It is coupled on line to a computer which accumulates and manipulates the processed data.

An effective and economical solution has been found for the construction of a large logic network for nuclear data accumulation. The functions provided are those normally found only in modular form; e.g., coincidence, with the necessary time resolution. Time differences for simultaneous signal paths have been restricted to ± 1 ns maximum with a minimum pulse width of 5 ns for any pulse input. The entire system is dc coupled and the pulse pair resolution, measured during construction, is 10 ns.

15512. White, H. J., Jr., **Data centers and data evaluation,** *Proc. Conf. on Thermodynamics and National Energy Problems, Warrenton, Va., June 10-12, 1974,* pp. 372-382 (National Academy of Sciences, Washington, D.C., 1975).

Key words: data center; data compilation; data evaluation; energy program; thermodynamics; transport properties.

The expected uses for numerical data in the national energy program are discussed. The uses and activities of mission-oriented data centers and discipline-oriented data centers in mission-oriented tasks are also discussed. It is concluded that both types of activities will be needed for the effective carrying out of currently proposed energy initiatives. A listing of existing discipline-oriented data centers in the area of thermodynamics and transport properties that could make a contribution to a national energy program is given.

15513. Eisenhart, C., **Samuel S. Wilks and the army experiment design conference series,** *Proc. Twentieth Conf. on the Design of Experiments in Army Research Development and Testing, Ft. Belvoir, Va., Oct. 23-25, 1974,* ARO Report 75-2, Pt. 1, 1-47 (Army Dept., Chief of Research, Development and Acquisition, 1974).

Key words: Annals of Mathematical Statistics; Army Experiment Design Conferences; Dodd, E. L.; educational testing; history of mathematical statistics in the U.S.A.; Hotelling, Harold; likelihood-ratio tests; multivariate analysis; order statistics; Princeton University; Rietz, H. L.; Shewhart, W. A.; statistical tolerance limits; Wilks, S. S.; Wishart, John.

A biography of Professor Samuel Stanley Wilks (1906-1964) of Princeton University, with particular attention to his early life, notes on the persons who shaped his professional development, review of his many facetted professional career and his role in initiating and launching the U.S. Army's annual series of Conferences on the Design of Experiments in Army Research, Development and Testing.

15514. Yokel, F. Y., **Stability and load capacity of members with no tensile strength,** *J. Structural Div. Proc. ASCE ST4*, 788-789 (Apr. 1973).

Key words: buckling; compression members; concrete; cracking; deflection; eccentricity; equilibrium; loads (forces); masonry; stability; stress distribution; structural engineering.

This is a closure of the discussion of ASCE Proceedings Paper 8253 by Felix Y. Yokel.

15515. Ludtke, P. R., **Register of hydrogen technology experts,** *NASA CR-2624*, 80 pages (National Aeronautics and Space Administration, Washington, D.C., Oct. 1975). (Available from National Technical Information Service, Springfield, Va. 22161.)

Key words: accident investigation; hydrogen energy systems; hydrogen experts; hydrogen fuel; hydrogen production; hydrogen properties experts; hydrogen safety; hydrogen systems; hydrogen technology; hydrogen transportation.

This register presents the names of approximately 235 individuals who are considered experts, or very knowledgeable, in various fields of technology related to hydrogen. Approximately 90 organizations are represented. Each person is listed by organizational affiliation, address, and principal area of expertise. The criteria for selection of names for the register are extensive experience in a given field of work, participation in or supervision of relevant research programs, contributions to the literature, or being recognized as an expert in a particular field. The purpose of the register is to present, in easy form, sources of dependable information regarding highly technical areas of hydrogen technology, with particular emphasis on safety. The register includes two indexes: an alphabetical listing of the experts and an alphabetical listing of the organizations with which they are affiliated.

15516. Kusch, P., Hessel, M. M., **Perturbations in the $A\ ^1\Sigma_u^+$ state of Na_2,** *J. Chem. Phys.* **63,** No. 9, 4087-4088 (Nov. 1, 1975).

Key words: alkali dimer; magnetic rotation; molecular constants; perturbations; sodium molecule; spectroscopy.

Perturbations have been observed in the $A\ ^1\Sigma_u^+$ state of the diatomic sodium molecule. For each rotational perturbation three discontinuities have been observed. This indicates the $^1\Sigma$ state is perturbed by a $^3\Pi$ state.

15517. Burns, G. W., Hurst, W. S., **Thermocouple thermometry,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement*, B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 144-161 (1975).

Key words: base-metal thermocouples; cryogenic thermocouples; noble-metal thermocouples; nonstandardized thermocouples; refractory metal thermocouples; standardization; temperature measurement; thermocouples; thermometry.

A broad overall view of the current status of thermocouple thermometry is given. The salient features and limitations of standard thermocouple types are reviewed, and some of the recent changes in standardization are noted. Some of the nonstandardized thermocouple types are discussed, giving particular attention to those employed at cryogenic temperatures and to those intended for use above the temperature limits or under conditions where the standard types are inadequate. Commonly used materials for insulation and protection are described, and some examples are noted of applications where stringent requirements are placed on thermocouple performance.

15518. Burley, N. A., Burns, G. W., Powell, R. L., **Nicrosil and Nisil: Their development and standardization,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement*, B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 162-171 (1975).

Key words: calibration; nickel-base alloys; nickel-chromium alloys; nickel-silicon alloys; reference tables; temperature measurements; thermal emf; thermocouples; thermoelectric reference data; thermometry.

This paper reviews the development of the new nickel-base thermocouple alloys Nicrosil and Nisil by the Australian Defense Standards Laboratories (now the Materials Research Laboratories of the Australian Government Department of Defence), and their standardization by the U.S. National Bureau of Standards.

The relevant properties of the new alloys are described, and they are shown to have much higher environmental, structural and thermoelectrical stabilities, and to be more suitable for use at the higher operating temperatures, than existing Type K nickel-base thermocouple materials.

The standardization procedures are summarized, including the derivation of reference tables. Calibration data were obtained, over the range 5 K to 1575 K, from prototype alloys specially fabricated by five major manufacturers of base-metal thermocouple alloys in the UK, the USA and Sweden.

15519. Kidnay, A. J., Miller, R. C., Parrish, W. R., Hiza, M. J., **Liquid-vapour phase equilibria in the $N_2 - CH_4$ system from 130 to 180 K,** *Cryogenics* **15,** No. 6, 531-540 (Sept. 1975).

Key words: Henry's constants; liquid-vapor phase equilibria; methane; nitrogen.

Isothermal composition measurements for both the equilibrium liquid and vapour phases have been determined for the nitrogen + methane system at eight temperatures between 112.00 and 180.00 K, and at pressures from 1 to 49 atm (1 to 50 bar). The internal consistency of these data is checked by comparing experimental and calculated thermodynamically consistent vapour phase compositions. Derived Henry's constants are used to provide a comparison between these data and those of other investigators.

15520. Ekin, J. W., **Critical currents in granular superconductors,** *Phys. Rev. B* **12,** No. 7, 2676-2681 (Oct. 1, 1975).

Key words: critical current densities; critical currents; granular aluminum films; granular films; Type II superconducting films; vortex pinning.

A relatively simple principle is experimentally demonstrated for producing extremely low critical-current density materials for application in quantum flux-flow devices. Essentially the technique consists of making the scale of structural disorder in the material small compared with the vortex core size. The smaller this ratio, the smaller the effects of bulk pinning, and the smaller the resulting critical-current density. Data for this study were obtained using superconducting granular aluminum films evaporated in a cylindrical geometry designed to eliminate edge-pinning effects. The data show J_c to exhibit a sharp minimum as a function of grain size, with the lowest values of J_c occurring in those films having the smallest ratio $\langle D\rangle/(\zeta_0 l)^{1/2}$. Here $\langle D\rangle$ is the average grain size, ζ_0 is the BCS coherence length, and l is the electronic mean free path. The normal-state resistivity ρ_n can be used as an index of $\langle D\rangle/(\zeta_0 l)^{1/2}$ for the granular aluminum system, with the lowest critical-current densities occurring in films prepared to have a ρ_n of about 10 $\mu\Omega$ cm. In addition to discussing the dependence of the critical current on microstructure, data on the temperature dependence and electric field dependence of J_c are presented.

15521. Ely, J. F., Hanley, H. J. M., **The statistical mechanics of non-spherical polyatomic molecules. Application to the properties of carbon dioxide,** *Mol. Phys.* **30,** No. 2, 565-578 (1975).

Key words: carbon dioxide; Clausius-Mossotti function; intermolecular forces; m-6-8 potential quadrupolar gas; second virial coefficient; viscosity coefficient.

Collision integrals and equilibrium pressure and dielectric second virial coefficients are calculated for a nonspherical m-6-8 model potential energy function. The results are applied in a correlation of the physical properties of carbon dioxide. It is shown that the inclusion of nonspherical contributions in the calculation of the collision integrals has a small but significant effect with respect to the accurate representation of data. The Mason-Monchick approximation that nonspherical molecules collide with fixed relative orientations is briefly discussed. Agreement between calculated and experimental values for the viscosity coefficient, the thermal conductivity coefficient, the second virial coefficients and the isotopic thermal diffusion factor is generally satisfactory.

15522. Weston, W. F., Naimon, E. R., Ledbetter, H. M., **Low temperature elastic properties of aluminum 5083-0 and four ferritic nickel steels,** (Proc. American Society for Testing and Materials Symp. on Properties of Materials for Liquefied Natural Gas Tankage, Boston, Mass., May 21-22, 1974), *Am. Soc. Test. Mater. Spec. Tech. Publ.* **579,** pp. 397-420 (1975).

Key words: aluminum alloy; bulk modulus; compressibility; Debye temperature; elastic constant; nickel steels; Poisson's ratio; shear modulus; sound velocity; Young's modulus.

The low-temperature elastic properties have been determined for five commercial alloys that have possible structural applications at cryogenic temperatures. The alloys are 5083-0 aluminum and four ferritic steels: 3.5, 5, 6, and 9 percent nickel. An ultrasonic (10 MHz) pulse-superposition method was used to measure longitudinal and transverse wave velocities. Using the velocities and the mass density as input, the following elastic constants were calculated: longitudinal modulus, Young's (tensile) modulus, shear (rigidity) modulus, bulk modulus (reciprocal compressibility), and Poisson's ratio. Measurements were made semicontinuously from 300 to 4K. The room-temperature composition dependence of iron-nickel alloys is reviewed comprehensively up to 12 percent nickel. Debye temperatures were calculated from the elastic constants. A discussion is given of the temperature dependences of the elastic constants and differential relationships among the elastic constants.

15523. Weston, W. F., **Low-temperature elastic constants of a superconducting coil composite,** *J. Appl. Phys.* **46,** No. 10, 4458-4465 (Oct. 1975).

Key words: bulk modulus; composite; compressibility; elastic compliance; elastic stiffness; piezoelectric oscillator; Poisson's ratio; shear modulus; Young's modulus.

A resonant piezoelectric oscillator method for measuring elastic moduli was applied to composite materials. The complete set of elastic compliances of a superconducting coil composite was determined semicontinuously between 4 and 300 K. Also, two moduli of a layered fiber-glass-epoxy composite were determined; this composite is essentially the matrix material of the coil composite. The Young's moduli, shear moduli, Poisson ratios, and elastic stiffness coefficients are also reported. Results agree closely with elastic data obtained by conventional testing methods.

15524. Meijer, P. H. E., Niemeijer, T., **Quantum-mechanical approximation to the ground state of cerous magnesium nitrate,** *Phys. Rev. B* **11,** No. 7, 2612-2623 (Apr. 1, 1975).

Key words: antiferromagnetism; cerous magnesium nitrate; dipole-dipole coupling; ferromagnetism; ground state; permutation group; quantum mechanics; spin cluster; spin-Hamiltonian.

In this paper we perform a complete quantum-mechanical calculation of the ground-state energy of a system of spins 1/2 that are coupled by dipole-dipole forces. The only hypothesis used is the assumption that the ground state has two times the periodicity of the underlying magnetic lattice. This paper is the application to a specific crystal of results derived in a preceding paper. The Hamiltonian is decomposed in eight invariant pieces each with its own coupling constant. The basis wave functions are decomposed according to the eight one-dimensional representations of the permutation group that leaves the cluster invariant. The results are given in the form of tables applicable to any compound that has the spins situated on a Bravais lattice. The calculation is applied to cerous magnesium nitrate and we show that the results for the lowest state of each representation are leading to a spectrum that is different from the results obtained with the classical or Hartree method. Although the lowest state is still the same antiferromagnetic configuration, it turns out now that this state lies barely below the ferromagnetic state; the order in which the ferromagnetic and antiferromagnetic levels appear is different from the order obtained in a classical calculation.

15525. Arora, V. K., Peterson, R. L., **Quantum theory of Ohmic galvano- and thermomagnetic effects in semiconductors,** *Phys. Rev. B* **12,** No. 6, 2285-2296 (Sept. 15, 1975).

Key words: galvanomagnetism; quantum transport theory; semiconductors; thermomagnetism.

A density-matrix formalism developed earlier for the evaluation of Ohmic magnetoconductivity is further elaborated and applied to other magnetotransport effects in nonpolar semiconductors in the presence of a magnetic field of arbitrary strength. The difference from earlier transport theories lies in a natural extension of the scattering dynamics beyond the strict Born approximation. The well-known divergence difficulties of older theories, usually removed by any of a number of *ad hoc* cutoff procedures, do not appear here. The transverse-conductivity expression turns out to be equivalent to that of some earlier theories of cyclotron resonance extrapolated to zero frequency, but derived in a different way. When applied to elastic scattering of electrons in a simple model of a semiconductor, the theory gives galvanomagnetic and thermomagnetic coefficients within the range of values usually seen experimentally, showing the basic correctness of the theory. It is then applied to the magnetophonon effect, where the resonance peaks are shown to be finite. An interesting inversion of one of the peaks in the Ettingshausen-Nernst coefficient is found. Landau-level broadening and phonon drag are not included in the present paper, although they can be incorporated when deemed important.

15526. Soulen, R. J., Jr., Marshak, H., **The establishment of an absolute temperature scale using noise and nuclear orientation thermometry,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics-LT 14,* **4,** 60-63 (Am. Elsevier Publ. Co., New York, N.Y., 1975).

Key words: dilution refrigerators; γ-ray anisotropy thermometry; Josephson junctions; noise thermometry; temperature.

We report on the present status of a comparison of the temperatures obtained from a Josephson junction noise thermometer and a ^{60}Co γ-ray anisotropy thermometer. The data reported here cover the range of 12 to 35 mK in 16 steps varying from ~ 0.5 to ~ 2 mK. Owing to improvements in: temperature stability of our dilution refrigerator, analysis of noise thermometer data, and the γ-ray data acquisition system, these new results have considerably less scatter than those reported previously. The overall agreement between both thermometers is about 1 percent.

15527. Utton, D. B., Soulen, R. J., Jr., Marshak, H., **Intercomparison of temperature scales using low transition-temperature superconductors,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics-LT 14,* **4,** 76-79 (Am. Elsevier Publ. Co., New York, N.Y., 1975).

Key words: copper NMR thermometer; γ-ray thermometer; noise thermometer; superconductive transition temperatures; temperature.

Recent studies of several superconductors (W, Be, $Ir_{80}Rh_{20}$, Ir, $AuAl_2$, and $AuIn_2$) showed them to provide useful temperature reference temperatures below 0.5 K. Samples of each material were used to intercompare the temperature scales obtained from noise, γ-ray, and copper NMR thermometers from 0.024 to 0.208 K. The results of this intercomparison are given in tabular form.

15528. Naimon, E. R., Ledbetter, H. M., Weston, W. F., **Low-temperature elastic properties of four wrought and annealed aluminium alloys,** *J. Mater. Sci.* **10,** No. 8, 1309-1316 (Aug. 1975).

Key words: aluminium; aluminium alloys; bulk modulus; compressibility; Debye temperature; elastic constants; elasticity; Poisson ratio; pulse-echo method; sound velocity; Young's modulus.

The elastic properties of four annealed polycrystalline commercial aluminium alloys were studied between 4 and 300 K using a pulse-superposition method. Results are given for longitudinal sound velocity, transverse sound velocity, Young's modulus, shear modulus, bulk modulus (reciprocal compressibility), Poisson's ratio, and elastic Debye temperature. The elastic stiffnesses of the alloys increase 4 to 13 percent on cooling from room temperature to liquid helium temperature. The elastic constant-temperature curves exhibit regular behaviour.

15529. Miller, A., McLaughlin, W. L., **Imaging and measuring electron beam dose distributions using holographic interferometry,** *Nucl. Instrum. Methods* **128,** 337-346 (1975).

Key words: calorimetry; depth dose; dose distributions; dosimetry; electron beams; holographic interferometry; holography; isodose; radiation imaging; radiation measurements.

Holographic interferometry was used to image and measure ionizing radiation depth-dose and isodose distributions in transparent liquids. Both broad and narrowly collimated electron beams from accelerators (2-10 MeV) provided short irradiation times of 30 ns to 0.6 s. Holographic images and measurements of absorbed dose distributions were achieved in liquids of various densities and thermal properties and in water layers thinner than the electron range and with backings of materials of various densities and atomic numbers. The lowest detectable dose in some liquids was of the order of a few kRad. The precision limits of the measurement of dose were found to be ± 4 percent. The procedure was simple and the holographic equipment stable and compact, thus allowing experimentation under routine laboratory conditions and limited space.

15530. Tobler, R. L., Mikesell, R. P., Durcholz, R. L., Reed, R. P., **Low temperature fracture behavior of iron-nickel alloy steels,** (Proc. American Society for Testing and Materials Symp. on Properties of Materials for Liquefied Natural Gas Tankage, Boston, Mass., May 21-22, 1974), *Am. Soc. Test. Mater. Spec. Tech. Publ.* **579,** pp. 261-287 (1975).

Key words: crack propagation; cryogenics; fracture toughness; mechanical properties; nickel steels.

Fracture toughness tests over the interval 298 to 4 K and fatigue crack growth rate tests at 298, 111, and 76 K are reported on selected iron-nickel (Fe-Ni) alloys which are commercially available for potential use in storage or transportation of liquefied natural gas (LNG). These alloys include Fe-6Ni and Fe-5Ni in newly developed three-step heat treatments and Fe-9Ni in the quenched and tempered condition. Linear elastic fracture mechanics parameters (K_Q, K_{IC}) and J-integral (J_{IC}) test data are presented for 1.25-in.-thick compact specimens. Discussion includes comparisons of fatigue crack growth rate and fracture data between alloys.

15531. Brauer, G. M., Termini, D. J., **Modification of collagenous surfaces by grafting polymeric side chains to collagen and soft and hard tissues,** Chapter 8 in *Advances in Chemistry Series,* No. 145, pp. 175-195 (American Chemical Society, New York, N.Y., 1975).

Key words: bone; collagen; grafting modification of collagenous surfaces; hard tissue; rat skin; soft tissue.

Collagen, soft tissue, and bone can be modified at 37 °C by allowing them to react with acrylic, methacrylic, or vinyl monomers using ceric ions, persulfate-bisulfite or comonomers forming donor-acceptor complexes as initiators. The polymeric methacrylate side chain is chemically attached to collagen; similar bonding may occur on reaction with other monomers. With rat skin, the reaction takes place mainly at the surface whereas a higher yield of more homogeneous product is formed on grafting onto collagen. Grafting onto bone is best accomplished with persulfate-bisulfite initiator. Modification of the collagenous surface is indicated by changes in wettability, decreased water sorption, and improved resistance to mold growth; e.g, hydrophobic, oleophobic surfaces are obtained with fluorinated monomers. The modified surfaces could be useful as adhesion-promoting liners for restorative materials.

15532. Geltman, S., **Coulomb correction for strong-field multiphoton free-free absorption,** *J. Phys. B Letter to Editor* **8,** No. 15, L374-L376 (1975).

Key words: absorption; bremsstrahlung; electrons; ions; laser; plasma.

A correction factor, which arises from the logarithmic phase factor in Coulomb waves, is shown to be necessary in the treatment of multiphoton free-free absorption in ultrastrong laser fields.

15533. Weston, W. F., Ledbetter, H. M., **Low-temperature elastic properties of a nickel-chromium-iron-molybdenum alloy,** *Mater. Sci. Eng. Short Commun.* **20,** 287-290 (1975).

Key words: bulk modulus; compressibility; Debye temperature; elastic constants; nickel-base alloys; Poisson's ratio; shear modulus; sound velocity; Young's modulus.

The elastic properties of a nickel-chromium-iron-molybdenum alloy were determined between room temperature and liquid-helium temperature by measuring both the longitudinal and transverse sound-wave velocities in a polycrystalline material. These properties include: the longitudinal modulus, Young's modulus, the shear modulus, the bulk modulus (reciprocal compressibility), and Poisson's ratio. Except for a small anomaly in the bulk modulus, this material exhibits regular elastic-constant/temperature behavior.

15534. Petersen, F. R., Evenson, K. M., Jennings, D. A., Wells, J. S., Goto, K., Jiménez, J. J., **Far infrared frequency synthesis with stabilized CO_2 lasers: Accurate measurements of the water vapor and methyl alcohol laser frequencies,** *IEEE J. Quantum Electron.* **QE-11,** No. 10, 838-843 (Oct. 1975).

Key words: absolute frequency measurements; laser frequency synthesis; water vapor laser.

A far infrared (FIR) frequency synthesis technique using saturated-absorption stabilized CO_2 lasers and a point-contact diode has been used to measure frequencies of a number of strong CW H_2O, D_2O, and CH_3OH laser lines. The first frequency measurements of the 79-μm H_2O, the 73- and 108-μm D_2O, and 11 CO_2-pumped CW $^{12}CH_3{}^{16}OH$ laser lines are reported. This measurement is the first demonstration of the general usefulness of CO_2 lasers for accurate synthesis of FIR frequencies.

15535. Patel, P. R., Brown, W. E., **Thermodynamic solubility product of human tooth enamel: powdered sample,** *J. Dent. Res.* **54,** No. 4, 728-736 (1975).

Key words: dental caries; hydroxyapatite: ion activity product; solubility; tooth enamel.

Solubility of human dental enamel in H_3PO_4 was studied in the pH range of 4.5 to 7.6. Thermodynamic solubility of the enamel mineral was calculated in terms of the ion activity product, $(Ca^{2+})^5(PO_4{}^{3-})^3(OH^-)$, for hydroxyapatite. The solubility product varied from 7.2×10^{-53} to 6.4×10^{-58} mol^9 liter^{-9} depending on the cumulative amount of the dissolution of the solid in a series of repetitive sequences of solubility experiments.

15536. Molino, J. A., **A proposed method for measuring the annoyance due to speech interference by noise,** (Proc. NASA Minisymposium, Hampton, Va., Jan. 21-22, 1975), Paper in *NASA Technical Memorandum, Noise and Speech Interference Proceedings of Minisymposium,* W. T. Shepherd, Ed., NASA TM X-72696, 15 pages (Available from National Technical Information Service, Springfield, Va., 22151 and STIF/NASA Scientific and Technical Information Facility, College Park, Md., 20740, 1975).

Key words: aircraft noise; annoyance; noise: psychoacoustics; speech interference.

A method is proposed to measure both the interference of speech by noise and the annoyance caused by such interference. It is based upon a nonverbal preference procedure developed at the National Bureau of Standards called an "acoustic menu." Subjects listen to audible speech signals in a background of noise. At the same time the subjects are given a limited opportunity to select the background noise. By analyzing the preference structure for the various types of interfering noise, as well as the decrement in speech intelligibility suffered with each noise, information can be obtained on both annoyance and interference.

15537. Radebaugh, R., Holste, J. C., Siegwarth, J. D., **Thermometric characteristics of some 1/8 W carbon resistors in the millikelvin range,** *Proc. Fifth Int. Cryogenic Engineering Conference, Kyoto, Japan, May 7-10, 1974,* Paper H11, pp. 253-255 (IPC Science & Technical Press, Kent, England, 1974).

Key words: carbon resistors; cryogenics; liquid helium; millikelvin; thermometry.

Gotoh and Awano have reported on the useful characteristics of 1/8 watt 100 Ω Matsushita carbon resistors (grade ERC-18GK) as thermometers for the region 0.4 and 4.2 K. We report here measurements on the resistance characteristics of this grade of resistors from 11 mK to 4 K. Nominal resistances of 56 Ω, 100 Ω and 220 Ω have been measured. We find that the 56 Ω resistor is useful as a thermometer down to at least 11 mK. Its sensitivity increases rather rapidly below 100 mK, which is a desirable feature because it is in this region where measuring power levels must be kept extremely small. At 20 mK the resistance of the 56 Ω resistor is about 4000 Ω, that of the 100 Ω resistor is about 5×10^5 Ω, and that of the 220 Ω resistor is about 10^8 Ω. A comparison of the resistance behavior of units immersed in dilute He^3-He^4 with those outside the liquid will also be made.

15538. Haight, W. C., **Establishment of OS AIDS as an RTOS task,** *Interchange* **5,** No. 3, 5-6 (June 1974).

Key words: debugging; Interdata 70; OS AIDS; RTOS; software.

A technique is detailed that allows OS AIDS, a debugging utility program, to be established as an RTOS system task. This expands the RTOS environment to comprehensively support all phases of program preparation at the user level. Modifications that must be made to AIDS and to the Task Establisher Task, TET, prior to task creation are defined. Conceptual problems that can occur when AIDS runs in a multi-programming environment are discussed.

15539. Manning, J. R., **Theory of diffusion,** (Proc. American Society for Metals Seminar on Diffusion, Cleveland, Ohio, Oct. 13-14, 1972), Chapter 1 in *Diffusion,* pp. 1-24 (American Society for Metals, Metals Park, Ohio, 1973).

Key words: atomic diffusion mechanisms: diffusion; random walk; review article; thermodynamic diffusion equations; vacancy diffusion mechanisms.

A survey of the theory of diffusion with emphasis on the role of atomic diffusion mechanisms. Random walk diffusion equations, modifications of these equations by atomic driving forces, correlation effects, vacancy wind effects, temperature and pressure dependences, the general thermodynamic diffusion equations, and the relation of planar diffusion to three-dimensional diffusion and the diffusion tensor are discussed.

15540. Goodman, L. J., Colvett, R. D., Caswell, R. S., **An international neutron dosimetry intercomparison,** *Proc. Second Symp. on Neutron Dosimetry in Biology and Medicine, Neuherberg/Munchen, Germany, Sept. 30-Oct. 4, 1974,* EUR 5273d-e-f, pp. 627-662 (1974).

Key words: absorbed dose; intercomparison: kerma; neutron dosimetry; neutron radiobiology; neutron therapy.

An International Neutron Dosimetry Intercomparison, sponsored by the International Commission on Radiation Units and

Measurements, has been completed at the Radiological Research Accelerator Facility at Brookhaven National Laboratory. Fourteen groups of scientists, from six countries, performed measurements to determine the separate neutron and photon (x- and gamma-ray) tissue kermas in free air for four energies of monoenergetic neutrons, 15.5, 5.5, 2.1, and 0.67 MeV, and for a source of fission neutrons, ^{252}Cf. For the two highest energies, measurements were also made to determine the separate absorbed doses in tissue of neutrons and of photons at three depths in a large water phantom.

15541. Rosenthal, R., **Accessing online network resources with a network access machine,** *Proc. IEEE Intercon 1975 Conf. Record on Access to Computer Networks, Session 25, New York, N.Y., Apr. 8-10, 1974,* 4 pages (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1974).

Key words: access procedures; command language; computer networks; macros; minicomputers; protocols.

While a large variety of computer resources is available to online users of computer networks, access to these resources is often complex and cumbersome. This paper describes a Network Access Machine (NAM) which acts as a network access point for a user at his terminal and assists the user through the automatic execution of access procedures.

15542. Manning, J. R., **Non-random diffusion in ionic crystals,** (Proc. Conf. on Mass Transport Phenomena in Ceramics, Cleveland, Ohio, June 3-5, 1974), Chapter in *Mass Transport Phenomena in Ceramics,* A. R. Cooper and A. H. Heuer, Eds., pp. 1-15 (Plenum Press, New York, N.Y., 1975).

Key words: correlation factor; diffusion; divacancy; driving force for diffusion; impurity diffusion; ion drift velocity; nonrandom diffusion; vacancy wind effect.

Nonrandom diffusion can result both from the presence of atomic driving forces and from the motion of defects in a crystal. Defect-related nonrandom effects appear in two different ways in the kinetic diffusion equations, as correlation effects and as defect-wind effects. The origins of these effects during diffusion in a driving force are discussed. Kinetic expressions for the drift velocity $\langle v_F \rangle$ are derived from expressions for the effective frequencies of independent atom jumps and are related to the tracer diffusion coefficient D^*. For impurity diffusion in an electric field, deviations from the Nernst-Einstein relation result from defect-wind effects. Recently developed equations for the ionic-impurity drift-mobility when diffusion occurs via divacancies moving on one of the sub-lattices in the NaCl structure are summarized. Possible extensions of the simple equations used here to more complex situations are discussed.

15543. Roestamsjah, Wall, L. A., Florin, R. E., Aldridge, M. H., Fetters, L. J., **Degrading mixtures of monodisperse poly-α-methylstyrenes: Rates and anomalous molecular weight distributions,** *J. Polym. Sci. Polym. Phys. Ed.* **13,** 1783-1787 (1975).

Key words: mixtures; molecular weight distribution; monodisperse poly-α-methylstyrene; thermal degradation.

When a mixture of two monodisperse samples of poly-α-methylstyrene is thermally degraded, the components behave independently as a first approximation, as shown by GPC and rate of volatilization data. The ratio M_w/M_n, before approaching the ultimate value of 2.0, first goes through a minimum at a much lower value.

15544. Rosenthal, R., Watkins, S. W., **Automated access to network resources. A network access machine,** *Proc. 1974 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., May 23, 1974,* pp. 47-50 (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1974).

Key words: automated computer access; computer networking; macro processor; minicomputer-based systems; operating systems.

A minicomputer based Network Access Machine to establish the access path between a user at a terminal and a computer network resource is described. The minicomputer maintains a file directory from which access procedures are referenced. Access procedures take the form of macros which expand to produce machine dependent dialogue. The dialogue consists of the messages to be sent to the computer network and the expected responses. Actual responses are compared with the expected response to ensure that resource access is proceeding normally.

15545. Fife, D. W., **Network management for expanded resource sharing,** (Proc. EDUCOM Fall Conf., Princeton, N.J., Oct. 9-11, 1973), Chapter 7 in *Facts and Futures,* pp. 55-61 (The Interuniversity Communications Council, Princeton, N.J., 1974).

Key words: computer network management; computer networking research; management evaluation; resource sharing.

Computer networking technology is adequately developed now to support research and experimentation to expand computing resource sharing. Whether progress will be made depends upon organizational initiative among multiple institutions, to pool personnel and capital so as to effectively address the major issues in management approach, support and software design that limit the feasible interdependence of computing operations. The organizational requirements are partially revealed by examining progressive stages of resource sharing in organizational and operational terms rather than such technical aspects as load sharing or program sharing that have been introduced in the past. Five stages are identified, ranging from simply establishing multiple service access to the advanced stage where multiple institutions organize for joint development of new resources. A preliminary evaluation framework for new management arrangements results when these stages are mapped against the four functional levels inherent in computer network management.

15546. Unassigned.

15547. Cotton, I. W., **Network management survey,** *Proc. Hawaii Int. Conf. on Systems Sciences, Univ. of Hawaii, Honolulu, Hawaii, Jan. 8-10, 1974,* 4 pages (1974).

Key words: computer network; management; network.

This report presents a condensation of the results of a study of management practices in different computer networks. Five networks were chosen as typical of different approaches to network implementation and management: Advanced Research Projects Agency (ARPA) Network, MERIT Network, Triangle Universities Computation Center (TUCC), Oregon State Regional Network, and Tymnet, a commercial network. A common format is employed to survey each network.

15548. Newbury, D. E., **The origin, detection, and uses of electron channelling contrast,** *Proc. 7th Scanning Electron Microscopy Symp., Chicago, Ill., Apr. 8-11, 1974,* pp. 1047-1054 (IIT Research Institute, Chicago, Ill., 1974).

Key words: bend contours; contrast formation; crystalline materials; electron channelling contrast; electron channelling patterns; scanning electron microscope.

In the scanning electron microscope contrast can be obtained which is related to the crystallographic nature of a specimen through the mechanism of electron channelling. This contrast originates from the periodic arrangement of atoms in a crystal and depends on the angular relationship between the beam and the lattice. When the beam is caused to sweep through a range of angles greater than the Bragg angle while confined to a single crystal, a contrast pattern, called an electron channelling pattern (ECP), results. This pattern is uniquely related to the orientation of the crystal and it can therefore be used to orient a crystal relative to the beam. Instrument techniques have been developed to obtain useful ECP's from selected areas as small as 1 μm in diameter (selected area channelling patterns, SACP). Electron channelling contrast can also be used in conventional microscopy to reveal grains, twins, and other crystallographic features in polycrystalline microstructures.

This tutorial paper discusses briefly the origin of electron channelling contrast. The stringent electron-optical conditions required to detect the contrast are described. The formation of the ECP and the SACP technique are discussed. Finally, the use of electron channelling contrast in conventional micrograph operation and the types of information which can be obtained are described.

15549. Berger, H., **An evaluation of radiographic paper for thermal-neutron radiography,** *Proc. American Nuclear Society Meeting, New Orleans, La., June 8, 1975,* pp. 148-149 (1975).

Key words: image quality; neutron converters; neutron radiography; neutron scintillator; thermal neutron detection; x-radiographic paper.

X-ray sensitive paper is evaluated for use as an image detector for thermal neutron radiography. With a gadolinium oxysulfide scintillator the paper requires an exposure of 6×10^7 n/cm^2 and yields a radiograph displaying 25 to 50 μm spatial resolution and 4 to 6 percent contrast. The paper is convenient (10 second processing) and inexpensive, and provides good quality images.

15550. Haight, W. C., Hawes, H. W., **An automated tuneup—Calibration of jet engine fuel controls,** *Proc. 1974 ASSC Conf. Record on Automated Support Systems for Advanced Maintainability, San Diego, Calif., Oct. 30—Nov. 1, 1974,* 12 pages (IEEE Aerospace and Electronics Systems Society, San Diego, Calif., 1974).

Key words: automation; calibration; fuel control; jet engine; minicomputer; multi-task; performance testing; process control; real-time; RTOS.

The National Bureau of Standards (NBS) has designed an automated process control system for the calibration of jet engine fuel controls. The principal aim of this system is to relieve the test operator of the necessity of setting up test conditions and to provide a means of fast and accurate data acquisition. When operated under a vendor-supplied real-time operating system, the NBS software affords ease of modification to suit changing test requirements, ease of maintenance, and a degree of transferability between similar applications. Attributes contributing to these design goals include a modular program structure, use of a high-level programming language (FORTRAN) for applications routines, a well-structured file system and utility package, and a mnemonic test-oriented language developed for coding test procedures.

15551. Krauss, M., Neumann, D., **The dipole moment function of CO($a^3\Pi$),** *Mol. Phys.* **30,** No. 4, 1015-1020 (1975).

Key words: $a^3\Pi$; CO; dipole moment; excited state; SCF; vibrational transition intensities.

The dipole moment function of the $a^3\Pi$ state of CO is calculated using the multi-configuration self-consistent-field method of Wahl and Das. Only the dominant valence charge-transfer correlation configurations are mixed with the Hartree-Fock configuration since only the region between the classical turning points of the $v = 1$ vibrational level is considered. The calculated function does not agree with the shape of the fitted dipole moment function of Wicke *et al.* Configurations chosen on the basis of the model of optimized valence configurations do not determine an accurate dipole moment function for an open shell system.

15552. Hughes, E. E., Taylor, J. K., **Accurate gas standards for air pollution analyses,** *Proc. WMO/WHO Tech. Conf. on Observation and Measurement of Atmospheric Pollution, Helsinki, Finland, July 30-Aug. 4, 1973,* pp. 1-13 (World Meteorological Organization, Geneva, Switzerland, 1974).

Key words: air pollution; carbon monoxide; gas analysis; permeation tubes; propane; sulfur dioxide.

The preparation of standards for the measurement of a particular pollutant, either at ambient levels or at source concentrations, requires either an absolute method of preparation or an accurate method of analysis. Few, if any, accurate methods of analysis are applicable at the low concentrations generally associated with air pollution and consequently, most standards have been prepared in this laboratory by a gravimetric technique. The factors which effect the degree of accuracy which can be attained are discussed in detail for the following gases: nitric oxide, nitrogen dioxide, carbon monoxide, carbon dioxide, sulfur dioxide, hydrocarbons, and oxygen. In general, an uncertainty of less than ± 1 percent can be achieved for these substances at concentrations where their mixtures with air or nitrogen are stable. The stability of these mixtures is, therefore, an equally important consideration in the preparation of accurate gas standards. The instability is either due to reaction within the container between the components of the mixture or between a component and the material of the container, or is due to adsorption on the walls of the container. Methods of assessing the degree of instability and methods of preventing it are discussed.

15553. Beaty, E. C., **Measurements of the energy and angular distribution of secondary electrons,** *Radiat. Res.* **64,** 70-79 (1975).

Key words: cross sections; electron impact; electrons, secondary; ionization.

Measurements have been made of the distribution in energy and angle of secondary electrons from ionizing collisions of electrons with several atoms and molecules. Such data have been published for a wide range of the relevant variables. Some of these measurements have now been repeated in other laboratories. Some recent interpretive efforts also reveal trends in the data that were not previously apparent.

15554. Peterlin, A., **Plastic deformation of polymers with fibrous structure,** *Colloid Polym. Sci.* **253,** No. 10, 809-823 (1975).

Key words: fibrous structure; plastic deformation; polymer solids.

The plastic deformation of fibrous material obtains primarily by sliding motion of fibrils. In first approximation the displacement of their centers of mass is well describable by the affine transformation corresponding to the deformation of the bulk sample. Such a sliding motion of fibrils does not affect the morphology of the micro-fibrils. But it smooths by chain unfolding the surface inhomogeneities of the fibrils caused by microfibril ends which act as point defects of the microfibrillar lattice. That makes possible a more perfect lateral contact between adjacent fibrils resulting in a steadily increasing resistance to plastic deformation. The sliding motion of fibrils produces a shearing stress on skewed fibrils yielding a slight shear displacement of microfibrils. But in spite of its smallness, it enormously extends the interfibrillar tie molecules by chain unfolding and this enhances their fraction per amorphous layer.

15555. Peterlin, A., **Structural model of mechanical properties and failure of crystalline polymer solids with fibrous structure,** *Int. J. Fract.* **11,** No. 5, 761-780 (Oct. 1975).

Key words: bond rupture; chain rupture; ESR; fibrils; load-elongation curve; microcracks; microfibrils; radicals.

The failure of an axially strained polymer solid having a fibrous structure is caused by formation, coalescence, and growth of microcracks up to critical size crack, which then propagates catastrophically through the cross-section of the sample. The primary candidates for microcrack formation are the ends of microfibrils where the material connection by tie molecules to the rest of the sample is almost completely interrupted. The opening of microcracks and sliding motion of fibrillar elements ruptures locally the most strained taut tie molecules and, thus, produces radicals detectable by ESR. But, chain rupture is the consequence and not the cause of displacement of the strong fibrillar elements. It also does not substantially affect the load carrying properties of the sample which mainly depend on the lateral autoadhesion of microfibrils and fibrils and on their quasi-viscous resistance to axial displacement. Hence, one has to reject the completely inadequate models trying to base the observed load-elongation curve of such samples on the load carrying properties of those tie molecules which are eventually ruptured upon straining. Some examples of these models are treated explicitly.

15556. Read, F. H., **Displaced electron energies and the "shake-down" effect,** *Radiat. Res.* **64,** 23-36 (1975).

Key words: atom; autoionizing; collision; cross section; electron; experiment; positive ion; review; Rydberg states.

A brief review is given of the apparent exchanges of energy that can occur sometimes between the outgoing particles in electron-atom impact experiments, when these final particles consist of two electrons receding from a positive ion, and when the incident electron energy is near the energy of an autoionizing state of the target atom. These energy exchanges manifest themselves as changes in the energies of electrons ejected from autoionizing states of atoms excited by near-threshold election impact, displacements of the thresholds for exciting autoionizing states, and structure in the cross sections for exciting Rydberg states of neutral atoms by electron impact at incident energies in the vicinity of autoionizing states. The experimental evidence for these processes is reviewed and qualitative explanations are given. Evidence for analogous effects in other scattering and absorption processes is also discussed.

15557. Cezairliyan, A., Coslovi, L., Righini, F., Rosso, A., **Radiance temperature of molybdenum at its melting point,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement,* B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 287-296 (Institute of Physics, London, England, 1975).

Key words: melting point; molybdenum; radiance temperature; wavelength.

Radiance temperature (at two wavelengths, 653 and 995 nm) of molybdenum at its melting point was measured using a subsecond-duration-pulse heating technique. Specimens in the form of strips with initially different surface roughnesses were used. The results do not indicate any dependence of radiance temperature (at the melting point) on initial surface or system operational conditions. The average radiance temperature at the melting point of molybdenum is 2531 K at 653 nm and 2331 K at 995 nm, with a standard deviation of about 0.6 K and a maximum absolute deviation of 1.2 K in both cases. The total inaccuracy in radiance temperature is estimated to be not more than ± 8 K.

15558. Simiu, E., Filliben, J. J., **Structural safety and the probabilistic definition of design wind speeds,** *Proc. CIB Int. Symp. on the Climatology of Building, Zurich, Switzerland, Sept. 25-27, 1974,* 99 pages (1974).

Key words: building codes; probability distribution function; reliability; risk; statistical analysis; storms; structural engineering; wind loads; wind speeds.

The reliability of the probabilistic approach to the definition of design wind speeds depends upon the extent to which it is possible to model adequately the probabilistic behavior of extreme wind speeds. In this connection, questions arise regarding the type of probability distribution best suited for this purpose and the adequacy of 20-year long wind records, i.e., of such records as have been used as a basis for developing wind maps included in various building codes and standards. With a view to answering these questions, the writers undertook a statistical study of wind speed records taken at 20 U.S. weather stations. The following results were obtained: (1) the assumption currently accepted in the literature that a single probability distribution is universally applicable to all extreme wind data sets, was not confirmed; (2) predictions of 100-year wind speeds based on overlapping 20-year sets of data taken at the same station differed between themselves by as much as 65 percent. These results suggest that extreme caution should be exercised in establishing or using probabilistically defined design wind speeds, particularly if records of sufficient length, considerably in excess of 20 years, do not exist.

15559. Ogburn, F., Johnson, C. E., **Mechanical properties of electrodeposited brass,** *Plating* **62,** 141-148 (Feb. 1975).

Key words: density, brass; ductility, brass; electrical resistivity, brass; electrodeposited brass; electroplated brass; internal stress, brass; mechanical properties, electrodeposited brass; properties, electrodeposited brass; tensile strength, brass; wear rate, brass.

Electrical resistivity, density, hardness, wear rate, tensile strength, internal stress, and ductility of electrodeposited 70-30 brass were measured and microstructures were observed. The deposits were obtained from a high speed cyanide bath designed to deposit 70-30 brass. Included are property data for deposits of other compositions obtained from the same bath under conditions other than normal.

15560. Ogburn, F., **Coating thickness—its measurement and its significance,** Chapter 14 in *Properties of Electrodeposits—Their Measurement and Significance,* pp. 229-245 (Electrochemical Society, Princeton, N.J., 1975).

Key words: coating thickness; coating thickness gages; coatings; electrodeposited coatings; electroplated coatings; metal coatings; properties of electrodeposits; thickness gages; thickness measurement.

In addition to dimensional tolerance, thickness is very significant to coating characteristics such as wear, corrosion, porosity, electrical resistance, magnetic properties, ductility, other mechanical properties and monetary value. Many methods of measuring the thickness of electrodeposits are available, and a number of gages are manufactured domestically. These gages are nondestructive, but they are not applicable to all coatings. Measurement accuracies of ± 5 to ± 10 percent are normally expected.

15561. Sanchez, I. C., Eby, R. K., **Thermodynamics and crystallization of random copolymers,** *Macromolecules* **8,** No. 5, 638-641 (Sept.-Oct. 1975).

Key words: comonomer concentration; copolymer; crystallization; defect energy; equilibrium dissolution temperature;

equilibrium melting temperature; fold surface energy; growth rate; heat of fusion; lamella thickness; melting.

Equations are developed for the bulk free energy of fusion, melting temperature, crystal thickness, and nucleation rate of copolymer crystals containing an arbitrary concentration of comonomer units. These equations which represent advances over earlier ones are shown to be consistent with experimental data for copolymers of L- and DL-lactides and *cis*- and *trans*-isoprenes. Analysis of the lactide data confirms an earlier prediction that the crystal thickness should increase linearly with increasing small concentrations of the comonomer units for crystallizations carried out at the same temperature. Further, this linear dependence is shown to extend to crystals containing both equilibrium and nonequilibrium concentrations of the comonomer units. The nucleation rate equation is in agreement with the observed linear dependence of the logarithm of the growth rate on the comonomer concentration in isoprene copolymers. The following are consistent with the experimental data for the lactides: 461 K, equilibrium melting temperature of the homopolymer; 403 K, equilibrium dissolution temperature in xylene; 1370 cal/mol of monomer (5730 J/mol) heat of fusion; 26.5 erg/cm^2 (2.65×10^{-2} J/m^2) surface free energy and 585 cal/mol (2447 J/mol) comonomer defect energy. Directions for future research are suggested.

15562. Gebbie, K. B., Steinitz, R., **Comparison of Hα and Ca II H and K spectroheliograms as a diagnostic probe,** (Proc. Int. Astronomical Union Symp. on Chromospheric Fine Structure, Surfers' Paradise, Qld. Australia, Sept. 1973), Paper in *Chromospheric Fine Structure*, R. Grant Athay, Ed., No. 56, 55-63 (Reidel Publishing Co., Boston, Mass., 1974).

Key words: Ca II; Hα; solar chromosphere; spectral line formation.

The line formations of Hα and Ca II H and K are compared in order to differentiate the various mechanisms giving rise to observable contrasts in the emergent intensities. Table II summarizes the criteria for distinguishing between horizontal spatial variations in temperature, density, and turbulent velocity.

15563. Newman, M., Sheingorn, M., **Continuous solutions of a homogeneous functional equation,** *Aequationes Math.* **13,** No. 1/2, 47-59 (1975).

Key words: analytic functions; functional equations; Hurwitz's theorem.

It is shown that the functional equation

$$f(x)+f(ax)+f(bx)=0 \quad , \quad 1<a<b \quad ,$$

has a nontrivial solution which is continuous for all real x if and only if $b\neq a^2$. Generalizations for the equation

$$\sum_{k=1}^{n} f(a_k x)=0 \quad , \quad 1=a_1<a_2<\ldots<a_n \quad ,$$

are also derived.

15564. McCamy, C. S., **Specification of geometric and spectral conditions relating to densitometry,** Paper 15.2 in *SPSE Handbook of Photographic Science and Engineering*, W. Thomas, Jr., Ed., pp. 831-840 (John Wiley & Sons, New York, N.Y., 1973).

Key words: modulation; notation; optical density; propagance; reflectance; reflectance factor; symbols; transmittance; transmittance factor.

Reflectance, transmittance, and optical density are regarded as kinds of flux modulation factors. Transmittance is defined as the ratio of transmitted flux to the incident flux, while transmittance factor is here defined for an optical system as the ratio of the emergent flux with the sample in the system to the emergent flux with the sample removed. Transmission density is defined as the negative logarithm of transmittance factor. Reflection, transmission, and fluorescence are considered generically as propagation and generalized modulation terms are given. A coordinate system and functional notation are adopted to systematize the description of optical systems which use or measure modulation. Simplified notation of the form D(g;S:g′S′) describes most cases.

15565. Chow, L. C., Brown, W. E., **Topical fluoridation of teeth before sealant application,** *J. Dent. Res.* **54,** No. 5, 1089 (Sept.-Oct. 1975).

Key words: dicalcium phosphate dihydrate; fluorapatite; fluoride; pit and fissure sealant; tooth enamel.

Pyrolysis experiments revealed that small amounts of $CaHPO_4\cdot2H_2O$ are formed in enamel during conditioning of teeth with 50 percent H_3PO_4 for pit-and-fissure sealants. Unlike the $Ca(HPO_4)_2\cdot H_2O$ which forms on the surface during the pretreatment, $CaHPO_4\cdot2H_2O$ is only sparingly soluble in water and would not be rinsed away in the clinical situation. The presence of $CaHPO_4\cdot2H_2O$ in enamel is undesirable because it may slowly dissolve and loosen the sealant. On the other hand, because of its high reactivity with fluoride, the $CaHPO_4\cdot2H_2O$ may be converted to $Ca_5(PO_4)_3F$ before sealant application, thereby further reducing caries tendency. Several basic-phosphate-fluoride solutions which had previously been shown to produce $Ca_6(PO_4)_3F$ when reacted with $CaHPO_4\cdot2H_2O$ were applied to acid etched enamel samples. Significant enamel-fluoride uptakes were obtained. SEM examinations of the samples show that these fluoride treatments produced no discernible deposits of CaF_2 on the surface which might interfere with sealant penetration and bonding.

15566. Krauss, M., Neumann, D., **On the interaction of O(^{1}S) with O(^{3}P),** *Chem. Phys. Lett.* **36,** No. 3, 372-374 (Nov. 15, 1975).

Key words: curve crossing; O(^{1}D); O(^{1}S); quenching rate; spin-orbit coupling; transition probability.

The quenching rate for O(^{1}S) by O(^{3}P) into the O(^{1}D) + O(^{1}D) channel is calculated using a theoretically calculated spin-orbit coupling matrix element. An upper bound to the rate is found to be 2.0×10^{-14} cm^3 s^{-1} which is much smaller than the experimental value. The low value of the rate constant is the result of a spin-orbit coupling matrix element of about 3 cm^{-1} at the relevant curve crossing.

15567. Koyanagi, R. S., **Development of a low-frequency-vibration calibration system,** *Exp. Mech.* **15,** 443-448 (Nov. 1975).

Key words: accelerometer; calibration; harmonic distortion; low frequency; pickup; vibration; vibration exciter.

The development of the low-frequency-vibration apparatus described in this report was done in response to a need to establish and verify vibration-pickup performance at infrasonic frequencies. The exciter design is an extension of the Dimoff type exciters and, in fact, many of its components are identical.

The motion of such an exciter must have very low distortion and minimal components of motion in all directions other than axial. In addition, the attainable amplitude must be large enough to produce a transducer signal that can be accurately measured. The attainable amplitude and accuracy of transducer calibration on this exciter is limited by transducer size, weight, geometry and vibration sensitivity. Examples of the types of accelerometers which can be calibrated on this exciter are servo or force balance, piezoelectric, piezoresistive and strain gage.

15568. Pontius, P. E., **Mass measurement: A study of anomalies,** *Science* **190,** 379-380 (Oct. 24, 1975).

Key words: density of air; mass measurement.

It has always been assumed that the measurement of the difference in mass between two objects would be the same in all laboratories. Recent National Bureau of Standards measurements involving dissimilar objects (effective density ranging from 2.7 to 16.6 grams per cubic centimeter) at a wide variety of pressures (0.5 to 2 atmospheres) have been made with sufficient precision to test this assumption. The results show unsuspected discrepancies which may approach 1 milligram in a kilogram in the assignment of mass values when dissimilar materials are involved. These discrepancies have not been noted in the past because precision comparisons of both like and unlike materials have nearly always been made in a relatively restricted range of environmental conditions. The worldwide mass measurement system is therefore consistent, because similar materials have been used in the construction of weight sets, but possibly offset with respect to the mass unit as embodied in the platinum-iridium defining artifact.

15569. Payne, B. F., Koyanagi, R. S., Federman, C., Jones, E., **Accelerometer calibration at the National Bureau of Standards,** *21st Int. Instrumentation Symp. ASD/TMD, Philadelphia, Pa., May 19-21, 1975,* pp. 1-17 (1975).

Key words: acceleration; automation; calibration; measurements; shakers; standards; transducers; vibration; vibration exciters; vibration pickups.

Accurate calibration of accelerometers requires that accurate measurement techniques be developed and maintained. No single vibration exciter or calibration procedure is adequate for the present calibration frequency range. This paper gives a summary of the various calibration procedures used in calibration of accelerometers and reference exciters at the National Bureau of Standards.

15570. Saltman, R. G., **The human side of automating,** *Proc. Association for Computing Machinery and National Bureau of Standards Conf., on The Systems Approach: Key to Successful Computer Applications, Gaithersburg, Md., June 20, 1974,* pp. E.4.1-4.11 (1974); *Cyberdent* **2,** No. 3, 1, 3-4 (1974).

Key words: automation; human relations; job enrichment; organizational development; project management; system integration.

The process of designing and installing an automated system must consider problems of human relations. If the automation will affect the operation of diverse groups within an organization, then the legitimate and conflicting interests of these groups must be recognized, and their cooperation achieved through compromise. Successful automation must include the establishment of a new network of human communications.

The effect of the automation should not be to eliminate or downgrade jobs, but to enrich or increase responsibilities, leaving the repetitive, tedious jobs to the machines. Specialists in job design should be included on the automation team.

Well-designed automation should integrate diverse groups in an organization through improved data flow, but may divorce outside data users completely if their needs are not considered in the design process. An ombudsman with the responsibility of correcting design errors to satisfy outside users' requirements should be provided.

15571. Rebbert, R. E., Ausloos, P. J., **Photodecomposition of $CFCl_3$ and CF_2Cl_2,** *J. Photochem.* **4,** 419-434 (1975).

Key words: absorption cross section; chlorine atom; dichlorodifluoromethane; freons; photochemistry; quantum yields; stratosphere; trichlorofluoromethane.

The photochemical decomposition of $CFCl_3$ and CF_2Cl_2 has been investigated, using added CH_4 and C_2H_6 as chlorine atom interceptors. From the quantum yields of the stable products formed at 213.9, 184.9, 163.3 and 147 nm, quantum yields of the primary photofragments $CFCl_2$, CF_2Cl, CFCl, CF_2, CF and Cl, were derived. At wavelengths close to the absorption threshold, detachment of one chlorine atom from $CFCl_3$ and CF_2Cl_2 occurs with a quantum yield of 0.95 ± 0.05. As the photon energy increased, there is a rapidly increasing probability that absorption of a photon will lead to the release of two chlorine atoms:

$$CFCl_3 + h\nu \rightarrow CFCl + 2Cl$$

$$CF_2Cl_2 + h\nu \rightarrow CF_2 + 2Cl$$

The CFCl or CF_2 formed in these processes (which are most likely in the ground singlet state) are unreactive towards the parent halocarbons, or alkanes. They combine with other free radicals to form stable products. No evidence was found for the cleavage of C-F bonds, or the elimination of stable chlorine molecules.

In the vicinity of the absorption threshold, the absorption cross-sections of CF_2Cl_2 and $CFCl_3$ diminish sharply with a decrease in temperature.

15572. Mighell, A. D., Santoro, A., **Geometrical ambiguities in the indexing of powder patterns,** *J. Appl. Crystallogr.* **8,** Part 3, 372-374 (June 1975).

Key words: ambiguities; geometrical; indexing; patterns; powder diffraction.

There are cases in which different lattices give calculated powder patterns with the identical number of distinct lines in identical 2θ angular positions. The number of planes *(hkl)* contributing to each reflection may differ, however. The lattices having this property are related to each other by transformation matrices with simple rational elements. The resulting ambiguity in indexing of powder patterns is, in these cases, geometrical rather than accidental.

15573. Cali, J. P., **Reference materials in clinical chemistry,** *Fed. Proc.* **34,** No. 12, 2123-2126 (Nov. 1975).

Key words: accuracy; accurate measurement in clinical chemistry; clinical chemistry; clinical reference materials; standardization.

Reference Materials (RM's) are necessary and critical components of measurement systems, especially useful in helping to achieve compatibility in large laboratory networks, such as those existing in clinical chemistry. What the measurement process is and how RM's fit into this process is discussed. The role of accuracy in helping achieve compatibility is explained and the role of RM's within an accurate measurement system is elucidated. Because RM's are the mechanism for transferring accuracy throughout a measurement network, the criteria for their production and certification are important. They include a knowledge and/or assurance of: purity, homogeneity, stability, continuity and availability of supply and information. Because measurement compatibility in clinical chemistry involves human life, only RM's of highest quality and integrity should be used. Clinical RM's should therefore bear a certificate (or guarantee). Minimal requirements for such certification are discussed.

Currently available clinical RM's from the National Bureau of Standards (NBS) are listed.

15574. Santoro, A., Choi, C. S., Abel, J. E., **1,5-diacetyl-3,7-dinitro-1,3,5,7-tetraazacyclooctane (DADN),** *Acta Crystallogr.* **B31,** Part 8, 2126-2128 (Aug. 1975).

Key words: crystal structure explosives; least-squares refinement; molecular packing; tetraazacyclooctane derivatives; x rays.

$C_8H_{14}N_6O_6$, monoclinic, $P2_1/c$, $a=7.422(1)$, $b=13.253(2)$, $c=6.156(1)$ Å, $\beta=103.38(1)°$, $Z=2$, $D_x=1.636$, $D_m=1.63$ gcm^{-3}, $F(000)=304$. X-ray intensities were measured with Mo $K\alpha$ radiation. The structure was solved by direct methods and refined by full-matrix least-squares calculations to final R and R_w values of 4.1 and 4.8 percent, respectively, for 1149 observed reflections.

15575. Berg, N. J., Lieberman, A. G., **The effects of radiation-induced displacement damage on impurity conduction in gallium arsenide,** *J. Appl. Phys.* **46,** No. 8, 3475-3482 (Aug. 1975).

Key words: activation energy; compensation; epitaxial gallium arsenide; high energy neutron; impurity conduction; reciprocal Hall coefficient; transition regime; ^{60}Co gamma.

The effects of ^{60}Co γ-ray and high-energy neutron displacement damage on impurity conduction in epitaxial gallium arsenide were investigated. The activation energy (ϵ_2) associated with the transition regime of the impurity conduction process was found to increase by a factor of 5 as a result of ^{60}Co γ irradiation, and only by a factor of 1.6 for a comparable neutron irradiation. In addition, the ratio of the Hall carrier density at low and high temperatures, $(n_H)_{4K}(n_H)_{300K}$, decreased by a larger amount for ^{60}Co γ irradiation than for neutron irradiation. The effects of neutron irradiation are explained in terms of increased compensation. For the case of ^{60}Co γ irradiation, it is postulated that a new donor level is introduced which does not participate in the impurity conduction process, it is found that ϵ_2 is proportional to ϵ_1 (the conduction-band activation energy) and varies inversely with neutral donor spacing in accord with the model proposed by Mikoshiba. Also ρ_{30}, the hopping regime resistivity, is found to vary inversely with the square of the free-carrier concentration and exponentially with the quantity $0.6/N_D{}^{1/3}a$.

15576. Sugar, J., **Ionization energies of quadruply ionized rare earths,** *J. Opt. Soc. Amer.* **65,** No. 11, 1366-1367 (Nov. 1975).

Key words: atomic spectra; ionization energies; lanthanides; spectra; rare earths.

Values for the ionization energies of four-times-ionized lanthanides are derived from interpolated spectroscopic properties of the $4f^{n-1}ns$ Rydberg series.

15577. Rains, T. C., **Iron, cobalt, and nickel,** Chapter 10 in *Flame Emission and Atomic Absorption Spectrometry,* J. A. Dean and T. C. Rains, Eds., 3, 216-246 (Marcel Dekker, Inc., New York, N.Y., Nov. 1975).

Key words: atomic absorption; atomic fluorescence; cobalt; interferences: iron; nickel; separations.

A summary is presented of the published work on the determination of iron, cobalt, and nickel by atomic absorption, emission, and fluorescence spectrometery. Optimum conditions for atomization and excitation are described for flame and non-flame methods for the three techniques. Spectral characteristics for wavelength ranges of analytical interest are given for the three elements with their sensitivity and/or detection limits. Interferences encountered under optimum instrumental conditions are minimal; however, separational techniques are described for each element. The paper contains 174 references in which numerous applications are described.

15578. Mighell, A., Santoro, A., Prince, E., Reimann, C., **Neutron diffraction structure determination of dichlorotetrapyrazolecopper(II), $Cu(C_3H_4N_2)_4Cl_2$,** *Acta Crystallogr.* **B31,** Part 10, 2479-2482 (Oct. 15, 1975).

Key words: dichlorotetrapyrazolecopper; neutron diffraction; structure.

The crystal and molecular structure of dichlorotetrapyrazolecopper(II), Cu(NHN:CHCH:CH)$_4$Cl$_2$, was determined by single-crystal neutron diffraction techniques. This compound crystallizes in the monoclinic system with $a=13.657$ (5), $b=9.200$ (5), $c=14.900$ (5) Å, $\beta=118.04$ (1)°, space group $C2/c$, $\rho_0=1.63$ g cm^{-3} and $Z=4$. The structure was refined by least-squares calculations to a conventional R value of 3 percent for 1143 reflections. The $Cu(C_3H_4N_2)_4Cl_2$ molecule is centrosymmetric with the Cu atom at the center of a distorted octahedron formed by two chlorine atoms and a nitrogen atom from each of four pyrazole rings. The accurate location of the hydrogen atoms shows that the conformation of the complex is due to intramolecular hydrogen bonding. The coordination distances Cu-Cl and Cu-N (2.84 and 2.02, 2.01 Å, respectively) are significantly different from those of the corresponding nickel analog (Ni-Cl and Ni-N 2.51; and 2.10, 2.09 Å, respectively).

15579. Berger, M. J., Seltzer, S. M., Domen, S. R., Lamperti, P. J., **Stopping-power ratios for electron dosimetry with ionization chambers,** (Proc. Int. Symp. on Advances in Biomedical Dosimetry, Vienna, Austria, Mar. 1975), Paper in *Advances in Biomedical Dosimetry,* pp. 589-609 (International Atomic Energy Agency, Vienna, Austria, 1975).

Key words: absorbed dose; dosimetry; electrons; ionization chambers; standards; stopping power ratio.

In the course of an NBS absorbed-dose standards program, theoretical and experimental determinations have been made of the conversion factor C that relates the absorbed dose from electron beams to the ionization in an air cavity. The average medium/air stopping-power ratio—which is proportional to C—has been calculated as a function of the beam energy (1 to 60 MeV) and of the depth in a water phantom, and similar stopping-power ratios have also been obtained for other phantom materials (carbon, polystyrene, acrylic plastic, muscle). The conversion factor in graphite has been measured at energies between 15 and 50 MeV and depths between 0.9 and 51 g/cm^2 with the use of a calorimeter and a parallel-plate ionization chamber. These measurements were made with beams broadened by lead scattering foils with various thicknesses from 0.144 to 1.584 g/cm^2. The extrapolation of the results to zero scattering-foil thickness provided conversion factors that could be compared with theoretical C-values for broad, parallel, monoenergetic electron beams. The agreement was found to be close (mean difference of 0.3% and r.m.s. difference of 0.8%). Comparisons have also been made with other C-values found in the literature and recommended by medical physics organizations. The overall conclusion can be drawn that the conversion factor is known reliably at the 1 percent level of accuracy.

15580. Ogburn, F., **Density of electrodeposited metal, its significance and measurement,** Chapter 5 in *Properties of Electrodeposits—Their Measurement and Significance,* R. Sard, H. Leidheiser, Jr., and F. Ogburn, Eds., pp. 71-79 (The Electrochemical Society, Inc., Princeton, N.J., 1975).

Key words: coatings; copper; density; electrodeposited coatings; electrodeposits; metal coatings.

Density of electrodeposits can give information about their soundness and composition. It can be measured by direct determination of the volume and mass of the deposit, but the best measurements are made by conventional hydrostatic techniques. A 2 liquid hydrostatic method of measurement is described. This method involves hydrostatic weighing with a float in a two liquid system. Data obtained by this method are given as an example. These data show a significant density variation between 11 one-half gram samples cut from a 6 gram piece of electrodeposited copper.

15581. Scheide, E. P., Taylor, J. K., **A piezoelectric crystal**

dosimeter for monitoring mercury vapor in industrial atmospheres, *Am. Ind. Hyg. Assoc. J.* **36,** No. 12, 897-901 (Dec. 1975).

Key words: air pollution; chemical analysis; dosimeter; industrial hygiene analysis; mercury; personnel monitor; piezoelectric sensor; trace analysis.

A personal dosimeter for mercury vapor in air based on the use of a piezoelectric sensor with a selective coating has been developed and evaluated. The sensor is a gravimetric device which indicates an integrated total exposure to mercury vapor. The mass of the material deposited or adsorbed is determined by measuring the change in oscillation frequency of the crystal. The sensor is small enough to be worn on a worker's clothing and is compatible with existing miniature air pumps. The adsorbed mercury can be desorbed by heating and the sensor can be reused many times. The precision and accuracy of this measurement technique, the effect of sampling flow rate, storage, sample concentration, interferences, sampling period, sensitivity and range, lifetime of the sensor, and other parameters considered in the development of prototype devices are discussed.

15582. Clifton, J. R., Foster, B. E., Trattner, E., Clevenger, R. A., **Dimensional stability of masonry walls,** *Am. Soc. Test Mater. Spec. Tech. Publ.* **589,** pp. 42-75 (1975).

Key words: brick; dolomitic mineral; masonry; mortars (materials); walls.

To assess the contribution of dolomitic limes to dimensional stability of masonry construction, 65 brick masonry walls, 34 by 40 by 8 in (0.86 by 1.0 by 0.20 m), were constructed. The program involved the following design variables: 6 hydrated limes ranging in autoclave expansion from 0.10 to 15.1 percent; 2 types of brick, one with high water absorption and high autoclave expansion, and the other with low water absorption and insignificant autoclave expansion; and, 2 mortars of cement:lime:sand proportions of 1:1:6 and 1:2:9 by volume. Half of the walls were subjected to temperature and moisture cycles, performed indoors, for 3 1/2 years; the other half were tested outdoors for 14 years. Half of the indoor and outdoor exposed walls were spring loaded at 25 psi ($1.7 \times 10^5 N/m^2$). Observed expansion of the walls was found to be related to the potential expansions (as measured by the autoclave test) of the limes. The largest wall expansion took place with the following combination: high potential expansive lime; stable, low absorption brick; unloaded wall; and, 14 year outdoor exposure. In the 14-year outdoor exposure, loss of bond and resulting damage from freezing were complicating factors. The effects of lime, mortar mix, brick, loading, and exposure on the dimensional instability of the masonry walls are discussed.

15583. Hammond, H. K., Hsia, J. J., **Evaluation of instrument tolerances for 75° gloss,** *Tappi Notes to Editor* **58,** No. 11, 143-144 (Nov. 1975).

Key words: gloss; optical properties; tolerances.

The instrument tolerances of the published TAPPI method for 75° specular gloss are unnecessarily strict. The 1954 report of Zabel and Wink on which the tolerances were based has been reexamined. Improvement in the photometric linearity on instruments and a statistical approach to the combined effect of a number of sources of uncertainty, reveal that if the goal for overall uncertainty is still to be one gloss unit, geometric tolerances could be increased by a factor of 7.

Dimensions and tolerances are all based on the dimension "d" rather than the unit distance of which d is only a part. All dimensions have been rounded to simple figures. The proposed dimensions and tolerances are tabulated.

15584. Gallagher, A., **Noble-gas broadening of the Li resonance line,** *Phys. Rev. A* **12,** No. 1, 133-138 (July 1975).

Key words: line broadening; lithium; noble gases.

The normalized fluorescence spectrum of the Li 6708-Å resonance line perturbed by the noble gases has been measured for 100 Å either side of the resonance line, at a temperature of 400 ± 10 °C. The noble-gas pressure range of 100-1800 torr was investigated. It was observed that the line wings scale linearly with this pressure for $2 < |\Delta\lambda| < 100$ Å, and it was demonstrated that a Lorentzian-broadened line core can be observed for this pressure range. The Li density was $\sim 10^{10}/cm^3$ and was varied to establish the fluorescence spectrum in the limit of no radiation entrapment. The central region of the line has been measured with high resolution and compared to calculated profiles due to the various fine structure and isotopic line components, each broadened by a convolution of Lorentz, Doppler, and instrumental profiles. The shift and Lorentz broadening rates, as well as the wavelengths for transition to non-Lorentzian behavior, are reported. In contrast to the heavier alkali-metal-noble-gas cases, no distinctive far-wing features such as satellites or sharp inflections are observed. This is consistent with the much larger collision velocities for the Li case.

15585. Mount, G. H., Linsky, J. L., **A new solar carbon abundance based on non-LTE CN molecular spectra,** *Astrophys. J.* **202,** No. 1, L51-L54 (Nov. 15, 1975).

Key words: carbon abundance; molecular spectra; solar photosphere.

A detailed non-LTE analysis of solar CN spectra strongly suggests a revised carbon abundance for the Sun. We recommend a value of $\log A_C = 8.35 \pm 0.15$ which is significantly lower than the presently accepted value of $\log A_C = 8.55$. This revision may have important consequences in astrophysics.

15586. King, G. C., Read, F. H., Bradford, R. C., **Structure near autoionizing energies in the excitation of bound states of helium, neon, and argon by electron impact,** *J. Phys. B* **8,** 2210 (1975).

Key words: Ar; atoms; autoionizing; cross sections; electron impact; excitation; He; inelastic; Ne.

Cross sections for the excitation of bound states of atoms by electron impact have been found to contain structures at incident energies near to the energies of short lived autoionizing states of the target atoms. These structures look superficially like resonance structures, but in fact they seem to be caused by a post-collision interaction between inelastically scattered and ejected electrons. Examples are given of these structures in He, Ne, and Ar. A quantum mechanical "shake-down" model to explain these structures is also described and compared with the experimental data.

15587. Shank, R., Henderson, M., **Federal Library cooperation,** *Library Trends* **24,** No. 2, 277-292 (Oct. 1975).

Key words: Federal libraries; library cooperation.

Federal support of cooperative library service is influenced by the direct participation of Federal libraries in consortia and various networks. An overview of Federal library activity reveals many instances in which leadership for major cooperative programs was given by librarians in Federal libraries, e.g., the Library of Congress shared cataloging began in 1901. This paper documents trends in cooperation by the more than 2,000 libraries of the Federal Government.

15588. Unassigned.

15589. Unassigned.

15590. Wang, F. W., DiMarzio, E. A., **The dynamics of block-copolymer molecules in solution. The free-draining limit,** *Macromolecules* **8,** No. 3, 356-360 (May-June 1975).

Key words: bead-spring model; block copolymers; concentrated solutions; dynamics; Rouse theory; solution properties; viscoelasticity.

A theory for the viscoelasticity of block-copolymer molecule solutions in the free-draining limit has been developed by modifying the bead-spring model theory of Rouse to take into account the existence of dissimilar segments in block copolymers. The eigenvalue problem encountered in the theory has been solved numerically by matrix computations. Furthermore, for the case of a diblock copolymer, a simple form of the secular equation which is useful for extracting the eigenvalues has been obtained. The applications of the theory have been illustrated with calculations for the viscoelastic properties of poly(styrene-*b-cis*-1,4-isoprene) solutions. It is found that the calculated properties for the diblock copolymer are nearly the same as those for the Rouse theory while the calculated properties for the symmetric triblock copolymers deviate from those of the Rouse theory.

15591. Rensberger, R. A., **Lead paint hazard abatement,** *Constr. Specifier* **28,** No. 6, 45-46, 48-49 (June 1975).

Key words: abatement; detection; heat-gun; lead paint; materials evaluation; performance specification; rehabilitation; renovation.

The article briefly discusses the history of lead paint poisoning and discusses the safety hazards of lead paint in renovation and rehabilitation work in housing and buildings. Techniques for lead paint detection and methods for abatement are discussed for reference by the specifications writer, architect, design professional, engineer, contractor and other individuals who may be confronted with the hazards of lead paint. The information is from investigations by NBS for the HUD research program on lead paint. A suggested performance specification for lead paint hazard abatement methods is offered as a guideline for materials evaluation. Also a selected bibliography of NBS publications is included for reference by the building community.

15592. Pella, P. A., Hughes, E. E., Taylor, J. K., **Development of gas-blending systems for calibration: application to hydrogen fluoride, arsine and phosgene in air,** *Am. Ind. Hyg. Assoc. J.* **36,** No. 10, 755-759 (Oct. 1975).

Key words: arsine; calibration of devices; gas-blending systems; hydrogen fluoride; phosgene.

The calibration of analytical monitoring devices is a prerequisite for making accurate measurements. For this purpose, self-contained gas-blending systems are being constructed and evaluated at the NBS for producing known concentrations of specific industrial contaminants in air from one-half to five times the TLV. This is accomplished by accurate dynamic dilution of a known relatively high concentration of the contaminant (i.e., standardized gas mixture) with air as a diluent to yield the desired range of concentrations. The development and evaluation of systems for producing known concentrations of hydrogen fluoride, arsine, and phosgene in air are reported including the measurement of the stability of these gases, and the determination of the concentrations upon dilution employing specific analytical methods.

15593. Dunn, G. H., **Collision studies with ion storage techniques,** (Proc. Int. Conf. on Atomic Physics, Heidelberg, Germany, July 1974), Paper in *Atomic Physics* **4,** pp. 575-587 (Plenum Press, New York, N.Y., 1975).

Key words: electrons; ion trap; positive molecular ions; recombination.

This paper is a report on recombination measurements made by studying electron-ion collisions in ion traps. We briefly review two-body recombination processes between electrons and ions and the means by which they have previously been measured. The trapping scheme and its realization for collision work is discussed, and results for some recombination measurements are given.

15594. Crawford, E. A., Phelps, A. V., **Formative time lags in CO_2 laser discharges,** *Appl. Phys. Lett.* **25,** No. 1, 59-61 (July 1, 1974).

Key words: CO_2 laser; electrical discharge; gas mixture; time delay.

Time lags for the growth of power input, i.e., formative time lags, have been measured in typical CO_2 laser gas mixtures at pressures from 200 to 760 torr using parallel plane electrodes with the 1- and 2-cm gaps illuminated by a trigger discharge. The measured time lags are about twice the values predicted using a single avalanche growth model and theoretical ionization and attachment coefficients.

15595. Berke, J. G., **Procurement—The pull side of technology transfer,** (Proc. ASME 5th Intersociety Conf. on Environmental Systems, San Francisco, Calif., July 21-24, 1975), *75-ENAs-3*, pp. 1-4 (The American Society of Mechanical Engineers, New York, N.Y., 1975).

Key words: innovation; procurement; specifications; standards; technology; transfer.

Public procurement at the federal, state or local levels can be a major influence on the adaptation, implementation and transfer of technology. Through the procurement process, problems can be defined, prototypes can be tested, cost/benefits determined and finally the product can be bought. This final step is what has traditionally been lacking in the technology transfer process. This paper describes ongoing experiments, at the federal, state or local levels, aimed at determining the transfer potential of such market incentives as the use of performance specifications, life cycle costing, value incentive clauses, consensus standards and test methods versus the traditional lowest price for lowest acceptable quality.

15596. Dziuba, R. F., Field, B. F., Finnegan, T. F., **Cryogenic voltage comparator system for 2e/h measurements,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 264-267 (Dec. 1974).

Key words: cryogenic resistor; current comparator; Josephson device; microstripline; microwave coupling; SQUID; superconducting switch; tunnel junction; voltage standard.

The design and operation of a cryogenic voltage comparator system for precision 2e/h measurements is described. Major improvements embodied in the new 2e/h system include the use of (1) a single microstripline-coupled Josephson tunnel junction to obtain usable step voltages up to 10 mV at 10.0 GHz, (2) a cryogenic voltage divider comprised of two resistors whose ratio is calibrated with a low temperature dc current comparator, (3) a

SQUID null detector, and (4) superconducting switching. The accuracy of the present 196:1 divider system is estimated to be about 2 parts in 10^8 on the basis of preliminary tests and is limited by resistor self-heating during calibration.

15597. Dziuba, R. F., Sullivan, D. B., **Cryogenic direct current comparators and their applications,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 716-719 (Mar. 1975).

Key words: cryogenic resistors; current comparators; low temperature; shielding; SQUID; superconducting shield; superconductivity.

Cryogenic direct current comparators, utilizing superconducting shields and Superconducting QUantum Interference Devices (SQUID's), provide current ratios of up to 100/1 or higher with accuracies of $\leq 1 \times 10^{-9}$ and current resolutions of $\leq 6 \times 10^{-11}$ A. Two types of comparators differing in the shielding arrangement of the ratio windings are described. One type consists of unit windings inside a seamless Pb tube; the other consists of multi-turn ratio winding within an overlapping toroidal superconducting shield. For both shielding configurations, SQUID's serve as flux sensors for the comparators. The application of these comparators to the measurement of resistance ratios is described.

15598. McClintock, W., Linsky, J. L., Henry, R. C., Moos, H. W., Gerola, H., **Ultraviolet observations of cool stars. III. Chromospheric and coronal lines in α Tauri, β Geminorum, and α Bootis,** *Astrophys. J.* **202,** 165-182 (Nov. 1975).

Key words: chromospheres; stellar coronae; stellar ultraviolet.

The ultraviolet spectrometer of the Princeton Experiment Package aboard the *Copernicus* satellite has been used to obtain high-resolution measurements of Lα, the Mg II λ2800 doublet, and upper limits on Si III λ1206 in the K giants α Tau and β Gem. The intensities and line shapes are compared with earlier observations of α Boo. The Lα and Mg II profiles for α Tau resemble those for α Boo, in that they are highly asymmetrical, while β Gem shows much more symmetrical profiles. The asymmetries for all lines except for those of α Boo and the Mg II lines of α Tau could be due to interstellar absorption. In the case of β Gem only, the O V intercombination line at 1218 Å is observed, suggesting a well-developed corona substantially cooler than that of the sun. The Lα profiles of α Tau and β Gem are consistent with the low interstellar hydrogen abundance in the solar neighborhood previously obtained from a similar observation of the α Boo Lα profile. The strength of the Mg II λ2796 line can be used to measure transition region and coronal pressures, and indicates a decrease in both with later spectral type and/or increasing luminosity.

15599. Finnegan, T. F., Toots, J., Wilson, J., **Frequency-pulling and coherent-locking in thin-film Josephson oscillators,** (Proc. 14th Int. Conf. on Low Temperature Physics, Helsinki, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics* **LT-14,** N. Krusius and N. Vuorio, Eds., **4,** 184-187 (North Holland Publishing Co., Amsterdam, 1975).

Key words: frequency source; Josephson radiation; Josephson tunnel junction; junction array: microstripline-coupling; thin-film device.

The results of a continuing study of the microwave radiation emitted by pairs of Josephson tunnel junctions simultaneously coupled to each other and an external microwave source are reported. Injection-locking of the junctions was observed and some qualitative features of the phenomenon are discussed.

15600. Kunasz, P. B., Hummer, D. G., Mihalas, D., **Theory of extended stellar atmospheres. II. A grid of static spherical models for O stars and planetary nebula nuclei,** *Astrophys. J.* **202,** 92-113 (Nov. 1975).

Key words: emission line stars; line profiles; stellar atmospheres; stellar limb darkening.

Spherical static non-LTE model atmospheres are presented for stars with $M/M_\odot$= 30 and 60 at various points on their evolutionary tracks, and for some nuclei of planetary nebulae at two points of a modified Harman-Seaton sequence. The method of Mihalas and Hummer was employed, which uses a parametrized radiation force multiplier to simulate the force of radiation arising from the entire line spectrum. However, in the present work the density structure computed in the LTE models was held fixed in the calculation of the corresponding non-LTE models; in addition, the opacity of an "average light ion" was taken into account. The effects of sphericity, as distinct from those arising from a density structure modified by a large radiation force, were investigated by computing a few planar models using the same parametrized radiation force multiplier as for the spherical models. These effects were found to be quite significant even though the atmospheric extension never becomes very large. The temperatures for the non-LTE models are generally lower, at a given depth, than for the corresponding LTE models when $T_{eff} < 45{,}000$ K, while the situation is reversed at higher temperatures. The continuous energy distributions are generally flattened by extension. The Lyman jump is in emission for extended models of massive stars, but never for the models of nuclei of planetary nebulae (this is primarily a temperature effect). The Balmer jumps are always in absorption. The Lyman lines are in emission and the Balmer lines in absorption; He II λ4686 comes into emission in the most extended models without hydrogen line pumping, showing that it is an indicator of atmospheric extension. Very severe limb darkening is found for extended models, which have apparent angular sizes significantly smaller than expected from the geometrical size of the star. Extensive tables are given of monochromatic magnitudes, continuum jumps and gradients, Strömgren-system colors, monochromatic extensions, and the profiles and equivalent widths of the hydrogen lines for all models, and of the He II lines for some of the 60 $M_\odot$ models.

15601. Sengers, J. M. H. L., Sengers, J. V., **Universality of critical behavior in gases,** *Phys. Rev. A* **12,** No. 6, 2622-2627 (Dec. 1975).

Key words: air constituents; critical region parameters; ethylene; heavy noble gases; helium; linear model; methane; NBS equation; scaling laws; statistical analysis; steam; universality.

P-V-T data in the critical region of six fluids (^{3}He, ^{4}He, Xe, O_2, CO_2, and H_2O) have been analyzed in terms of two scaled equations of state using the methods of statistical analysis. The results confirm the hypothesis of universality of critical behavior for these gases to within the current experimental accuracy. The results also support the validity of hyperscaling relations between thermodynamic and correlation function exponents for gases. Using the hypothesis of universality we then present critical-region parameters for fourteen fluids in terms of a universal equation of state.

15602. Gravatt, C. C., Allegrini, I., **A new light scattering method for the determination of the size distribution of particulate matter in air,** (Proc. 3rd Int. Clean Air Congress (IUAPPA), Dusseldorf, W. Germany, Oct. 8-12, 1973), Paper in *Proceedings of the 3rd International Clean Air Congress,* pp. C3-C5 (Verlag GMBH, Dusseldorf, W. Germany, 1973).

Key words: air pollution; light scattering; particulate matter.

An instrument has been developed which determines the size distribution of particulate matter in air in essentially real time by a forward lobe light scattering method. The basic concept involves the simultaneous measurement of the intensity of light scattered by a single particle at two small scattering angles. The ratio of the two intensities is a direct measure of the size and is fairly independent of the index of refraction of the particle. Numerical solutions of the Mie equations for spheres have indicated that the sizing error by this method is no greater than 15 percent for the range of particle sizes from 0.1 to 10 μm for essentially all possible indices of refraction. In addition, techniques have been found which extend the lower limit of size determination to 0.05 μm and which may permit some degree of chemical characterization of the particle.

15603. Interrante, C. G., **Report on the ferrous metals workshop,** (Proc. National Materials Conservation Symp. on Resource Recovery and Utilization, Gaithersburg, Md., Apr. 29-May 1, 1974), Paper in *Resource Recovery and Utilization,* H. Alter and E. Horowitz, Eds., *Am. Soc. Test. Mater. Spec. Tech. Publ.* **592,** pp. 146–152 (American Society for Testing and Materials, Philadelphia, Pa., 1975).

Key words: conservation; materials recovery; natural resources: reclamation.

This paper reports the nontechnical and technical findings of the workshop on ferrous metals. Discussions include the technology for the use of municipal ferrous scrap, the economic outlook, and potential markets for ferrous waste. Eight recommendations are suggested for improved recovery of ferrous waste.

15604. Graminski, E. L., **Problems and potentials in paper recycling,** (Proc. National Materials Conservation Symp. on Resource Recovery and Utilization, Gaithersburg, Md., Apr. 29-May 1, 1974), Paper in *Resource Recovery and Utilization,* H. Alter and E. Horowitz, Eds., *Am. Soc. Test. Mater. Spec. Tech. Publ.* **592,** pp. 132-139 (American Society for Testing and Materials, Philadelphia, Pa., 1975).

Key words: market pulp; paper, waste; pulp, secondary; recycled paper; secondary pulp; waste paper.

The U.S. consumed more than 60 million tons of paper and paperboard in 1973, about 20 percent of which was recycled. Steel is the only product that is consumed in larger quantities than paper. The principal disincentives for paper recycling are (1) the ready availability of virgin wood fibers, (2) lack of research on recycling of paper, (3) economics favor the use of virgin fibers, and (4) contaminants in wastepaper present major problems in recycling. In spite of the large amount of wastepaper that is available, a wastepaper shortage occurred in 1973 and has continued into 1974 because of problems in collection, fluctuation of the wastepaper market, and lack of manufacturing capacity. It is anticipated that about 32 million tons of paper and paperboard are available for recycling. About 130 pulp mills with a capacity of 600 tons per day would be needed to recycle this amount of wastepaper, which would produce about 24 million tons of recycled paper. The capital for building these mills is not available, and if a large number of secondary fiber mills were built immediately, it would create chaos in the virgin fiber industry. It is suggested that market pulp mills, located in or near large municipalities, be erected as needed to provide the need for more market pulp. This secondary pulp would be available to many mills that now are not equipped to process wastepaper.

15605. Jackson, R. H. F., **Towards algorithmic standardization in mathematical programming: Another step,** *Proc. 1974 Fall UNIVAC Users' Conf., Toronto, Canada, Sept. 1974,* pp. 3-147–3-153 (1974).

Key words: algorithms; mathematical programming standards; testing.

This talk discusses the Mathematical Programming Society's newly formed Working Committee on Algorithms, whose domain of interest includes the accuracy, availability, and transportability of computer codes for the solution of mathematical programming problems. The Committee, it is hoped, will satisfy the pressing need for real achievements in these areas. The discussion will focus on the goals and accomplishments to date of the Committee, and will stress the importance of a good working relationship between it and the O.R. community.

15606. Holton, J. K., Driscoll, P., **Linking research and practice,** *AIA J.*, pp. 67-68 (Apr. 1975).

Key words: AIA/NBS Architect-in-Residence; architectural research; daylight research; National Bureau of Standards; programs for architects; research communication.

There has been a long standing need for more effective interchange between the building community and researchers. The American Institute of Architects and the National Bureau of Standards have established an Architect-in-Residence program to help foster better communications between these groups. The first year of the program is now one-half completed and the activities of the Architect-in-Residence have fallen into three areas: (1) a resource for ongoing research activities at CBT; (2) liaison with the building community; and (3) a personal research project. This latter activity is a study of "The Introduction and Control of Natural Light in Buildings" and exemplifies the objectives of the program, the interrelationship of research work at CBT and the needs and demands of the working building community.

15607. Goldman, A. J., **The adequacy of management science technology for nonmilitary applications in the Federal Government,** (Proc. Workshop on Management Science in the Federal Government, Washington, D.C., Sept. 18, 1969), Chapter 6 in *Management and Policy Science in American Government,* M. J. White, M. Radnor, and D. A. Tansik, Eds., Part III, pp. 135-170 (Lexington Books, D. C. Heath & Co., Lexington, Mass., 1975).

Key words: management science; mathematical models; numerical analysis; operations research; systems analysis.

The "technology" of management science (MS) is here broadly construed to include physical equipment (e.g., high-speed computers), formal techniques (such as linear programming), paradigms and insights from various disciplines, and at the most basic level the analytical aptitudes of the management scientist. A middle ground is struck between those who consider this technology adequate and sound for the applications in question, and those who regard it as relatively useless for the nonquantitative value-laden problems facing nonmilitary government agencies. The discussion of adequacy and soundness includes the elements of: practical availability of methods and data (the technology's "raw material"); soundness in actual employment; and usefulness in principle when values and/or qualitative considerations are prominent. Some speculative comments are offered concerning the disparity, between promise and actuality, in MS contributions to governmental decision-making and operating procedures. In particular, some principal advantages of MS technology seem subject to considerable negation by typical attributes of large organizations.

15608. Kan, P. T., Peterson, G. A., Webb, D. V., Szalata, Z. M., O'Connell, J. S., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electrodisintegration of ^{3}He,** *Phys. Rev. C* **12,** No. 4, 1118-1125 (Oct. 1975).

Key words: continuum; electron scattering; helium-3; monopole state; multipole decomposition; zero range approximation.

The continuum spectra of ^3He have been measured up to excitation energies of 40 MeV by means of inelastic electron scattering. Incident electron beam energies between 60 and 120 MeV were used, corresponding to a momentum transfer range of 0.3 fm^{-1} to 1.1 fm^{-1}. Scattered electrons were observed at two angles, 92.6 and 127.7°. The radiation corrected spectra and the form factors are presented, and compared with calculations based on a zero-range approximation. In this model, the sharp rise from the $p+d$ threshold previously reported may be identified as a $^2S \rightarrow {}^2S$ Coulomb monopole transition.

15609. Walker, G. R., Minor, J. E., Marshall, R. D., **The Darwin cyclone valuable lesson in structural design,** *Civ. Eng.* **45,** No. 12, 82-86 (Dec. 1975).

Key words: buildings; codes and standards; cyclones; natural disasters; structural engineering; wind damage; wind loads.

Damage to buildings in Darwin, Australia caused by Cyclone Tracy is described. The approximate cyclone track and probable maximum wind speeds are presented along with an assessment of the performance of several types of buildings under extreme wind loading. Australian activities in reconstruction are discussed and it is concluded that what happened at Darwin provides a strong argument for the reassessment of residential construction practices in the United States.

15610. Rubin, S., **Thermal resistance measurements on monolithic and hybrid Darlington power transistors,** (Proc. 1975 IEEE Power Electronics Specialists Conf., Culver City, Calif., June 9-11, 1975), *PESC 75 Record,* **75-CHO,** 965-4 AES, 252-261 (The Institute of Electrical and Electronics Engineers, New York, N.Y., Sept. 1975).

Key words: Darlington hot spot screen; Darlington thermal resistance; emitter-only switching; hot spot screen for Darlingtons; integrated power Darlington thermal resistance; thermal resistance measurement.

A method for measuring the thermal resistance, R_θ, of integrated power Darlington transistors is described that is based upon the emitter-only switching technique. It is shown that for specified measurement conditions this method can be used to measure the average thermal resistance, $R_{\theta(1+2)}$, of the input and output transistors of the Darlington pair and is therefore applicable to production-line monitoring of the thermal characteristics of the Darlington. It is shown that although a direct measurement of the thermal resistance, $R_{\theta(2)}$, of the output transistor cannot be made for most Darlingtons, an indirect determination of $R_{\theta(2)}$ can be made using the emitter-only switching technique and a simple equation. Comparisons of the differences between the infrared-determined thermal resistance and the electrically-measured thermal resistance of Darlingtons and of discrete power transistors illustrate that the accuracy of the Darlington measurements is comparable with that achievable for discrete devices. It is also shown that measurements which attempt to use the collector-base voltage of the output transistor of the Darlington as a temperature-sensitive-parameter, either alone or in conjunction with an output commutating diode (when present), are too sensitive to the magnitude of the measuring current to be reliable. Also, the use of the base-current screen for hot spots, as used for discrete transistors, is marginally applicable to integrated Darlingtons, but it is shown that the emitter-base voltage sensed during emitter-only switching is quite effective for detecting hot-spot formation.

15611. Krauss, M., Neumann, D., **Ion-pair states of O_2,** *J. Chem. Phys.* **63,** No. 12, 5073-5076 (Dec. 15, 1975).

Key words: ion-pair; O_2; photodissociation; predissociation; Rydberg states; valence states.

Valence states of O_2 that correlate adiabatically to the ion pair asymptote, $O^+(^4S) + O^-(^2P)$, have been calculated using the multiconfiguration description of the electronic structure. The production of the ion pair is attributed to valence-Rydberg mixing that predissociates Rydberg states of the excited O_2^+ ion such as those leading to the $b\,^4\Sigma_g^-$ state. The electronic states required the calculation of excited states of a given symmetry. This is possible with the BISON-MC codes if the rigorous restriction on orthogonality to the lower states is relaxed. For homonuclear valence states, in particular, this should be a good approximation.

15612. Cezairliyan, A., Righini, F., **Measurement of melting point, radiance temperature (at melting point), and electrical resistivity (above 2,100 K) of zirconium by a pulse heating method,** *Rev. Int. Hautes Temp. Refract.* **12,** No. 3, 201-207 (1975).

Key words: electrical resistivity; high-speed measurements; high temperature; melting point; normal spectral emittance; radiance temperature; zirconium.

A subsecond duration pulse heating method is used to measure the melting point, radiance temperature (at 650 nm) at the melting point, and electrical resistivity (above 2,100 K) of zirconium. The results yield a value of 2,128 K for the melting point on the International Practical Temperature Scale of 1968. The radiance temperature (at 650 nm) of zirconium at its melting point is 1,940 K, and the corresponding normal spectral emittance is 0.367. At 2,100 K electrical resistivity is $128.7 \times 10^{-8}\ \Omega$ m. Estimated inaccuracy is: 8 K in the melting point and in the radiance temperature, and 3 percent in the normal spectral emittance and in the electrical resistivity.

15613. Teague, E. C., **Surface finish measurements: An overview,** *Soc. Manuf. Eng. Tech. Pap.* **IQ75-137,** 1-21 (1975).

Key words: electron microscopes; horizontal resolution; optical instruments; stylus instruments; surface texture measurement; surface texture parameters; vertical resolution.

This paper reviews existing methods of surface finish measurement. The methods are considered from the standpoint of measurement systems whose components—specimen surface, measuring instrument, analyzing equipment and data display devices are equally important. Stylus, optical and electron optical instruments are evaluated and compared in terms of peak-to-valley-range, measurement area, vertical resolution, horizontal resolution, and profile measuring capability. Finally, the use of a digital computer as part of a measurement system will be discussed.

15614. Greenberg, O. W., Nelson, C. A., **Composite models of leptons,** *Phys. Rev. D* **10,** No. 8, 2567-2573 (Oct. 15, 1974).

Key words: composite model of leptons; electron number; leptonic quarks; lorks; muon-electron universality; muon number; neutrino quarks; strong interactions; three triplet model.

We give ten criteria for composite models of leptons, and present two models which satisfy a number of these criteria. Both models use three triplets of leptonic analogs of quarks which we call "leptoquarks"; the first model uses fractionally charged leptoquarks and the second model uses integrally charged ones. In the second model, leptoquarks and quarks could be identical and there is a possibility of unifying the description of leptonic and hadronic phenomena. Both models assign leptons to nonsinglet representations of SU(3)″. A plausible SU(3)″ mass formula allows the known leptons to be less massive than baryons if leptoquarks and quarks are identical.

15615. Lee, T. G., Parker, W. J., Tryon, M., **Laboratory fire performance characteristics of a dibromotetrafluoroethane-blown**

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rigid polyurethane foam, *J. Fire Flammability* **6,** 499-510 (Oct. 1975).

Key words: dibromotetrafluoroethane; fire tests; flame spread index; heat release rate; ignition temperature; rigid urethane foam; smoke.

The fire performance characteristics of a dibromotetrafluoroethane-blown rigid polyurethane foam with a core density of 0.046 g/cm³ were measured by several laboratory test methods. Measurements included: surface flammability, smoke and gases generated at elevated temperature and during combustion, ignition temperature, rate of heat release, and fire growth. The maximum concentration of the blowing agent in the specimen was approximately 13 wt percent. The release of the blowing agent from the heated specimen began at about 60 °C and reached a rate of about 3 wt percent/hr at 100 °C. The material had a flame spread index (ASTM E 162) of 11 and smoke levels (NFPA 258-T) of 170 and 480, maximum specific optical density under nonflaming and flaming exposures, respectively. The measured rate of heat release was 8.8 W/cm², about five times that of a fibrous glass insulation. The measured flash ignition temperature was 530 °C for the material.

15616. Hughes, C. E., Singletary, W. E., **Triadic partial implicational propositional calculi,** *Zeitschr. f. math. Logik und Grundlagen d. Math.* **21,** 21-28 (1975).

Key words: degrees of unsolvability; propositional calculus; recursion theory; undecidability.

A partial implicational propositional calculus (PIPC) is an inference system having as axioms some finite set of tautologies of the implicational calculus. Its rules of inference are substitution and modus ponens. Its decision problem is the problem of deciding for an arbitrary well-formed formula whether or not it may be inferred. A given PIPC is said to be n-adic if at most n propositional variables appear in any of its well-formed formulas. In this paper we investigate decision problems for triadic (3-adic) PIPC's. The major results presented are: (i) every r.e. many-one degree is represented by the class of decision problems for triadic PIPC's, denoted I_3; (ii) not every r.e. one-one degree is represented by I_3; and (iii) the class of decision problems for partial propositional calculi is many-one equivalent to I_3.

15617. Quintiere, J., **The application and interpretation of a test method to determine the hazard of floor covering fire spread in building corridors,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 355-367 (1975).

Key words: corridor fire; experiments; flame spread; floor-covering; test method; theory.

In recent years, much attention has been given to measuring the potential flame spread hazard of building corridors, in which a floor covering material is the only combustible present. The intention has been to develop standards for floor coverings which will limit corridor flame spread when the corridor is exposed to a large room fire. Under such circumstances, flame spread along the corridor floor is promoted by radiant heat transfer due to the room fire.

The proposed test method measures the flame spread characteristics of a floor covering material under an external radiant heat flux. One parameter the test measures is the external heat flux at the point of extinguishment. This has been interpreted as the minimum or "critical" radiant heat flux required to support flame spread. A theoretical model was developed to simulate the physical characteristics of the test method and sample materials.

The test method can be applied to measure the potential hazard of building corridors with floor coverings by comparing the critical flux measured for a material with an anticipated corridor heat flux due to a large fire. Results are presented which display corridor floor heat flux for various room fire intensities. These results are compared to theoretical predictions which illustrate the effect of corridor geometry and fire conditions on heat flux to the floor.

15618. Hocken, R., Moldover, M. R., Muth, E., Gerner, S., **Versatile cells for optical studies in fluids,** *Rev. Sci. Instrum.* **46,** No. 12, 1699-1700 (Dec. 1975).

Key words: cell; Kovar; sapphire; temperature; thickness.

We describe high quality optical cells designed for ease of cleaning and accurate definition of optical path length. The cells perform well from liquid nitrogen temperatures to 500 K at pressures up to 11 MPa (112 atm).

15619. Miller, A., Hussmann, E. K., McLaughlin, W. L., **Interferometer for measuring fast changes of refractive index and temperature in transparent liquids,** *Rev. Sci. Instrum.* **46,** No. 12, 1635-1638 (Dec. 1975).

Key words: calorimeter; dosimetry; electron beam; interferometer; radiation chemical kinetics; radiation measurement; refractive index; temperature measurement.

A double-beam interferometer has been designed for detecting changes of refractive index in transparent liquids associated with the absorption of ionizing radiation energy, due to short electron beam pulses from an accelerator. The response time of the interferometer is less than 0.2 μsec, and refractive index changes of the order of 10^{-7} can be measured, corresponding to a temperature change of ~ 10^{-3} °C and an absorbed dose in water of ~ 350 rad. The interferometer can be used as either a real-time or integrating radiation dosimeter, if the temperature coefficient of the refractive index (dn/dT) is known for the irradiated liquid in the temperature region of interest.

15620. Cullen, W. C., **The composite roofing membrane,** *The Roofing Spec.* **3,** No. 5, 17-21 (Sept. 1975).

Key words: application procedures; built-up roofing systems; composite membrane; composition; performance criteria.

The Composite Roofing Membrane is an indispensable component of the built-up roofing system. The paper reviews the functions of the membrane's components and the importance of application procedures on the quality and performance of the membrane. The impact of the development of performance criteria for the composite roofing membrane is described.

15621. Blanc, R. P., **Availability and useability of computer communication networks,** *Proc. Seventh Int. Conf. on Systems Sciences, Honolulu, Hawaii, Jan. 8-10, 1974,* pp. 10-13 (1974).

Key words: computer networks; computer terminals; networking technology; value-added networks.

The technological characteristics of existing approaches to computer networking technology are reviewed for the purpose of identifying those features which lend themselves particularly well to the interconnection of computers, as well as computer terminals.

15622. Rubin, R. J., Mazur, J., **Ordered spans of unrestricted and self-avoiding random-walk models of polymer chains. I. Space-fixed axes,** *J. Chem. Phys.* **63,** No. 12, 5362-5374 (Dec. 15, 1975).

Key words: Monte Carlo analysis; ordered spans; self-avoiding polymer chains; shape of polymer chains; spans; unrestricted polymer chains.

An N-step random walk on a cubic lattice is adopted as a model of a random polymer chain. The spans, or extents, of each random walk configuration in the principal lattice directions are arranged in order of magnitude, $\xi_3 \geq \xi_2 \geq \xi_1$. In the case of the unrestricted random walk, the average values of the ordered spans $\langle \xi_{i,u} \rangle$ and $\langle \xi_{i,u}^2 \rangle$, $i=1$, 2, and 3, are calculated analytically in the limit of large N. The limiting relative values of the first moments, $\langle \xi_{i,u} \rangle$ are 1.637:1.267:1; and the limiting values of the second moments $\langle \xi_{i,u}^2 \rangle$ are 2.710:1,600:1. In the case of the restricted or self-avoiding walk, the corresponding average spans $\langle \xi_{i,r} \rangle$ and $\langle \xi_{i,r}^2 \rangle$ are estimated for $N \leq 150$ by using a Monte Carlo procedure. The same Monte Carlo procedure is used to estimate the values of $\langle \xi_{i,u} \rangle$ and $\langle \xi_{i,u}^2 \rangle$ for $N \leq 1000$. On the assumption that the rate of approach of the average ordered snaps of the self-avoiding walks to their asymptotic forms is similar to the rate of approach of the average ordered spans of the unrestricted walks to their asymptotic forms, the following estimates are obtained for the ordered spans of the self-avoiding walks: $\langle \xi_{i,r}(N) \rangle = \bar{\xi}_{i,r} N^{0.61}$ for $N \gg 1$ and $\bar{\xi}_{3,r} : \bar{\xi}_{2,r} : \bar{\xi}_{1,r} = 1.75 : 1.31 : 1$. The relative values of the estimates of the second moments of these ordered spans for $N \gg 1$ are $\langle \xi_{3,r}^2 \rangle : \langle \xi_{2,r}^2 \rangle : \langle \xi_{1,r}^2 \rangle = 3.08:1.71:1$. A simple ellipsoidal model is analyzed in order to obtain estimates of the intrinsic spans of the two kinds of random walks. It is assumed that all random walks have the same intrinsic dimensions and form (ellipsoidal), but that their principal axes are oriented at random. The average ordered spans with respect to a set of orthogonal space-fixed axes of this randomly oriented ensemble of ellipsoids depend uniquely on the principal diameters of the ellipsoid (intrinsic spans). A procedure is devised to solve the inversion problem of determining the relative lengths of the principal diameters which correspond to a given set of relative ordered moments with respect to space-fixed axes. The relative values obtained for the principal diameters of the ellipsoid are 2.59 : 1.61 : 1 in the case of the unrestricted random walk and 3.05 : 1.77 : 1 in the case of the self-avoiding walk.

15623. Cezairliyan, A., McClure, J. L., **A subsecond pulse heating technique for the study of solid-solid phase transformations at high temperatures: Application to iron,** *High Temp. Sci.* **7**, 189-196 (1975).

Key words: high-speed measurement; high temperature; iron; phase transformation; thermodynamics.

A system based on an accurate pulse heating technique is described that can be used for investigations of solid-solid phase transformations at temperatures above 1500 K. The system is capable of heating the specimen from room temperature to its melting point in less than 1 s and of measuring the pertinent experimental quantities every 0.4 ms with a full-scale signal resolution of approximately one part in 8000. Specimen temperature is measured with a high-speed photoelectric pyrometer and recordings of experimental quantities are made with a high-speed digital data acquisition system. Application of the technique to investigations at the $\gamma \rightarrow \delta$ transformation point of iron is described. Measurements yielded the following results: 1683 K for the transformation temperature, 890 J · mol^{-1} for the transformation energy, and 0.36 for the normal spectral emittance (at 0.65 μm) at the transformation point.

15624. Masters, L. W., Reichard, T. W., **Evaluation of adhesive-bonded joints in housing components of glass fiber-reinforced polyester laminate,** (Proc. American Society for Testing and Materials Conf. on Composite Reliability, Las Vegas, Nev., Apr. 15-16, 1974), Paper in *Composite Reliability, Am. Soc. Test. Mater. Spec. Tech. Publ.* **580,** pp. 146-156 (American Society for Testing and Materials, Philadelphia, Pa., Aug. 1975).

Key words: adhesive bonding; aging tests (materials); composite materials; glass fibers; housing system; laminates; reinforced plastics; shear strength; sustained loading; tensile strength.

A series of tests was performed on sandwich panel housing components made with glass fiber-reinforced polyester (FRP) laminates. Specifically, long- and short-tests were performed to evaluate the adhesive bonds between the FRP laminate facings and cores of the panels. Specimens of two different FRP laminates were analyzed and their bonding characteristics with two different adhesives were studied. The test data show that the bond strength was significantly affected by the laminate formulation, adhesive formulation, adhesive thickness, sustained loading, and temperature.

15625. Lovas, F. J., **Application of microwave spectroscopy to chemical analysis,** *ISA Trans.* **14,** No. 2, 145-151 (1975).

Key words: applications; chemical analysis; microwave; qualitative analysis; quantitative analysis; rotational spectra.

Traditional analytical techniques have been successfully employed on a great variety of systems for identifying stable reaction products as well as for purity analysis and reaction efficiency. However, most analytical techniques generally can only be applied to "well behaved" chemical systems. Since gas phase reaction products do not always follow the "well behaved" guideline, an alternate analytical tool, such as microwave spectroscopy, could prove beneficial for analyzing such systems and may well provide some new routes to synthetic chemistry. A general review of the present state-of-the-art for applications of microwave techniques to analytical studies will be presented. An attempt will be made to describe the limitations and advantages of microwave spectroscopy for probing chemical systems for product identification and for optimization of the efficiency of gas phase chemical reactions. As an illustration, some recent results obtained in our laboratory on the complex pyrolytic decomposition reactions of ethylamine will be described. Further examples of possible applications will be taken from typical industrial processes that employ vapor phase chemical synthesis techniques.

15626. Chwirut, D. J., **Tensile creep of angle-plied boron/epoxy laminates,** *J. Test. Eval.* **3,** No. 6, 442-448 (1975).

Key words: angle-plied laminates; boron/epoxy; composite materials; creep; viscoelasticity, linear and nonlinear.

Tensile creep tests were performed at 75 °F (24 °C) and 300 °F (149 °C) on 26 specimens cut from $\pm$30-deg and $\pm$45-deg laminates of boron/epoxy composite material to characterize the creep behavior of these materials. A linear viscoelastic laminate theory proposed by McQuillen was compared with the experimental data for the tests run at 75 °F (24 °C). The predicted creep strains differed greatly from the measured values, indicating that the linear theory is not applicable to laminates with these filament orientations. A general creep equation of the form $\epsilon = k\sigma^m t^n$ was fitted to the experimental data with excellent correlation. The stress exponents m varied from 1.79 to 5.17 for the four series of tests, thus characterizing the nonlinear behavior of boron/epoxy laminates with these filament orientations.

15627. Ausloos, P., **Pulse radiolysis of alkanes in the gas-phase, ion-molecule reactions and neutralization mechanism of hydrocarbon ions,** (Proc. Symp. on Mechanisms of Hydrocarbon Reactions, Siófok, Hungary, June 5-7, 1973), Paper in *Mechanisms of Hydrocarbon Reactions*, F. Márta and D. Kalló, Eds., *Plenary Lecture* **3,** pp. 603-624 (1975).

Key words: charge recombination rate constants; cobalt gamma radiolysis; hydrocarbons; ion-molecule reaction; neutralization mechanisms; pulse radiolysis.

A discussion is presented of the fate of unreactive hydrocarbon ions in various selected gaseous systems. It is shown that experiments performed with the high radiation dose rates obtained in pulse radiolysis experiments have several advantages over conventional low dose rate experiments for the elucidation of the mechanism of homogeneous neutralization of unreactive hydrocarbon ions. This is so because the charged species has a much shorter life-time with respect to neutralization under high dose rate (pulse radiolysis) conditions, so that the reaction of the ions with minor impurities or accumulated products is much less probable than in low dose rate experiments. It is further shown through a few examples, that quantitative information about the rate constants of neutralization events and ion-molecule reactions can be obtained when the dose rate is high enough for neutralization and chemical reaction to be in competition. Once reliable rate constants for neutralization and ion-molecule reactions are derived, one can obtain a quantitative evaluation of the products which will be formed in the pulse radiolysis of a hydrocarbon gas mixture from a computer calculation.

15628. Birky, M. M., **Review of smoke and toxic gas hazards in fire environment,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 231-252 (1975).

Key words: bioassay; combustion products; fire; hazard assessment; toxicity.

Fire statistics show that at least 50 percent of the fire related deaths can be attributed to "smoke inhalation." Detailed investigations of fire fatalities and autopsies of fire victims show that the interaction of carbon monoxide, pulmonary injury, alcohol and cardiovascular disease plays a role in many of these deaths.

The research efforts designed to assess the toxicological effects of products of thermal degradation can be divided into three broad categories: (1) assessment based on extensive chemical analysis, (2) assessment based on analyzing for specific toxicants and (3) assessment based on bioassay techniques frequently combined with analysis for a few selected toxicants.

Assessment categories 1 and 2 have mainly addressed the problem of the gaseous phase of the degradation products, with little consideration given to the particulate phase (smoke). These methodologies illustrate the limitation of basing a hazard assessment on the assumption that the toxicity of the fire environment is due solely to a few known toxicants. In addition, the particulate phase may play a predominant role in the inhalation toxicity that cannot be assessed with chemical analysis. One concludes that due to the complexity of the fire environment, an assessment of this hazard will require the combined efforts of toxicologist, chemists and combustion scientists.

15629. Mathey, R. G., Cullen, W. C., **Performance criteria for built-up roofing—Part 2,** *Roofing Siding Insulation* **52,** No. 1, 44-46, 56 (Jan. 1975).

Key words: bituminous roof membranes; performance attributes; performance criteria; physical and engineering properties; test methods.

This report is the last in a series of publications on performance criteria for built-up roof membranes. To remind the reader of the scope of these articles, the authors' introductory remarks for Part I follow. The development of a performance approach to bituminous built-up roof membranes is described and preliminary performance criteria are recommended. A number of test methods have been developed in order to obtain data to evaluate roofing membranes against the recommended criteria. Twenty attributes that affect the performance of roof membranes under service conditions are identified and laboratory tests are described for measuring the engineering properties of the membrane that pertain to many of these attributes. A level of performance is recommended for nine of the identified performance attributes.

15630. McCaffrey, B. J., Quintiere, J. G., **Fire-induced corridor flow in a scale model study,** *Proc. International Council on Building Research and Documentation (CIB) Symp. on the Control of Smoke Movement in Building Fires, Garston, Watford, England, Nov. 4-5, 1975,* **1,** 34-47 (1975).

Key words: corridors; fire induced flow; recirculating flow; scale-model; smoke movement; stratified flow; theory.

The flow induced by a room fire was studied within a corridor for a scale model configuration. The effect of corridor exit opening was determined for a fixed room door opening and temperature gradient. Velocity and temperature measurements were made. At the room doorway and corridor exit the thermally stratified flow would enter and leave with a sharp boundary between the counter current flows. However, within the corridor the flow was more complex, giving rise to a large recirculating zone traversing the corridor length and trapped between the hot ceiling jet and entering cold flow. Smoke tracer visualization techniques illuminated these complex flow patterns along with mixing caused by shedding vortexes. These flow results are quantitatively presented and their nature is discussed. The measured total mass flow rate induced into the corridor was measured and compared to theoretical results. At this time, the implications of these complex corridor flows in a scale-model must be limited until they are verified in similar full-scale experiments and their nature is more thoroughly understood.

15631. Berg, J. L., **Federal Privacy Act countdown—Is the private sector ready?,** *Infosystems* **22,** No. 7, 25-27 (July 1975).

Key words: privacy; privacy legislation; privacy planning.

Reporting on the joint NBS/MITRE workshop, *Planning for Action—the Privacy Mandate,* the article provides, in capsule form, a description of the workshop with specific attention to those comments of use to EDP managers.

15632. Buchbinder, B., **Pilot implementation of the Fire Incident System,** *Fire J.* **69,** No. 3, 65-69 (May 1975).

Key words: data; fire; fire incident system; fire service; incident reports; loss; National Fire Data System.

The Fire Incident System (FIS) is based on a data file of individual fire incident reports from the fire services. The pilot implementation of the Fire Incident System is an integral part of the National Fire Data System. This paper examines the objectives of the pilot project, describes the system and its participants, and discusses the project status.

15633. Cotton, I. W., **Cost-benefit analysis of interactive systems,** *Proc. Second Jerusalem Conf. on Information Technology, Jerusalem, Israel, July 29-Aug. 1, 1974,* pp. 729-746 (1974).

Key words: cost-benefit analysis; cost-effectiveness; economics; interactive systems; performance evaluation.

This report assesses the state-of-the-art in cost-benefit analyses of interactive systems and suggests an approach for developing improved methodology. Cost-benefit analyses are distinguished from analyses of system performance in that the latter are directed at optimizing system performance at a given level of investment, while the former are directed at justifying the investment itself.

Methods of analyzing the performance and costs of computer systems in general and interactive systems in particular are discussed. With this information it is shown how cost-effectiveness analyses may be performed. The next crucial step is to conduct benefit analysis, an ill-defined art. The results of benefit analysis must be combined with cost-effectiveness analysis in order to perform the desired cost-benefit analysis.

An experimental methodology is suggested for better performing benefit analyses of interactive systems. A more rigorous formulation of the cost-benefit procedure is then outlined. No attempt is made in this report to actually perform such an analysis.

15634. Hudson, R. P., Pfeiffer, E. R., **Magnetic susceptibility of single-crystal CMN, 0.002K to 2K,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics* **LT-14,** M. Krusius and M. Vuorio, Eds., **3,** 242-245 (North Holland Publishing Co., Amsterdam, 1975).

Key words: CMN; entropy; magnetic susceptibility; magnetic temperature; thermodynamic temperature.

Correction of a small systematic error present in our earlier measurements leads to a much improved determination of the magnetic temperature (T*) scale for single crystal CMN. These latest results are compared with recently published findings of another laboratory.

15635. Buchbinder, B., Buchbinder, L. B., **The fire hazard analysis process at the National Bureau of Standards,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 156-161 (1975).

Key words: clothing flammability; fabric flammability; fire hazard; fire investigation; flammability testing; hazard analysis; hazard quantification.

The Office of Information and Hazard Analysis (OIHA) performs its hazard analysis function by means of a multi-faceted program combining in-depth case history investigation of fire accidents, laboratory experimentation, fire testing, and data analysis to identify and characterize specific hazards.

Hazard characterization serves to influence the formulation of basic fire research, to guide test method development for codes and standards, to identify data required to be collected, and to provide input to public education for fire safety. These functions are performed in concert with other United States government agencies, including the National Fire Prevention and Control Administration (NFPCA) in the Department of Commerce with which we have a close working relationship, and the Consumer Product Safety Commission which we support in product standard development.

The main portion of this paper defines the current fire hazard analysis process illustrated by results from the fabric flammability project, describes how this process is evolving into the more quantitative process of the future, and discusses the data needed for future hazard models.

15636. Parrish, W. R., Steward, W. G., **Vapor-liquid equilibria data for helium-carbon monoxide and helium-nitrous oxide systems,** *J. Chem. Eng. Data* **20,** No. 4, 412-416 (Oct. 1975).

Key words: binary mixture; experimental vapor-liquid equilibria; helium-carbon monoxide system; helium-nitrous oxide system; Henry's constants.

Liquid-vapor data are reported for the helium-carbon monoxide system at 80, 85, 90, 100, and 120K and for the helium-nitrous oxide system at 195, 215, 235, 245, 255, 265, and 285K at pressures up to 138 bars. The data are analyzed for internal consistency using pseudo-Henry's law constants and enhancement factors.

15637. Beers, Y., Howard, C. J., **The microwave spectrum of HO_2 near 65 GHz,** *J. Chem. Phys.* **63,** No. 10, 4212-4216 (Nov. 15, 1975).

Key words: HO_2; hydroperoxyl; microwave.

Using a Zeeman-modulated cavity spectrometer with a 10 sec time constant and a phase locked klystron, we have observed in the products of a discharge-flow system, Zeeman components of the six allowed zero-field lines at 65 070 $\pm$ 2, 65 082 $\pm$ 2, 65 098 $\pm$ 2, 65 373 $\pm$ 2, 65 397 $\pm$ 2, and 65 401 $\pm$ 2 MHz, and of one forbidden zero-field line at 65 369 $\pm$ 4 MHz. The Q of the Fabry-Perot cavity is about 10 000, and the magnetic field was swept from 0-30 G. Chemical tests indicate that the observed lines are due to HO_2. They have been assigned and least-squares fitted using a simple theoretical model to yield a value of 65 185 $\pm$ 2 MHz for the 1_{01}-0_{00} asymmetric rotor transition frequency of HO_2, a value of -208 ± 2 MHz for the linear combination $(\epsilon_{bb} + \epsilon_{cc})/2$ of elements of the electron spin-molecular rotation interaction tensor, a value of -28 ± 2 MHz for the nuclear spin-electron spin Fermi contact interaction parameter σ, and a value of $+4 \pm 2$ MHz for the spin-spin tensor interaction parameter λ. These constants are in excellent agreement with three less precise constants obtained from an earlier laser magnetic resonance study and have been confirmed by recent more accurate measurements of Saito.

15638. Clough, R. B., **The effects of specimen size and microstructure on the Larson-Miller parameter,** *Scr. Metall.* **9,** No. 12, 1325-1329 (1975).

Key words: crack nucleation; elevated temperature; failure prediction; Larson-Miller parameter.

There is a great need for the standardization of methods for predicting elevated temperature material failure. Generally, metallurgical instability limits the accuracy of these methods. Quantitative metallurgical models predicting lifetimes from microscopic parameters are virtually nonexistent. Here an elementary metallurgical model of the well-known Larson-Miller parameter is developed, based on the thermally-activated nucleation of Griffith-type cracks. The concept of the activation volume for fracture is introduced. The analysis permits calculation of the size and surface energy of crack nuclei from stress-rupture curves. These are computed theoretically from stress rupture data of typical high temperature iron- and nickel-base alloys. No independently measured nuclei size data exists, but the surface energies agree with energies obtained from similar alloys by direct measurement. The analysis also predicts that the stress-rupture lifetime is a sensitive function of crack nucleus surface energy, and gives a quantitative rationale for the invariability of the constant in the Larson-Miller parameter predicted from microstructural values.

15639. Straty, G. C., **Hypersonic velocities in saturated and compressed fluid methane,** *Cryogenics* **15,** No. 12, 729-731 (Dec. 1975).

Key words: compressibility; interferometry; light scattering; methane; sound velocity; specific heat ratio.

Brillouin scattering techniques have been used to measure the velocity of hypersonic waves in gaseous and liquid methane. Measurements were made on the saturated liquid and vapour and along selected isotherms to a maximum pressure of about 17.5 MPa. The data, which agree well with previously measured ultrasonic velocities, have been combined with PVT data to obtain the isentropic compressibility and the ratio of specific heats.

15640. Cotton, I. W., **Remark on stably updating mean and standard deviation of data,** *Commun. ACM* **18,** No. 8, 458 (Aug. 1975).

Key words: data analysis; mean; standard deviation; statistics; updating estimates.

Hanson's article describes an elegant procedure for recomputing the weighted mean and standard deviation of a series of numbers when new values are added. As he observes, in the case of unit weights a considerable simplification occurs; however, he does not present the simplest equations for this case. This remark derives simple results for updating mean and standard deviation in the case of unit weights, when only the previous values of mean, standard deviation, number of occurrences and the new datum are known.

15641. Kanda, M., **Accuracy considerations in the measurement of the power gain of a large microwave antenna,** *IEEE Trans. Antennas Propag.* **AP-23,** No. 3, 407-411 (May 1975).

Key words: calibration; ground antenna; standard antenna gain; three-antenna extrapolation.

Accuracy considerations in the measurement of the power gain of a large microwave antenna are discussed. The analysis indicates that, using the power gain comparison method with a standard antenna of nominally 40-dB gain, a large antenna with a power gain of nominally 60 dB could be calibrated to within an error of 0.17 dB (3σ). The power gain of the standard antenna is considered to be determined via the generalized three-antenna extrapolation method. Individual sources of errors in both the generalized three-antenna extrapolation method and the power gain comparison method are discussed.

15642. Abrams, M. D., **Consumer-oriented measurement of computer network performance,** *Proc. IEEE National Telecommunications Conf., San Diego, Calif., Dec. 2-4, 1974,* pp. 843-844 (1974).

Key words: computer; consumer; contract; evaluation; network; performance.

This short paper describes measurement of computer network services from the consumer's viewpoint. Two common measures of performance are described. The ICST Network Measurement Machine and its data analysis programs are presented as a prototypical device capable of measuring network service for analysis according to various criteria. Sample results are given. Application of measurement to procurement and contractual obligations is discussed.

15643. Pyke, T. N., Jr., **Networked minis and micros—Configurations, applications, and standards,** *Proc. Mini Micro Computer Symp., U.S. Naval Academy, Annapolis, Md., Apr. 15, 1975,* pp. 44-46 (1975).

Key words: microcomputers; minicomputers; networks; standards.

Both minis and micros have found their way into extensive use as a part of computer networks. Minicomputers have a head start, but microcomputers will fast catch up in numbers, especially as a part of terminals connected to networks. Mini/micro network configurations can be divided into two categories, local and distributed. Most research-oriented and operational networks can be placed directly into one of these categories. Successful development and operation of these networks employing minis and micros requires a variety of standards, both internally and externally.

15644. Lawton, R. A., Andrews, J. R., **Pulsed-laser application to sampling oscilloscope,** *Electron. Lett.* **11,** No. 7, 138 (Apr. 3, 1975).

Key words: GaAs; laser; photoconductor; sampling oscilloscope.

An optically strobed sampling oscilloscope is described in which a GaAs laser diode is used to strobe a GaAs photo-conductive sampling gate.

15645. Hamilton, C. A., Phelan, R. J., Jr., Day, G. W., **Pyroelectric radiometers,** *Opt. Spectra* **9,** No. 10, 37-38 (Oct. 1975).

Key words: electrically calibrated; pyroelectric; radiometer.

The performance and detailed operation of an electrically calibrated pyroelectric radiometer are discussed.

15646. Zimmerman, J. E., **Phase slip, dissipation, Bernoulli effect, parametric capacitance, and other curious features of the Josephson effect,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 852-855 (Mar. 1975).

Key words: Josephson effect; phase slip; weak superconductivity.

The details of the Josephson effect in thin metal bridges are difficult to derive quantitatively, and many papers have been written on the subject attempting to describe quantitatively such qualitative features as irreversible phase slip, instantaneous 2π phase slip, variation of order parameter in time and space, Bernoulli effect, and others. It does not seem to be generally recognized that all of these qualitative features are universal attributes of the Josephson effect and occur also in tunnel junctions. In addition, when a steady voltage is impressed across a junction, a term in the electric field is set up (in addition to the Bernoulli field) which has a rather complex temporal and spatial variation.

15647. Andrews, J. R., Gans, W. L., **Pulsed wavemeter timing reference for sampling oscilloscope calibration,** *IEEE Trans. Instrum. Meas. Short Papers,* **IM-24,** No. 1, 82 (Mar. 1975).

Key words: oscilloscopes; pulsed wavemeter timing.

A pulsed wavemeter technique is described that is useful as a source of microwave frequency sine waves for the time base calibration of sampling oscilloscopes.

15648. Bussey, H. E., Richmond, J. H., **Scattering by a lossy dielectric circular cylindrical multilayer, numerical values,** *IEEE Trans. Antennas Propag.* **23,** No. 5, 723-725 (Sept. 1975).

Key words: cylinder scattering; electromagnetic scattering; lossy dielectric; multilayer cylinder; reference values; scattering.

The theoretical scattering solution for a plane wave incident normally on a lossy dielectric multilayer circular cylinder of infinite length is outlined. Numerical values of the modal scattering coefficient for TE and TM modes are given for several single and multilayer cylinders. Verifications of the results are described. The values may serve as reference data.

15649. Hoer, C. A., Roe, K. C., **Using an arbitrary six-port junction to measure complex voltage ratios,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 12, 978-984 (Dec. 1975).

Key words: attenuation; automation; detector; insertion loss; microwaves; phase angle; ratio; six-port junction; vector voltmeter; voltage.

An arbitrary six-port junction is analyzed as a microwave vector voltmeter, measuring the amplitudes and phase differences of two input signals in terms of power readings taken at the remaining four ports. The junction may be calibrated for measuring the complex ratio of these two signals using a self-calibration procedure which requires no attenuation or phase standards.

15650. Engen, G. F., **Automated calibration of directional-coupler-bolometer-mount assemblies,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 12, 984-990 (Dec. 1975).

Key words: automation; calibration; directional coupler; microwave; microwave power.

Although the application of automated methods to power calibration problems in the UHF and microwave region has been described by a number of authors, the primary orientation has been towards the calibration of bolometer mounts and similar items. Little has been published on the problem of calibrating directional-coupler-bolometer-mount assemblies, which also play a major role in the calibration and measurement of UHF and microwave power.

This paper develops a theoretical basis for several different approaches to this measurement problem.

15651. Lawton, R. A., Scavannec, A., **Photoconductive detector of fast-transition optical waveforms,** *Electron. Lett.* **11,** No. 4, 74-75 (Feb. 20, 1975).

Key words: detector; dye laser; GaAs; photoconductor; picosecond; pulse.

The letter reports the development of a fast-response bulk photoconductor that can be used as a photodetector and as an optically gated switch. The photoconducting material used is semi-insulating, chromium-doped GaAs, a sample of which is mounted in a 50 Ω stripline holder. An estimated detector transition time of 92 ps or less was obtained from tests made with a mode-locked dye laser.

15652. Ott, W. R., Slater, J., Cooper, J., Gieres, G., **H^- shape-resonance studies in an arc plasma,** *Phys. Rev. A* **12,** No. 5, 2009-2016 (Nov. 1975).

Key words: arc; hydrogen; negative ion; plasma; resonance; vacuum ultraviolet.

Calculations by Macek have shown that the H^- photoabsorption cross section should be affected by a shape resonance at 1129.5 Å. This experiment is an attempt to observe the resonance in emission according to the reaction $e+H \rightarrow [H^-]^* \rightarrow H^- + h\nu$. The plasma is in a condition of local thermodynamic equilibrium and is generated by a stationary wall-stabilized hydrogen arc. With an axis temperature of 14 000 K and 1 atm pressure, the H^- free-bound continuum contributes only about 2 percent of the total radiation which is dominated in the 1130-Å region by the Ly-α wing. However, the peak of the shape resonance, according to Macek, should have a cross section about 25 times greater than the continuous free-bound cross section; therefore, it should appear as a very noticeable 50 percent structure superimposed on the Ly-α wing. Except for some small features which are attributed to weak molecular emission, there is no obvious indication of the shape resonance in either deuterium or hydrogen spectra between 1105 and 1135 Å. It is estimated that the minimum feature which could have been detected at 1129 Å was about 2 percent of the total signal.

15653. Andrews, J. R., **Directional-coupler technique for triggering a tunnel diode,** *IEEE Trans. Instrum. Meas.* **IM-24,** No. 3, 275-277 (Sept. 1975).

Key words: directional coupler; picosecond; pulse generator; risetime; trigger; tunnel diode.

Present tunnel diode (TD) pulse generators have distortions in the pulse baseline and topline due to feedthrough of the triggering signal. This paper presents a new technique for reducing the trigger-induced distortions. A directional coupler is used to couple the trigger signal to the TD.

15654. Birmingham, B. W., Smith, C. N., **Cryogenics and the energy crisis,** *Cryogenics* **15,** No. 3, 115-118 (Mar. 1975).

Key words: coal gasification; cryogenics; energy crisis; hydrogen economy; LNG; superconducting electrical equipment and instrumentation.

This paper reviews some of the ways cryogenics can help solve the energy crisis. Five specific areas are covered: the use of LNG, the conversion of coal to fuel gas using oxygen from air separation plants, the use of superconductors in power plants and electrical transmission lines, superconducting instruments for geophysical exploration of new energy resources, and the Hydrogen Economy.

15655. Ventre, F. T., **Transforming environmental research into regulatory policy,** (6th Annual Meeting of the Environmental Design Research Association (EDRA), Lawrence, Kans., Apr. 23, 1975), Paper in *Responding to Social Change,* pp. 277-284 (Dowden, Hutchinson & Ross, Inc., Stroudsburg, Pa., Apr. 1975).

Key words: applied research; building codes; building design; building standards; diffusion of information; regulation.

Outlines a means enabling environmental design researchers to participate in the formulation of regulatory policies affecting buildings. The standards system is shown to be an underused channel for relaying research findings to building professionals and the regulatory system is shown to be a potential means for directing building technology toward socially-valued ends. Notes include a brief listing of standards- and codes-generating organizations.

15656. Buchbinder, B., Mathers, W., **Preliminary indications from survey of U.S. household fire experience,** *Proc. 8th Annual Meeting Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1974,* pp. 174-178 (1975).

Key words: Census Bureau; Consumer Product Safety Commission; data; fire; households; injury; loss; National Fire Data System; National Fire Survey; survey.

A survey of over 33,000 U.S. households was conducted in April, 1974. It was sponsored by the National Bureau of Standards and the Consumer Product Safety Commission. This paper discusses the survey scope and the accuracy of the national estimates. Estimates are presented of the number of household-related fires, classified by such parameters as ignition source and room of origin. Property loss and injury estimates are given.

15657. Branstad, D. K., **Encryption protection in computer data communications,** *Proc. Fourth Data Communications Symp., Quebec City, Canada, Oct. 7-9, 1975,* pp. 8-1 —8-7 (1975).

Key words: communications; computer security; cryptography; data security; encryption; network security; security.

Encryption can be an effective process for protecting data during transmission within distributed computer systems and networks. The degree of protection provided by encryption depends on the encryption algorithm employed, the implementation of the algorithm and the administrative procedures regulating the use of algorithm. Additional security requirements of user identification, access authorization and security auditing may be satisfied by combining encryption technology with a network access control machine in a network security center. This paper presents an encryption algorithm for use in computer data communications and the security requirements that are satisfied by proper use of the algorithm. It also discusses the use of a network access control machine to enforce access restrictions for the network.

15658. Andrews, J. R., Baldwin, E. E., **Baseband impulse generator useful to 5 GHz,** *Proc. 1975 IEEE Int. Symp. on Electromagnetic Compatibility, San Antonio, Tex., Oct. 7-9, 1975,* pp. 1-4 (1975).

Key words: impulse generator; picosecond; spectrum; spectrum amplitude; step recovery diode.

A baseband impulse generator recently developed at NBS is described. It is completely solid state and features a 100 kHz maximum repetition rate, 50 ohm source impedance, an extremely narrow 100 ps duration impulse of 8 volts amplitude, and a flat spectrum greater than 60 dBμV/MHz up to 5 GHz. The generator was evaluated on the NBS Automatic Pulse Measurement System which measured the time domain waveform with a sampling oscilloscope and computed the spectrum on a minicomputer.

15659. Newell, A. C., **Improved polarization measurements using a modified three antenna technique,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-4, 1975, Session* **15,** pp. 337-340 (1975).

Key words: antennas; measurement; polarization.

Absolute polarization parameters have previously been obtained using a 3-antenna measurement technique. By a modification of this approach, the accuracies of the results are significantly increased, and the measurements are easier to perform. This work demonstrates the power and utility of using complex rather than scalar polarization parameters in formulating polarization problems.

15660. Daywitt, W. C., Kanda, M., **G/T measurement errors with radio stars,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-5, 1975, Session* **20,** pp. 460-463 (1975).

Key words: antenna gain; G/T; radio star; satellite communications.

This talk highlights often-overlooked or poorly treated aspects in G/T error analyses for satellite communication earth terminals. In particular, correction factors due to star size, differential system temperature, antenna pointing, and refractive attenuation used in G/T measurements are discussed in detail.

15661. Andrews, J. R., Gans, W. L., **Time domain automatic network analyzer,** (Proc. Colloque International sur L'Electronique et la mesure, Paris, France, May 26-30, 1975), Paper in *La Mesure Electrique de Precision,* pp. 258-267 (Le Comité d'Organisation du Colloque International sur L'Electronique et la mesure, Paris, France, 1975).

Key words: attenuation; automated measurement; network analyzer; pulse; S parameters; time domain.

NBS has recently developed a Time Domain Automatic Network Analyzer (TDANA). It measures the S parameters of RF and microwave networks as a function of frequency using pulse measurement techniques. The signal source is typically a tunnel diode pulse generator with a 10-90 percent risetime of less than 20 ps. This generator produces a useful amplitude spectrum extending from dc to beyond 18 GHz. The receiver is a sampling oscilloscope with a 20 ps risetime. The oscilloscope is controlled by a minicomputer. The data measured by the oscilloscope is stored and processed in the minicomputer. The minicomputer averages the data to improve the signal to noise ratio, then Fourier transforms the time domain data into frequency domain data and calculates the S parameters. Examples of measurements are presented. They include the measurement of 40 dB attenuators to 12.5 GHz.

15662. Engen, G. F., **Automated calibration of directional-coupler-bolometer-mount assemblies,** *Proc. IEEE-MTT-S Int. Microwave Symp., Palo Alto, Calif., May 12-14, 1975,* pp. 85-97 (Institute of Electrical and Electronics Engineers, Inc., Piscataway, N.J., May 1975).

Key words: calibration; calibration factor; directional coupler; measurement; microwave; microwave power.

Although the application of automated methods to power calibration problems in the UHF and microwave region has been described by a number of authors, the primary orientation has been towards the calibration of bolometer mounts and similar items. Little has been published on the problem of calibrating directional-coupler-bolometer-mount assemblies, which also play a major role in the calibration and measurement of UHF and microwave power.

This paper describes several approaches to this measurement problem.

15663. Achenbach, P. R., Didion, D. A., **Energy conservation measures in the National Bureau of Standards laboratory complex,** *Proc. Energy Conservation and Energy Management in Buildings, London, England, Nov. 13-14, 1975,* pp. 51-68 (1975).

Key words: building retrofit; building systems; energy conservation in buildings; HVAC automatic control; HVAC systems; measurement of building energy.

Energy conservation measures at the National Bureau of Standards site are being carried out under two separate but interrelated programs; a low-investment, immediate-impact program and a long-range, major retrofit program. The low-investment program has already been implemented and includes lighting reductions, thermostat resettings and nighttime shutdowns of heating, ventilating, air conditioning systems. Data on energy usage before and after this program was instituted are presented. The methodology and analysis of the long-range program are also presented. Various building energy conservation options were considered and evaluated by means of a mathematical model. Quantitative estimates of savings for each are presented. The decision to invest in automatic controls for the air conditioning systems of the laboratory complex and steam/chilled-water power plant is discussed.

15664. Newell, A. C., Yaghjian, A. D., **Study of errors in planar near-field measurements,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-4, 1975, Session* **20,** pp. 470-473 (1975).

Key words: antennas; error analysis; measurements; near-field.

In recent years, planar near-field antenna measurements have been developed and used in a number of applications. One of the primary concerns with this, or any, measurement approach is the accuracy of the results; that is, how do errors in measured near-field quantities affect the accuracies of far-field parameters such as gain, side lobe level, monopulse difference level, beam width, etc. Some efforts have been made in the past to estimate these errors, but the results have been limited in generality and primarily of a qualitative nature.

We have used a two-fold approach to obtain equations giving reasonable upper-bound errors resulting from systematic and random errors in the near-field measurements. The strategy has been to derive error expressions from the equations relating near and farfield quantities and also to simulate errors on actual measured near-field data. The simulation has been given some direction to, and confirmed the results of the analysis. The errors which have been investigated are: truncation of the measurement area, x, y, and z-position errors of the probe, amplitude and phase uncertainties of the measured data, and multiple reflections between the probe and test antenna. The results not only give the effects of errors in a given quantity, but also specify the form of the error (i.e., linear, quadratic, periodic, etc.) which will produce the largest effect. This information is very valuable in designing the measuring equipment so that these types of errors can be avoided or minimized.

15665. Hoer, C. A., Roe, K. C., **Using an arbitrary six-port junction to measure complex voltage ratios,** *Proc. 1975 IEEE Microwave Theory and Technique Symp. Int., Palo Alto, Calif., May 12-14, 1975*, pp. 98-99 (1975).

Key words: attenuation; microwave; phase angle; ratio; self-calibration; six-port; vector voltmeter; voltage.

An arbitrary six-port junction is analyzed as a microwave vector voltmeter, measuring the amplitudes and phase difference of two input signals in terms of power readings taken at the remaining four ports. The junction may be calibrated for measuring complex voltage ratios using a self-calibration procedure which requires no standards.

15666. Kanda, M., **A measure for the stability of solid state noise sources,** *Proc. 1975 IEEE Microwave Theory and Technique Symp. Int., Palo Alto, Calif., May 12-14, 1975*, pp. 315-317 (1975).

Key words: Allan variance; argon gas noise source; cross correlation; solid state noise source; stability measure.

A measure for the stability of solid state noise sources is discussed. Its applicability is demonstrated. A technique similar to cross correlation is employed to separate the instabilities of the noise source from those of the measurement system.

15667. Kasen, M. B., **Mechanical and thermal properties of filamentary-reinforced structural composites at cryogenic temperatures. 2: Advanced composites,** *Cryogenics* **15,** No. 12, 701-722 (Dec. 1975).

Key words: advanced fiber composites; cryogenics; dynamic mechanical properties; literature review; static mechanical properties; thermal properties.

The low-temperature mechanical and thermal properties of advanced-fiber reinforced structural composites are reviewed. The magnitude and range of particular properties are discussed with respect to composite type and temperature. A property-material cross reference is given with a 128-entry bibliography. This is Part 2 of a two-part series. Part 1 considered glass-reinforced composites.

15668. Sibley, E. H., **Summary of CODASYL report on selection and acquisition of data base management systems,** *Digest of Papers, Association for Computing Machinery 1975 Conf., Minneapolis, Minn., Sept. 1974*, 3 pages (1974).

Key words: acquisition; CODASYL; computer; data base management; designers; evaluation; selection; users.

This report presents a method for the selection and acquisition of a data base management system as part of the development of an automated information processing system. It does not attempt to discuss all aspects of information systems, but only those that are pertinent to the utilization of a data base management system. Those issues which relate to information system design, as well as the design and implementation considerations of a data base management system are deferred. This report is the third in a series of CODASYL System Committee reports on its efforts to build up an expertise in and to develop advanced languages for data processing. The report should be of significant value to users and designers of such systems, since it approaches the question of evaluation and selection by relating users needs to system capabilities.

15669. Lyon, G., Walker, J. C., **On some polynomial search methods for hash tables of prime and composite sizes,** *Proc. Canadian Information Processing Society (CIPS) Nat. Conf., Regina, Sask., Canada, June 25, 1975*, pp. 290-299 (1975).

Key words: collision resolution; hash tables; polynomial search; pseudo-random numbers; scatter storage.

Necessary and sufficient conditions are given for a simple collision resolution polynomial bi**k to search fully a hash table of prime size. Sufficient conditions are then established which ensure a search of all locations of any table using a polynomial bi**k + ai. Observations on special cases for bi**k + ai relate this polynomial to the more simple search bi**k. A final example illustrates a typical pseudo-random sequence generated by a polynomial bi**k + ai.

15670. Fong, E., **A benchmark test approach for generalized data base software,** *Proc. COMPCON fall Conf. Digest, Washington, D.C., Sept. 8-10, 1975*, 7 pages (1975).

Key words: benchmark testing; data base management; performance measurement; test data bases; test transactions.

A benchmark test approach for generalized data base software is described. Although the benchmark test has been designed to experiment on one specific data base management system, the approach is rather general and applicable to many data base management systems that are currently available. The benchmark test consists of the specification of a test data base and the specification of a set of processing transactions to exercise the candidate software on the test data base. This benchmark test can be used both to measure the performance of a data base management system, and as a saturation test. The two parameters to be used in the saturation test are data base size and workload. The data base size is varied by increasing the number of records within the test data base. The workload is varied analytically via a queueing model.

15671. Hiza, M. J., Kidnay, A. J., Miller, R. C., **Equilibrium properties of fluid mixtures, a bibliography of data on fluids of cryogenic interest,** Volume in *NSRDS Bibliographic Series*, 160 pages (IFI/Plenum Data Co., New York, N.Y., 1975).

Key words: bibliography; calorimetric measurements; fluid mixtures; Joule-Thomson coefficients; phase equilibria; review.

This bibliography contains references to experimental data for ten equilibria properties of fluid mixtures. The data considered are: solid-liquid, solid-vapor, solid-liquid-vapor, liquid-liquid, liquid-vapor, and gas-gas. In addition, there are sections on liquid mixture densities, gas or vapor mixture densities, Joule-Thomson coefficients, and calorimetric measurement.

15672. Allan, D. W., Hellwig, H., Glaze, D. J., **An accuracy algorithm for an atomic time scale,** *Metrologia* **11,** No. 3, 133-138 (1975).

Key words: coordinate time scales; frequency calibration; international frequency comparisons; optimum frequency estimate; primary frequency standards; relativity; SI second; time scale accuracy algorithm; time scale stability.

The accuracy of the rate or frequency of an atomic time scale is the degree to which its unit agrees with the SI second. Primary frequency standards are constructed in such a manner that they provide the most accurate possible physical realization of the SI second. These standards are then used to calibrate or construct an atomic time scale which may also be used as a stable reference standard.

Mathematical models characterizing the performance of both the primary frequency standards and reference standards are developed, and based on these models a current best estimate of the SI second is derived utilizing current and previous calibrations.

The modeling techniques and theory are applied to the NBS primary frequency standards and atomic time scale system and a significant improvement is realized in the accuracy of the frequency estimate so derived. We estimate that the second used by the Bureau International de l'Heure in generating TAI and UTC was too short by about 9 ± 2 parts in 10^{13} during the fall of 1974.

15673. Walls, F. L., Wainwright, A. E., **Measurements of the short-term stability of quartz crystal resonators—a window on future developments in crystal oscillators,** *Proc. 6th Annual Precise Time and Time Interval (PTTI) Planning Meeting, Washington, D.C., Dec. 3-5, 1974,* pp. 143-153 (1974).

Key words: crystal controlled oscillator; fast linewidth; quartz crystal resonators; short-term stability; spectral density of frequency fluctuations; time domain stability.

Recent measurements of the inherent short-term stability of quartz crystal resonators will be presented. These measurements show that quartz resonators are much more stable for times less than 1 s than the best available commercial quartz oscillators. A simple model appears to explain the noise mechanism in crystal controlled oscillators and points the way to design changes which should permit more than 2 orders of magnitude improvement in their short-term stability. Stabilities of order 1 part in 10^{12} at. 0.001 s appear obtainable. The achievement of short-term stabilities of this level would in many cases greatly reduce the time necessary to achieve a given level of accuracy in frequency measurements. Calculations show that a reference signal at 1 THz, derived from frequency multiplying a 5 MHz source with the above measured crystal stability, should have an instantaneous or fast linewidth of order 1 Hz. These calculations explicitly include the noise contribution of our present multiplier chains and will be briefly outlined.

15674. Hellwig, H., Wainwright, A. E., **Submicrosecond time transport with a rubidium portable clock,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975,* pp. 384-386 (1975).

Key words: clock; frequency stability; frequency standard; time comparison.

Based on a commercially available rubidium standard, the National Bureau of Standards (NBS) developed a portable rubidium clock. Technical modifications which improve the temperature and magnetic environment characteristics allow stabilities in the 10^{-12} range under typical clock transport conditions. The physical size is such that the clock can be carried as hand baggage on commercial airlines allowing up to 18-hours continuous battery operation.

15675. Walls, F. L., DeMarchi, A., **RF spectrum of a signal after frequency multiplication; measurement and comparison with a simple calculation,** *IEEE Trans. Instrum. Meas.* **IM-24,** 210-217 (Sept. 1975).

Key words: frequency multiplication; linewidth; multiplier chain; precision oscillator; rf spectrum; spectral density of phase fluctuations; spectral purity.

A novel experimental technique is introduced and used to measure the effect of frequency multiplication on the RF spectrum of an oscillator. This technique makes it possible to produce the RF spectrum at X band—where measurements are relatively straightforward—that would have been produced by frequency multiplication of the 5-MHz source to any frequency from 9.2 GHz to 100 THz (10^{14} Hz). A simplified theory is developed and shown to reproduce the experimental results for the relative power in the carrier and noise pedestal, and the shape and the width of the carrier and noise pedestal, to within the measurement uncertainty of 2 or 3 dB, from 5 MHz to 10 THz. The calculations are easily made using analytical techniques from the measurement of the spectral density of phase fluctuations of the source, the effective input spectrum density and the bandwidth of the multiplier chain, and the frequency multiplication factor. It is shown that present 5-MHz-crystal-controlled oscillators are useful as a precision source to ~ 500 GHz. Suggestions for extending their range to ~ 100 THz are made.

15676. Stein, S. R., **Application of superconductivity to precision oscillators,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975,* pp. 321-327 (1975).

Key words: cavity stabilization; frequency multiplication; funnel diode oscillator; parametric oscillator; superconducting oscillator.

Advances in superconducting technology during the last decade have resulted in many experimental applications in the generation of stable frequencies. The properties which make superconducting resonators attractive are their high Q, high frequency, and high operating power level. A variety of techniques can be used to make a superconducting cavity the frequency determining element of an oscillator. They include cavity stabilization via injection locking of a free-running oscillator, negative feedback to a voltage-controlled oscillator, positive feedback around an amplifier, and coupling to a negative resistance amplifier. These techniques are discussed in terms of some of their theoretical and practical limitations with particular emphasis placed on the goal of achieving state-of-the-art frequency stability. The best performance obtained with a superconducting oscillator to date is summarized.

At NBS, work on superconducting oscillators is primarily motivated by the need for a microwave signal which can be multiplied to the infrared and used to measure the frequency of a laser with no loss in precision as compared to the primary cesium standard. The signal source which has been selected for this purpose is the superconducting parametric oscillator. Its principles of operation are discussed along with the reasons why it is expected to have state-of-the-art short-term frequency stability.

15677. Evenson, K. M., **Frequency measurements in the optical region and the speed of light,** (Proc. ICO Conf. Optical Methods in Science and Industrial Measurements, Tokyo, Japan, Aug. 26-30, 1974), *Japan J. Appl. Phys.* **14,** Suppl. 14-1, 1-10 (1975).

Key words: laser frequency measurements; speed of light.

Since the advent of the laser and saturated absorption locking of the laser, the extension of radio frequency technology into the optical region has produced exciting new results, such as a 10 000 fold increase in the resolution of spectroscopy in this region and a new value of the speed of light, 100 times more accurate than the previously accepted value. This paper will describe the techniques and results achieved.

15678. Roberts, R. W., **The other face of the measurement base,** *Anal. Chem.* **47,** No. 7, 648A-656A (June 1975).

Key words: length; mass; National Bureau of Standards; reference methods; SI units.

The universal language of measurement is provided by the International System of Units. Progress leading to the present definitions of some of the SI base units, and research that may lead to improved definitions, is described. Work at the National Bureau of Standards that is of interest to analytical chemists, such as atomic weight determinations, standard reference data, physical constants, calibrations, etc., is also described.

15679. Achenbach, P. R., **National Bureau of Standards research in support of energy conservation standards for buildings,** *Proc. 10th Intersociety Energy Conversion Engineering Conf., Newark, Del., Aug. 18-22, 1975,* pp. 667-676 (1975).

Key words: building research; building standards; economics of energy conservation; energy conservation; energy conservation research; energy savings.

Initiation of an energy conservation program for buildings revealed that, until very recently, buildings and the mechanical and electrical equipment installed therein have been designed for low first cost, with little attention given to energy cost. Current efforts to draft energy conservation standards for buildings showed that neither the energy conservation potential nor the life-cycle costs of many well-known energy conservation techniques are established. The research program of the National Bureau of Standards on energy conservation in buildings is presented in overview, and selected projects are discussed in some detail to show the types of information being developed in the laboratory, and in full-scale studies of new and existing buildings. Additional research needs for energy standards purposes are identified.

15680. Evenson, K. M., Howard, C. J., **Laser magnetic resonance spectroscopy,** *Laser Spectrosc.,* pp. 535-540 (1975).

Key words: CH; free radical; HCO; HO_2; laser magnetic resonance; OH; pollution.

Laser magnetic resonance spectroscopy provides one of the most sensitive techniques ever devised for the detection of free radicals such as OH, CH, HO_2, and HCO. Paramagnetic molecules inside a laser cavity are Zeeman tuned into coincidence with the laser frequency and a decrease in laser power is detected. With this technique, the reaction rates of free radicals can be measured in a reaction flow system.

15681. Evenson, K. M., Petersen, F. R., Wells, J. S., **Speed of light from direct laser frequency and wavelength measurements: Emergence of a laser standard of length,** *Laser Spectrosc.,* pp. 143-146 (1975).

Key words: laser frequency; laser wavelength; length standard; speed of light.

Recent frequency and wavelength measurements of a methane stabilized laser yield a value of the speed of light 100 times less uncertain than the previously accepted value. Various possibilities using lasers as radiation sources for a new length standard are discussed. One possibility is to fix the value of the speed of light in the redefinition of the meter.

15682. Kamas, G., **TV color frequencies defended as accurate,** *Electron. Design Letter to the Editor* **13,** 7 (June 21, 1975).

Key words: crystal oscillator; frequency calibration; network-originated programs; NBS traceability; phase comparison; television.

This letter is a reply to a previous letter to the editor regarding accuracy of TV color signals to calibrate oscillators.

15683. Glaze, D. J., Hellwig, H., Allan, D. W., Jarvis, S., Jr., Wainwright, A. E., **Accuracy evaluation and stability of the NBS primary frequency standards,** *IEEE Trans. Instrum. Meas.* **IM-23,** 489-501 (Dec. 1974).

Key words: accuracy; accuracy evaluations; cavity phase shift; cesium beam tube; frequency stability; interaction length; phase noise; primary frequency standards; Ramsey cavity.

The National Bureau of Standards has two primary standards for frequency and the unit of time. They are both cesium devices and are designated NBS-4 and NBS-5. The design of NBS-5 is discussed in detail, including its relationship to its predecessor NBS-III, and a brief description of NBS-4 is given. NBS-4 and NBS-5 have been used since January 1973 for a total of twelve calibrations of the NBS Atomic Time Scale.

The application of pulsed microwave excitation, and the use in the accuracy evaluations of frequency shifts due to known changes in the exciting microwave power are discussed. Measurements of the atomic velocity distributions are reported.

A stability of 9×10^{-15} derived from the comparison of NBS-4 and NBS-5 is reported for averaging times of 20 000 s, and data on accuracy are given. Results obtained to date give an evaluated accuracy of $1\text{-}2 \times 10^{-13}$ with indications that this accuracy may be improved in the future.

The bias-corrected frequencies of NBS-4 and NBS-5 agree to within $(1 \pm 10) \times 10^{-13}$ with the value obtained for NBS-III in 1969 — which value is preserved in the rate of the NBS Atomic Time Scale.

15684. Allan, D. W., Daams, H., **Picosecond time difference measurement system,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975,* pp. 404-411 (1975).

Key words: atomic clocks; frequency measurements; frequency stability; phase delay; precise time metrology; subpicosecond time difference measurements; time stability.

Recently a time difference measurement system was developed in the Frequency and Time Standards Section of the National Bureau of Standards and independently at the National Research Council which shows more than three orders of magnitude improvement over that which is currently available commercially. Current state-of-the-art time difference measurement devices have specified accuracies of about 1 nanosecond. Measurement precision and potential accuracy of better than 1 picosecond has been demonstrated in this new time difference measuring device. This has significant implications in frequency and time metrology using: state-of-the-art frequency standards and clocks. A brief report was given on this measurement system at the PTTI Planning Meeting at the Naval Research Laboratory on the 5th of December 1974. This paper will give more detailed circuit diagrams necessary to build up such a measurement system.

This particular measurement system has the advantage that it can measure time differences with accuracies of a few picoseconds and with repetition rates ranging from a few milliseconds to as slow a repetition rate as would be desirable, thus expanding convenient measurement of time domain stabilities of frequency and time standards over several decades with only one measurement system. The system is also very amenable to self-calibration and self-noise analysis. Specifically, a fractional frequency stability of about 10^{-16} was measured for the noise of this measurement system at a sample time of 10^3 s.

15685. Drullinger, R. E., Hessel, M. M., Smith, E. W., **New laser measurement techniques for excited electronic states of diatomic**

molecules, *Proc. Megeve Laser Spectroscopy Conf., Megeve, France, June 23-27, 1975, Lecture Notes in Physics*, 91-99 (1975).

Key words: diatomic mercury; excimer molecules; fluorescence; lasers; NaK molecule; spectroscopy.

This paper will briefly outline several new laser measurements techniques which we have developed for the analysis of excited electronic states of diatomic molecules. For molecules which have bound ground states, a visible laser is used to selectively excite a single vibration-rotation level in the electronic state of interest. We then use DC Stark effect, RF double resonance and various fluorescence techniques, as discussed in Sections I and II, to obtain excited state dipole moments, lifetimes, quenching cross sections, transition moments as a function of internuclear distance, and other molecular structure data. We have also developed new laser excitation techniques and used optical double resonance methods for excimer molecules which have repulsive ground states and are bound only in their excited states. These techniques, discussed in Sections III and IV, have been used to obtain potential energy curves, *f*-values, lifetimes and various kinetic rates.

15686. Hessel, M. M., Drullinger, R. E., Broida, H. P., **Chemiluminescent reactions in a heat-pipe oven,** *J. Appl. Phys.* **46,** No. 5, 2317-2318 (May 1975).

Key words: BaO; chemical reactions; chemiluminescent; electronic spectra; heat-pipe ovens; N_2O.

A heat-pipe oven has been used to contain and control the chemiluminescent reaction $Ba + N_2O \rightarrow BaO^* + N_2$. The heat-pipe oven permits Ba vapor to be maintained at any desired pressure. Reactions were easily controlled by varying the flow rate of N_2O or pressure of Ba. A large volume (about 20 cm^3) of chemiluminescence was produced and spectra were taken from 0.1 to 5 torr. In addition to emission from BaO $A^1\Sigma$-$X^1\Sigma$, numerous atomic Ba lines also have been observed. This device is well suited to the study and control of chemical reactions between metal vapors and oxidizers.

15687. Walls, F. L., Wainwright, A. E., **Measurement of the short-term stability of quartz crystal resonators and the implications for crystal oscillator design and applications,** *IEEE Trans. Instrum. Meas.* **IM-24,** 15-20 (Mar. 1975).

Key words: crystal controlled oscillator; fast linewidth; quartz crystal resonators; short-term stability; spectral density of frequency fluctuations; time domain stability.

A new technique is presented which makes it possible to measure the inherent short-term stability of quartz crystal resonators in a passive circuit. Comparisons with stability measurements made on crystal controlled oscillators indicate that noise in the electronics of the oscillators very seriously degrades the inherent stability of the quartz resonators for times less than 1 s. A simple model appears to describe the noise mechanism in crystal controlled oscillators and points the way to design changes which should improve their short-term stability by two orders of magnitude. Calculations are outlined which show that with this improved short-term stability it should be feasible to multiply a crystal controlled source to 1 THz and obtain a linewidth of less than 1 Hz. In many cases, this improved short-term stability should also permit a factor of 100 reduction in the length of time necessary to achieve a given level of accuracy in frequency measurements.

15688. Evenson, K. M., Petersen, F. R., **Stabilized lasers and applications,** *Proc. Physics of Quantum Electronics Summer School, Crystal Mountain, Wash., July 8-20, 1973*, pp. 367-436 (1975).

Key words: laser frequency measurements; laser strainmeter; saturated absorption spectroscopy; speed of light; the meter.

Three papers are reproduced which summarize some applications and uses of highly stabilized lasers and applications. Laser frequency measurements, the speed of light, a redefinition of the meter, ultrahigh resolution saturated absorption spectroscopy, the design and operation of a methane absorption stabilized laser strainmeter are all discussed.

15689. Howe, D. A., Salazar, H. F., **A digital 5.00688 MHz synthesizer and squarewave FM servo system for cesium standards,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975*, pp. 387-393 (1975).

Key words: indirect synthesis; phase noise; squarewave servo.

The cesium clock transition is at 9, 192, 631, 770 Hz by definition. In the design of a cesium frequency standard, it is common to generate a 5-MHz signal which is locked to this transition. Since 5-MHz cannot be directly multiplied to match the exact clock transition frequency, usually another frequency is synthesized and mixed in such a way that the clock transition frequency is produced.

This paper describes a synthesizer using a 5-MHz reference which has an output frequency of 5.00688 MHz which is very nearly an integer submultiple of the cesium clock transition frequency. Indirect synthesis is used in which an internal (number controlled) oscillator is locked at a prescribed frequency offset relative to the reference. Resolution (quantization error) is 1.4 parts in 10^{13}. A frequency stability plot $\sigma_y(\tau)$ of the synthesizer noise is presented. The synthesizer can be made very compact and reliable. Since its output has low phase noise, the signal may be multiplied directly to the cesium clock transition frequency. In a cesium standard, this simplifies the amount of microwave hardware compared to traditional schemes. The design concepts of the synthesizer can easily be extended in order to implement squarewave frequency modulation of the beam tube RF excitation.

15690. Casella, R. C., Rowe, J. M., Trevino, S. F., **Determining the number of independent real parameters in the phonon dynamical matrix,** *Phys. Rev. B* **12,** No. 10, 4573-4574 (Nov. 15, 1975).

Key words: dynamical matrix; matrix, dynamical; phonon dynamical matrix; real parameters.

We apply the algorithm developed earlier by one of us to several illustrative examples and compare with results obtained by Warren and Worlton where difficulties occur as noted by these authors.

15691. Greer, S. C., Hocken, R., **Thermal expansion near a critical solution point,** *J. Chem. Phys.* **63,** No. 12, pp. 5067-5072 (Dec. 15, 1975).

Key words: consolute point; critical exponent α; critical phenomena; critical solution point; density; gravity effects; mixture, binary; mixture, liquid; nitroethane; thermal expansion; 3-methylpentane.

We report precise measurements of the density as a function of temperature in the one-phase region near the consolute point in nitroethane + 3-methylpentane. We find evidence of the critical anomaly in the thermal expansion, but are not able to determine a unique value for the critical exponent α. We have performed computer experiments to determine under what conditions α could be extracted from thermal expansion data.

15692. Vagelatos, N., Rowe, J. M., Rush, J. J., **Lattice dynamics of ND_4I in the NaCl phase (I) at 296°K,** *Phys. Rev. B* **12,** No. 10, 4522-4529 (Nov. 15, 1975).

Key words: acoustic phonons; lattice sodium-chloride; translational dynamics.

Dispersion curves for translational phonons propagating in the high-symmetry directions of sodium-chloride-phase ND_4I have been determined at room temperature by coherent inelastic neutron scattering from single crystals. Acoustic phonons were well defined throughout the Brillouin zone. Optic phonons were considerably more difficult to measure because of the low signal-to-background ratio. The observed phonon energies were fitted to a "simple" and a "breathing" shell model with general repulsive short-range forces out to second neighbors. The results of the model fitting lead to conclusions similar to those reached in previous alkali halide studies. Model predictions of crystal properties are generally in good agreement with observation. The best fit model was used as in interpolation formula to calculate the density of states, $g(\nu)$. The mean-square displacements are in excellent agreement with those derived from the neutron-diffraction results of Seymour and Pryor. The lattice-dynamics results are compared with similar results obtained recently for the NaCl phases of the alkali cyanides.

15693. Abrams, M. D., **Computer communications network performance measurement (Abstract),** *Proc. Eurocon 1974 Conf. Digest on Electrotechnics, Amsterdam, The Netherlands, Apr. 22-26, 1974,* 2 pages (1974).

Key words: communications; computer; evaluation; measurement; network; performance.

This publication consists of an abstract only which describes computer networks, measures of service, measurement of service delivered, measured effects and applications.

15694. Cabana, A., Laurin, M., Lafferty, W. J., Sams, R. L., **High resolution infrared spectra of the ν_2 and $2\nu_1$ bands of $^{14}N^{16}O_2$,** *Can. J. Phys.* **53,** No. 19, 1902-1926 (1975).

Key words: equilibrium structure; ground state constants; infrared spectrum; nitrogen dioxide, $2\nu_1$ band; nitrogen dioxide, ν_2 band; upper state constants; vibration-rotation interaction constants.

The infrared spectra of two *B* type bands, ν_2 and $2\nu_1$, of $^{14}N^{16}O_2$ have been recorded under high resolution. Ground state combination differences from these bands have been combined with combination differences obtained in previous studies and eight pure rotational microwave transitions to yield improved ground state rotational constants. Upper state constants and band centers for the ν_2 and $2\nu_1$ bands are also reported. The $2\nu_1$ band contains internal intensity anomalies believed to arise from a weak Coriolis interaction with the much stronger $\nu_1+\nu_3$ band. Equilibrium rotational constants have been calculated. The equilibrium structure of the molecule is: $r_e = 1.1945 \pm 0.0005$ Å and $\Theta_e = 133.85 \pm 0.10°$. For the sake of comparison, effective, substitution, and average structures are also reported.

15695. Danos, M., **Relativistic nuclear physics, why and how?,** (Proc. Int. Conf. on Interaction Studies in Nuclei, Mainz, Germany, Feb. 17-20, 1975), Paper in *Interaction Studies in Nuclei,* H. Jochim and B. Ziegler, Eds., pp. 885-910 (North-Holland Publishing Co., The Netherlands, 1975).

Key words: axiomatic field theory; composite particles; Haag's theorem; nuclear structure; quantum field theory; relativistic nuclear physics.

It is proposed that by this time the development of physics has progressed to a point where one can tackle the "hydrogen atom" problem of nuclear physics, viz., a description of the deuteron "from first principles." This requires to formulate the problem in terms of strong interaction relativistic field theory. The contemporary work is done instead almost exclusively in terms of the quasi-relativistic framework of effective Lagrangian theory. The inherent inaccuracies of this framework are reviewed. A framework for actually solving the relativistic field theory problem is described. It requires inescapably to consider the composite structure of the deuteron. The nature of the stationary solutions is discussed; their relation to the results of the covariant treatment is explained, and the relevance to certain theorems of field theory is pointed out.

15696. Holt, D. R., Nahman, N. S., **Coaxial line pulse-response error due to a planar skin effect approximation,** *Proc. 1972 CPEM Conf. on Precision Electromagnetic Measurement, Boulder, Colo., June 26-29, 1972,* pp. 1-2 (1972).

Key words: coaxial; cylindrical; error; line; loss; response; skin effect; step; time; transition.

The purpose of this paper is to characterize the time domain step response error in the analysis of coaxial lines terminated in their characteristic impedence.

15697. Cataland, G., Plumb, H. H., **Fixed points: Superconductive transition temperatures of lead and indium,** *Metrologia* **11,** 161-163 (1975).

Key words: acoustical thermometry; fixed points; lead and indium transition temperatures; low temperature fixed points; low temperature thermometry; superconducting transition temperatures of lead and indium.

This note presents the temperature values for the superconductive transition fixed points (T_c) of lead and indium. Values of T_c derived by interpolations on the NBS P(2-20K) 1965 scale are given. Determinations of isotherms by the NBS acoustical thermometer produced T_c's of 7.199_0 K $\pm$ 1.3 mK for lead and 3.414_2 K $\pm$ 1.3 mK for indium.

15698. Sibley, E. H., **On the equivalences of data based systems,** *Proc. Association for Computing Machinery SIGMOD Conf., Ann Arbor, Mich., May 1-3, 1974,* **II,** 1-52 (1974).

Key words: data base technology; data manipulation, data structured; data manipulation, relational.

Practitioners of data base technology have been somewhat confused by the many different theories and systems for describing and manipulating data. The two major philosophies which have emerged may be termed the *relational* or set theoretic approach and the *data structured* or procedural approach. There are obviously differences in these, but there are also similarities.

This paper looks at these approaches from three aspects: (1) The method of describing data and its structure; (2) the methods of manipulating this data; and (3) the time of binding the data name to its operation.

15699. Fechter, J. V., Pezoldt, V. J., Persensky, J. J., Lepkowski, J. R., **Study of the National Standards for Directional and Other Official Signs. Overview of their adequacy,** *Report No. FHWA-RD-75-118,* 75 pages (Available from the National Technical Information Service, Springfield, Va., 22161, Oct. 1975).

Key words: driver information; highway; highway signing; human factors; information displays; standards.

In 1969 the Federal Highway Administration (FHWA) issued National Standards for Directional and Other Official Signs allowing owners of privately-operated scenic and historical sites to erect directional signs in a zone extending from the edge of the right-of-way to a distance 660 ft *(201.2 m)* beyond. Objectors to these Standards sought increases in the height, length, total area, and number of signs allowed. FHWA requested the assistance of the National Bureau of Standards (NBS) to respond to these requests and to evaluate the Standards with respect to the needs of motorists. NBS reviewed pertinent literature and analyzed hypothetical Standards-conforming signs. The analysis showed that the sign dimensions needed to display legible messages vary considerably as the values of each design variable (e.g., vehicle speed) are changed. For many speeds, sign locations, and driver characteristics, Standards-conforming signs are inadequate. The following conclusions were reached: (1) the Standards should require that sign characters be legible at the levels of visual acuity required by state driver licensing regulations, (2) maximum sign size should be specified in terms of the visual angle subtended, rather than as a maximum physical size, and (3) technical material does not support any change to the number of signs allowed to the spacing between signs, or to the spacing from signs to interchanges or exits.

15700. Rothschild, W. G., Rosasco, G. J., Livingston, R. C., **Dynamics of molecular reorientational motion and vibrational relaxation in liquids. Chloroform,** *J. Chem. Phys.* **62,** No. 4, 1253-1268 (Feb. 15, 1975).

Key words: chloroform; infrared spectra; molecular reorientation; Raman spectra; vibrational relaxation.

Vibrational and rotational (dipole and second-order tensor) correlation functions were obtained by Fourier inversion of infrared and Raman vibrational band contours of the three ∥ and one ⊥ fundamentals of liquid $CHCl_3$, $CDCl_3$, and isotopically pure $CH^{35}Cl_3$. All correlation functions are nonexponential at short times and approximately for long times. The symmetry axis of the molecule reorients by "free" jumps of about 1/3 rad, turning through a root-mean-square angle of 1 radian within 2 psec by about 13 orientational jumps. Computer simulations show that J diffusion is too fast beyond 1 psec and that M diffusion fits the data up to 4 psec ($\tau_J = 0.12$ psec); thereafter, M diffusion is too slow. The Raman rotational correlation time is approximately equal to the NMR quadrupolar correlation time; the infrared rotational correlation time is only 0.75 of a corresponding dielectric relaxation time. Vibrational relaxation in the symmetric near-infrared carbon-hydrogen stretch is of the same order of importance as rotational relaxation; however, the dynamics of the vibrational relaxation of this mode do not support the presence of "hydrogen bonding" in the neat liquid. In the symmetric far-infrared carbon-chlorine deformation mode, vibrational relaxation is of considerably lesser significance than rotational relaxation throughout the whole time domain, whereas the rate of vibrational relaxation of the symmetric midinfrared carbon-chlorine stretch is intermediate to those of the other two symmetric fundamentals. None of these modes obeys vibrational energy dissipation or resonance vibrational energy transfer mechanisms induced by dipole-dipole interaction. The ratios of the derived polarizability tensor elements, which are required to evaluate the rotational correlation function of the degenerate mode (carbon-hydrogen deformation), were computed from formulations relating them to the bond polarizabilities: It appears that its Raman and infrared correlation functions do not contain the same vibrational correlation function and that the respective contour is determined essentially by nonorientational relaxation processes. An extensive analysis of the experimental errors inherent in our Raman band contour determinations is presented, as well as a critical comparison of our conclusions with previous results in the literature.

15701. Rosasco, G. J., Prask, H. J., **Polarized Raman study of lattice modes in ammonium perchlorate at low temperatures,** *Solid State Commun.* **16,** No. 1, 135-138 (1975).

Key words: ammonium perchlorate; lattice dynamics; Raman scattering; structure.

The Raman spectra of oriented single crystals of ammonium perchlorate have been measured as a function of temperature between 12 and 300 K. The results are consistent with the assignment of NH_4ClO_4 to the D_{2h}^{16} space group at all temperatures. A weak B_{1g} mode at 180 cm^{-1} is assigned as an NH_4^+ libration. Anomalous temperature dependence is observed for low frequency B_{1g} and B_{3g} lattice modes. Detailed results are presented for these modes in the range 18-80 K.

15702. Utton, D. B., **The response of phase-sensitive detectors to Lorentzian and Gaussian lineshapes,** *J. Appl. Phys.* **46,** No. 12, 5268-5271 (Dec. 1975).

Key words: Gaussian; lineshapes; Lorentzian; phase sensitive detector.

Calculations are made of the response to Gaussian and Lorentzian lineshapes of a phase-sensitive detector operated at twice the modulation frequency. The modulation traverses the line resonance condition twice each cycle. Sensitivity to variations in linewidth, modulation width, and line center position are discussed. These are compared with the more common operation where small modulation widths result in signals proportional to the derivatives of the lineshape. A discussion is made of the effects on the phase-sensitive detector output of signals at the harmonics of the modulation frequency.

15703. Rosasco, G. J., Simmons, J. H., **Identification of sulfur deposits in bubbles in glass by Raman scattering spectroscopy,** *Am. Ceramic Soc. Bull.* **54,** No. 6, 590-591 (June 1975).

Key words: bubble content analysis; gas analysis; inclusions in glass; Raman spectroscopy of sulfur; sulfur identification.

Raman scattering spectroscopy was conducted on solid deposits in bubbles in glass. Elemental sulfur was identified as forming small spherical deposits, amorphous in appearance. An analysis of the gas contents of the bubbles was also conducted and the changes of concentration with successive heat-treatments provided an estimate of the process of bubble formation.

15704. Rosasco, G. J., Simmons, J. H., **Investigation of gas content of inclusions in glass by Raman scattering spectroscopy,** *Am. Ceramic Soc. Bull.* **53,** No. 9, 626-630 (Sept. 1974).

Key words: gas analysis; inclusions in glass; Raman scattering.

Laser Raman spectroscopy is used to identify the gaseous contents of inclusions in glass. This test is offered as a valuable complement to other analytical techniques. It requires relatively simple specimen preparation, offers good sensitivity to the gases of interest and is a nondestructive test. Further, since the sample is not contained in a confining test apparatus, the temperature of the contents of the bubble may be raised, for example, to vaporize solid deposits for analysis. Spherical bubbles 0.5 mm in diameter have been routinely analyzed without special optics and with good signal-to-noise ratio. The elements of the theory and practice of laser Raman spectroscopy are outlined and their application to the study of the gaseous content of inclusions is discussed in detail.

15705. Forman, R. A., Thurber, W. R., Aspnes, D. E., **Second indirect band gap in silicon,** *Solid State Commun.* **14,** No. 10, 1007-1010 (1974).

Key words: band gap; band structure; electronic structure; energy bands; optical properties; silicon.

We report the first observation of the $\Gamma_{25'} \rightarrow L_1$ (second indirect) transition in Si based on optical absorption studies. The energy, (1650 ± 10) meV, measured for this critical point shows that there remains a large discrepancy between theoretical band structure calculations and experimental results for this material.

15706. May, W. E., Chesler, S. N., Cram, S. P., Gump, B. H., Hertz, H. S., Enagonio, D. P., Dyszel, S. M., **Chromatographic analysis of hydrocarbons in marine sediments and seawater,** *J. Chromatogr. Sci.* **13,** 535-540 (Nov. 1975).

Key words: baseline studies; gas chromatography; gas chromatography-mass spectrometry; hydrocarbon; liquid chromatography; marine sediments; pollution; seawater.

The low concentration of hydrocarbons anticipated in pollution baseline studies necessitates the development of analytical techniques sensitive at the sub-microgram per kilogram concentration level. The method of analysis developed in this laboratory involves dynamic headspace sampling for volatile hydrocarbon components of the sample, followed by coupled-column liquid chromatography for the nonvolatile components. These techniques require minimal sample handling, reducing the risk of sample component loss and/or sample contamination.

Volatile sample components are separated from the matrix in a closed system and concentrated on a TENAX-GC packed pre-column, free from large amounts of solvent and ready for GC/GC-MS analysis. Nonvolatile compounds, such as the benzpyrenes, may be extracted from large volumes of water and concentrated on a Bondapak C18 packed pre-column for coupled-column liquid chromatographic separation and analysis. Results of the application of these techniques to the analysis of samples from sites of known low level hydrocarbon contamination are presented and discussed.

5. LISTING OF NBS PAPERS BY MAJOR SUBJECT AREA

This section provides a listing of 1974 papers organized by primary subject matter. It permits users of this catalog to scan the Bureau's output by major subject category. The user should bear in mind that a paper is listed once by major subject even though it might well contain other secondary subject matters of interest. The key-word index permits the reader to determine the overall context of a paper, and provides an excellent secondary reference source.

The categories currently in use for classifying NBS publications are listed below and are followed by a listing of each paper by category. Full citations (including key-words and abstracts) will be found under the appropriate publication series, which is included in the paper title. Also of use will be the key-word index (mentioned above) and the author index. See Section 6 for information on their organization and use.

Acoustics and Sound

NBSIR 75-652. **Procedures for estimating sound power from measurements of sound pressure,** C. I. Holmer, 78 pages (July 1975). Order from NTIS as COM 75-11399.

NBSIR 75-685. **Improved ultrasonic standard reference blocks,** D. G. Eitzen, G. F. Sushinsky, D. J. Chwirut, C. J. Bechtoldt, and A. W. Ruff, 83 pages (Apr. 1975). Order from NTIS as COM 75-10690.

14786. Cook, R. K., Schade, P. A., **New method for measurement of the total energy density of sound waves,** (Proc. 1974 International Noise Control Engineering Conference, Washington, D.C., Sept. 30-Oct. 2, 1974), Paper in *Inter-Noise 74 Proceedings,* J. C. Snowdon, Ed., pp. 101-106 (Inter-Noise 74, Institute of Noise Control Engineering, Poughkeepsie, N.Y., 1974).

14796. Cook, R. K., **Paraholography—a new method for measurement of the directional distribution of sound waves in a reverberation chamber,** *J. Acoust. Soc. Amer.—Technical Notes and Research Briefs* **56,** No. 4, 1305-1307 (Oct. 1974).

14800. Cook, R. K., **Colloquium on infrasound in Paris,** *J. Acoust. Soc. Amer.* **56,** No. 2, 721-722 (Aug. 1974).

14866. Flynn, D. R., **Accuracy and precision,** *Noise Control Eng.—Editorial Section* **3,** No. 3, p. 2 (Nov.-Dec. 1974).

14900. Kerns, D. M., **Scattering-matrix description and nearfield measurements of electroacoustic transducers,** *J. Acoust. Soc. Amer.* **57,** No. 2, 497-507 (Feb. 1975).

14960. Breckenridge, F. R., Tschiegg, C. E., Greenspan, M., **Acoustic emission: Some applications of Lamb's problem,** *J. Acoust. Soc. Amer.* **57,** No. 3, 626-631 (Mar. 1975).

15082. Bartel, T. W., Schade, P. A., **Digital processing of decay rates for reverberant sound fields,** *Proc. 1974 Int. Conf. on Noise Control Engineering, Washington, D.C., Sept. 30-Oct. 2, 1974,* pp. 61-64 (Oct. 1974).

15206. Leasure, W. A., Jr., Bender, E. K., **Tire-road interaction noise,** *J. Acoust. Soc. Am.* **58,** No. 1, 39-50 (July 1975).

15217. Lang, W. W., Flynn, D. R., **Noise power emission level for product designation,** *Noise Control Eng.* **4, No. 3, 108-113 (May-June 1975).**

15222. Hruska, G. R., Koidan, W., **Free-field method for sound-attenuation measurement,** *J. Acoust. Soc. Am.* **58,** No. 2, 507-509 (Aug. 1975).

15462. Pallett, D. S., **Force platform instrumentation system for the study of impact forces,** *Proc. Inter-Noise Conf., Sept. 30-Oct. 2, 1974,* J. C. Snowdon, Ed., pp. 89-92 (Noise Control Foundation, Poughkeepsie, N.Y., 1974).

15492. Holmer, C. I., **Estimation of sound power in the free field over a reflecting plane. Errors associated with far field and near field measurements,** *Proc. Noise-Con 75, Gaithersburg, Md., Sept. 15-17, 1975,* pp. 429-438 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

15500. Pallett, D. S., **Noise and the national measurement system,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975,* W. W. Lang, Ed., pp. 157-182 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

15502. Magrab, E. B., Leasure, W. A., Jr., **Research in acoustics and noise measurements at the National Bureau of Standards,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975,* W. W. Lang, Ed., pp. 191-200 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

Analytical Chemistry

SP427. **Secondary ion mass spectrometry.** Proceedings of a Workshop on Secondary Ion Mass Spectrometry and Ion Microprobe Mass Analysis, held at the National Bureau of Standards, Gaithersburg, Md., September 16-18, 1974, K. F. J. Heinrich and D. E. Newbury, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 427, 230 pages (Oct. 1975) SD Catalog No. C13.10:427.

The ion microprobe—Instrumentation and techniques, H. Liebl, *SP427,* pp. 1-31 (Oct. 1975).

Looking at the collection efficiency problem through the ion microscope optics, G. Slodzian, *SP427,* pp. 33-61 (Oct. 1975).

High mass resolution secondary ion mass spectrometry, P. Williams and C. A. Evans, Jr., *SP427,* pp. 63-68 (Oct. 1975).

A comparison of mass spectra from three ion probes, J. G. Bradley, D. Y. Jerome, and C. A. Evans, Jr., *SP427,* pp. 69-77 (Oct. 1975).

A critical discussion of the local thermal equilibrium model for the quantitative correction of sputtered ion intensities, C. A. Andersen, *SP427,* pp. 79-119 (Oct. 1975).

An outline of secondary ion emission models, J. M. Schroeer, *SP427,* pp. 121-127 (Oct. 1975).

Empirical quantitation procedures in SIMS, J. A. McHugh, *SP427,* pp. 129-134 (Oct. 1975).

Application of SIMS microanalysis techniques to trace element and isotopic studies in geochemistry and cosmochemistry, J. F. Lovering, *SP427,* pp. 135-178 (Oct. 1975).

Factors that influence an elemental depth concentration profile, J. A. McHugh, *SP427,* pp. 179-189 (Oct. 1975).

A comparison of Auger electron spectroscopy (AES) and secondary ion mass spectrometry (SIMS), J. M. Morabito, *SP427*, pp. 191-224 (Oct. 1975).

TN857. **Real-time acquisition and processing of fluorimetry data,** P. S. Shoenfeld, Nat. Bur. Stand. (U.S.), Tech. Note 857, 45 pages (June 1975) SD Catalog No. C13.46:857.

NBSIR 75-713. **A file management system for a laboratory automation facility,** P. S. Shoenfeld and L. J. Kaetzel, 54 pages (June 1975). Order from NTIS as COM 75-11134.

14785. Durst, R. A., **Ion selective electrodes,** (Proc. Int. Conf. on Localized Corrosion, Williamsburg, Va., Dec. 6-10, 1971), Paper in *Localized Corrosion,* R. W. Staehle, B. F. Brown, J. Kruger, and A. Agrawal, Eds., pp. 151-157 (National Association of Corrosion Engineers, Houston, Texas, 1974).

14803. Durst, R. A., **Ion-selective electrode response in biologic fluids,** (Proc. Conf. on Workshop on Ion-Selective Microelectrodes, Boston, Mass., June 5, 1973), Chapter 2 in *Ion-Selective Microelectrodes,* H. J. Berman and N. C. Hebert, Eds., pp. 13-21 (Plenum Publ. Corp., New York, N.Y., 1974).

14818. Pella, P. A., **Mössbauer spectrometry,** Chapter 26 in *Systematic Materials Analysis,* J. H. Richardson and R. V. Peterson, Eds., **III,** 241-267 (Academic Press, New York, N.Y., 1974).

14888. Rains, T. C., **Atomic absorption spectrometry—general considerations for the application of experimental techniques,** *Amer. Soc. Testing Mater. Spec. Tech. Publ.* **564,** pp. 50-66 (1974).

14897. Yakowitz, H., **Electron-probe microanalysis—a capsule survey,** *J. Vac. Sci. Technol.* **11,** No. 6, 1100-1104 (Nov./Dec. 1974).

14901. Rains, T. C., Menis, O., **Determination of aluminum by flame emission spectrometry with repetitive optical scanning,** *Anal. Lett.* **7,** No. 11, 715-727 (1974).

14904. Moore, Y J., Machlan, L. A., Shields, W. R., Garner, E. L., **Internal normalization techniques for high accuracy isotope dilution analyses-application to molybdenum and nickel in standard reference materials,** *Anal. Chem.* **46,** No. 8, 1082-1089 (July 1974).

14918. Barnes, I. L., Shields, W. R., Murphy, T. J., Brill, R. H., **Isotopic analysis of Laurion lead ores,** Chapter 1 in *Archaeological Chemistry, Advances in Chemistry Series,* No. 138, 1-10 (1975).

14956. Herron, J. T., Huie, R. E., **Application of beam sampling mass spectrometry to the kinetics of ozone reactions,** *Int. J. Mass Spectrom. Ion Phys.* **16,** No. 1/2, 125-136 (1975).

15088. Freeman, D. H., Angeles, R. M., **The influence of hydrogen bonding upon gel permeation chromatography,** *J. Chromotogr. Sci.* **12,** 730-735 (Nov. 1974).

15106. Cram, S. P., Chesler, S. N., **Analytical fluidic sampling systems,** *J. Chromatogr.* **99,** 267-279 (1974).

15136. Barkley, J. F., Shoenfeld, P. S., **A central laboratory automation facility,** *Amer. Lab.* **7,** No. 2, 19-20, 22, 24-25 (Feb. 1975).

15165. Meinke, W. W., **Characterization of solids-chemical composition,** Chapter 7 in *Treatise on Solid State Chemistry,* N. B. Hannay, Ed., **1**, 387-435 (Plenum Press, New York, N.Y., 1973).

15236. Coxon, B., **Preliminary communication: Nitrogen-15 n.m.r. spectroscopy of amino sugars,** *Carbohydr. Res.* **35,** C1-C3 (1974).

15243. Hastie, J. W., **Sampling reactive species from flames by mass spectrometry,** *Int. J. Mass Spectrom. Ion Phys.* **16,** No. 1/2, 89-100 (Jan. 1975).

15261. Lovas, F. J., **Application of microwave spectroscopy to chemical analysis,** *Anal. Instrum.* **12,** 103-109 (1974).

15268. Coxon, B., Tipson, R. S., Alexander, M., Deferrari, J. O., **Conformational analysis of acylated 1,1-bis(acylamido)-1-deoxypentitols by Fourier-transform, p.m.r. spectroscopy,** *Carbohydr. Res.* **35,** 15-31 (1974).

15295. McCormick, P. G., Burke, R. W., Doumas, B. T., **Precautions in use of soft-glass disposable pipets in clinical analyses,** *Clin. Chem. Scientific Note* **18,** No. 8, 854-856 (1972).

15319. Goldberg, R. N., Prosen, E. J., Staples, B. R., Boyd, R. N., Armstrong, G. T., Berger, R. L., Young, D. S., **Heat measurements applied to biochemical analysis: Glucose in human serum,** *Anal. Biochem.* **64,** No. 1, 68-73 (Mar. 1975).

15321. Velapoldi, R. A., Travis, J. C., Cassatt, W. A., Yap, W. T., **Inorganic ion-doped glass fibres as microspectrofluorimetric standards,** *J. Microsc.* **103,** Part 3, 293-303 (Apr. 1975).

15358. Pella, P. A., DeVoe, J. R., **Systematic error in tin ore assay by Mössbauer spectrometry,** *J. Radioanal. Chem. Short Commun.* **25,** No. 1, 185-188 (1975).

15379. Wagner, G. A., Reimer, G. M., Carpenter, B. S., Faul, H., Van der Linden, R., Gijbels, R., **The spontaneous fission rate of U-238 and fission track dating,** *Geochim. Cosmochim. Acta* **39,** No. 9, 1279-1286 (1975).

15385. Gladney, E. S., Rook, H. L., **Simultaneous determination of tellurium and uranium by neutron activation analysis,** *Anal. Chem.* **47,** No. 9, 1554-1557 (Aug. 1975).

15427. Maienthal, E. J., **The application of linear sweep voltammetry to the determination of trace elements in biological and environmental materials,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 243-246 (1974).

15456. Rook, H. L., Suddueth, J. E., Becker, D. A., **Determination of iodine-129 at natural levels using neutron activation and isotopic separation,** *Anal. Chem.* **47,** No. 9, 1557-1562 (Aug. 1975).

15459. Gills, T. E., LaFleur, P. D., **The determination of hafnium in standard reference materials using bis(2-ethylhexyl) phosphate (HDEHP) with neutron activation analysis,** (Proc. Int. Meeting on Activation Analysis, Saclay, France, Oct. 1-6, 1972), *J. Radioanal. Chem.* **19,** 235-237 (1974).

15479. Taylor, J. K., **Electrochemical analysis,** *Med. Electron. Data,* pp. 39-42 (May-June 1972).

15577. Rains, T. C., **Iron, cobalt, and nickel,** Chapter 10 in *Flame Emission and Atomic Absorption Spectrometry,* J. A. Dean and T. C. Rains, Eds., **3,** 216-246 (Marcel Dekker, Inc., New York, N.Y., Nov. 1975).

15625. Lovas, F. J., **Application of microwave spectroscopy to chemical analysis,** *ISA Trans.* **14,** No. 2, 145-151 (1975).

15703. Rosasco, G. J., Simmons, J. H., **Identification of sulfur deposits in bubbles in glass by Raman scattering spectroscopy,**

595-079 OL - 76 - 19

Am. Ceramic Soc. Bull. 54, No. 6, 590-591 (June 1975).

15704. Rosasco, G. J., Simmons, J. H., **Investigation of gas content of inclusions in glass by Raman scattering spectroscopy,** *Am. Ceramic Soc. Bull.* 53, No. 9, 626-630 (Sept. 1974).

Atomic and Molecular Studies

The iron-neon hollow-cathode spectrum, H. M. Crosswhite, *J. Res. Nat. Bur. Stand. (U.S.),* 79A (Phys. and Chem.), No. 1, 17-69 (Jan.-Feb. 1975).

The third spectrum of copper (Cu III), A. G. Shenstone, *J. Res. Nat. Bur. Stand. (U.S.),* 79A (Phys. and Chem.), No. 3, 497-521 (May-June 1975).

Relativistic effects on line strengths for transitions in the hydrogenic isoelectronic sequence, S. M. Younger and A. W. Weiss, *J. Res. Nat. Bur. Stand. (U.S.),* 79A (Phys. and Chem.), No. 5, 629-633 (Sept.-Oct. 1975).

Monogr. 143. **Analysis of optically excited mercury molecules,** R. E. Drullinger, M. M. Hessel, and E. W. Smith, Nat. Bur. Stand. (U.S.), Monogr. 143, 51 pages (Jan. 1975) SD Catalog No. C13.44:143.

SP366-2. **Bibliography on atomic line shapes and shifts (July 1973 through May 1975),** J. R. Fuhr, G. A. Martin, and B. J. Specht, Nat. Bur. Stand. (U.S.), Spec. Publ. 366 Suppl. 2, 75 pages (Nov. 1975) SD Catalog No. C13.10:366/Suppl. 2.

NSRDS-NBS54. **The radiolysis of methanol: product yields, rate constants, and spectroscopic parameters of intermediates,** J. H. Baxendale and P. Wardman, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 54, 26 pages (Apr. 1975) SD Catalog No. C13.48:54.

14722. Jacox, M. E., Milligan, D. E., **Vibrational spectrum of CO_2^- in an argon matrix,** *Chem. Phys. Lett.* 28, No. 2, 163-168 (Sept. 15, 1974).

14731. Carrington, C. G., Gallagher, A., **Blue satellite bands of Rb broadened by noble gases,** *Phys. Rev. A* 10, No. 5, 1464-1473 (Nov. 1974).

14753. Cowan, R. D., Radziemski, L. J., Jr., Kaufman, V., **Effect of continuum configuration interaction on the position of s p^6 in neutral chlorine and other halogens,** *J. Opt. Soc. Amer.* 64, No. 11, 1474-1478 (Nov. 1974).

14755. Sugar, J., Spector, N., **Spectrum and energy levels of doubly ionized europium (Eu III),** *J. Opt. Soc. Amer.* 64, No. 11, 1484-1497 (Nov. 1974).

14756. Van Brunt, R. J., Kieffer, L. J., **Angular distribution of O^- from dissociative electron attachment to NO,** *Phys. Rev. A* 10, No. 5, 1633-1637 (Nov. 1974).

14762. Jackson, J. A. A., Lias, S. G., **Primary processes in the photolysis of n-butane with 8.4 and 10.0 eV photons,** *J. Photochem.* 3, 151-162 (1974).

14763. Bridges, J. M., Kornblith, R. L., **ARC measurements of Fe I oscillator strengths,** *Astrophys. J.* 192, 793-812 (Sept. 15, 1974).

14764. Geltman, S., **The Coulomb-projected Born approximation V. Ionization of helium,** *J. Phys. B* 7, No. 15, 1994-2002 (1974).

14767. Mies, F. H., **Calculated vibrational transition probabilities of OH(X^2 Π),** *J. Mol. Spectrosc.* 53, 150-188 (1974).

14768. Hummer, D. G., Norcross, D. W., **Light ions of astrophysical interest—radiative transition probabilities for C III, N IV, O V and Ne VIII,** *Mon. Notic. Roy. Astron. Soc.* 168, No. 2, 263-272 (1974).

14769. Lafferty, W. J., Sams, R. L., **High resolution infra-red spectrum of the $2\nu_3$ band of NO_2,** *Mol. Phys.* 28, No. 4, 861-878 (1974).

14771. Eyler, J. R., Atkinson, G. H., **Dye laser-induced photodetachment of electrons from SH^- studied by ion cyclotron resonance spectroscopy,** *Chem. Phys. Lett.* 28, No. 2, 217-220 (Sept. 15, 1974).

14773. Collin, G. J., **Photolyse du butène-1 dans l'ultraviolet à vide,** *Can. J. Chem.* 51, No. 17, 2853-2859 (1973).

14787. Gerola, H., Linsky, J. L., Shine, R., McClintock, W., Henry, R. C., Moos, H. W., **Evidence for a corona of Beta Geminorum,** *Astrophys. J.* 193, No. 3, L107-L110 (Nov. 1, 1974).

14792. Shine, R. A., Linsky, J. L., **A facular model based on the wings of the Ca II lines,** *Solar Phys.* 37, 145-150 (1974).

14805. Stevens, W. J., Das, G., Wahl, A. C., Krauss, M., Neumann, D., **Study of the ground state potential curve and dipole moment of OH by the method of optimized valence configurations,** *J. Chem. Phys.* 61, No. 9, 3686-3699 (Nov. 1, 1974).

14808. Krauss, M., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Electron impact energy loss spectra of the 1 $^2B_2 \leftarrow X$ $^2A_1$ transition in NO_2,** *Chem. Phys. Lett.* 27, No. 2, 285-288 (July 15, 1974).

14810. Hessel, M. M., Smith, E. W., Drullinger, R. E., **Transition dipole moment of Na_2 and its variation with internuclear distance,** *Phys. Rev. Lett.* 33, No. 21, 1251-1254 (Nov. 18, 1974).

14814. Sugar, J., Kaufman, V., **Spectra and energy levels of three- and four-times ionized hafnium (Hf IV and Hf V),** *J. Opt. Soc. Amer.* 64, No. 12, 1656-1664 (Dec. 1974).

14832. Klots, C. E., Sieck, L. W., **Argon sensitized formation of Xe_2^+: A new mechanism for the Jesse effect,** *Chem. Phys. Lett.* 27, No. 1, 71-72 (July 1, 1974).

14839. Ausloos, P., Eyler, J. R., Lias, S. G., **Thermal energy charge transfer reactions involving CH_4 and SiH_4. Lack of evidence for nonspiralling collisions,** *Chem. Phys. Lett.* 30, No. 1, 21-25 (Jan. 1, 1975).

14844. Sieck, L. W., Gorden, R., Jr., Lias, S. G., Ausloos, P., **Ionic polymerization of vinyl halides initiated by photoionization using photons with energies near the ionization threshold,** *Int. J. Mass Spectrom. Ion Phys.* 15, 181-196 (1974).

14848. Tilford, S. G., Simmons, J. D., **Reexamination of the vacuum ultraviolet emission spectrum of CO in the 950-1200 Å region,** *J. Mol. Spectrosc.* 53, 436-442 (1974).

14855. Malloy, T. B., Jr., Lafferty, W. J., **On the barriers to planarity and the isotope effect in cyclobutane and cyclobutane-d_8,** *J. Mol. Spectrosc.* 54, 20-38 (1975).

14863. Shine, R. A., Linsky, J. L., **Physical properties of solar chromospheric plages. II. Chromospheric plage models,** *Solar Phys.* 39, No. 1, 49-77 (Nov. 1974).

14865. Phaneuf, R. A., Crandall, D. H., Dunn, G. H., **Production of $D_-(n=4)$ from electron-D_2^+ dissociative recombination,** *Phys. Rev. A* 11, No. 2, 528-535 (Feb. 1975).

14867. Lovas, F. J., **Small silicon molecules: Possible sources of the unidentified molecular lines U81.5, U86.2, U89.2, and U90.7,** *Astrophys. J.* **193,** No. 1, 265-272 (Oct. 1, 1974).

14884. Lias, S. G., **Ion-molecule reactions in radiation chemistry,** (Proc. NATO Advanced Study Institute Conf. on Ion-Molecule Interactions, Biarritz, France, June 24-July 6, 1974), Paper in *Interactions Between Ions and Molecules,* P. Ausloos, Ed., pp. 541-562 (Plenum Publishing Corp., New York, N.Y., 1975).

14890. Collin, G. J., **Réactions des ions iso-$C_4H_8^+$ et t-$C_4H_9^+$ avec l'isobutène en phases liquide et gazeuse,** *Can. J. Chem.* **52,** No. 12, 2341-2347 (1974).

14893. Reader, J., **Spectrum and energy levels of singly ionized rubidium (Rb II),** *J. Opt. Soc. Amer.* **65,** No. 3, 286-301 (Mar. 1975).

14894. Kaufman, V., Sugar, J., **Spectrum and energy levels of five-times ionized tantalum (Ta VI),** *J. Opt. Soc. Amer.* **65,** No. 3, 302-309 (Mar. 1975).

14896. Lias, S. G., Viscomi, A., Field, F. H., **Chemical ionization mass spectra. XXI. Reactions in t-$C_5H_{11}Cl$, t-$C_5H_{11}Br$, t-$C_5H_{11}OH$, and t-$C_5H_{11}SH$,** *J. Amer. Chem. Soc.* **96,** No. 2, 359-364 (Jan. 23, 1974).

14898. Prosen, E. J., Goldberg, R. N., Staples, B. R., Boyd, R. N., Armstrong, G. T., **Microcalorimetry applied to biochemical processes,** (Proc. U.S. Japan Joint Seminar, Akron, Ohio, April, 8-12, 1974), Paper in *Thermal Analysis: Comparative Studies on Materials,* H. Kambe and P. D. Garn, Eds., pp. 253-289 (Kodansha Ltd. and John Wiley and Sons, Tokyo and New York, 1974).

14907. Ederer, D. L., Lucatorto, T. B., Saloman, E. B., Madden, R. P., Sugar, J., **Photoabsorption of the 4d electrons in barium,** *J. Phys. B: Atom. Molec. Phys., Letter to Editor* **8,** No. 3, L21-L25 (1975).

14908. Lias, S. G., Rebbert, R. E., Ausloos, P., **Carbonium ions in radiation chemistry. II. Isomerization processes in $C_3H_7^+$ and $C_4H_9^+$ ion,** *J. Amer. Chem. Soc.* **92,** No. 22, 6430-6440 (Nov. 4, 1970).

14910. Hougen, J. T., **The assignment of molecular infrared spectra from a laser magnetic resonance spectrometer,** *J. Mol. Spectrosc.* **54,** No. 3, 447-471 (Mar. 15, 1975).

14948. Gebbie, K. B., Steinitz, R., **A mechanism for the production of light and dark contrasts in radiatively controlled lines,** *Solar Phys.* **29,** No. 1, 3-15 (Mar. 1973).

14953. Olson, W. B., Maki, A. G., Sams, R. L., **Infrared measurements on arsine: ν_1 and ν_3 bands, perturbation-allowed transitions, equilibrium structure,** *J. Mol. Spectrosc.* **55,** Nos. 1-3, 252-270 (1975).

14983. Zecca, A., Lazzizzera, I., Krauss, M., Kuyatt, C. E., **Electron scattering from NO and N_2O below 10 eV,** *J. Chem. Phys.* **61,** No. 11, 4560-4566 (Dec. 1, 1974).

14986. Okabe, H., **Photodissociation of acetylene and bromoacetylene in the vacuum ultraviolet: Production of electronically excited C_2H and C_2,** *J. Chem. Phys.* **62,** No. 7, 2782-2787 (Apr. 1, 1975).

14989. Ederer, D. L., Lucatorto, T. B., Saloman, E. B., **Photoabsorption from the 4d and 5p shells of barium,** (Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974), Chapter 3.5 in *Proceedings of the IV International Conference on VUV Radiation Physics,* E. Koch, R. Haensel, and C. Kunz, Eds., pp. 245-246 (Friedr. Vieweg Sohn Verlagsgesellschaft, mbH, Braunschweig, West Germany, 1974).

14993. LaVilla, R. E., **The sulfur Kβ emission and K-absorption spectra from gaseous H_2S, III,** *J. Chem. Phys.* **62,** No. 6, 2209-2212 (Mar. 15, 1975).

14996. Rebbert, R. E., Lias, S. G., Ausloos, P., **The photolysis of neopentane and isobutane with 7.6, 8.4, and 10.0 eV photons,** *J. Photochem.* **4,** 121-137 (1975).

15000. Sams, R. L., Maki, A. G., **High-resolution infrared measurements of ν_1 and force-field calculations for thioborine (HBS),** *J. Mol. Struct.* **26,** 107-115 (1975).

15001. Zuckerman, B., Turner, B. E., Johnson, D. R., Clark, F. O., Lovas, F. J., Fourikis, N., Palmer, P., Morris, M., Lilley, A. E., Ball, J. A., Gottlieb, C. A., Litvak, M. M., Penfield, H., **Detection of interstellar trans-ethyl alcohol,** *Astrophys. J.* **196,** L99-L102 (Mar. 15, 1975).

15003. Jacox, M. E., **Matrix isolation study of the vibrational spectrum and structure of HC_2,** *Chem. Phys.* **7,** 424-432 (1975).

15004. Johnson, D. R., Clark, F. O., **Observations of circular polarization of the $J=2-1$, $v=1$ transition of the SiO maser,** *Astrophys. J.* **197,** L69-L72 (Apr. 15, 1975).

15005. Crandall, D. H., Phaneuf, R. A., Dunn, G. H., **Electron impact excitation of Hg^+,** *Phys. Rev. A* **11,** No. 4, 1223-1232 (Apr. 1975).

15007. Ekberg, J. O., **Term analysis of Fe VI,** *Phys. Scr.* **11,** No. 1, 23-30 (1975).

15008. Artru, M. C., Kaufman, V., **Extension of the analysis of triply ionized aluminum (Al IV),** *J. Opt. Soc. Amer.* **65,** No. 5, 594-599 (May 1975).

15009. Roszman, L. J., **Effects of time ordering on plasma-broadened hydrogen profiles,** *Phys. Rev. Lett.* **34,** No. 13, 785-788 (Mar. 31, 1975).

15010. Collin, G. J., Ausloos, P., **Réactions des ions moléculaires cyclohexane en phase gazeuse,** *Can. J. Chem.* **53,** No. 5, 680-687 (1975).

15023. Roberts, J. R., Voigt, P. A., Czernichowski, A., **Experimentally determined absolute oscillator strengths of Ti I, Ti II, and Ti III,** *Astrophys. J.* **197,** 791-798 (May 1, 1975).

15042. Fuggle, J. C., Madey, T. E., Steinkilberg, M., Menzel, D., **X-ray photoelectron spectroscopy (XPS) of adsorbate valence bands,** *Phys. Lett.* **51A,** No. 3, 163-164 (Feb. 24, 1975).

15044. Mount, G. H., Linsky, J. L., **One- and multi-component models of the upper photosphere based on molecular spectra. IV. Non-LTE treatment of the CN violet system,** *Solar Phys.* **41,** No. 1, 17-33 (Mar. 1975).

15045. Madey, T. E., Engelhardt, H. A., Menzel, D., **Adsorption of oxygen and oxidation of CO on the ruthenium (001) surface,** *Surface Sci.* **48,** 304-328 (1975).

15054. Ederer, D. L., Manalis, M., **Photoabsorption of the 4*d* electrons in xenon,** *J. Opt. Soc. Amer.* **65,** No. 6, 634-637 (June 1975).

15055. Julienne, P. S., Krauss, M., **Predissociation of the Schumann-Runge bands of O_2,** *J. Mol. Spectrosc.* **56,** 270-308 (1975).

15058. Klose, J. Z., **Mean life of the 27 887-cm^{-1} level in U I,** *Phys.*

Rev. A **11**, No. 6, 1840-1844 (June 1975).

15064. Wiese, W. L., Kelleher, D. E., Helbig, V., **Variations in Balmer-line Stark profiles with atom-ion reduced mass,** *Phys. Rev. A* **11**, No. 6, 1854-1864 (June 1975).

15066. Voigt, P. A., **Measurement of U I and U II relative oscillator strengths,** *Phys. Rev. A* **11**, No. 6, 1845-1853 (June 1975).

15068. Reader, J., Epstein, G. L., **Resonance lines of Cs II, Ba III, and La IV,** *J. Opt. Soc. Amer.* **65**, No. 6, 638-641 (June 1975).

15070. Ottinger, C., Scheps, R., York, G. W., Gallagher, A., **Broadening of the Rb resonance lines by the noble gases,** *Phys. Rev. A* **11**, No. 6, 1815-1828 (June 1975).

15075. Bardsley, J. N., Holstein, T., Junker, B. R., Sinha, S., **Calculations of ion-atom interactions relating to resonant charge-transfer collisions,** *Phys. Rev. A* **11**, No. 6, 1911-1920 (June 1975).

15076. Vogler, M., Dunn, G. H., **Dissociative recombination of electrons and D_2^+ to yield D(2*p*),** *Phys. Rev. A* **11**, No. 6, 1983-1987 (June 1975).

15079. Cooper, J. W., **Photoionization of inner-shell electrons,** Chapter 3 in *Atomic Inner-Shell Processes, Vol. 1, Ionization and Transition Probabilities*, pp. 159-199 (Academic Press, Inc., San Francisco, Calif., 1975).

15110. Jacox, M. E., Milligan, D. E., **The infrared spectrum of methylenimine,** *J. Mol. Spectrosc.* **56**, 333-356 (1975).

15111. Bennett, S. L., Lias, S. G., Field, F. H., **Ion-molecule reactions in ethane,** *J. Phys. Chem.* **76**, No. 26, 3919-3926 (1972).

15120. Klose, J. Z., **Mean life of the 5*p* $^2P_{3/2}$ resonance level in Ag I,** *Astrophys. J.* **198**, 229-233 (May 15, 1975).

15129. Herbst, J. F., Watson, R. E., **5*f*-electron excitation energies and the Coulomb term, *U*, in the light actinide metals,** *Phys. Rev. Lett.* **34**, No. 22, 1395-1398 (June 2, 1975).

15134. Swanson, N., Celotta, R. J., Kuyatt, C. E., Cooper, J. W., **Resonant structure in electron impact excitation of CO near threshold,** *J. Chem. Phys.* **62**, No. 12, 4880-4888 (June 15, 1975).

15149. Lambropoulos, M., Moody, S. E., Smith, S. J., Lineberger, W. C., **Observation of electric quadrupole transitions in multiphoton ionization,** *Phys. Rev. Lett.* **35**, No. 3, 159-162 (July 21, 1975).

15152. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for molecular oxygen derived from electron energy-loss measurements,** *J. Chem. Phys.* **63**, No. 1, 241-248 (July 1, 1975).

15153. Powell, C. J., **Cross sections for ionization of inner-shell electrons by electron impact,** *Proc. 10th Annual Conf. of the Microbeam Analysis Society, Las Vegas, Nevada, Aug. 11-15, 1975*, pp. 3a-b (1975).

15167. York, G., Scheps, R., Gallagher, A., **Continuum radiation and potentials of Na-noble gas molecules,** *J. Chem. Phys.* **63**, No. 3, 1052-1064 (Aug. 1, 1975).

15205. Laufer, A. H., Bass, A. M., **Mechanism and rate constant of the reaction between methylene bnd methyl radicals,** *J. Phys. Chem.* **79**, No. 16, 1635-1638 (1975).

15209. Mazur, J., McIntyre, D., **The determination of chain statistical parameters by light scattering measurements,** *Macromolecules* **8**, No. 4, 464-476 (July-Aug. 1975).

15210. Buhl, D., Snyder, L. E., Lovas, F. J., Johnson, D. R., **Silicon monoxide: Detection of maser emission from the second vibrationally excited state,** *Astrophys. J.* **192**, L97-L100 (Sept. 1, 1974).

15240. Huie, R. E., Herron, J. T., **Reactions of atomic oxygen (O^3P) with organic compounds,** Paper in *Progress in Reaction Kinetics*, K. R. Jennings and R. B. Cundall, Eds., **8**, No. 1, Part 1, 1-80 (Pergamon Press, Great Britain, 1975).

15253. Sams, R. L., Lafferty, W. J., **High-resolution infrared spectrum of the $\nu_2 + \nu_3$ band of $^{14}N^{16}O_2$,** *J. Mol. Spectrosc.* **56**, 399-410 (1975).

15254. Fatiadi, A. J., **Symmetrical phenylosotriazoles from inositols,** *Carbohydr. Res. Note* **35**, 280-287 (1974).

15255. Reader, J., **Spectrum of Rb III observed with a pulsed-rf light source,** *J. Opt. Soc. Am.* **65**, No. 9, 988-990 (Sept. 1975).

15256. LaVilla, R. E., **The O $K\alpha$ and C $K\alpha$ emission and O K absorption spectra from O_2 and CO_2. IV,** *J. Chem. Phys.* **63**, No. 6, 2733-2737 (Sept. 15, 1975).

15257. Sugar, J., Kaufman, V., **Seventh spectrum of tungsten (W VII); resonance lines of Hf V,** *Phys. Rev. A* **12**, No. 3, 994-1012 (Sept. 1975).

15258. Lovas, F. J., Clark, F. O., Tiemann, E., **Pyrolysis of ethylamine. I. Microwave spectrum and molecular constants of vinylamine,** *J. Chem. Phys.* **62**, No. 5, 1925-1931 (Mar. 1, 1975).

15262. Giguere, P. T., Clark, F. O., **Radio search for HC_3N, HCN, OH, and detection of U8.19 in comet Kohoutek (1973f),** *Astrophys. J.* **198**, 761-764 (June 15, 1975).

15275. Karo, A., Krauss, M., Wahl, A. C., **Recent applications of the multiconfiguration self-consistent field method to polarizabilities, excited states, Van der Waals forces, and triatomic surfaces,** (Proc. Int. Symp. on Atomic, Molecular and Solid-State Theory and Quantum Biology, Sanibel Island, Fla., Jan. 21-27, 1973), *Int. J. Quantum Chem. Symp.* No. 7, 143-159 (John Wiley & Sons, New York, N.Y., 1973).

15281. Brown, D. W., Lowry, R. E., **Radiation-induced polymerization of tetrafluorethylene and 1,2,3,4,5-pentafluorostyrene at high pressure,** *J. Polym. Sci. Polym. Chem. Ed.* **13**, No. 7, 1677-1689 (July 1975).

15286. Machado, M. E., Linsky, J. L., **Flare model chromospheres and photospheres,** *Sol. Phys.* **42**, No. 2, 395-420 (June 1975).

15289. Scheps, R., Ottinger, C., York, G., Gallagher, A., **Continuum spectra and potentials of Li-noble gas molecules,** *J. Chem. Phys.* **63**, No. 6, 2581-2590 (Sept. 15, 1975).

15298. Van Brunt, R. J., Kieffer, L. J., **Angular distribution of N^+ from dissociative ionization of N_2 near threshold,** *J. Chem. Phys.* **63**, No. 8, 3216-3221 (Oct. 15, 1975).

15299. Manson, S. T., Cooper, J. W., **Angular distribution of photoelectrons: Outer shells of noble gases,** *Phys. Rev. A* **2**, No. 5, 2170-2171 (Nov. 1970).

15311. Maki, A. G., **High-resolution infrared spectrum of the $\nu_1 + \nu_3$ band of ozone,** *J. Mol. Spectrosc.* **57**, No. 3, 416-427 (1975).

15329. Farmer, B. L., Eby, R. K., **Methyl branches in hydrocarbon crystals: Calculation of relaxation parameters,** *J. Appl. Phys.* **46**, No. 10, 4209-4217 (Oct. 1975).

15330. Torchia, D. A., Lyerla, J. R., Jr., Quattrone, A. J., **Molecular dynamics and structure of the random coil and helical states of the collagen peptide, α1-CB2, as determined by ^{13}C magnetic resonance,** *Biochemistry* **14,** No. 5, 887-900 (1975).

15334. Jacox, M. E., Milligan, D. E., **Matrix isolation study of the infrared spectrum of thioformaldehyde,** *J. Mol. Spectrosc.* **58,** No. 1, 142-157 (1975).

15335. Tomuta, L., Mizushima, M., Howard, C. J., Evenson, K. M., **Rotational structure and magnetic g factors of $O_2(X^3\Sigma_g^-, \nu = 0)$ from laser-magnetic-resonance spectra,** *Phys. Rev. A* **12,** No. 3, 974-979 (Sept. 1975).

15336. Gillispie, G. D., Khan, A. U., Wahl, A. C., Hosteny, R. P., Krauss, M., **The electronic structure of nitrogen dioxide. I. Multiconfiguration self-consistent-field calculation of the low-lying electronic states,** *J. Chem. Phys.* **63,** No. 8, 3425-3444 (Oct. 15, 1975).

15340. Shih, A., **van der Waals forces between a Cs atom or a CsCl molecule and metal or dielectric surfaces,** *Phys. Rev. A* **9,** No. 4, 1507-1514 (Apr. 1974).

15349. Gallagher, A., **The spectra of colliding atoms,** (Proc. 4th Int. Conf. on Atomic Physics, Heidelberg, Germany, July 1974), Paper in *Atomic Physics* **4,** G. zu Putlitz, E. W. Weber, and A. Winnacker, Eds., pp. 559-574 (Plenum Publ. Corp. New York, N.Y., 1975).

15351. Dibeler, V. H., McCulloh, K. E., **Enthalpy of formation of methyl and methylene radicals by photoionization studies of methane and ketene,** (Proc. IV Int. Conf. on Vacuum-UV Radiation Physics, Hamburg, Germany, July 22-26, 1974), Paper in *Vacuum-UV Radiation Physics,* E. E. Koch, R. Haensel, and C. Kunz, Eds., pp. 191-194 (Pergamon-Vieweg, Braunschweig, Germany, 1974).

15352. McCulloh, K. E., **Threshold energies for formation of OH^+ and NH_2^+ by dissociative photoionization of water and ammonia,** (Proc. IV Int. Conf. on Vacuum-UV Radiation Physics, Hamburg, Germany, July 22-26, 1974), Paper in *Vacuum-UV Radiation Physics,* E. E. Koch, R. Haensel, and C. Kunz, Eds., pp. 195-197 (Pergamon-Vieweg, Braunschweig, Germany, 1974).

15365. Snyder, L. E., Buhl, D., Schwartz, P. R., Clark, F. O., Johnson, D. R., Lovas, F. J., Giguere, P. T., **Radio detection of interstellar dimethyl ether,** *Astrophys. J.* **191,** No. 2, Part 2, L79-L82 (July 15, 1974).

15370. Bernstein, L. S., Kim, J. J., Pitzer, K. S., Abramowitz, S., Levin, I. W., **Potential function for the ν_7 vibration of phosphorus pentafluoride,** *J. Chem. Phys.* **62,** No. 9, 3671-3675 (May 1, 1975).

15373. Wang, F. W., **Dynamics of block-copolymer molecules in dilute solution,** *Macromolecules* **8,** No. 3, 364-371 (May-June 1975).

15380. Kaufman, V., Sugar, J., **Spectrum of six-times ionized rhenium (Re VII),** *Phys. Rev. A* **12,** No. 4, 1402-1403 (Oct. 1975).

15381. Sugar, J., Kaufman, V., **Nuclear magnetic dipole moment of ^{181}Ta,** *Phys. Rev. C* **12,** No. 4, 1336-1339 (Oct. 1975).

15384. Ausloos, P., Lias, S. G., Eyler, J. R., **Reactions of halomethyl ions with carbonyl-containing compounds,** *Int. J. Mass Spectrom. Ion Phys.* **18,** No. 3, 261-271 (1975).

15386. Simmons, J. D., Tilford, S. G., **Evidence for an accidental predissociation of CO,** *J. Mol. Spectrosc. Note* **49,** No. 1, 167-168 (Jan. 1974).

15411. Bridges, J. M., **Arc measurements of Fe II oscillator strengths,** *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.3.5,* p. 418 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

15413. Behringer, K., Ott, W. R., **Measurement of the Ly-α Stark profile in a pure hydrogen arc,** *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.1.1,* p 396 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

15418. Mount, G. H., Ayres, T. R., Linsky, J. L., **A non-LTE analysis of the CN 3883 Å band head in the upper photosphere of Arcturus,** *Astrophys. J.* **200,** 383-391 (Sept. 1, 1975).

15436. Maki, A. G., **High-temperature infrared spectrum of HCN near 3300 cm^{-1},** *J. Mol. Spectrosc.* **58,** 308-315 (1975).

15442. Swanson, N., Celotta, R. J., Kuyatt, C. E., **Electron excitation of xenon near threshold,** (Proc. Int. Symp. on Electron and Photon Interactions w/Atoms, Univ. of Stirling, Stirling, Scotland, July 16-19, 1974), Chapter in *Electron and Photon Interactions with Atoms,* pp. 661-667 (Oct. 1975).

15443. Huebner, R. H., Fergurson, C. H., Celotta, R. J., Mielczarek, S. R., **Apparent oscillator-strength distributions derived from electron energy-loss measurement: Methane and n-hexane,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 41-44 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

15444. Huebner, R. H., Fergurson, C. H., Celotta, R. J., Mielczarek, S. R., **Apparent oscillator strength distributions derived from electron energy-loss measurements: Methane and n-hexane,** *Proc. IVth Int. Conf. on Vacuum-Ultraviolet Radiation Physics, Hamburg, Germany, July 22-26, 1974,* Article 111, 4 pages (1974).

15445. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Dipole oscillator-strength distributions derived for several hydrocarbons from electron energy-loss spectra,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 45-48 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

15446. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for molecular oxygen,** *ANL-75-3,* Part 1, *Biology and Medicine UC-48,* pp. 49-52 (Argonne National Laboratory, Radiological and Environmental Research Division, Argonne, Ill., July 1973-July 1974).

15463. Wiese, W. L., **Experimental progress on plasma broadening of hydrogen lines,** *Proc. Invited Lectures given at the 7th Yugoslav Symp. and Summer School on the Physics of Ionized Gases, Rovinj, Yugoslavia, Sept. 16-21, 1974,* V. Vujnovic, Ed., pp. 637-673 (Institute of Physics, University of Zagreb, Yugoslavia, 1974).

15465. Ayres, T. R., Linsky, J. L., **Stellar model chromospheres. III. Arcturus (K2 III),** *Astrophys. J.* **200,** No. 3, 660-674 (Sept. 15, 1975).

15467. Huebner, R. H., Celotta, R. J., Mielczarek, S. R., Kuyatt, C. E., **Apparent oscillator strengths for nitrous oxide,** (Proc. IX Int. Conf. on Physics of Electronic and Atomic Collisions, Seattle, Wash., July 24-30, 1975), Abstract in *Electronic and*

Atomic Collisions, J. S. Risley and R. Geballe, Eds., **2**, 1043-1044 (University of Washington Press, Seattle, Wash., 1974).

15473. Swanson, N., Celotta, R. J., Kuyatt, C. E., **Excitation of low-lying triplet states in ozone by electron impact,** (Proc. IX Int. Conf. on Physics of Electronic and Atomic Collisions, Seattle, Wash., July 24-30, 1975), Abstract in *Electronic and Atomic Collisions*, J. S. Risley, Ed., **2**, 128-129 (University of Washington Press, Seattle, Wash., 1974).

15474. Wiese, W. L., Martin, G. A., **Oscillator strength distributions in the lithium isoelectronic sequence,** (Proc. Invited Lectures 7th Yugoslav Symp. and Summer School on the Physics of Ionized Gases, Rovinj, Yugoslavia, Sept. 16-21, 1974), Paper in *Physics of Ionized Gases*, V. Vujnovic, Ed., pp. 675-700 (Institute of Physics, University of Zagreb, Zagreb, Yugoslavia, 1974).

15478. Cosby, P. C., Bennett, R. A., Peterson, J. R., Moseley, J. T., **Photodissociation and photodetachment of molecular negative ions. II. Ions formed in oxygen,** *J. Chem. Phys.* **63**, No. 4, 1612-1620 (Aug. 15, 1975).

15487. Ayres, T. R., Linsky, J. L., **Stellar model chromospheres. IV. The formation of the Hϵ feature in the sun (G2 V) and Arcturus (K2 III),** *Astrophys. J.* **201**, No. 1, 212-221 (Oct. 1, 1975).

15516. Kusch, P., Hessel, M. M., **Perturbations in the $A\ {}^1\Sigma_u^+$ state of Na_2,** *J. Chem. Phys.* **63**, No. 9, 4087-4088 (Nov. 1, 1975).

15521. Ely, J. F., Hanley, H. J. M., **The statistical mechanics of non-spherical polyatomic molecules. Application to the properties of carbon dioxide,** *Mol. Phys.* **30**, No. 2, 565-578 (1975).

15524. Meijer, P. H. E., Niemeijer, T., **Quantum-mechanical approximation to the ground state of cerous magnesium nitrate,** *Phys. Rev. B* **11**, No. 7, 2612-2623 (Apr. 1, 1975).

15532. Geltman, S., **Coulomb correction for strong-field multiphoton free-free absorption,** *J. Phys. B Letter to Editor* **8**, No. 15, L374-L376 (1975).

15543. Roestamsjah, N. N., Wall, L. A., Florin, R. E., Aldridge, M. H., Fetters, L. J., **Degrading mixtures of monodisperse poly-α-methylstyrenes: Rates and anomalous molecular weight distributions,** *J. Polym. Sci. Polym. Phys. Ed.* **13**, 1783-1787 (1975).

15551. Krauss, M., Neumann, D., **The dipole moment function of $CO(a^3\Pi)$,** *Mol. Phys.* **30**, No. 4, 1015-1020 (1975).

15553. Beaty, E. C., **Measurements of the energy and angular distribution of secondary electrons,** *Radiat. Res.* **64**, 70-79 (1975).

15556. Read, F. H., **Displaced electron energies and the "shakedown" effect,** *Radiat. Res.* **64**, 23-36 (1975).

15562. Gebbie, K. B., Steinitz, R., **Comparison of Hα and Ca II H and K spectroheliograms as a diagnostic probe,** (Proc. Int. Astronomical Union Symp. on Chromospheric Fine Structure, Surfers' Paradise, Qld. Australia, Sept. 1973), Paper in *Chromospheric Fine Structure*, R. Grant Athay, Ed., No. 56, 55-63 (Reidel Publishing Co., Boston, Mass., 1974).

15566. Krauss, M., Neumann, D., **On the interaction of $O(^1S)$ with $O(^3P)$,** *Chem. Phys. Lett.* **36**, No. 3, 372-374 (Nov. 15, 1975).

15576. Sugar, J., **Ionization energies of quadruply ionized rare earths,** *J. Opt. Soc. Amer.* **65**, No. 11, 1366-1367 (Nov. 1975).

15584. Gallagher, A., **Noble-gas broadening of the Li resonance line,** *Phys. Rev. A* **12**, No. 1, 133-138 (July 1975).

15585. Mount, G. H., Linsky, J. L., **A new solar carbon abundance based on non-LTE CN molecular spectra,** *Astrophys. J.* **202**, No. 1, L51-L54 (Nov. 15, 1975).

15586. King, G. C., Read, F. H., Bradford, R. C., **Structure near autoionizing energies in the excitation of bound states of helium, neon, and argon by electron impact,** *J. Phys. B* **8**, 2210 (1975).

15590. Wang, F. W., DiMarzio, E. A., **The dynamics of block-copolymer molecules in solution. The free-draining limit,** *Macromolecules* **8**, No. 3, 356-360 (May-June 1975).

15593. Dunn, G. H., **Collision studies with ion storage techniques,** (Proc. Int. Conf. on Atomic Physics, Heidelberg, Germany, July 1974), Paper in *Atomic Physics* **4**, pp. 575-587 (Plenum Press, New York, N.Y., 1975).

15598. McClintock, W., Linsky, J. L., Henry, R. C., Moos, H. W., Gerola, H., **Ultraviolet observations of cool stars. III. Chromospheric and coronal lines in α Tauri, β Geminorum, and α Bootis,** *Astrophys. J.* **202**, 165-182 (Nov. 1975).

15600. Kunasz, P. B., Hummer, D. G., Mihalas, D., **Theory of extended stellar atmospheres. II. A grid of static spherical models for O stars and planetary nebula nuclei,** *Astrophys. J.* **202**, 92-113 (Nov. 1975).

15611. Krauss, M., Neumann, D., **Ion-pair states of O_2,** *J. Chem. Phys.* **63**, No. 12, 5073-5076 (Dec. 15, 1975).

15627. Ausloos, P., **Pulse radiolysis of alkanes in the gas-phase, ion-molecule reactions and neutralization mechanism of hydrocarbon ions,** (Proc. Symp. on Mechanisms of Hydrocarbon Reactions, Siófok, Hungary, June 5-7, 1973), Paper in *Mechanisms of Hydrocarbon Reactions*, F. Márta and D. Kalló, Eds., *Plenary Lecture* **3**, pp. 603-624 (1975).

15637. Beers, Y., Howard, C. J., **The microwave spectrum of HO_2 near 65 GHz,** *J. Chem. Phys.* **63**, No. 10, 4212-4216 (Nov. 15, 1975).

15652. Ott, W. R., Slater, J., Cooper, J., Gieres, G., **H^- shape-resonance studies in an arc plasma,** *Phys. Rev. A* **12**, No. 5, 2009-2016 (Nov. 1975).

15686. Hessel, M. M., Drullinger, R. E., Broida, H. P., **Chemiluminescent reactions in a heat-pipe oven,** *J. Appl. Phys.* **46**, No. 5, 2317-2318 (May 1975).

15694. Cabana, A., Laurin, M., Lafferty, W. J., Sams, R. L., **High resolution infrared spectra of the ν_2 and $2\nu_1$ bands of $^{14}N^{16}O_2$,** *Can. J. Phys.* **53**, No. 19, 1902-1926 (1975).

15700. Rothschild, W. G., Rosasco, G. J., Livingston, R. C., **Dynamics of molecular reorientational motion and vibrational relaxation in liquids. Chloroform,** *J. Chem. Phys.* **62**, No. 4, 1253-1268 (Feb. 15, 1975).

Building Technology

BSS60. **Hydraulic performance of a full-scale townhouse drain-waste- vent system with reduced-size vents,** M. J. Orloski and R. S. Wyly, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 60, 43 pages (Aug. 1975) SD Catalog No. C13.29/2:60.

BSS63. **Analysis of current technology on electrical connections in residential branch circuit wiring,** W. J. Meese and R. L. Cilimberg, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 63, 23 pages (Mar. 1975) SD Catalog No. C13.29:2/63.

BSS68. **Review of standards and other information on thermoplastic piping in residential plumbing,** R. S. Wyly, W. J. Parker, D. E. Rorrer, J. R. Shaver, G. C. Sherlin, and M.

Tryon, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 68, 65 pages (May 1975) SD Catalog No. C13.29:2/68.

BSS71. **A proposed concept for determining the need for air conditioning for buildings based on building thermal response and human comfort,** J. E. Hill, T. Kusuda, S. T. Liu, and F. J. Powell, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 71, 155 pages (Aug. 1975) SD Catalog No. C13.29/2:71.

BSS74. **The buffeting of tall structures by strong winds,** E. Simiu and D. W. Lozier, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 74, 90 pages (Oct. 1975) SD Catalog No. C13.29:2/74.

BSS77. **Acoustical and thermal performance of exterior residential walls, doors and windows,** H. J. Sabine, M. B. Lacher, D. R. Flynn, and T. L. Quindry, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 77, 170 pages (Nov. 1975) SD Catalog No. C13.29/2:77.

TN863. **Fatigue tests of bituminous membrane roofing specimens,** G. F. Sushinsky and R. G. Mathey, Nat. Bur. Stand. (U.S.), Tech. Note 863, 32 pages (Apr. 1975) SD Catalog No. C13.46:863.

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14759. Wyllie, L. A., Jr., Wright, R. N., Sozen, M. A., Degenkolb, H. J., Steinbrugge, K. V., Kramer, S., **Effects on structures of the Managua earthquake of December 23, 1972,** *Bull. Seismol. Soc. Amer.* **64,** No. 4, 1069-1133 (Aug. 1974).

15024. Orloski, M. J., **The numbers game in stacks and drains,** (Proc. Sixty-Eighth Annual Meeting of the American Society of Sanitary Engineering, New Orleans, La., Oct. 13-16, 1974), Paper in *ASSE Yearbook* **52,** 122-136 (ASSE, Cleveland, Ohio, 1975).

15190. Margulis, S. T., **A comparison of the opinions of Operation Breakthrough occupants and conventional housing occupants about their housing,** *Industrialization Forum* **6,** No. 1, 21-26 (1975).

15364. Parkinson, J. S., **Studies of human factors in building design,** *Constr. Specifier* **27,** No. 11, 41-43 (Nov. 1974).

15369. Yokel, F. Y., **Reply to a question on connections between bearing walls and precast floor panels,** *Civ. Engr. Engineers' inquiry box,* 60-61 (Dec. 1974).

15372. Yokel, F. Y., **The Operation Breakthrough evaluation, an experience in the application of performance criteria,** *Industrialization Forum* **6,** No. 1, 27-33 (1975).

15403. Hill, J. E., Kusuda, T., **Dynamic characteristics of air infiltration,** *ASHRAE Trans.* **81,** Part 1, 168-185 (1975).

15404. Yokel, F. Y., **Reply to question on the design of unreinforced masonry load-bearing walls,** *Civ. Engr. Engineers' inquiry box,* p. 79 (Nov. 1973).

15454. Wehrli, R., **Metrication and the construction industry: Potential problems and promising opportunities,** *AIA J.,* pp. 50-54 (May 1974).

15503. Somes, N. F., **Factors influencing structural safety,** Paper 48-7 in *Industrialization in Concrete Building Construction, ACI Publ. SP48,* pp. 177-189 (American Concrete Institute, Detroit, Mich., 1975).

15507. Yokel, F. Y., Dikkers, R. D., Fattal, S. G., **Strength of load-bearing masonry walls,** *J. Structural Div. Proc. ASCE ST5,* 948-950 (May 1973).

15514. Yokel, F. Y., **Stability and load capacity of members with no tensile strength,** *J. Structural Div. Proc. ASCE ST4,* 788-789 (Apr. 1973).

15558. Simiu, E., Filliben, J. J., **Structural safety and the probabilistic definition of design wind speeds,** *Proc. CIB Int. Symp. on the Climatology of Building, Zurich, Switzerland, Sept. 25-27, 1974,* 99 pages (1974).

15582. Clifton, J. R., Foster, B. E., Trattner, E., Clevenger, R. A., **Dimensional stability of masonry walls,** *Am. Soc. Test Mater. Spec. Tech. Publ.* **589,** pp. 42-75 (1975).

15606. Holton, J. K., Driscoll, P., **Linking research and practice,** *AIA J.,* pp. 67-68 (Apr. 1975).

15609. Walker, G. R., Minor, J. E., Marshall, R. D., **The Darwin cyclone valuable lesson in structural design,** *Civ. Eng.* **45,** No. 12, 82-86 (Dec. 1975).

15620. Cullen, W. C., **The composite roofing membrane,** *The Roofing Spec.* **3,** No. 5, 17-21 (Sept. 1975).

15629. Mathey, R. G., Cullen, W. C., **Performance criteria for built-up roofing—Part 2,** *Roofing Siding Insulation* **52,** No. 1, 44-46, 56 (Jan. 1975).

Computer Science and Technology

H118. **MUMPS Language Standard,** J. T. O'Neill, Ed., Nat. Bur. Stand. (U.S.), Handb. 118, 144 pages (Dec. 1975) SD Catalog No. C13.11.118.

SP406. **Computer performance evaluation: Report of the 1973 NBS/ACM Workshop,** T. E. Bell, B. W. Boehm, and S. Jeffery, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 406, 180 pages (Aug. 1975) SD Catalog No. C13.10:406.

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14916. Stewart, S. L., **STAPLE, an experimental structured programming language,** *Comput. Languages* **1,** No. 1, 61-71 (Jan. 1975).

15071. Cotton, I. W., **Standards for network graphics communications,** *Comput. & Graphics* **1,** 45-47 (1975).

15072. Cotton, I. W., **Methodologies for the cost-benefit analysis of computer graphics systems,** *Comput. & Graphics* **1,** 33-43 (1975).

15077. Cotton, I. W., Meissner, P., **Approaches to controlling personal access to computer terminals,** *Proc. 1975 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., June 18, 1975,* pp. 32-39 (IEEE Computer Society, Long Beach, Calif., 1975).

15093. Abrams, M. D., **A new approach to performance evaluation of computer networks,** *Proc. 1974 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., May 23, 1974,* pp. 15-20 (Institute of Electrical and Electronic Engineers, Inc., New York, N.Y., 1974).

15241. Geller, S. B., **Archival data storage,** *Datamation* **20,** No. 10, 72, 75-76, 80 (Oct. 1974).

15287. Albus, J. S., **Data storage in the cerebellar model articulation controller (CMAC),** *Trans. ASME Series G, J. Dyn. Syst. Meas. Control* **97,** No. 3, 228-233 (Sept. 1975).

15348. Lyon, G., Stillman, R. B., **Simple transforms for instrumenting FORTRAN decks,** *Software—Pract. Exper.* **5,** No. 4, 347-358 (Oct.-Dec. 1975).

15371. Treu, S., **Interactive command language design based on required mental work,** *Int. J. Man-Mach. Stud.* **7,** No. 1, 135-149 (1975).

15448. Fife, D. W., **Primary issues in user needs,** (Proc. EDUCOM Working Seminar on the National Science Computer Network, Warrenton, Va., Nov. 1972), Chapter 10 in *Networks for Research and Education,* pp. 89-95 (The Massachusetts Institute of Technology, Cambridge, Mass., 1974).

15485. Cotton, I. W., **Computer networks: Capabilities and limitations,** (Proc. Int. Symp. on Structural Mechanics Software, Univ. of Maryland, College Park, Md., June 12-14, 1974), Paper in *Structural Mechanics Computer Programs,* W. Pilkey, K. Sczalski, H. Schaeffer, Eds., pp. 1043-1055 (University Press of Virginia, Charlottesville, Va., 1974).

15488. Cotton, I. W., **Some trade-offs in the design of minicomputer-based graphic systems,** *Proc. Compcon 74, Washington, D.C., Sept. 1974,* pp. 47-52 (1974).

15495. Davis, R. M., **Quality software can change the computer industry,** (Proc. Symp. on Computer Program Test Methods, Chapel Hill, N.C., June 21-23, 1972), Paper in *Program Test Methods,* W. C. Hetzel, Ed., pp. 303-311 (Prentice-Hall, Inc., Englewood Cliffs, N.J., 1973).

15538. Haight, W. C., **Establishment of OS AIDS as an RTOS task,** *Interchange* **5,** No. 3, 5-6 (June 1974).

15541. Rosenthal, R., **Accessing online network resources with a network access machine,** *Proc. IEEE Intercon 1975 Conf. Record on Access to Computer Networks, Session 25, New York, N.Y., Apr. 8-10, 1974,* 4 pages (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1974).

15544. Rosenthal, R., Watkins, S. W., **Automated access to network resources. A network access machine,** *Proc. 1974 Symp. on Computer Networks: Trends and Applications, Gaithersburg, Md., May 23, 1974,* pp. 47-50 (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1974).

15545. Fife, D. W., **Network management for expanded resource sharing,** (Proc. EDUCOM Fall Conf., Princeton, N.J., Oct. 9-11, 1973), Chapter 7 in *Facts and Futures,* pp. 55-61 (The Interuniversity Communications Council, Princeton, N.J., 1974).

15547. Cotton, I. W., **Network management survey,** *Proc. Hawaii Int. Conf. on Systems Sciences, Univ. of Hawaii, Honolulu, Hawaii, Jan. 8-10, 1974,* 4 pages (1974).

15570. Saltman, R. G., **The human side of automating,** *Proc. Association for Computing Machinery and National Bureau of Standards Conf., on The Systems Approach: Key to Successful Computer Applications, Gaithersburg, Md., June 20, 1974,* pp. E.4.1-4.11 (1974); *Cyberdent* **2,** No. 3, 1, 3-4 (1974).

15605. Jackson, R. H. F., **Towards algorithmic standardization in mathematical programming: Another step,** *Proc. 1974 Fall UNIVAC Users' Conf., Toronto, Canada, Sept. 1974,* pp. 3-147 —3-153 (1974).

15621. Blanc, R. P., **Availability and useability of computer communication networks,** *Proc. Seventh Int. Conf. on Systems Sciences, Honolulu, Hawaii, Jan. 8-10, 1974,* pp. 10-13 (1974).

15631. Berg, J. L., **Federal Privacy Act countdown—Is the private sector ready?,** *Infosystems* **22,** No. 7, 25-27 (July 1975).

15633. Cotton, I. W., **Cost-benefit analysis of interactive systems,** *Proc. Second Jerusalem Conf. on Information Technology, Jerusalem, Israel, July 29-Aug. 1, 1974,* pp. 729-746 (1974).

15642. Abrams, M. D., **Consumer-oriented measurement of computer network performance,** *Proc. IEEE National Telecommunications Conf., San Diego, Calif., Dec. 2-4, 1974,* pp. 843-844 (1974).

15643. Pyke, T. N., Jr., **Networked minis and micros—Configurations, applications, and standards,** *Proc. Mini Micro Computer Symp., U.S. Naval Academy, Annapolis, Md., Apr. 15, 1975,* pp. 44-46 (1975).

15657. Branstad, D. K., **Encryption protection in computer data communications,** *Proc. Fourth Data Communications Symp., Quebec City, Canada, Oct. 7-9, 1975*, pp. 8-1 – 8-7 (1975).

15668. Sibley, E. H., **Summary of CODASYL report on selection and acquisition of data base management systems,** *Digest of Papers, Association for Computing Machinery 1975 Conf., Minneapolis, Minn., Sept. 1974*, 3 pages (1974).

15669. Lyon, G., Walker, J. C., **On some polynomial search methods for hash tables of prime and composite sizes,** *Proc. Canadian Information Processing Society (CIPS) Nat. Conf., Regina, Sask., Canada, June 25, 1975*, pp. 290-299 (1975).

15670. Fong, E., **A benchmark test approach for generalized data base software,** *Proc. COMPCON fall Conf. Digest, Washington, D.C., Sept. 8-10, 1975*, 7 pages (1975).

15693. Abrams, M. D., **Computer communications network performance measurement (Abstract),** *Proc. Eurocon 1974 Conf. Digest on Electrotechnics, Amsterdam, The Netherlands, Apr. 22-26, 1974*, 2 pages (1974).

15698. Sibley, E. H., **On the equivalences of data based systems,** *Proc. Association for Computing Machinery SIGMOD Conf., Ann Arbor, Mich., May 1-3, 1974*, **II,** 1-52 (1974).

Health and Safety

H114. **General safety standard for installations using non-medical x-ray and sealed gamma-ray sources, energies up to 10 MeV.** *(ANS N43-5)*, E. H. Eisenhower, Nat. Bur. Stand. (U.S.), Handb. 114, 69 pages (Feb. 1975) SD Catalog No. C13.11:114.

SP415. **Biomaterials.** Proceedings of a Symposium held in conjunction with the Ninth Annual Meeting of the Association for the Advancement of Medical Instrumentation, New Orleans, April 19-20, 1974, E. Horowitz and J. L. Torgesen, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 415, 109 pages (May 1975) SD Catalog No. C13.10:415.

Plasma formed polymers for biomedical application. Part I. Synthesis and fundamental studies, K. G. Mayhan, A. W. Hahn, M. R. Havens, and B. W. Peace, *SP415*, pp. 1-12 (May 1975).

Plasma-formed polymers for biomedical applications. Part II. Biocompatibility and applications, A. W. Hahn, K. G. Mayhan, J. R. Easley, and C. W. Sanders, *SP415*, pp. 13-17 (May 1975).

Interfacial behavior of ceramic implants, L. L. Hench, H. A. Paschall, W. C. Allen, and G. Piotrowski, *SP415*, pp. 19-36 (May 1975).

Soft tissue response to a series of dense ceramic materials and two clinically used biomaterials, W. C. Richardson, Jr., S. F. Hulbert, J. J. Klawitter, and B. W. Sauer, *SP415*, pp. 37-44 (May 1975).

Engineering and biological studies of metallic implant materials, N. D. Greene, C. Onkelinx, L. J. Richelle, and P. A. Ward, *SP415*, pp. 45-54 (May 1975).

Materials characterization of implantable porous electrodes, R. B. Beard, J. F. DeRosa, S. F. Dubin, L. Sturm, R. M. Koerner, and A. Miller, *SP415*, pp. 55-61 (May 1975).

Properties of fibrous biomaterials with statistically dispersed orientation, E. Y. Robinson, *SP415*, pp. 63-74 (May 1975).

A simple *in vitro* test for screening the blood compatibility of materials, H. Kambic, T. Komai, R. J. Kiraly, and Y. Nosé, *SP415*, pp. 75-82 (May 1975).

Conformation of adsorbed blood proteins, B. W. Morrissey, L. E. Smith, C. A. Fenstermaker, R. R. Stromberg, and W. H. Grant, *SP415*, pp. 83-90 (May 1975).

A nerve implant prosthesis for facilitating peripheral nerve regeneration. Part I. Development of the prosthetic device and system of repair, W. E. Kuhn and J. L. Hall, *SP415*, pp. 91-98 (May 1975).

A nerve implant prosthesis for facilitating peripheral nerve regeneration. Part II. Development of the prosthetic device and system of repair neuroanatomical aspects, J. L. Hall and W. E. Kuhn, *SP415*, pp. 99-101 (May 1975).

BSS61. **Natural hazards evaluation of existing buildings,** C. G. Culver, H. S. Lew, G. C. Hart, and C. W. Pinkham, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 61, 958 pages (Jan. 1975) SD Catalog No. C13.29:2/61.

TN666. **Efflux of gaseous hydrogen or methane fuels from the interior of an automobile,** J. M. Arvidson, J. Hord, and D. B. Mann, Nat. Bur. Stand. (U.S.), Tech. Note 666, 56 pages (Mar. 1975) SD Catalog No. C13.46:666.

TN858. **A program for survey of fire loads and live loads in office buildings,** C. Culver and J. Kushner, Nat. Bur. Stand. (U.S.), Tech. Note 858, 229 pages (May 1975) SD Catalog No. 13.46:858.

TN859. **Literature search: Law enforcement facilities – planning, design, construction,** R. Kapsch and J. Stroik, Eds., Nat. Bur. Stand. (U.S.), Tech. Note 859, 221 pages (Nov. 1975) SD Catalog No. C13.46:859.

TN867. **Relationship of garment characteristics and other variables to fire injury severity,** L. B. Buchbinder, Nat. Bur. Stand. (U.S.), Tech. Note 867, 41 pages (June 1975) SD Catalog No. C13.46:867.

TN878. **The M40 fingerprint matcher,** J. H. Wegstein, Nat. Bur. Stand. (U.S.), Tech. Note 878, 14 pages (July 1975) SD Catalog No. C13.46:878.

NBSIR 73-262. **Some cutting experiments on human skin and synthetic materials,** J. R. Sorrells and R. E. Berger, 70 pages (Oct. 1973). Order from NTIS as COM 75-10370.

NBSIR 74-605. **Crush characteristics of automobile structural components,** D. C. Robinson, 65 pages (Jan. 1975). Order from NTIS as COM 75-10464.

NBSIR 74-606. **Consumer product noise: A basis for regulation,** P. G. Weissler, G. A. Zerdy, and S. G. Revoile, 80 pages (Nov. 1974). Order from NTIS as COM 75-10340.

NBSIR 74-613. **Preliminary study of the slipperiness of flooring,** A. P. Cramp and L. W. Masters, 42 pages (July 1974). Order from NTIS as COM 75-10059.

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NBSIR 74-623. **Stability and abuse tests of riding toys,** W. C. Brown and H. A. Baker, 87 pages (Jan. 1975). Order from

NTIS as COM 75-10210.

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NBSIR 75-647. **Mechanical tests of FAA-E2491 airport in-pavement approach and threshold lights,** D. C. Robinson, 26 pages (Jan. 1975). Order from NTIS as COM 75-10418.

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NBSIR 75-697. **Consideration in the use of sampling plans for effecting compliance with mandatory safety standards,** V. L. Broussalian, A. J. Farrar, U. W. Lyons, C. O. Muehlhause, M. G. Natrella, J. R. Rosenblatt, R. D. Stiehler, and J. H. Winger, 58 pages (June 1975). Order from NTIS as COM 75-10920.

NBSIR 75-702. **Design criteria for firefighters' turnout coats,** J. W. Eisele, 37 pages (Oct. 1975). Order from NTIS as COM 75-11433.

NBSIR 75-707. **Tamper-resistant television surveillance system,** O. B. Laug and K. W. Yee, 38 pages (May 1975). Order from NTIS as COM 75-11017.

NBSIR 75-714. **Report on test on a sample of non-standard size baby cribs,** R. Pierson, Jr., R. I. Beall, and J. A. Huckeba, 33 pages (June 1975). Available from the author, NBS, Washington, D.C. 20234.

NBSIR 75-718. **Report of fire test on an AM General Metro Bus,** E. Braun, 21 pages (June 1975). Order from NTIS as COM 75-10750.

NBSIR 75-723. **Aluminum branch circuit wiring in residences summary report for the Consumer Product Safety Commission January-September 1974,** J. Rabinow, 91 pages (June 1975). Order from NTIS as COM 75-10753.

NBSIR 75-733. **An evaluation of proposed safety requirements for infants' pacifiers,** S. D. Toner and H. A. Baker, 20 pages (Aug. 1975). Order from NTIS as COM 75-11139.

NBSIR 75-734. **Report on an investigation of the high speed hazards of steel belted patrol tires on police patrol cars,** J. J. Collard, 51 pages (June 1975). Order from NTIS as COM 75-11212.

NBSIR 75-748. **Power saws: A review of injury data and power saw industry survey,** V. J. Pezoldt and J. J. Persensky, 95 pages (July 1975). Order from NTIS as COM 75-11031.

NBSIR 75-766. **Properties and interactions of oral structures and restorative materials,** J. M. Cassel, 51 pages (July 1975). Order from NTIS as COM 75-11376.

NBSIR 75-797. **An evaluation of a range-top warning light system,** M. E. Stefl and J. J. Persensky, 22 pages (July 1975). Order from NTIS as COM 75-11465.

NBSIR 75-908. **Characterization of sharp points and edges by electrical breakdown,** J. Cohen, 21 pages (Aug. 1975). Order from NTIS as PB247270.

NBSIR 75-917. **A multiple-chamber humidity apparatus,** L. Greenspan, 22 pages (Dec. 1975). Order from NTIS as PB247655.

14761. Massey, R. G., Druckenbrod, W. F., **Terms and definitions for police patrol cars,** *LESP-RPT-0401.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1974).

14778. Pella, P. A., **A discussion of a performance standard for evidential breath alcohol instruments,** (Proc. 1974 Carnahan and International Crime Countermeasures Conf., Lexington, Ky., April 16-19, 1974), Paper in *Proceedings 1974 Carnahan and International Crime Countermeasures Conference, UKY Bull.* **105,** 98-101 (1974).

14793. Weissler, P. G., Kobal, M. T., **Noise of police firearms,** *J. Acoust. Soc. Amer.* **56,** No. 5, 1515-1522 (Nov. 1974).

14835. Mabie, C. P., Wallace, B. M., **Optical, physical and chemical properties of pineal gland calcifications,** *Calcif. Tissue Res.* **16,** 59-71 (1974).

14880. Brauer, G. M., Termini, D. J., **Grafting of polymeric side chains to soft tissues,** *J. Biomed. Mater. Res.* **8,** 451-470 (1974).

14909. Chow, L. C., Brown, W. E., **Formation of $CaHPO_4 \cdot 2H_2O$ in tooth enamel as an intermediate product in topical fluoride treatments,** *J. Dent. Res.* **54,** No. 1, 65-76 (Jan.-Feb. 1975).

14920. Griffin, R. J., Jr., **The thermesthesiometer—an innovation in heat measurement,** *Lab. Data Winter,* pp. 13-14 (1975).

14922. Taggart, H. E., Nelson, R. E., Scott, W. W., Shafer, J. F., Tary, J. J., Workman, J. L., Treado, M. J., **Mobile FM transmitters,** *NILECJ-STD-0202.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

14923. Eliason, L. K., Hamlin, G. L., Grover, C. G., **Selection and application guide to fixed surveillance cameras,** *NILECJ-GUIDE-0301.00,* 24 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Dec. 1974).

14943. Brauer, G. M., **Adhesion and adhesives,** Chapter 2 in *Scientific Aspects of Dental Materials,* J. A. von Fraunhofer, Ed., pp. 49-96 (Butterworths, London, England, 1975).

14950. Isler, M., Grover, C., **Simplified procedures for evaluating the image quality of objective lenses for night vision devices,** *LESP-RPT-0304.00,* 16 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., May 1974).

14958. Jones, F. E., Quindry, T. L., Rinkinen, W. J., **Summary report on emergency vehicle sirens,** *LESP-RPT-0502.00,* 47 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Sept. 1974).

14959. Westfall, M., Hurley, C. W., Eliason, L. K., **Metallic handcuffs,** *NILECJ-STD-0307.00,* 8 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

14961. Kapsch, R. J., **Life cycle costing techniques applicable to**

law enforcement facilities, *LESP-RPT-0801.00,* 23 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

14966. Loebenstein, W. V., **The surface area of aggregates applied to dental materials,** *J. Biomed. Mater. Res.* 9, 35-53 (1975).

14977. Mabie, C. P., **Evaluation of the physical properties of crown dental porcelain and the effect of newly developed antiballing additive,** *J. Biomed. Mater. Res.* 9, 1-25 (1975).

14985. Brown, W. E., **Physicochemistry of apatite dissolution,** (Transactions of Colloquium on Physico-Chimie et Cristallographie des Apatites D'Intérêt Biologique, Paris, France, 1973), *Colloq. Int. Cent. Nat. Rech. Sci.,* No. 230, 355-368 (1975).

14988. Mills, R., Yee, K., **Hand-held metal detectors for use in weapons detection,** *NILECJ-STD-0602.00,* 13 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

14990. Jickling, R. M., Shafer, J. F., **Repeaters for law enforcement communication systems,** *LESP-RPT-0206.00,* 18 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

14992. Miller, T. R., Weikel, M. K., **Blood donor eligibility, recruitment, and retention,** *Transfusion* **14,** No. 6, 616-622 (Nov.-Dec. 1974).

15002. Leasure, W. A., Jr., Corley, D. M., **Truck noise-1B: Spectral and directional characteristics of noise generated by truck tires,** *Report No. DOT-TST-75-71,* 180 pages (Available from the National Technical Information Service, Springfield, Va., 22161, Sept. 1974).

15013. Barton, J. A., Jr., Brauer, G. M., Antonucci, J. M., Raney, M. J., **Reinforced polycarboxylate cements,** *J. Dent. Res.* **54,** No. 2, 310-323 (1975).

15019. Misra, D. N., Bowen, R. L., Wallace, B. M., **Adhesive bonding of various materials to hard tooth tissues. VIII nickel and copper ions on hydroxyapatite; role of ion exchange and surface nucleation,** *J. Colloid Interface Sci.* **51,** No. 1, 36-43 (Apr. 1975).

15029. Gilsinn, J. F., **Validation of maximum airport throughput levels estimated by the DELCAP simulation model,** *FAA Report No. FAA-RD-75-66,* 72 pages (National Technical Information Service, Springfield, Va. 22151, Jan. 1975).

15048. Murphey, W. M., Schleter, J. C., **Practicality of diversion path analysis,** (Proc. 15th Annual Meeting of the Institute of Nuclear Materials Management, Inc., Atlanta, Ga., June 19-21, 1974), *Nucl. Mater. Manage. Journal of the Institute of Nuclear Materials Management* **III,** No. III, 236-268 (1974).

15049. Murphey, W. M., Schleter, J. C., Maltese, M. D. K., **Internal control vis-a-vis diversion path analysis,** (Proc. 14th Annual Meeting of the Institute of Nuclear Materials Management, Inc., San Diego, Calif., June 20-22, 1973), *Nucl. Mater. Manage. Journal of the Institute of Nuclear Materials Management* **II,** No. 3, 232-274 (1973).

15050. Wu, Y. C., **On the control of thermal impact for thermal safety,** (Proc. AIAA 10th Thermophysics Conf., Denver, Colo., May 27-29, 1975), *AIAA Paper No. 75-713,* 1-11 (American Institute of Aeronautics and Astronautics, New York, N.Y., May 1975).

15086. Malitson, I. H., Lechner, J. A., **Refractive index variance in auto headlamp glass,** *Crime Lab. Dig.* **75,** No. 5, 8-11 (July 1975).

15117. Nimeroff, I., Hall, W. A., **Instrumental colorimetry of retroreflective sign materials,** *Report No. FHWA-RD-75-4,* 89 pages (Available by purchase as PB239-633 from the National Technical Information Service, Springfield, Va. 22161, Jan. 1975).

15158. Argentar, H., Bowen, R. L., **Colored charge-transfer complexes from *N,N*-dimethyl-*p*-toluidine,** *J. Dent. Res.* **54,** No. 3, 588-598 (May-June 1975).

15159. Bowen, R. L., Antonucci, J. M., **Dimethacrylate monomers of aromatic diethers,** *J. Dent. Res.* **54,** No. 3, 599-604 (May-June 1975).

15161. Bowen, R. L., **Adhesive bonding of various materials to hard tooth tissues. VII metal salts as mordants for coupling agents,** (Proc. Symp. on Dental Adhesive Materials, New York, N.Y., Nov. 8-9, 1973), Paper in *Dental Adhesive Materials,* H. D. Moskowitz, G. T. Ward, and E. D. Woolridge, Eds., pp. 205-221 (Prestige Graphic Services, New York, N.Y., 1974).

15162. Brown, W. E., Patel, P. R., Chow, L. C., **Formation of $CaHPO_4 \cdot 2H_2O$ from enamel mineral and its relationship to caries mechanism,** *J. Dent. Res.* **54,** No. 3, 475-481 (May-June 1975).

15164. Haas, S. S., Brauer, G. M., Dickson, G., **A characterization of polymethylmethacrylate bone cement,** *J. Bone J. Surg.* **57-A,** No. 3, 380-391 (Apr. 1975).

15185. Brauer, G. M., **Modification of soft and hard tissues,** (Proc. Symp. on Dental Adhesive Materials, New York, N.Y., Nov. 8-9, 1973), Paper in *Dental Adhesive Materials,* Moskowitz-Ward-Woolridge, Eds., pp. 180-204 (Prestige Graphic Services, New York, N.Y., Sept. 1974).

15186. Rupp, N. W., **Dental amalgam, a plea for clinical research,** *J. Am. Acad. Gold Foil Operators* **13,** No. 1, 29-31 (Spring 1975).

15191. Haas, S. S., Dickson, G., Brauer, G. M., **A proposed specification for acrylic bone cement,** *J. Biomed. Mater. Res. Symp.* **9,** No. 6, 105-117 (1975).

15193. Ehrlich, M., **The use of pressed LiF for thermoluminescence dosimetry without furnace annealing,** *Phys. Med. Biol. Tech. Note* **19,** No. 5, 725-731 (1974).

15194. Cunitz, R. J., Galloway, W. D., Berman, C. M., **Behavioral suppression by 383-MHz radiation,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 3, 313-316 (Mar. 1975).

15195. Chuong, R., **Experimental study of surface and lattice effects on the solubility of hydroxyapatite,** *J. Dent. Res.* **52,** Supplement to No. 5, 911-914 (Sept.-Oct. 1973).

15203. Pella, P. A., Diamondstone, B. I., **Stability of aqueous ethanol solutions stored in glass ampules,** *J. Forensic Sci. Tech. Note* **20,** No. 3, 537-538 (1975).

15208. Berger, R. E., **Effect of contact lens motion on the oxygen tension distribution under the lens,** *Am. J. Optom. Physiol. Opt.* **51,** No. 7, 441-456 (July 1974).

15229. Buchbinder, L. B., **Human activity patterns and injury severity in fire incidents involving apparel,** *J. Fire Flammability/Consumer Product Flammability* **1,** 4-18 (Mar. 1974).

15244. Finkel, P. W., Miller, T. R., Weikel, M. K., **Reply to clinical chemistry article,** *Clin. Chem.* **20,** No. 4, 521, 523-524 (1974).

15273. Finkel, P. W., Miller, T. R., Weikel, M. K., **NBS replies to Dr. Barnett's critique,** *Lab World* **25,** No. 4, 6 and 16 (Apr. 1974).

15279. Lechner, J. A., **Applying statistics in criminalistics,** (Proc. 8th Annual Crime Countermeasures Conf., Lexington, Ky., April 16-19, 1974), Paper in *Proc. 1974 Carnahan and Int. Crime Countermeasures Conf., UKY BU* **105,** 113-123 (Aug. 1974).

15285. Marzetta, L. A., **A thermesthesiometer—An instrument for burn hazard measurement,** *IEEE Trans. Biomed. Eng.* **BME-21,** No. 5, 425-427 (Sept. 1974).

15303. Marzetta, L. A., **Some measurement engineering innovations in consumer products,** *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974,* pp. 41-44 (Instrument Society of America, Pittsburgh, Pa., 1975).

15306. Mills, R. M., **A performance standard for walk-through metal detectors,** (Proc. 8th Annual Crime Countermeasures Conf., Lexington, Ky., Apr. 16-19, 1974), Paper in *Proc. 1974 Carnahan and Int. Crime Countermeasures Conf., UKY BU* **105,** 78-82 (Aug. 1974).

15316. Yonemura, G. T., **An image quality criterion for the identification of faces,** *Photogr. Sci. Eng.* **19,** No. 4, 223-227 (July-Aug. 1975).

15325. Collard, J. J., **U.S. law enforcement receives scientific support,** *Int. Crim. Police Rev. No. 262,* 261 (Nov. 1972).

15374. Bowen, R. L., **Adhesive bonding of various materials to hard tooth tissues. IX. The concept of polyfunctional surface-active comonomers,** *J. Biomed. Mater. Res.* **9,** No. 5, 501-510 (Sept. 1975).

15375. Cali, J. P., **Tying methodology to standards,** *Lab World* **25,** No. 7, 22-24 (July 1974).

15390. Carpenter, B. S., Samuel, D., Wassermann, I., **The location of lithium in the brain,** *ANS Trans.* **18,** 85-86 (1974).

15393. Wassermann, I., Samuel, D., Yuwiler, A., Carpenter, B. S., **Location of catecholamines in the brain using the** $^{17}O(n, \alpha)^{14}C$ **reaction,** *ANS Trans.* **18,** 85 (1974).

15408. Gills, T. E., McClendon, L. T., Maienthal, E. J., Becker, D. A., Durst, R. A., LaFleur, P. D., **Determination of toxic trace elements in body fluid reference samples,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 273-280 (1974).

15438. Buchbinder, L. B., **Human behavioral patterns vs. injury severity for apparel fire victims,** *Proc. Seventh Annual Meeting, Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1973,* pp. 236-253 (Information Council on Fabric Flammability, New York, N.Y., July 1, 1974).

15494. Stenbakken, G. N., Phillips, W. E., Bergsman, S. E., **Terms and definitions for intrusion alarm systems,** *LESP-RPT-0305.00,* 16 pages (U.S. Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice, Washington, D.C., Oct. 1974).

15496. Cali, J. P., **Meaningful measurement in clinical chemistry,** *Proc. San Diego Biomedical Symp., San Diego, Calif., Feb. 6-8, 1974,* **13,** 499-505 (1974).

15497. Meyerson, M. R., **The role of the National Bureau of Standards in consumer product safety,** *Proc. Product Liability Prevention Conf., Newark College of Engineering, Newark, N.J., Aug. 22, 1974, IEEE Catalog 74CHO911-8R,* pp. 149-152 (1974).

15531. Brauer, G. M., Termini, D. J., **Modification of collagenous surfaces by grafting polymeric side chains to collagen and soft and hard tissues,** Chapter 8 in *Advances in Chemistry Series,* No. 145, pp. 175-195 (American Chemical Society, New York, N.Y., 1975).

15535. Patel, P. R., Brown, W. E., **Thermodynamic solubility product of human tooth enamel: powdered sample,** *J. Dent. Res.* **54,** No. 4, 728-736 (July-Aug. 1975).

15565. Chow, L. C., Brown, W. E., **Topical fluoridation of teeth before sealant application,** *J. Dent. Res.* **54,** No. 5, 1089 (Sept.-Oct. 1975).

15591. Rensberger, R. A., **Lead paint hazard abatement,** *Constr. Specifier* **28,** No. 6, 45-46, 48-49 (June 1975).

Consumer Information and Protection

H117. **Examination of vapor-measuring devices for liquefied petroleum gas. A manual for weights and measures officials,** S. Hasko, Nat. Bur. Stand. (U.S.), Handb. 117, 25 pages (Dec. 1975) SD Catalog No. C13.11:117.

CIS6. **Color in our daily lives,** D. B. Judd, Nat. Bur. Stand. (U.S.), Consum. Inf. Ser. 6, 32 pages (Mar. 1975) SD Catalog No. C13.53:6.

CIS8. **Making the most of your energy dollars in home heating and cooling,** M. Jacobs and S. Petersen, Nat. Bur. Stand. (U.S.), Consum. Inf. Ser. 8, 20 pages (June 1975) SD Catalog No. C13.53:8.

NBSIR 74-590. **A study of the feasibility of establishing generic environmental test parameters for all consumer products,** S. D. Toner, 9 pages (Mar. 1975). Order from NTIS as COM 75-11434.

NBSIR 74-621. **Stability and strength of home playground equipment,** B. M. Mahajan, 39 pages (Dec. 1974). Order from NTIS as COM 75-10422.

NBSIR 75-909. **Index of automated system design requirements as derived from the OMB Privacy Act implementation guidelines,** D. K. Branstad and R. A. Krell, Standards Coordinators, 14 pages (Oct. 1975). Order from NTIS as PB246863.

14720. Edgerly, D. E., **Are aerosol packages proliferated within the meaning of The Fair Packaging and Labeling Act?,** *Proc. 1969 Chemical Specialties Manufacturers Association 55th Annual Meeting, Washington, D.C., Dec. 8-11, 1968,* pp. 68-69 (1968).

15204. Meyerson, M. R., **The proposed Department of Commerce "Voluntary" Labeling Program,** (Proc. 1973 Technical Seminar for College Educators of Home Equipment, Dallas, Tex., Nov. 1-3, 1973), Paper in *Proceedings 1973 Technical Seminar for College Educators of Home Equipment,* pp. 9-10 (Association of Home Appliance Manufacturers, Chicago, Ill., 1973).

15498. Davis, R. M., **National Bureau of Standards: Its role in computer security,** *Proc. IBM Data Security Symp., Cambridge, Mass., Apr. 10-11, 1973,* Paper G-520-2838, 11 pages (1973).

15504. Troy, T. N., **Working hand in hand with government,** (Proc. 36th Annual National Packaging Forum, Chicago, Ill., Oct. 7-9, 1974), *Packaging Report F-7432,* 10 pages (The Packaging Institute, U.S.A., New York, N.Y., 1974).

Electromagnetic Metrology

Monogr. 144. **The rotary-vane attenuator as an interlaboratory standard,** W. Larson, Nat. Bur. Stand. (U.S.), Monogr. 144, 70 pages (Nov. 1975) SD Catalog No. C13.44:144.

TN658. **Development of electric and magnetic near-field probes,** F. M. Greene, Nat. Bur. Stand. (U.S.), Tech. Note 658, 53 pages (Jan. 1975) SD Catalog No. C13.46:658.

TN660. **Molecular beam tube frequency biases due to distributed cavity phase variations,** S. Jarvis, Jr., Nat. Bur. Stand. (U.S.), Tech. Note 660, 43 pages (Jan. 1975) SD Catalog No. C13.46:660.

TN663. **Characterization of a high frequency probe assembly for integrated circuit measurements,** R. L. Jesch and C. A. Hoer, Nat. Bur. Stand. (U.S.), Tech. Note 663, 55 pages (Apr. 1975) SD Catalog No. C13.46:663.

TN667. **Upper-bound errors in far-field antenna parameters determined from planar near-field measurements. Part I: Analysis,** A. D. Yaghjian, Nat. Bur. Stand. (U.S.), Tech. Note 667, 120 pages (Oct. 1975) SD Catalog No. C13.46:667.

TN672. **Time domain automatic network analyzer for measurement of RF and microwave components,** W. L. Gans and J. R. Andrews, Nat. Bur. Stand. (U.S.), Tech. Note 672, 176 pages (Sept. 1975) SD Catalog No. C13.46:672.

TN673. **Using six-port and eight-port junctions to measure active and passive circuit parameters,** C. A. Hoer, Nat. Bur. Stand. (U.S.), Tech. Note 673, 29 pages (Sept. 1975) SD Catalog No. C13.46:673.

TN674. **Report on the 1975 survey of users of the services of Radio Stations WWV and WWVH,** J. A. Barnes and R. E. Beehler, Nat. Bur. Stand. (U.S.), Tech. Note 674, 91 pages (Oct. 1975) SD Catalog No. C13.46:674.

NBSIR 74-379. **Completion of the program to evaluate/improve instrumentation and test methods for electroexplosive device safety qualification,** P. A. Hudson, D. G. Melquist, A. R. Ondrejka, and P. E. Werner, 37 pages (June 1974). Order from NTIS as PB247658.

NBSIR 74-381. **Electromagnetic attenuation properties of clay and gravel soils,** D. A. Ellerbruch, 24 pages (Aug. 1974). Order from NTIS as COM 75-10522.

NBSIR 74-391. **Electromagnetic noise in Lucky Friday Mine,** W. W. Scott, J. W. Adams, W. D. Bensema, and H. Dobroski, 139 pages (Oct. 1974). Order from NTIS as COM 74-10258.

NBSIR 74-394. **A rack-mounted precision waveguide-below-cutoff attenuator with an absolute electronic readout,** C. C. Cook, 45 pages (Nov. 1974). Order from NTIS as COM 75-10126.

NBSIR 74-395. **Bibliography of the Electromagnetics Division, June 30, 1973 to June 30, 1974,** M. L. Woolley, 26 pages (Nov. 1974). Order from NTIS as COM 75-10161.

NBSIR 75-804. **Generation of standard EM fields for calibration of power density meters 20 kHz to 1000 MHz,** M. L. Crawford, 44 pages (Jan. 1975). Order from NTIS as COM 75-10395.

NBSIR 75-809. **Non-planar near-field measurements: Spherical scanning,** P. F. Wacker, 67 pages (June 1975). Order from NTIS as COM 75-10989.

NBSIR 75-818. **Bibliography of the electromagnetics division June 30, 1974 to June 30, 1975,** M. L. Woolley, 27 pages (Sept. 1975). Order from NTIS as PB246439.

NBSIR 75-822. **Study of errors in absolute flux density measurements of Casiopeia A,** M. Kanda, 34 pages (Oct. 1975). Order from NTIS as PB246933.

14725. Crawford, M. L., **Generation of standard EM fields using TEM tranmission cells,** *IEEE Trans. Electromagn. Compat.* **EMC-16,** No. 4, 189-195 (Nov. 1974).

14726. Adair, R. T., Hoer, C. A., Kamper, R. A., Simmonds, M. B. **RF attenuation measurements using quantum interference in superconductors,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest No. 113,* 4-5 (Institution of Electrical Engineers, London, England, 1974).

14738. Little, W. E., **Automated computer controlled measurements,** (Proc. 197 4Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest* No. 113, 331-332 (Institution of Electrical Engineers, London, England, 1974).

14739. Beatty, R. W., **2-port standards for evaluating automatic network parameter measurement systems,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest No. 113,* 87-89 (Institution of Electrical Engineers, London, England, 1974).

14740. Kerns, D. M., **Comment on correction of errors in aerial far-field radiation-pattern determinations,** *Electron. Lett.* **7,** No. 24, 706 (Dec. 2, 1971).

14766. Wacker, P. F., **Near-field antenna measurements using a spherical scan: Efficient data reduction with probe correction,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Paper in *CPEM Digest,* No. 113, 286-288 (Institution of Electrical Engineers, London, England, 1974).

14776. Andrews, J. R., **Precision picosecond pulse measurements using a high quality superconducting delay line,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), Abstract in *CPEM Digest* No. 113, 316-318 (Institution of Electrical Engineers, London, England, 1974).

14784. Wacker, P. F., **Antenna measurements at the National Bureau of Standards near-field and extrapolation techniques,** (Abstract only), (Proc. 5th Colloquium on Microwave Communication, Budapest, Hungary, June 24-30, 1974), pp. ME-113—ME-114 (Academy of Sciences, Budapest, Hungary, 1974).

14823. Komarek, E. L., Tryon, P. V., **An application of the power equation concept and automation techniques to precision bolometer unit calibration,** *IEEE Trans. Microwave Theory Tech., Part II, 1974 Symposium Issue,* **MTT-22,** No. 12, 1260-1267 (Dec. 1974).

14826. Engen, G. F., **Calibration technique for automated network analyzers with application to adapter evaluation,** *IEEE*

Trans. Microwave Theory Tech., Part II, 1974 Symposium Issue, **MTT-22,** No. 12, 1255-1260 (Dec. 1974).

14883. Kasa, I., **Closed-form mathematical solutions to some network analyzer calibration equations,** (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 399-402 (Dec. 1974).

14917. Bussey, H. E., Morris, D., Zal'tsman, E. B., **International comparison of complex permittivity measurement at 9 GHz,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 3, 235-239 (Sept. 1974).

14952. Crawford, M. L., **Evaluation of reflectivity level of anechoic chambers using isotropic, 3-dimensional probing,** (Proc. 1974 Int. IEEE/AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper in *1974 International IEEE/AP-S Symposium Digest,* pp. 28-34 (IEEE Inc., New York, N.Y., June 1974).

14954. Engen, G. F., **An alternative calibration technique for automated network analyzers with application to adapter evaluation,** (Proc. 1974 IEEE S-MTT Int. Microwave Symp., Atlanta, Ga., June 12-14, 1974), Paper in *Microwave Symposium Digest,* pp. 261-262 (IEEE Inc., New York, N.Y., June 1974).

14970. Kanda, M., **Accuracy considerations in the measurement of the power gain of a large microwave antenna,** (Proc. 1974 Int. IEEE/AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper in *1974 International IEEE/AP-S Symposium Digest,* 43-45 (IEEE Inc., New York, N.Y., June 1974).

14994. Newell, A. C., Crawford, M. L., **Planar near-field measurements on phased array antennas,** Abstract only, (Proc. Int. IEEE AP-S Symp., Atlanta, Ga., June 10-12, 1974), Paper 6-7 in *1974 International IEEE/AP-S Symposium Digest,* p. 423 (IEEE Inc., New York, N.Y., June 1974).

14995. Komarek, E. L., **An application of the power equation concept and automation techniques to precision bolometer unit calibration,** (Proc. 1974 IEEE S-MTT Int. Microwave Symp., Atlanta, Ga., June 12-14, 1974), Paper in *Microwave Symposium Digest,* pp. 263-265 (IEEE Inc., New York, N.Y., June 1974).

14999. Bussey, H. E., **Rapport sur la comparaison internationale des mesures de permittivité complexe á 9 GHz,** (Proc. Comité Consultatif, D'Electricité Comité International des Poids et Mesures, Sèvres, France, Oct. 12-13, 1972), Paper in *Comité International Des Poids et Mesures,* pp. 124-137 (Bureau International des Poids et Mesures Sèvres, France, 1972).

15035. Zimmerman, J. E., Campbell, W. H., **Tests of cryogenic SQUID for geomagnetic field measurements,** *Geophysics* **40,** No. 2, 269-284 (Apr. 1975).

15641. Kanda, M., **Accuracy considerations in the measurement of the power gain of a large microwave antenna,** *IEEE Trans. Antennas Propag.* **AP-23,** No. 3, 407-411 (May 1975).

15648. Bussey, H. E., Richmond, J. H., **Scattering by a lossy dielectric circular cylindrical multilayer, numerical values,** *IEEE Trans. Antennas Propag.* **23,** No. 5, 723-725 (Sept. 1975).

15649. Hoer, C. A., Roe, K. C., **Using an arbitrary six-port junction to measure complex voltage ratios,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 12, 978-984 (Dec. 1975).

15650. Engen, G. F., **Automated calibration of directional-coupler-bolometer-mount assemblies,** *IEEE Trans. Microwave Theory Tech.* **MTT-23,** No. 12, 984-990 (Dec. 1975).

15651. Lawton, R. A., Scavannec, A., **Photoconductive detector of fast-transition optical waveforms,** *Electron. Lett.* **11,** No. 4, 74-75 (Feb. 20, 1975).

15653. Andrews, J. R., **Directional-coupler technique for triggering a tunnel diode,** *IEEE Trans. Instrum. Meas.* **IM-24,** No. 3, 275-277 (Sept. 1975).

15658. Andrews, J. R., Baldwin, E. E., **Baseband impulse generator useful to 5 GHz,** *Proc. 1975 IEEE Int. Symp. on Electromagnetic Compatibility, San Antonio, Tex., Oct. 7-9, 1975,* pp. 1-4 (1975).

15659. Newell, A. C., **Improved polarization measurements using a modified three antenna technique,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-4, 1975, Session* **15,** pp. 337-340 (1975).

15660. Daywitt, W. C., Kanda, M., **G/T measurement errors with radio stars,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-5, 1975, Session* **20,** pp. 460-463 (1975).

15661. Andrews, J. R., Gans, W. L., **Time domain automatic network analyzer,** (Proc. Colloque International sur L'Electronique et la mesure, Paris, France, May 26-30, 1975), Paper in *La Mesure Electrique de Precision,* pp. 258-267 (Le Comité d'Organisation du Colloque International sur L'Electronique et la mesure, Paris, France, 1975).

15662. Engen, G. F., **Automated calibration of directional-coupler-bolometer-mount assemblies,** *Proc. IEEE-MTT-S Int. Microwave Symp., Palo Alto, Calif., May 12-14, 1975,* pp. 85-97 (Institute of Electrical and Electronics Engineers, Inc., Piscataway, N.J., May 1975).

15664. Newell, A. C., Yaghjian, A. D., **Study of errors in planar near-field measurements,** *Proc. IEEE Int. AP-Symp., Urbana/Champaign, Ill., June 2-4, 1975, Session* **20,** pp. 470-473 (1975).

15665. Hoer, C. A., Roe, K. C., **Using an arbitrary six-port junction to measure complex voltage ratios,** *Proc. 1975 IEEE Microwave Theory and Technique Symp. Int., Palo Alto, Calif., May 12-14, 1975,* pp. 98-99 (1975).

15666. Kanda, M., **A measure for the stability of solid state noise sources,** *Proc. 1975 IEEE Microwave Theory and Technique Symp. Int., Palo Alto, Calif., May 12-14, 1975,* pp. 315-317 (1975).

15667. Kasen, M. B., **Mechanical and thermal properties of filamentary-reinforced structural composites at cryogenic temperatures. 2: Advanced composites,** *Cryogenics* **15,** No. 12, 701-722 (Dec. 1975).

15673. Walls, F. L., Wainwright, A. E., **Measurements of the short-term stability of quartz crystal resonators—a window on future developments in crystal oscillators,** *Proc. 6th Annual Precise Time and Time Interval (PTTI) Planning Meeting, Washington, D.C., Dec. 3-5, 1974,* pp. 143-153 (1974).

15675. Walls, F. L., DeMarchi, A., **RF spectrum of a signal after frequency multiplication; measurement and comparison with a simple calculation,** *IEEE Trans. Instrum. Meas.* **IM-24,** 210-217 (Sept. 1975).

15676. Stein, S. R., **Application of superconductivity to precision oscillators,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975,* pp. 321-327 (1975).

15682. Kamas, G., **TV color frequencies defended as accurate,** *Electron. Design Letter to the Editor* **13,** 7 (June 21, 1975).

15687. Walls, F. L., Wainwright, A. E., **Measurement of the short-term stability of quartz crystal resonators and the implications for crystal oscillator design and applications,** *IEEE Trans. Instrum. Meas.* **IM-24,** 15-20 (Mar. 1975).

15696. Holt, D. R., Nahman, N. S., **Coaxial line pulse-response error due to a planar skin effect approximation,** *Proc. 1972 CPEM Conf. on Precision Electromagnetic Measurement, Boulder, Colo., June 26-29, 1972,* pp. 1-2 (1972).

Electronic Technology

SP400-5. **Semiconductor measurement technology: Measurement of transistor scattering parameters,** G. J. Rogers, D. E. Sawyer, and R. L. Jesch, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-5, 53 pages (Jan. 1975) SD Catalog No. C13.10:400-5.

SP400-8. **Semiconductor measurement technology. Quarterly report, April 1 to June 30, 1974,** W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-8, 70 pages (Feb. 1975) SD Catalog No. C13.10:400-8.

SP400-11. **Semiconductor measurement technology: A BASIC program for calculating dopant density profiles from capacitance-voltage data,** R. L. Mattis and M. G. Buehler, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-11, 39 pages (June 1975) SD Catalog No. C13.10:400-11.

SP400-12. **Semiconductor measurement technology: Quarterly report, July 1 to September 30, 1974,** W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-12, 59 pages (May 1975) SD Catalog No. C13.10:400-12.

SP400-13. **Semiconductor measurement technology: Improved infrared response technique for detecting defects and impurities in germanium and silicon *p-i-n* diodes,** A. H. Sher, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-13, 26 pages (Feb. 1975) SD Catalog No. C13.10:400-13.

SP400-17. **Semiconductor measurement technology: Progress report, October 1 to December 31, 1974,** W. M. Bullis, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 400-17, 79 pages (Nov. 1975) SD Catalog No. C13.10:400-17.

SP400-20. **Semiconductor measurement technology: Optical and dimensional-measurement problems with photomasking in microelectronics,** J. M. Jerke, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-20, 42 pages (Oct. 1975) SD Catalog No. C13.10:400-20.

NBSIR 74-626. **Semiconductor nuclear radiation detector studies—A final report,** A. H. Sher, 10 pages (Sept. 1974). Order from NTIS as COM 75-10411.

14963. Blackburn, D. L., Oettinger, F. F., **Transient thermal response measurements of power transistors,** *IEEE Trans. Ind. Electron. Control Instrum.* **IECI-22,** No. 2, 134-141 (May 1975).

15039. Ciarlo, D. R., Schultz, P. A., Novotny, D. B., **Automated inspection of IC photomasks,** *Proc. Society of Photo-Optical Instrumentation Engineers, Seminar 8, Technological Advances in Micro and Submicro Photofabrication Imagery, San Diego, Ca., Aug. 1974,* **55,** 84-89 (May 1975).

15231. Jones, F. E., **Magnetic retention of evaporation or sputtering masks (Abstract only),** *Rev. Sci. Instrum. Letter to Editor* **46,** No. 6, 793 (June 1975).

15259. Lewis, D. C., **On the determination of the minority carrier lifetime from the reverse recovery transient of *pn*R diodes,** *Solid-State Electron.* **18,** 87-91 (1975).

15431. Harman, G. G., **Metallurgical failure modes of wire bonds,** *12th Annual Proc. IEEE Reliability Physics, Las Vegas, Nev., April 2-4, 1974,* pp. 131-141 (Nov. 15, 1974).

15493. Blackburn, D. L., **An electrical technique for the measurement of the peak junction temperature of power transistors,** *Proc. 13th Annual Reliability Physics Conf., Las Vegas, Nev., Apr. 1-3, 1975* pp. 142-150 (Electron Devices and Reliability Groups, IEEE, New York, N.Y., July 1975).

15575. Berg, N. J., Lieberman, A. G., **The effects of radiation-induced displacement damage on impurity conduction in gallium arsenide,** *J. Appl. Phys.* **46,** No. 8, 3475-3482 (Aug. 1975).

15610. Rubin, S., **Thermal resistance measurements on monolithic and hybrid Darlington power transistors,** (Proc. 1975 IEEE Power Electronics Specialists Conf., Culver City, Calif., June 9-11, 1975), *PESC 75 Record,* **75-CHO,** 965-4 AES, 252-261 (The Institute of Electrical and Electronics Engineers, New York, N.Y., Sept. 1975).

Energy Conservation and Production

H115. Supplement 1. **Energy conservation program guide for industry and commerce (EPIC),** R. G. Massey, Ed., Nat. Bur. Stand. (U.S.), Handb. 115, Suppl. 1, 89 pages (Dec. 1975) SD Catalog No. C13.11:115.

SP419. **Selected topics on hydrogen fuel,** W. R. Parrish, R. O. Voth, J. G. Hust, T. M. Flynn, C. F. Sindt, and N. A. Olien, and J. Hord, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 419, 212 pages (May 1975) SD Catalog No. C13.10:419.

BSS57. **Comparison of measured and computer-predicted thermal performance of a four bedroom wood-frame townhouse,** B. A. Peavy, D. M. Burch, F. J. Powell, and C. M. Hunt, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 57, 62 pages (Apr. 1975) SD Catalog No. C13.29/2:57.

BSS66. **Underground heat and chilled water distribution systems,** T. Kusuda, Ed., Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 66, 146 pages (May 1975) SD Catalog No. C13.29:2/66.

The energy situation and central plant, T. R. Casberg, *BSS66,* pp. 5-8 (May 1975).

Economic advantages of central heating and cooling systems, J. E. Mesko, *BSS66,* pp. 9-17 (May 1975).

Heat transfer studies of underground chilled water and heat distribution systems, T. Kusuda, *BSS66,* pp. 18-41 (May 1975).

Design criteria of underground heat and chilled water distribution systems for corrosion systems for corrosion protection, J. H. Fitzgerald, III and K. J. Moody, *BSS66,* pp. 42-51 (May 1975).

Available types of underground heat distribution systems, H. A. Borger, *BSS66,* pp. 52-59 (May 1975).

Design criteria for auxiliary equipment for underground heating and cooling distribution systems, R. O. Couch, *BSS66,* pp. 60-72 (May 1975).

Federal agency specification for underground heat distribution systems, L. V. Irvin, Jr., *BSS66,* pp. 73-77 (May 1975).

Specifications for an underground heated and chilled water vapor system for private sector contracts, G. S. Campbell, *BSS66,* pp. 78-87 (May 1975).

Fiberglass reinforced plastic pipe in underground condensate return service, H. O. Andersen, *BSS66*, pp. 88-101 (May 1975).

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Experience with central heat distribution systems in cold regions, W. Tobiasson, *BSS66*, pp. 122-135 (May 1975).

BSS78. **Pre-design analysis of energy conservation options for a multi-story demonstration office building,** T. Kusuda, J. E. Hill, S. T. Liu, J. P. Barnett, and J. W. Bean, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 78, 64 pages (Nov. 1975) SD Catalog No. C13.29/2:78.

BSS79. **Energy conservation potential of modular gas-fired boiler systems,** G. E. Kelly and D. A. Didion, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 79, 54 pages (Dec. 1975) SD Catalog No. C13.29:2/79.

TN664. **Hydrogen-future fuel—A bibliography (with emphasis on cryogenic technology),** N. A. Olien and S. A. Schiffmacher, Nat. Bur. Stand. (U.S.), Tech. Note 664, 131 pages (Feb. 1975) SD Catalog No. C13.46:664.

TN789-1. **Emergency workshop on energy conservation in buildings,** S. A. Berry, Nat. Bur. Stand. (U.S.), Tech. Note 789-1, 31 pages (July 1975) SD Catalog No. C13.46:789-1.

TN886. **Modification of fluorescent luminaires for energy conservation,** R. W. Beausoliel, W. J. Meese, and G. Yonemura, Nat. Bur. Stand. (U.S.), Tech. Note 886, 15 pages (Oct. 1975) SD Catalog No. C13.46:886.

TN892. **Retrofitting a residence for solar heating and cooling: The design and construction of the system,** J. E. Hill and T. E. Richtmyer, Nat. Bur. Stand. (U.S.), Tech. Note 892, 99 pages (Nov. 1975) SD Catalog No. C13.46:892.

NBSIR 74-633. **The NBS computerized carpool matching system: User's guide,** J. F. Gilsinn and S. Landau, 64 pages (Dec. 1974). Order from NTIS as COM 75-10691.

NBSIR 74-634. **Method of testing for rating thermal storage devices based on thermal performance,** G. E. Kelly and J. E. Hill, 45 pages (May 1975). Order from NTIS as COM 74-10685.

NBSIR 74-635. **Method of testing for rating solar collectors based on thermal performance,** J. E. Hill, T. Kusuda, 63 pages (Dec. 1974). Order from NTIS as COM 75-10276.

NBSIR 75-660. **Voluntary labeling program for household appliances and equipment to effect energy conservation: Annual report for calendar year 1974,** B. J. McGuire and E. A. Vadelund, 46 pages (Feb. 1975). Order from NTIS as COM 75-10609.

NBSIR 75-711. **Site analysis and field instrumentation for an apartment application of a total energy plant,** J. B. Coble and P. R. Achenbach, 65 pages (May 1975). Order from NTIS as COM 75-10689.

NBSIR 75-712. **Solar heating and cooling in buildings: Methods and economic evaluation,** R. T. Ruegg, 47 pages (July 1975). Order from NTIS as COM 75-11070.

NBSIR 75-747. **Building energy authority and regulations survey: State activity,** R. M. Eisenhard, 25 pages (June 1975). Order from NTIS as COM 75-11131.

NBSIR 75-795. **Recommended criteria for retrofit materials and products eligible for tax credit,** W. J. Rossiter, Jr. and R. G. Mathey, Eds., 44 pages (Nov. 1975). Order from NTIS as PB246866.

NBSIR 75-823. **Helium research in support of superconducting power transmission,** V. D. Arp, D. E. Daney, N. V. Frederick, M. C. Jones, P. R. Ludtke, W. R. Parrish, and R. L. Powell, 79 pages (Oct. 1975). Order from NTIS as PB246436.

14868. Hord, H., **Cryogenic H_2 and national energy needs,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper A-1 in *Advances in Cryogenic Engineering* **19,** 1-11 (Plenum Press, New York, N.Y., 1974).

14872. Flynn, T. M., Powell, R. L., Chelton, D. B., Birmingham, B. W., **Superconducting electrical generators for central power station use,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper B-1 in *Advances in Cryogenic Engineering* **19,** 35-43 (Plenum Press, New York, N.Y., 1974).

14936. Hord, J., **Research opportunities in cryogenic hydrogen-energy systems,** (Proc. Symp. on Hydrogen Energy Fundamentals, Miami Beach, Fla., March 3-5, 1975), Paper in *Hydrogen Energy Fundamentals,* T. N. Viziroglu, Ed., pp. S3-11—S3-24 (University of Miami, Coral Gables, Fla., 1975).

15057. Hosler, W. R., Frederikse, H. P. R., **Doped ceria for MHD-materials,** (Proc. Sixth Int. Conf. on Magnetohydrodynamic Electrical Power Generation, Washington, D.C., June 9-13, 1975), Paper in *MHD Sixth International Conference on Magnetohydrodynamic Electrical Power Generation* **II,** Conf-750601-P2, 67-76 (The Energy Research and Development Administration-Fossil Energy, Washington, D.C., 1975).

15065. Armstrong, G. T., Domalski, E. S., **Energy from wastes,** *Report of the Conference on Thermodynamics and National Energy Problems, Warrenton, Va., June 10-12, 1974,* pp. 386-400 (National Academy of Sciences, National Research Council, Washington, D.C., 1974).

15094. Armstrong, G. T., Domalski, E. S., Minor, J. I., Jr., **Standard combustion data for the fuel gas industry,** *Proc. American Gas Association Section Conf., Atlanta, Ga., May 8-10, 1972,* pp. D-74—D-87 (1972).

15113. Hunt, C. M., Burch, D. M., **Air infiltration measurements in a four-bedroom townhouse using sulfur hexafluoride as a tracer gas,** *ASHRAE Trans.* **81,** Part 1, 186-201 (1975).

15118. Berger, H., **A report on the American Nuclear Society Topical Meeting "Nondestructive Testing in the Nuclear Power Industry,"** *Nucl. News* **18,** No. 1, 68, 73-74 (Jan. 1975).

15154. Ludtke, P. R., **Register of specialized sources for information on selected fuels and oxidizers,** *NASA CR-134807,* 44 pages (Available from the National Technical Information Service, Springfield, Va. 22161, 1975).

15155. Arvidson, J. M., Brennan, J. A., **ASRDI oxygen technology survey, Vol. VIII: Pressure measurement,** *NASA Spec. Publ. 3092,* 200 pages (Available from the National Technical Information Service, Springfield, Va. 22161, 1975).

595-079 OL - 76 - 20

15415. Robertson, B., **Evaluation of automotive fuel flowmeters,** *Proc. Automotive Energy Efficiency Program, Cambridge, Mass., Jan. 15-17, 1975, DOT-TSC-OST-75-31,* pp. 121-134 (National Technical Information Service, Springfield, Va., June 1975).

15416. Parrish, W. R., **An economic study of electrical peaking alternatives,** (Proc. Conf. Hydrogen Economy Energy, Miami Beach, Fla., Mar. 18-20, 1974), Paper R-889 in *Hydrogen Energy,* pp. 949-968 (Plenum Press, New York, N.Y., 1975).

15449. Hosler, W. R., Capps, W., Plante, E. R., **Some physical and chemical properties of coal slags,** *Proc. 14th Symp. on Engineering Aspects of Magnetohydrodynamics, The Univ. of Tennessee Space Institute, Tullahoma, Tenn., April 8-10, 1974,* pp. IV.7.1-IV.7.5 (1974).

15451. Meyerson, M., **The Department of Commerce voluntary labeling program for household appliances and equipment to effect energy conservation,** *Proc. Conf. on Improving Efficiency in HVAC Equipment and Components for Residential and Small Commercial Buildings, Purdue Univ., West Lafayette, Ind., Oct. 7-8, 1974,* pp. 222-225 (1974).

15455. Strobridge, T. R., **Feasibility study of a multipurpose refrigerator for a superconducting cable test facility,** *Paper EPRI* **282,** 52 pages (Electric Power Research Institute, Palo Alto, Calif., July 1975).

15468. Sarkes, L. A., Mann, D. B., **A survey of LNG technological needs in the U.S.A.—1974 to beyond 2000,** *Proc. 4th Int. Conf. on Liquefied Natural Gas, Algiers, Algeria, June 24-27, 1974, Session VII,* Paper 1, pp. 1-21 (Institute of Gas Technology, Chicago, Ill., 1974).

15505. McDaniel, C. L., Plante, E. R., **Phase relations involving seed-electrode-insulator materials in MHD,** *Proc. 14th Symp. on Engineering Aspects of Magnetohydrodynamics, Tullahoma, Tenn., Apr. 8-10, 1974,* pp. IV.6.1-IV.6.4 (University of Tennessee, Tullahoma, Tenn., 1974).

15510. Schneider, S. J., Capps, W., Frederikse, H. P. R., Hosler, W. R., McDaniel, C. L., Plante, E. R., *Proc. US-USSR Colloquium on MHD Power Generation, Moscow, USSR, Feb. 25-27, 1974,* pp. 350-367 (Institute of High Temperatures, Moscow, USSR, 1975).

15515. Ludtke, P. R., **Register of hydrogen technology experts,** *NASA CR-2624,* 80 pages (National Aeronautics and Space Administration, Washington, D.C., Oct. 1975). (Available from National Technical Information Service, Springfield, Va. 22161.)

15654. Birmingham, B. W., Smith, C. N., **Cryogenics and the energy crisis,** *Cryogenics* **15,** No. 3, 115-118 (Mar. 1975).

15663. Achenbach, P. R., Didion, D. A., **Energy conservation measures in the National Bureau of Standards laboratory complex,** *Proc. Energy Conservation and Energy Management in Buildings, London, England, Nov. 13-14, 1975,* pp. 51-68 (1975).

15679. Achenbach, P. R., **National Bureau of Standards research in support of energy conservation standards for buildings,** *Proc. 10th Intersociety Energy Conversion Engineering Conf., Newark, Del., Aug. 18-22, 1975,* pp. 667-676 (1975).

Engineering, Product and Information Standards

SP329. Supplement 2. **An index of U.S. voluntary engineering standards,** W. J. Slattery, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 329, Suppl. 2, 472 pages (May 1975) SD Catalog No. C13.10:329, Suppl. 2.

SP407. **59th National conference on weights and measures 1974,** S. J. Edgerly, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 407, 284 pages (June 1975) SD Catalog No. C13.10:407.

Advancing measurement assurance in the marketplace, J. H. Lewis, *SP407,* pp. 1-6 (June 1975).

Address, Betsy Ancker-Johnson, *SP407,* pp. 6-11 (June 1975).

Expanding the Nation's measurement system, A. O. McCoubrey, *SP407,* pp. 11-23 (June 1975).

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Metric conversion:

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Temperature correction of petroleum products at retail:

Why temperature correction?, G. E. Mattimoe, *SP407,* pp. 166-180 (June 1975).

Temperature correction of petroleum products at retail, H. E. Harris, *SP407,* pp. 181-196 (June 1975).

SP417. **Directory of United States standardization activities,** S. J.

Chumas, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 417, 228 pages (Nov. 1975) SD Catalog No. C13.10:417.

SP429. **Proceedings of the 7th Annual Conference of the National Conference of States on Building Codes and Standards,** S. A. Berry, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 429, 129 pages (Sept. 1975) SD Catalog No. C13.10:429.

FIPS PUB 21-1. **COBOL,** M. V. Vickers, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 21-1, 5 pages (Dec. 1, 1975) SD Catalog No. C13.52:21-1.

FIPS PUB 34. **Guide for the use of International System of Units (SI),** R. R. Roundtree, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 34, 4 pages (1975) SD Catalog No. C13.52:34.

FIPS PUB 35. **Code extension techniques in 7 or 8 bits,** J. L. Little, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 35, 4 pages (1975) SD Catalog No. C13.52:35.

FIPS PUB 36. **Graphic representation of the control characters of ASCII (FIPS 1),** J. L. Little, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 36, 4 pages (1975) SD Catalog No. C13.52:36.

FIPS PUB 37. **Synchronous high speed data signaling rates between data terminal equipment and data communications equipment,** G. E. Clark, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 37, 4 pages (1975) SD Catalog No. C13.52:37.

FIPS PUB 42. **Guidelines for benchmarking ADP systems in the competitive procurement environment,** J. F. Wood, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 42, 8 pages (Dec. 1975) SD Catalog No. C13.52:42.

FIPS PUB 43. **Aids for COBOL program conversion (FIPS PUB 21 to FIPS PUB 21-1),** M. V. Vickers, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 43, 54 pages (1975) SD Catalog No. C13.52:43.

PS1-74. **Construction and industrial plywood.** *(ANS A199.1-1974),* K. G. Newell, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 1-74, 34 pages (Mar. 1975) SD Catalog No. C13.20/2:1-74.

PS61-74. **Plastic containers (jerry-cans) for petroleum products.** *(ANS MH 17.1-1974),* K. G. Newell, Jr., Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 61-74, 6 pages (May 1975) SD Catalog No. C13.20/2:61-74.

PS62-74. **Grading of diamond powder in sub-sieve sizes.** *(ANS Z300.1-1974),* C. W. Devereux, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 62-74, 5 pages (Jan. 1975) SD Catalog No. C13.20/2:62-74.

PS63-75. **Latex foam mattresses for hospitals.** *(ANS Z 255.1-1975),* G. S. Chaconas, Technical Standards Coordinator, Nat. Bur. Stand. (U.S.), Prod. Stand. 63-75, 8 pages (Apr. 1975) SD Catalog No. C13.20/2:63-75.

TN885. **A technical review of the Nicaraguan building regulatory system,** R. N. Wright and I. A. Lamana, Nat. Bur. Stand. (U.S.), Tech. Note 885, 85 pages (Oct. 1975) SD Catalog No. C13.46:885.

NBSIR 75-769. **Report on an NBS/AID/OAS Workshop on standardization and measurement services in industrializing economies,** H. S. Peiser, R. S. Marvin, M. McNeil, and J. Mejeur, Eds., 227 pages (Sept. 1975). Order from NTIS as PB247978.

14858. Wood, L. A., **Physical constants of different rubbers,** Paper in *Polymer Handbook, 2nd Edition,* J. Brandrup and E. H. Immergut, Eds., pp. V-7 – V-12 (John Wiley & Sons, Inc., New York, N.Y., 1975).

15200. Schutz, G. C., Clark, G. E., **Data communication standards,** *Computer* 7, No. 11, 32-37 (Feb. 1974).

15406. Harrison, J. O., Jr., **Computer program characteristics,** (Proc. Seminar on Metric Conversion Engineering and Manufacturing, Gaithersburg, Md., Dec. 12-13, 1974), Appendix B in *ANMC-74-1, Metric Conversion in Engineering and Manufacturing,* L. Perica, Ed., pp. 133-136 (American National Metric Council, Washington, D.C., May 1974).

15490. Harrison, J. O., Jr., **Metric conversion and the COMMON computers,** *Proc. COMMON Users Group, Hollywood, Fla., Oct. 14-16, 1974,* 22 pages (1974).

Environmental Studies: Pollution Measurement

TN866. **Chemical kinetic and photochemical data for modelling atmospheric chemistry,** R. F. Hampson, Jr., and D. Garvin, Eds., Nat. Bur. Stand. (U.S.), Tech. Note 866, 118 pages (June 1975) SD Catalog No. C13.46:866.

NBSIR 73-256. **Development of reference materials for atmospheric analysis of the occupational environment: Filter samples containing toxic metals,** R. Mavrodineanu, J. R. Baldwin, and J. K. Taylor, 16 pages (Oct. 1973). Order from NTIS as COM 75-11443.

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NBSIR 73-259. **A gas dilution system for methyl bromide,** E. P. Scheide, E. E. Hughes, and J. K. Taylor, 11 pages (Oct. 1973). Order from NTIS as COM 75-11446.

NBSIR 73-260. **A gas dilution system for arsine-air mixtures,** P. A. Pella, E. E. Hughes, and J. K. Taylor, 14 pages (Oct. 1973). Order from NTIS as COM 75-11440.

NBSIR 73-261. **A gas dilution system for hydrogen fluoride-air-mixtures,** P. A. Pella, E. E. Hughes, and J. K. Taylor, 23 pages (Oct. 1973). Order from NTIS as COM 75-11441.

NBSIR 74-488. **Measurements of railroad noise-line operations, yard boundaries, and retarders,** J. M. Fath, D. S. Blomquist, J. M. Heinen, and M. Tarica, 108 pages (Dec. 1974). Order from NTIS as COM 75-10088.

NBSIR 74-530. **Preparation of charcoal sampling tubes containing known quantities of adsorbed solvents,** B. C. Cadoff, E. E. Hughes, R. Alvarez, and J. K. Taylor, 36 pages (July 1974). Order from NTIS as COM 75-10041.

NBSIR 74-581. **Development of a solid sorption tube for sampling hydrogen fluoride in the work atmosphere,** J. Wing and J. K. Taylor, 45 pages (Oct. 1974). Order from NTIS as COM 75-10127.

NBSIR 74-608. **Procedure for measuring noise emission from** power lawn mowers, J. I. Adler, 19 pages (Nov. 1974). Order from NTIS as COM 75-10056.

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NBSIR 75-653. **Measurement methodology and supporting documentation for portable air compressor noise,** C. I. Holmer, 48 pages (Jan. 1975). Order from NTIS as PB248097.

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NBSIR 75-675. **Evaluation of x-ray fluorescence analysis for the determination of mercury in coal,** R. L. Myklebust, M. M. Darr, K. F. J. Heinrich, 20 pages (Dec. 1974). Order from NTIS as COM 75-10686.

NBSIR 75-693. **Measurement methodology for determining the sound output of model airplanes and noise producing bicycle attachments,** M. A. Cadoff and W. A. Leasure, Jr., 24 pages (Apr. 1975). Order from NTIS as COM 75-11194.

NBSIR 75-962. **An outdoor noise monitoring system with automatic calibration and remote digital display,** D. S. Blomquist, J. S. Forrer, and D. M. Corley, 11 pages (Oct. 1975). Order from NTIS as PB247639.

14789. Alvarez, R., **Sub-microgram per gram concentrations of mercury in orchard leaves determined by isotope dilution and spark-source mass spectrometry,** *Anal. Chim. Acta* **73,** 33-38 (1974).

14873. Leasure, W. A., Jr., Corley, D. M., Farrer, J. S., Flynn, D. R., **Truck noise—1. Peak A-weighted sound levels due to truck tires (final report),** *DOT Report No. OST-ONA-71-9,* 248 pages (Available as PB204188 from the National Technical Information Services, Springfield, Va., 22161, Sept. 1970).

14874. Leasure, W. A., Jr., Corley, D. M., Farrer, J. S., Flynn, D. R., **Truck noise—1. Peak A-weighted sound levels due to truck tires (addendum),** *DOT Report No. OST/TST-72-1,* 223 pages (Available as PB238912 from the National Technical Information Services, Springfield, Va., 22161, July 1972).

14875. Leasure, W. A., Jr., Mathews, D. E., Rinkinen, W. J., **Truck noise 1-A: Noise evaluation tests of military truck tires (final report),** *DOT Report No. DOT-TST-74-21,* 54 pages (Available as PB234348 from the National Technical Information Services, Springfield, Va., 22161, Feb. 1974).

14939. Byerly, R., **New developments in the measurement of gaseous pollutants in air,** *IEEE Trans. Nucl. Sci.* **NS-22,** No. 2, 856-869 (Apr. 1975).

14955. Wasik, S. P., **Determination of hydrocarbons in sea water using an electrolytic stripping cell,** *J. Chromatogr. Sci.* **12,** 845-848 (Dec. 1974).

14991. Schwarz, F. P., Okabe, H., **Fluorescence detection of nitric oxide in nitrogen,** *Anal. Chem.* **47,** No. 4, 703-707 (Apr. 1975).

15027. Freund, S. M., Sweger, D. M., **Vinyl chloride detection using carbon monoxide and carbon dioxide infrared lasers,** *Anal. Chem.* **47,** No. 6, 930-932 (May 1975).

15099. Gump, B. H., Hertz, H. S., May, W. E., Chesler, S. N., Dyszel, S. M., Enagonio, D. P., **Drop sampler for obtaining fresh and sea water samples for organic compound analysis,** *Anal. Chem.* **47,** No. 7, 1223-1224 (June 1975).

15101. Ball, J. J., Keller, R. A., **Quantitative determination of gaseous nitrogen dioxide concentrations over long path lengths by selective absorption of argon ion laser emission,** *J. Air Pollut. Contr. Ass.* **25,** No. 6, 631-633 (June 1975).

15312. Leasure, W. A., Jr., Mathews, D. E., Cadoff, M. A., **Automobile tire noise: Results of a pilot study and review of the open literature,** *Report DOT/TST-76-4,* 75 pages (Office of Noise Abatement, Department of Transportation, Washington, D.C., Aug. 1975). (Available from the National Technical Information Service, Springfield, Va. 22161.)

15331. Scheide, E. P., Taylor, J. K., **Piezoelectric sensor for mercury in air,** *Environ. Sci. Technol.* **8,** No. 13, 1097-1099 (Dec. 1974).

15376. Harrison, S. H., LaFleur, P. D., Zoller, W. H., **Evaluation of lyophilization for the preconcentration of natural water samples prior to neutron activation analysis,** *Anal. Chem.* **47,** No. 9, 1685-1688 (Aug. 1975).

15397. Dzubay, T. G., Rook, H. L., Stevens, R. K., **A chemiluminescent approach to measurement of strong acid aerosols,** Chapter 4 in *Analytical Methods Applied to Air Pollution Measurements,* R. K. Stevens and W. F. Herget, Eds., pp. 71-83 (Ann Arbor Science Publishers, Inc., Ann Arbor, Mich., 1974).

15409. McClendon, L. T., **Selective determination of chromium in biological and environmental matrices,** (Proc. Eighth Annual Conf. on Trace Substances in Environmental Health, Univ. of Missouri-Columbia, Columbia, Mo., June 11-13, 1974), Paper in *Trace Substances in Environmental Health,* D. D. Hemphill, Ed., **VIII,** 255-257 (1974).

15420. Flynn, D. R., Blomquist, D. S., **Environmental noise measurement,** (Proc. Northeast Electronics Research and Engineering Meeting, Boston, Mass., Nov. 6-8, 1973), Paper in *NEREM (of the IEEE) 1973 Record,* pp. 40-43 (1973).

15457. Carpenter, B. S., Reimer, G. M., **Fission track technique for uranium determination in coal and fly ash standard reference materials,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 141-143 (Available from the National Technical Information Service, Springfield, Va., 1974).

15458. Rook, H. L., Moody, J. R., **Stabilization and determination of nanogram quantities of mercury in water,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 44-53 (Available from the National Technical Information Service, Springfield, Va., 1974).

15466. Menis, O., Garn, P. D., Diamondstone, B. I., **The application of thermoanalytical methods to the environmental health problems,** (Proc. Fourth ICTA Conf., Budapest, Hungary, July 8-13, 1974), Chapter in *Thermal Analysis,* I. Buzas, Ed., **3,** 127-139 (Akademiai, Kiado, Budapest, Hungary, 1975).

15472. Becker, D. A. **Accuracy and precision in activation analysis—counting,** (Proc. Second Int. Conf. on Nuclear Methods in Environmental Research, Univ. of Missouri, Columbia, Mo., July 29-31, 1974), Paper in *Nuclear Methods in Environmental Research,* J. R. Vogt and W. Meyer, Eds., CONF 740701, pp. 69-80 (Available from the National Technical Information Service, Springfield, Va., 1974).

15477. Marshall, H. E., **Cost sharing and efficiency in salinity control,** (Proc. 15th Annual Western Resources Conf. on Salinity in Water Resources, Boulder, Colo., July 9-10, 1974), Chapter 8 in *Salinity in Water Resources*, J. E. Flack and C. W. Howe, Eds., pp. 139-152 (Merriman Publ. Co., Boulder, Colo., 1974).

15501. Pallett, D. S., **INCE laboratory measurements survey,** *Proc. Noise-Conf., Gaithersburg, Md., Sept. 15-17, 1975*, W. W. Lang, Ed., pp. 313-316 (Noise Control Foundation, Poughkeepsie, N.Y., 1975).

15536. Molino, J. A., **A proposed method for measuring the annoyance due to speech interference by noise,** (Proc. NASA Minisymposium, Hampton, Va., Jan. 21-22, 1975), Paper in *NASA Technical Memorandum, Noise and Speech Interference Proceedings of Minisymposium,* W. T. Shepherd, Ed., NASA TM X-72696, 15 pages (Available from National Technical Information Service, Springfield, Va. 22161 and STIF/NASA Scientific and Technical Information Facility, College Park, Md., 20740, 1975).

15552. Hughes, E. E., Taylor, J. K., **Accurate gas standards for air pollution analyses,** *Proc. WMO/WHO Tech. Conf. on Observation and Measurement of Atmospheric Pollution, Helsinki, Finland, July 30-Aug. 4, 1973*, pp. 1-13 (World Meteorological Organization, Geneva, Switzerland, 1974).

15571. Rebbert, R. E., Ausloos, P. J., **Photodecomposition of $CFCl_3$ and CF_2Cl_2,** *J. Photochem.* **4,** 419-434 (1975).

15581. Scheide, E. P., Taylor, J. K., **A piezoelectric crystal dosimeter for monitoring mercury vapor in industrial atmospheres,** *Am. Ind. Hyg. Assoc. J.* **36,** No. 12, 897-901 (Dec. 1975).

15592. Pella, P. A., Hughes, E. E., Taylor, J. K., **Development of gas-blending systems for calibration: application to hydrogen fluoride, arsine and phosgene in air,** *Am. Ind. Hyg. Assoc. J.* **36,** No. 10, 755-759 (Oct. 1975).

15602. Gravatt, C. C., Allegrini, I., **A new light scattering method for the determination of the size distribution of particulate matter in air,** (Proc. 3rd Int. Clean Air Congress (IUAPPA), Dusseldorf, W. Germany, Oct. 8-12, 1973), Paper in *Proceedings of the 3rd International Clean Air Congress*, pp. C3-C5 (Verlag GMBH, Dusseldorf, W. Germany, 1973).

15603. Interrante, C. G., **Report on the ferrous metals workshop,** (Proc. National Materials Conservation Symp. on Resource Recovery and Utilization, Gaithersburg, Md., Apr. 29-May 1, 1974), Paper in *Resource Recovery and Utilization,* H. Alter and E. Horowitz, Eds., *Am. Soc. Test. Mater. Spec. Tech. Publ.* **592,** pp. 146-152 (American Society for Testing and Materials, Philadelphia, Pa., 1975).

15604. Graminski, E. L., **Problems and potentials in paper recycling,** (Proc. National Materials Conservation Symp. on Resource Recovery and Utilization, Gaithersburg, Md., Apr. 29-May 1, 1974), Paper in *Resource Recovery and Utilization,* H. Alter and E. Horowitz, Eds., *Am. Soc. Test. Mater. Spec. Tech. Publ.* **592,** pp. 132-139 (American Society for Testing and Materials, Philadelphia, Pa., 1975).

15655. Ventre, F. T., **Transforming environmental research into regulatory policy,** (6th Annual Meeting of the Environmental Design Research Association (EDRA), Lawrence, Kans., Apr. 23, 1975), Paper in *Responding to Social Change,* pp. 277-284 (Dowden, Hutchinson & Ross, Inc., Stroudsburg, Pa., Apr. 1975).

15706. May, W. E., Chesler, S. N., Cram, S. P., Gump, B. H., Hertz, H. S., Enagonio, D. P., Dyszel, S. M., **Chromatographic analysis of hydrocarbons in marine sediments and seawater,** *J. Chromatogr. Sci.* **13,** 535-540 (Nov. 1975).

Failure Analysis

SP436. **Detection, diagnosis, and prognosis,** Proceedings of the 22d Meeting of the Mechanical Failures Prevention Group held at Anaheim, Calif., Apr. 23-25, 1975, T. R. Shives and W. A. Willard, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 436, 366 pages (Dec. 1975) SD Catalog No. C13.10:436.

Signal analysis techniques for vibration diagnostics, D. R. Houser, *SP436*, pp. 3-15 (Dec. 1975).

A new technology for bearing performance monitoring, G. J. Philips, *SP436*, pp. 18-28 (Dec. 1975).

Bearing contact resistance as a diagnostic aid, R. L. Smith, *SP436*, pp. 31-41 (Dec. 1975).

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Oil analysis in perspective, R. S. Miller (presented by M. Hoobchaak), *SP436*, pp. 104-112 (Dec. 1975).

Instrumentation for predictive maintenance monitoring, R. James, B. Reber, B. Baird, and W. Neal, *SP436*, pp. 114-122 (Dec. 1975).

Gas turbine engine diagnostic test results utilizing a thermodynamic analysis technique, R. L. Stenberg, *SP436*, pp. 137-149 (Dec. 1975).

Problem areas encountered in establishing a data baseline and evaluating the A-7E inflight engine condition monitoring system, A. J. Hess, *SP436*, pp. 151-161 (Dec. 1975).

Tri service oil analysis research and development program, P. B. Senholzi, *SP436*, pp. 165-181 (Dec. 1975).

Development of inspection and diagnostic equipment for motor vehicle equipment for motor vehicle inspection, G. L. Parker (presented by L. H. Emery), *SP436*, pp. 185-192 (Dec. 1975).

On vehicle mobility measurement and recording system, F. K. Chin and R. Watts, *SP436*, pp. 195-219 (Dec. 1975).

VIDEC ship propulsion system performance monitor, R. P. Wallace and W. L. McCarthy, *SP436*, pp. 221-256 (Dec. 1975).

An overview of current efforts to detect and prevent steel wheel failures, G. L. Leadley, *SP436*, pp. 261-287 (Dec. 1975).

Diagnostics for refrigerator car diesel generating sets, R. F. McKee, *SP436*, pp. 289-302 (Dec. 1975).

Using acoustic emission technology to predict structural failure, H. L. Dunegan, *SP436*, pp. 304-319 (Dec. 1975).

Applications of the shock pulse technique to helicopter diagnostics, J. A. George, T. C. Mayer, and E. F. Covill, *SP436*, pp. 321-340 (Dec. 1975).

LST 1179 diesel diagnostic system feasibility study, M. B. Peterson, J. Frarey, D. Dominy, H. Hegner, and H. C. Burnett, *SP436*, pp. 342-354 (Dec. 1975).

NBSIR 75-730. **Equilibrium penny-like crack in indentation fracture,** B. R. Lawn and E. R. Fuller, Jr., 28 pages (Sept. 1975). Order from NTIS as COM 75-11461.

15213. Berger, H., **Summary/Conference on Emerging Techniques for Nondestructive Field Testing,** *Mater. Eval.* **XXXIII,** No. 7, 189-191 (July 1975).

15214. Berger, H., **Radiographic nondestructive testing,** *Stand. News* **3,** No. 3, 21-29 (Mar. 1975).

15315. Thomson, R. M., **A review of nondestructive evaluation opportunities,** *ASTM Stand. News* **3,** No. 3, 8-14 (Mar. 1975).

15401. Evans, A. G., **The role of inclusions in the fracture of ceramic materials,** *J. Mater. Sci.* **9,** 1145-1152 (1974).

15422. Evans, A. G., **High-temperature slow crack growth in ceramic materials,** (Proc. Second Army Materials Technology Conf., Hyannis, Mass., Nov. 13-16, 1973), Chapter 17 in *Ceramics for High-Performance Applications*, pp. 373-396 (Army Materials and Mechanics Research Center, Watertown, Mass., 1974).

Fire Research

SP416. **Attacking the fire problem: A plan for action,** K. Giles and P. Powell, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 416, 37 pages (May 1975) SD Catalog No. C13.10:416.

BSS72. **Fire endurance of gypsum board walls and chases containing plastic and metallic drain, waste and vent plumbing systems,** W. J. Parker, M. Paabo, J. T. Scott, D. Gross and I. A. Benjamin, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 72, 114 pages (Sept. 1975) SD Catalog No. C13.29/2:72.

TN850. **Gasoline and gasoline container fire incidents,** E. A. Tyrrell, Nat. Bur. Stand. (U.S.), Tech. Note 850, 34 pages (Jan. 1975) SD Catalog No. C13.46:850.

TN861. **A survey for the collection of professional opinion on selected fire protection engineering topics,** G. A. Harrison and J. L. Houser, Nat. Bur. Stand. (U.S.), Tech. Note 861, 30 pages (Mar. 1975) SD Catalog No. C13.46:861.

TN879. **Fire buildup in a room and the role of interior finish materials,** J. B. Fang, Nat. Bur. Stand. (U.S.), Tech. Note 879, 49 pages (June 1975) SD Catalog No. C13.46:879.

NBSIR 73-145. **Study of relationships between activity, reaction, garment parameter patterns and injury severity for fire incidents involving apparel,** L. B. Buchbinder, 33 pages (Apr. 1973). Order from NTIS as COM 75-10541.

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NBSIR 74-588. **Development of a bench test for Type X core gypsum board,** J. L. Houser, 26 pages (Dec. 1974). Order from NTIS as COM 75-10040.

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NBSIR 74-596. **Radiative heat transfer from products of combustion in building corridor fires,** K. Bromberg and J. G. Quintiere, 28 pages (Feb. 1975). Order from NTIS as COM 75-10209.

NBSIR 75-673. **Development of a fire test method for flexible connectors in air distribution systems,** L. A. Issen, 31 pages (Apr. 1975). Order from NTIS as COM 75-10921.

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NBSIR 75-736. **Fire research publications, 1974,** N. H. Jason, 11 pages (June 1975). Order from NTIS as COM 75-11018.

NBSIR 75-741. **Mechanistic studies of triphenylphosphine oxide-poly (ethyleneterephthalate) and related flame retardant systems,** J. W. Hastie and C. L. McBee, 45 pages (Aug. 1975). Order from NTIS as COM 75-11136.

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14723. Runyan, C. C., Moulder, J. C., Clark, A. F., **Time-resolved spectra of bulk titanium combustion,** *Combust. Flame Brief Communication* **23,** No. 1, 129-133 (Aug. 1974).

14794. Krasny, J. F., **Fabric flammability: Needs for research,** *Home Econ. Res. J.* **2,** No. 3, 160-166 (Mar. 1974).

15069. Harrison, G. A., **The high-rise fire problem,** *CRC Critical Rev. Environ. Control* **4,** No. 4, 483-505 (Oct. 1974).

15103. Birky, M. M., Yeh, K. N., **Calorimetric study of flammable fabrics. I. Instrumentation and measurements,** *J. Appl. Polym. Sci.* **17,** 239-253 (1973).

15183. Cohen, J., Edelman, S., **Polymeric pyroelectric sensors for fire protection,** *Tech. Rep. AFAPL-TR-74-16,* 27 pages (Available from the National Technical Information Service, Springfield, Va. 22161, 1975).

15218. Bright, R. G., **Recent advances in residential smoke detection,** *Fire J.* **68,** No. 6, 69-77 (Nov. 1974).

15227. Kashiwagi, T., **A radiative ignition model of a solid fuel,** *Combust. Sci. Technol.* **8,** 225-236 (1974).

15230. Fung, F. C. W., Suchomel, M. R., Oglesby, P. L., **The NBS program on corridor fires,** *Fire J.* **67,** No. 3, 41-48 (May 1973).

15267. Lee, T. G., Huggett, C., **Interlaboratory evaluation of ASTM E 84-70 tunnel test applied to floor coverings,** *J. Test. Eval.* **3,** No. 1, 3-14 (1975).

15269. Kashiwagi, T., **Experimental observation of flame spread characteristics over selected carpets,** *J. Fire Flammability/Consumer Product Flammability* **1,** 367-389 (Dec. 1974).

15292. McCarter, R. J., **A new technique for thermal analysis of vapor-producing reactions,** *J. Appl. Polym. Sci.* **17,** No. 6, 1833-1846 (1973).

15345. Clark, A. F., Moulder, J. C., Runyan, C. C., **Combustion of bulk titanium in oxygen,** (Proc. 15th Int. Symp. on Combustion, Tokyo, Japan, Aug. 25-31, 1974), Paper in *Fifteenth Symposium (International) on Combustion,* pp. 489-499 (The Combustion Institute, Pittsburgh, Pa., 1974).

15410. Quintiere, J., **Some observations on building corridor fires,** *Proc. Fifteenth Symp. (International) on Combustion, Tokyo, Japan, Aug. 25-31, 1974,* pp. 163-174 (The Combustion Institute, Pittsburgh, Pa., 1974).

15440. Kashiwagi, T., **A study of flame spread over a porous material under external radiation fluxes,** *Proc. Fifteenth Symp. (International) on Combustion, Tokyo, Japan, Aug. 25-31, 1974,* pp. 255-265 (The Combustion Institute, Pittsburgh, Pa., 1974).

15470. Krasny, J. F., Winger, J. H., **Current status of flammability test development at the National Bureau of Standards,** *Proc. 8th Annual Meeting Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1974,* 5 pages (1974).

15484. Vickers, A., Krasny, J., Tovey, H., **Some apparel fire hazard parameters,** *Proc. Seventh Annual Meeting of the Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1973,* pp. 205-226 (1975).

15615. Lee, T. G., Parker, W. J., Tryon, M., **Laboratory fire performance characteristics of a dibromotetrafluoroethane-blown rigid polyurethane foam,** *J. Fire Flammability* **6,** 499-510 (Oct. 1975).

15617. Quintiere, J., **The application and interpretation of a test method to determine the hazard of floor covering fire spread in building corridors,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 355-367 (1975).

15628. Birky, M. M., **Review of smoke and toxic gas hazards in fire environment,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 231-252 (1975).

15630. McCaffrey, B. J., Quintiere, J. G., **Fire-induced corridor flow in a scale model study,** *Proc. International Council on Building Research and Documentation (CIB) Symp. on the Control of Smoke Movement in Building Fires, Garston, Watford, England, Nov. 4-5, 1975,* **1,** 34-47 (1975).

15632. Buchbinder, B., **Pilot implementation of the Fire Incident System,** *Fire J.* **69,** No. 3, 65-69 (May 1975).

15635. Buchbinder, B., Buchbinder, L. B., **The fire hazard analysis process at the National Bureau of Standards,** *Proc. Int. Symp. on Fire Safety of Combustible Materials, Edinburgh, Scotland, Oct. 15-17, 1975,* **1,** 156-161 (1975).

15656. Buchbinder, B., Mathers, W., **Preliminary indications from survey of U.S. household fire experience,** *Proc. 8th Annual Meeting Information Council on Fabric Flammability, New York, N.Y., Dec. 5, 1974,* pp. 174-178 (1975).

Fluids: Liquids, Gases and Plasmas

SP421. **A guide to methods and standards for the measurement of water flow,** G. Kulin and P. R. Compton, Nat. Bur. Stand. (U.S.), Spec. Publ. 421, 97 pages (May 1975) SD Catalog No. C13.10:421.

NBSIR 74-620. **An in-line density and viscosity sensor,** L. O. Olsen and F. W. Ruegg, 20 pages (Nov. 1974). Order from NTIS as PB246622.

NBSIR 75-772. **The dynamic response of helicoid anemometers,** J. M. McMichael and P. S. Klebanoff, 54 pages (Nov. 1975). Order from NTIS as PB246861.

14757. Haynes, W. M., **Measurements of the viscosity of compressed gaseous and liquid fluorine,** *Physica* **76,** No. 1, 1-20 (Aug. 1974).

14795. Ruegg, F. W., **Expansion factors for two variable area flow meters,** *J. Eng. Ind. Trans. ASME Papers No. 73-WA/FM-2,* **96,** No. 4, 1347-1353 (Nov. 1974).

14879. Hord, J., **Discussion of "experimental studies on thermodynamic effects of developed cavitation" by Robert S. Ruggeri,** Article in *Fluid Mechanics, Acoustics and Design of Turbomachinery, Part I,* pp. 394-395 (1974).

15047. Arp, V., **Thermodynamics of single-phase one-dimensional fluid flow,** *Cryogenics* **15,** No. 5, 285-289 (May 1975).

15080. Baker, D. W., Sayre, C. L., Jr., **Decay of swirling turbulent flow of incompressible fluids in long pipes,** (Proc. 1st Symp. on Flow, Pittsburgh, Pa., May 10-14, 1971), Chapter in *Flow, Its Measurement and Control in Science and Industry. Part I. Flow Characteristics,* H. W. Stoll, Ed., **1,** 301-312 (Instrument Society of America, Pittsburgh, Pa., 1974).

15116. Frenkiel, F. N., Klebanoff, P. S., **On the lognormality of the small-scale structure of turbulence,** *Boundary-Layer Meteorol.* **8,** No. 2, 173-200 (Mar. 1975).

15141. Hanley, H. J. M., Haynes, W. M., **The density expansion of the viscosity coefficient,** *J. Chem. Phys.* **63,** No. 1, 358-361 (July 1, 1975).

15157. Kelly, G. E., Sengers, J. V., **Droplet growth in a dilute vapor,** *J. Chem. Phys.* **61,** No. 7, 2800-2807 (Oct. 1, 1974).

15168. Hanley, H. J. M., Watts, R. O., **Molecular dynamics stu-**

dies of an *m*-6-8 fluid, *Physica* **79A**, No. 4, 351-376 (Feb. 1975).

15293. Mulholland, G. W., Zollweg, J. A., Sengers, J. M. H. L., **Liquid-vapor asymmetries in pure fluids,** *J. Chem. Phys.* **62,** No. 7, 2535-2549 (Apr. 1, 1975).

15382. McCarty, R. D., **Hydrogen technological survey-thermophysical properties,** *NASA Spec. Publ.* **3089,** 530 pages (National Aeronautics and Space Administration, Washington, D.C., 1975).

15405. Compton, P. R., **National Measurement System study,** *Natl. Conf. Stand. Lab. (NCSL) Newsletter* **13,** No. 3, 10-14 (Nov. 1973).

15461. Marvin, R. S., Hogenboom, D. L., **Viscosity of liquids,** Paper 2m in the *American Institute of Physics Handbook Third Edition*, pp. 2-187 – 2-202 (McGraw-Hill Book Co., New York, N.Y., 1972).

15519. Kidnay, A. J., Miller, R. C., Parrish, W. R., Hiza, M. J., **Liquid-vapour phase equilibria in the N_2-CH_4 system from 130 to 180 K,** *Cryogenics* **15,** No. 6, 531-540 (Sept. 1975).

15636. Parrish, W. R., Steward, W. G., **Vapor-liquid equilibria data for helium-carbon monoxide and helium-nitrous oxide systems,** *J. Chem. Eng. Data* **20,** No. 4, 412-416 (Oct. 1975).

General Theoretical Chemistry and Physics

15169. Spencer, L. V., **Some comments on Fano's theorem,** *Radiat. Res.* **63,** 191-199 (1975).

15176. Raveché, H. J., Mountain, R. D., Streett, W. B., **Reply to the comment on "Monte Carlo studies of the fluid-solid phase transition in the Lennard-Jones system,"** *J. Chem. Phys.* **62,** No. 11, 4582-4583 (June 1, 1975).

15178. Raveché, H. J., Stuart, C. A., **Towards a molecular theory of freezing,** *J. Chem. Phys.* **63,** No. 3, 1099-1111 (Aug. 1, 1975).

15216. Casella, R. C., **Algorithm for computing the number of independent real parameters in the phonon dynamical matrix,** *Phys. Rev. B* **11,** No. 12, 4795-4800 (June 15, 1975).

15354. Beers, Y., **A simplified discussion of energy storage associated with an electrostatic field,** *Am. J. Phys.* **43,** No. 8, 739-740 (Aug. 1975).

15489. Rybicki, G. B., Hummer, D. G., **A note on the "peaking effect" in spherical-geometry transfer problems,** *Mon. Not. Roy. Astr. Soc.* **170,** 423-427 (1975).

Instrumentation and Experimental Methods

SP413. **Special technical facilities at the National Bureau of Standards,** H. L. Mason and I. M. Lloyd, Nat. Bur. Stand. (U.S.), Spec. Publ. 413, 56 pages (Jan. 1975) SD Catalog No. C13.10:413.

TN855. **An experimental technique for the evaluation of thermal transient effects on piezoelectric accelerometers,** C. F. Vezzetti and P. S. Lederer, Nat. Bur. Stand. (U.S.), Tech. Note 855, 48 pages (Jan. 1975) SD Catalog No. C13.46:855.

TN856. **Note on a vibratory phenomenon arising in transducer calibration,** R. Kraft, Nat. Bur. Stand. (U.S.), Tech. Note 856, 13 pages (Feb. 1975) SD Catalog No. C13.46:856.

TN870. **Sampling techniques for electric power measurement,** R. S. Turgel, Nat. Bur. Stand. (U.S.), Tech. Note 870, 35 pages (June 1975) SD Catalog No. C13.46:870.

TN873. **Electro-optical deflection measuring device,** R. A. Crist, R. D. Marshall, and H. I. Laursen, Nat. Bur. Stand. (U.S.), Tech. Note 873, 24 pages (Dec. 1975) SD Catalog No. C13.46:873.

NBSIR 73-343. **Calibration of impulse noise generators,** G. R. Reeve, 77 pages (Oct. 1973). Order from NTIS as COM 75-10282.

NBSIR 74-355. **Carbon thin film thermometry,** R. S. Collier, L. L. Sparks, and T. R. Strobridge, 65 pages (Oct. 1973). Order from NTIS as N74-30195.

NBSIR 74-372. **Cryogenic refrigerators for shipboard forward looking infrared applications,** R. O. Voth, 75 pages (June 1974). Order from NTIS as AD-A006037.

NBSIR 74-553. **Preparation and calibration of phosphor standards,** M. L. Greenough and H. K. Hammond, III, 70 pages (Oct. 1974). Order from NTIS as COM 75-10058.

NBSIR 74-580. **Spectral characteristics of additional Bar Code Readers. II,** J. Cohen, 12 pages (Sept. 1974). Order from NTIS as

NBSIR 74-597. **Piezoelectric accelerometer low-frequency response by signal insertion methods,** R. S. Koyanagi and J. D. Pollard, 33 pages (May 1975). Order from NTIS as COM 75-11069.

NBSIR 75-654. **NBS interagency transducer project—A project report,** P. S. Lederer and J. S. Hilten, 15 pages (Feb. 20, 1975). Order from NTIS as COM 75-10367.

NBSIR 75-708. **Development of a dynamic pressure calibration technique—A progress report,** C. F. Vezzetti, J. S. Hilten, and P. S. Lederer, 20 pages (June 5, 1975). Order from NTIS as COM 75-10817.

NBSIR 75-732. **NBS InterAgency transducer project—A project report,** P. S. Lederer, J. S. Hilten, and C. F. Vezzetti, 23 pages (June 27, 1975). Order from NTIS as COM 75-11022.

NBSIR 75-740. **Piezoelectric polymer transducer for impact pressure measurement,** A. S. DeReggi, 39 pages (July 1975). Order from NTIS as COM 75-11127.

NBSIR 75-760. **Proceedings of piezoelectric and pyroelectric symposium-workshop,** M. G. Broadhurst, 222 pages (Sept. 1975). Order from NTIS as COM 75-11436.

NBSIR 75-793. **Microsecond-resolution pulse calorimetry for semiconducting materials at high temperatures (a feasibility study),** A. Cezairliyan and C. W. Beckett, 51 pages (Oct. 1975). Order from NTIS as PB247538.

14721. Blevin, W. R., Geist, J., **Infrared reflectometry with a cavity-shaped pyroelectric detector,** *Appl. Opt.* **13,** No. 10, 2212-2217 (Oct. 1974).

14727. Wexler, A., **Humidity measurement system—A micro study,** *Nat. Conf. Stand. Lab. Newsletter* **14,** No. 2, 38-41 (Oct. 1974).

14730. Greer, S. C., Moldover, M. R., Hocken, R., **A differential transformer as a position detector in a magnetic densimeter,** *Rev. Sci. Instrum. Notes* **45,** No. 11, 1462-1463 (Nov. 1974).

14733. Lawton, R. A., Nahman, N. S., **Pyroelectric detector application to baseband pulse measurements,** *Electron. Lett.* **8,** No. 12, 318-320 (June 15, 1972).

14735. Schneider, S. J., McDaniel, C., **Problems in accurate temperature measurement: The melting point of Y_2O_3,** *Can. Met. Quart.* **13,** No. 2, 365-368 (1974).

14741. Lawton, R. A., **Autocorrelation and power measurement with pyroelectric and dielectric bolometers,** *IEEE Trans. Instrum. Meas.* **IM-22,** No. 4, 299-306 (Dec. 1973).

14742. Lawless, W. N., Radebaugh, R., Siegwarth, J. D., **Improvements on "low-temperature dielectric bolometer,"** *J. Opt. Soc. Amer.* **64,** No. 6, 820-822 (June 1974).

14760. Phelan, R. J., Jr., Peterson, R. L., Hamilton, C. A., Day, G. W., **The polarization of PVF and PVF_2 pyroelectrics,** *Ferroelectrics* **7,** 375-377 (1974).

14804. Goebel, D. G., Poole, E. W., Hartsock, R. G., **Instrument for measuring phototube spectral response,** *Appl. Opt.* **8,** No. 8, 1749-1750 (Aug. 1969).

14819. Zapf, T. L., **Calibration of quartz transducers as ultrasonic power standards by an electrical method,** *Proc. 1974 Ultrasonics Symp., Milwaukee, Wisconsin, Nov. 11-14, 1974, IEEE Cat. No. 74 CHO 896-ISU,* pp. 45-50 (IEEE, Inc., New York, N.Y., 1974).

14824. Flynn, J. H., **Theory of differential scanning calorimetry—coupling of electronic and thermal steps,** Paper in *Analytical Calorimetry,* R. S. Porter and J. F. Johnson, Eds., **3,** 17-44 (Plenum Publ. Corp., New York, N.Y., 1974).

14838. Adair, R. T., Simmonds, M. B., Kamper, R. A., Hoer, C. A., **RF attenuation measurements using quantum interference in superconductors,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 375-381 (Dec. 1974).

14840. Mielenz, K. D., **Aberrations of ellipsoidal reflectors for unit magnification,** *Appl. Opt.* **13,** No. 12, 2931-2933 (Dec. 1974).

14843. Lamaze, G. P., Whittaker, J. K., Schrack, R. A., Wasson, O. A., **After-pulse suppression for 8850 and 8854 photomultipliers,** *Nucl. Instrum. Methods Letters to Editor* **123,** 403-404 (1975).

14877. Souders, T. M., **An audio-frequency four-terminal resistance bridge,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 342-345 (Dec. 1974).

14878. Turgel, R. S., **Digital wattmeter using a sampling method,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 337-341 (Dec. 1974).

14885. Zobrist, D. W., Fassbender, P., Bearden, F. E., Costrell, L., **Software standards and CAMAC,** *Instrum. Technol.* **22,** No. 3, 33-38 (Mar. 1975).

14903. Ederer, D. L., Dhez, P., **Some applications of GM counters in the vacuum ultraviolet spectral region,** *Rev. Sci. Instrum.* **46,** No. 2, 144-146 (Feb. 1975).

14926. McNesby, J. R., Hughes, E. E., **Calibration gas standards,** *Proc. Int. Instrumentation-Automation Conf. and Exhibit, New York, N.Y., Oct. 28-31, 1974, Paper 74-633, 1-5 (Instrument Society of America, Pittsburgh, Pa., 1974).*

14971. Kamper, R. A., **Review of superconducting electronics,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 141-146 (Mar. 1975).

14980. Heydemann, P., **Pulse shaper,** *Rev. Sci. Instrum. Notes* **46,** No. 3, 329-330 (Mar. 1975).

15030. Yakowitz, H., **Future growth of SEM—toward super efficient microscopy,** *Proc. 8th Annual Scanning Electron Microscope Symposium, St. Louis, Mo., Apr. 7-11, 1975,* Part 1, 1-10 (IIT Research Institute, Chicago, Ill., Apr. 1975).

15034. Jennings, D. A., **Simple, adjustable lens holder,** *Rev. Sci. Instrum.* **46,** No. 4, 487-488 (Apr. 1975).

15037. Yakowitz, H., Newbury, D. E., **Magnetic domain structures in Fe-3.2Si revealed by scanning electron microscopy—A photo essay,** *J. Test. Eval.* **3,** No. 1, 75-78 (Jan. 1975).

15038. Yakowitz, H., Newbury, D. E., Myklebust, R. L., **Approaches to particulate analysis in the SEM with the aid of a Monte Carlo program,** (Proc. 8th Annual Scanning Electron Microscope Symp., St. Louis, Mo., Apr. 7-11, 1975), Paper in *Scanning Electron Microscopy/1975,* Part 1, 93-102 (ITT Research Institute, Chicago, Ill., Apr. 1975).

15040. Angel, W. T., Bean, V. E., **Tracking, pulsed ultrasonic interferometer,** *Rev. Sci. Instrum.* **46,** No. 5, 533-535 (May 1975).

15041. Costrell, L., **Standardized instrumentation system for computer automated measurement and control,** *IEEE Trans. Ind. Appl.* **IA-11,** No. 3, 319-323 (May-June 1975).

15059. Hebner, R. E., Jr., Booker, S. R., **A portable Kerr system for the measurement of high voltage pulses,** *Proc. 1975 IEEE Southeastcon, Charlotte, N.C., Apr. 6-9, 1975,* **1,** 3A-1-1/3A-5-1 (Institute of Electrical and Electronics Engineers, Inc., New York, N.Y., 1975).

15074. Hurst, W. S., **Note on the measurement of the response of oceanographic temperature sensors,** *J. Geophys. Res.* **80,** No. 18, 2663-2666 (June 20, 1975).

15087. Baker, D. W., Koenig, A. L., **An automated prototype test system for aircraft engine fuel controls, design and operating experience,** *Proc. 13th Annual Tech. Symp., Washington, D.C., Chapter ACM, June 20, 1974,* pp. B.4.1-B.4.11 (Association for Computing Machinery, New York, N.Y., 1974).

15102. Churney, K. L., West, E. D., Armstrong, G. T., **A cell model for isoperibol calorimeters,** *Proc. 1st Natl. Conf. on Calorimetry, Zakopane, Poland, Sept. 8-18, 1973,* pp. 1-43 (Polish Academy of Science, Institute of Chemical Physics, Warszawa, Poland, 1973).

15126. Mielenz, K. D., Eckerle, K. L., **Averaging spheres without target,** *Appl. Opt.* **14,** No. 7, 1649-1651 (July 1975).

15128. Melmed, A. J., Stein, R. J., **Field-ion microscopy of silicon,** *Surface Sci. (Letters to Editor)* **49,** No. 2, 645-648 (Apr. 1975).

15224. Piermarini, G. J., Block, S., **Ultrahigh pressure diamond-anvil cell and several semiconductor phase transition pressures in relation to the fixed point pressure scale,** *Rev. Sci. Instrum.* **46,** No. 8, 973-979 (Aug. 1975).

15226. Saloman, E. B., **Time response of NBS windowless XUV radiometric transfer standard detectors,** *Appl. Opt.* **14,** No. 8, 1764 (Aug. 1975).

15228. Hasegawa, S., Stokesberry, D. P., **Automatic digital microwave hygrometer,** *Rev. Sci. Instrum.* **46,** No. 7, 867-873 (July 1975).

15242. Davis, G. T., Eby, R. K., **Low-temperature x-ray attachment,** *Rev. Sci. Instrum.* **46,** No. 9, 1285-1286 (Sept. 1975).

15245. Newbury, D. E., Yakowitz, H., **Specimen preparation,** special techniques, and applications of the scanning electron microscope, Chapter VI in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 211-262 (Plenum Press, New York, N.Y., 1975).

15246. Yakowitz, H., **Methods of quantitative x-ray analysis used in electron probe microanalysis and scanning electron microscopy**, Chapter IX in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 327-372 (Plenum Press, New York, N.Y., 1975).

15247. Yakowitz, H., Goldstein, J. I., **Practical aspects of x-ray microanalysis**, Chapter XI in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 401-434 (Plenum Press, New York, N.Y., 1975).

15248. Yakowitz, H., **Computational schemes for quantitative x-ray analysis: On-line analysis with small computers**, Chapter X in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 373-400 (Plenum Press, New York, N.Y., 1975).

15249. Goldstein, J. I., Yakowitz, H., Newbury, D. E., **Introduction to practical scanning electron microscopy**, Chapter I in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 1-19 (Plenum Press, New York, N.Y., 1975).

15250. Newbury, D. E., **Image formation in the scanning electron microscope**, Chapter IV in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 95-148 (Plenum Press, New York, N.Y., 1975).

15251. Newbury, D. E., Yakowitz, H., **Contrast mechanisms of special interest in materials science**, Chapter V in *Practical Scanning Electron Microscopy*, J. I. Goldstein and H. Yakowitz, Eds., pp. 149-210 (Plenum Press, New York, N.Y., 1975).

15302. Simpson, J. A., **Modernizing gage block calibrations: A case study in measurement assurance**, *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974*, pp. 153-157 (Instrument Society of America, Pittsburgh, Pa., 1975).

15304. Andrews, J. R., Lawton, R. A., **Picosecond pulse research at NBS**, *Proc. 1974 Joint Measurement Conference, Gaithersburg, Md., Nov. 12-14, 1974*, 123-140 (Instrument Society of America, Pittsburgh, Pa., 1975).

15309. McCrackin, F. L., Chang, S. S., **Simple calibration procedures for platinum resistance thermometers from 2.5 to 14 K**, *Rev. Sci. Instrum.* **46**, No. 5, 550-553 (May 1975).

15425. Newbury, D. E., **Techniques of signal processing in the scanning electron microscope**, *Proc. 8th Symp. on Scanning Electron Microscopy, St. Louis, Mo., Apr. 7, 1975*, pp. 727-736 (IIT Research Institute, Chicago, Ill., Apr. 1975).

15511. Whittaker, J. K., **A signal processing system for a semiconductor detector ladder**, *Proc. IEEE Thirteenth Scintillation and Semiconductor Counter Symp., Washington, D.C., Mar. 1-3, 1972*, pp. 444-452 (June 1972).

15548. Newbury, D. E., **The origin, detection, and uses of electron channelling contrast**, *Proc. 7th Scanning Electron Microscopy Symp., Chicago, Ill., Apr. 8-11, 1974*, pp. 1047-1054 (IIT Research Institute, Chicago, Ill., 1974).

15549. Berger, H., **An evaluation of radiographic paper for thermal-neutron radiography**, *Proc. American Nuclear Society Meeting, New Orleans, La., June 8, 1975*, pp. 148-149 (1975).

15567. Koyanagi, R. S., **Development of a low-frequency-vibration calibration system**, *Exp. Mech.* **15**, 443-448 (Nov. 1975).

15618. Hocken, R., Moldover, M. R., Muth, E., Gerner, S., **Versatile cells for optical studies in fluids**, *Rev. Sci. Instrum.* **46**, No. 12, 1699-1700 (Dec. 1975).

15619. Miller, A., Hussmann, E. K., McLaughlin, W. L., **Interferometer for measuring fast changes of refractive index and temperature in transparent liquids**, *Rev. Sci. Instrum.* **46**, No. 12, 1635-1638 (Dec. 1975).

15623. Cezairliyan, A., McClure, J. L., **A subsecond pulse heating technique for the study of solid-solid phase transformations at high temperatures: Application to iron**, *High Temp. Sci.* **7**, 189-196 (1975).

15644. Lawton, R. A., Andrews, J. R., **Pulsed-laser application to sampling oscilloscope**, *Electron. Lett.* **11**, No. 7, 138 (Apr. 3, 1975).

15645. Hamilton, C. A., Phelan, R. J., Jr., Day, G. W., **Pyroelectric radiometers**, *Opt. Spectra* **9**, No. 10, 37-38 (Oct. 1975).

15647. Andrews, J. R., Gans, W. L., **Pulsed wavemeter timing reference for sampling oscilloscope calibration**, *IEEE Trans. Instrum. Meas. Short Papers*, **IM-24**, No. 1, 82 (Mar. 1975).

15702. Utton, D. B., **The response of phase-sensitive detectors to Lorentzian and Gaussian lineshapes**, *J. Appl. Phys.* **46**, No. 12, 5268-5271 (Dec. 1975).

Lasers and Their Applications

TN665. **A pyroelectric power meter for the measurement of low level laser radiation**, C. A. Hamilton and G. W. Day, Nat. Bur. Stand. (U.S.), Tech. Note 665, 41 pages (Feb. 1975) SD Catalog No. C13.46:665.

14737. Smith, R. L., Case, W. E., Rasmussen, A. L., Russell, T. W., West, E. D., **A calorimeter for high power CW lasers**, (Proc. Conf. on Precision Electromagnetic Measurements, Boulder, Colo., June 26-29, 1972), Paper in *CPEM Digest, pp. 138-139 (1972)*.

14770. Eyler, J. R., **Intracavity dye laser technique for the study of laser-induced ionic processes**, *Rev. Sci. Instrum.* **45**, No. 9, 1154-1156 (Sept. 1974).

14849. Phelps, A. V., **Applications of gaseous electronics to laser technology**, Chapter 3 in *Gaseous Electronics, Some Applications*, J. W. McGowan and P. K. John, Eds., pp. 25-46 (North-Holland Publishing Co., Amsterdam, The Netherlands, 1974).

14857. Holt, H. K., **Laser intracavity absorption**, *Phys. Rev. A* **11**, No. 2, 625-629 (Feb. 1975).

14859. Lamotte, M., Dewey, H. J., Keller, R. A., Ritter, J. J., **Laser induced photochemical enrichment of chlorine isotopes**, *Chem. Phys. Lett.* **30**, No. 2, 165-170 (Jan. 15, 1975).

14861. West, E. D., Case, W. E., **Current status of NBS low-power laser energy measurement**, (Proc. 1974 Conf. on Precision Electromagnetic Measurements, London, England, July 1-5, 1974), *IEEE Trans. on Instrumentation and Measurements*, **IM-23**, No. 4, 422-425 (Institute of Electrical and Electronics Engineers, New York, N.Y., Dec. 1974).

14951. Bordé, C., Hall, J. L., **Ultrahigh resolution saturated absorption spectroscopy**, (Proc. Conf. on Laser Spectroscopy, Vail, Colo., June, 1973), Paper in *Laser Spectroscopy*, pp. 125-142 (Plenum Press, New York, N.Y., 1974).

14965. Franzen, D. L., **Precision beam splitters for CO_2 lasers,** *Appl. Opt.* **14,** No. 3, 647-652 (Mar. 1975).

14969. Kurylo, M. J., Braun, W., Xuan, C. N., Kaldor, A., **Infrared laser enhanced reactions: Temperature resolution of the chemical dynamics of the O_3+NO reaction system,** *J. Chem. Phys.* **62,** No. 6, 2065-2071 (Mar. 15, 1975).

15033. West, E. D., Schmidt, L. B., **Spectral-absorptance measurements for laser calorimetry,** *J. Opt. Soc. Amer.* **65,** No. 5, 573-578 (May 1975).

15067. Hougen, J. T., Radford, H. E., Evenson, K. M., Howard, C. J., **Analysis of the laser magnetic resonance spectrum of HO_2,** *J. Mol. Spectrosc.* **56,** 210-228 (1975).

15160. Barger, R. L., West, J. B., English, T. C., **Fast frequency stabilization of a cw dye laser,** *Appl. Phys. Lett.* **27,** No. 1, 31-33 (July 1, 1975).

15196. Jennings, D. A., Evenson, K. M., Jimenez, J. J., **New CO_2 pumped CW far-infrared laser lines,** *IEEE J. Quantum Electron.* **QE-11,** No. 8, 637 (Aug. 1975).

15221. Braun, W., Kurylo, M. J., Kaldor, A., **Infrared laser enhanced reactions: $V\rightarrow V$ and $V\rightarrow T$ energy transfer in the O_3-SiF_4-O_2 system,** *Chem. Phys. Lett.* **28,** No. 3, 440-444 (Oct. 1, 1974).

15270. Freund, S. M., Ritter, J. J., **CO_2 TEA laser-induced photochemical enrichment of boron isotopes,** *Chem. Phys. Lett.* **32,** No. 2, 255-260 (Apr. 15, 1975).

15534. Petersen, F. R., Evenson, K. M., Jennings, D. A., Wells, J. S., Goto, K., Jiménez, J. J., **Far infrared frequency synthesis with stabilized CO_2 lasers: Accurate measurements of the water vapor and methyl alcohol laser frequencies,** *IEEE J. Quantum Electron.* **QE-11,** No. 10, 838-843 (Oct. 1975).

15594. Crawford, E. A., Phelps, A. V., **Formative time lags in CO_2 laser discharges,** *Appl. Phys. Lett.* **25,** No. 1, 59-61 (July 1, 1974).

15680. Evenson, K. M., Howard, C. J., **Laser magnetic resonance spectroscopy,** *Laser Spectrosc.*, pp. 535-540 (1975).

15685. Drullinger, R. E., Hessel, M. M., Smith, E. W., **New laser measurement techniques for excited electronic states of diatomic molecules,** *Proc. Megeve Laser Spectroscopy Conf., Megeve, France, June 23-27, 1975, Lecture Notes in Physics,* 91-99 (1975).

15688. Evenson, K. M., Petersen, F. R., **Stabilized lasers and applications,** *Proc. Physics of Quantum Electronics Summer School, Crystal Mountain, Wash., July 8-20, 1973,* pp. 367-436 (1975).

Low Temperature Science and Engineering

NBSIR 74-393. **Semi-annual report on materials research in support of superconducting machinery,** R. P. Reed, R. L. Durcholz, F. R. Fickett, P. J. Giarratano, J. G. Hust, M. B. Kasen, H. M. Ledbetter, R. P. Mikesell, E. R. Naimon, R. E. Schramm, L. L. Sparks, R. L. Tobler, and W. F. Weston, 283 pages (Oct. 1974). Order from NTIS as COM 75-10768.

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NBSIR 75-807. **Turbulent natural convection of liquid deuterium, hydrogen, and nitrogen within enclosed vessels,** D. E. Daney, 82 pages (Feb. 1975). Order from NTIS as COM 75-10396.

NBSIR 75-810. **Semi-annual report on materials research in support of superconducting machinery,** R. P. Reed, J. G. Hust, M. B. Kasen, H. M. Ledbetter, R. P. Mikesell, R. E. Schramm, L. L. Sparks, R. L. Tobler, and W. F. Weston, 201 pages (Apr. 1975). Order from NTIS as COM 75-10919.

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NBSIR 75-820. **Study of cryogenic propellant systems for loading the space shuttle—Part II, Hydrogen systems,** W. G. Steward, 63 pages (Oct. 1975). Order from NTIS as PB246658.

14774. Mann, D. B., Dean, J. W., Brennan, J. A., Kneebone, C. H., **Cryogenic flow measurement—positive displacement volumetric flowmeters,** (Proc. 1st Symp. on Flow, Its Measurement and Control in Science and Industry, Pittsburgh, Pa., May 9-14, 1971), Paper in *Flow, Its Measurement and Control in Science and Industry,* Part 2, pp. 381-386 (Instrument Society of America, Pittsburgh, Pa., 1974).

14783. Arp, V., **New forms of state equations for helium,** *Cryogenics* **14,** No. 11, 593-598 (Nov. 1974).

14869. Sindt, C. F., **Heat transfer to slush hydrogen,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper K-3 in *Advances in Cryogenic Engineering* **19,** 427-436 (Plenum Press, New York, N.Y., 1974).

14930. Giarratano, P. J., Hess, R. C., Jones, M. C., **Forced convection heat transfer to subcritical helium I,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper K-1 in *Advances in Cryogenic Engineering* **19,** 404-416 (Plenum Press, New York, N.Y., 1974).

14962. Giarratano, P. J., Jones, M. C., **Deterioration of heat transfer to supercritical helium at 2.5 atmospheres,** *Int. J. Heat Mass Transfer* **18,** No. 5-E, 649-653 (1975).

15021. Hust, J. G., **Low-temperature thermal conductivity of two fibre-epoxy composites,** *Cryogenics* **15,** No. 3, 126-128 (Mar. 1975).

15031. Hust, J. G., **Low temperature thermal conductivity measurements on longitudinal and transverse sections of a superconducting coil,** *Cryogenics* **15,** No. 1, 8-11 (Jan. 1975).

15043. Brennan, J. A., Stokes, R. W., Kneebone, C. H., Mann, D. B., **NBS-CGA cryogenic flow measurement program,** (Proc. ISA International Instrumentation-Automation Conf. and Exhibit, New York, N.Y., Oct. 28-31, 1974), Paper in *Advances in Instrumentation* **29,** 612-1/612-13 (Instrument Society of America, Pittsburgh, Pa., 1974).

15046. Lawless, W. N., **Dielectric and thermal properties of a** machinable glass-ceramic at low temperatures, *Cryogenics* **15**, No. 5, 273-277 (May 1975).

15127. Hudson, R. P., Marshak, H., Soulen, R. J., Jr., Utton, D. B., **Review Paper: Recent advances in thermometry below 300 mK**, *J. Low Temp. Phys.* **20**, Nos. 1/2, 1-102 (July 1975).

15170. Kasen, M. B., **Mechanical and thermal properties of filamentary-reinforced structural composites at cryogenic temperatures. 1: Glass-reinforced composites**, *Cryogenics* **15**, No. 6, 327-349 (June 1975).

15173. Hanley, H. J. M., Watts, R. O., **The self-diffusion coefficient of liquid methane**, *Mol. Phys.* **29**, No. 6, 1907-1917 (June 1975).

15177. Reinker, R. P., Timmerhaus, K. D., Kropschot, R. H., **Thermal conductivity and diffusivity of selected porous insulations between 4 and 300 K**, Chapter I-4 in *Advances in Cryogenic Engineering* **20**, 343-354 (Plenum Press, New York, N.Y., 1975).

15182. Arp, V. D., Clark, A. F., Flynn, T. M., **Superconducting levitation of high speed vehicles**, *Transp. Eng. J.* **99**, No. TE4, 873-885 (Nov. 1973).

15184. Hanley, H. J. M., McCarty, R. D., Haynes, W. M., **Equations for the viscosity and thermal conductivity coefficients of methane**, *Cryogenics* **15**, No. 7, 413-417 (July 1975).

15188. Robinson, R. L., Jr., Hiza, M. J., **Solid-vapor equilibrium—A survey**, Chapter F-2 in *Advances in Cryogenic Engineering* **20**, 218-239 (Plenum Press, New York, N.Y., 1975).

15192. Cox, J. E., Bostock, J., Waterstrat, R. M., **Superconducting properties of A15 phase V-Ir alloys**, (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT 13*, K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3**, 480-484 (Plenum Publishing Corp., New York, N.Y., 1974).

15219. Radebaugh, R., Siegwarth, J. D., Holste, J. C., **Heat transfer between sub-micron silver powder and dilute He^3He^4 solutions**, (Proc. 5th Int. Cryogenic Engineering Conf., Kyoto, Japan, May 7, 1974), Paper H6 in *5th International Cryogenic Engineering Conference*, K. Mendelssohn, Ed., pp. 242-245 (IPC Science and Technology Press, Surrey, England, 1974).

15238. Radebaugh, R., Siegwarth, J. D., Oda, Y , Nagano, H., **Experiments with miniature heat exchangers for dilution refrigerators**, (Proc. 5th Int. Cryogenic Engineering Conf., Kyoto, Japan, May 7, 1974), Paper H3 in *5th International Cryogenic Engineering Conference, K. Mendelssohn, Ed., pp. 235-237 (IPC Science and Technology Press, Surrey, England, 1974).*

15491. Radebaugh, R., Lawless, W. N., Siegwarth, J. D., **Semiannual technical report on electrocaloric refrigeration for superconductors**, *ARPA Order 2535*, 17 pages (Available as AD-A008-852 from the National Technical Information Service, Springfield, Va., 1974).

15522. Weston, W. F., Naimon, E. R., Ledbetter, H. M., **Low temperature elastic properties of aluminum 5083-0 and four ferritic nickel steels**, (Proc. American Society for Testing and Materials Symp. on Properties of Materials for Liquefied Natural Gas Tankage, Boston, Mass., May 21-22, 1974), *Am. Soc. Test. Mater. Spec. Tech. Publ.* **579**, pp. 397-420 (1975).

15530. Tobler, R. L., Mikesell, R. P., Durcholz, R. L., Reed, R. P., **Low temperature fracture behavior of iron-nickel alloy steels**, (Proc. American Society for Testing and Materials Symp. on Properties of Materials for Liquefied Natural Gas Tankage, Boston, Mass., May 21-22, 1974), *Am. Soc. Test. Mater. Spec. Tech. Publ.* **579**, pp. 261-287 (1975).

15533. Weston, W. F., Ledbetter, H. M., **Low-temperature elastic properties of a nickel-chromium-iron-molybdenum alloy**, *Mater. Sci. Eng. Short Commun.* **20**, 287-290 (1975).

15537. Radebaugh, R., Holste, J. C., Siegwarth, J. D., **Thermometric characteristics of some 1/8 W carbon resistors in the millikelvin range**, *Proc. Fifth Int. Cryogenic Engineering Conference, Kyoto, Japan, May 7-10, 1974*, Paper H11, pp. 253-255 (IPC Science & Technical Press, Kent, England, 1974).

15639. Straty, G. C., **Hypersonic velocities in saturated and compressed fluid methane**, *Cryogenics* **15**, No. 12, 729-731 (Dec. 1975).

15671. Hiza, M. J., Kidnay, A. J., Miller, R. C., **Equilibrium properties of fluid mixtures, a bibliography of data on fluids of cryogenic interest**, Volume in *NSRDS Bibliographic Series*, 160 pages (IFI/Plenum Data Co., New York, N.Y., 1975).

Mathematical and Statistical Methods

Ideal elements for perturbed Keplerian motions, A. Deprit, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 1-15 (Jan.-June 1975).

Generalized or adjoint reciprocity relations for electroacoustic transducers, A. D. Yaghjian, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 17-39 (Jan.-June 1975).

The diophantine equation $p^2x^4 + 3px^2y^2 + y^4 = z^2$, p an odd prime, T. N. Sinha, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 41-44 (Jan.-June 1975).

A condition for the diagonalizability of a partitioned matrix, C. R. Johnson and M. Newman, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 45-48 (Jan.-June 1975).

Linearly independent sets of isotropic Cartesian tensors of ranks up to eight, E. A. Kearsley and J. T. Fong, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 49-58 (Jan.-June 1975).

Maximal network flows, matroids and matchings, E. Minieka, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 59-62 (Jan.-June 1975).

A note on the metrizability of spaces with countably based closed sets, R. R. Sabella, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 63-69 (Jan.-June 1975).

Charge profiles in parallel-plate ionization chambers, G. F. L. Ferreira, L. Nunes de Oliveira, and B. Gross, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 1 and 2, 65-78 (Jan.-June 1975).

Two submatrix properties of certain induced norms, C. R. Johnson, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 3 and 4, 97-102 (July-Dec. 1975).

Properties of neighboring sequences in stratifiable spaces, R. R. Sabella, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 3 and 4, 103-105 (July-Dec. 1975).

Maximin facility location, P. J. Slater, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 3 and 4, 107-115 (July-Dec. 1975).

Similarity of partitioned matrices, R. B. Feinberg, *J. Res. Nat.*

Bur. Stand. (U.S.), **79B** (Math. Sci.) Nos. 3 and 4, 117-125 (July-Dec. 1975).

On the dimension group of classical physics, C. H. Page, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 3 and 4, 127-135 (July-Dec. 1975).

Complete elliptic integrals resulting from infinite integrals of Bessel functions. II., S. Okui, *J. Res. Nat. Bur. Stand. (U.S.)*, **79B** (Math. Sci.), Nos. 3 and 4, 137-170 (July-Dec. 1975).

NBSIR 75-637. **Note on simplified estimators for type I extreme-value distribution,** J. Lieblein, 14 pages (Dec. 1974). Order from NTIS as COM 75-10055.

NBSIR 75-737. **Mathematical methods of site selection for electronic message systems (EMS),** C. Witzgall, 44 pages (June 1975). Order from NTIS as COM 75-11472.

14782. Johnson, C. R., **Sufficient conditions for D-stability,** *J. Econ. Theory* **9**, No. 1, 53-62 (Sept. 1974).

14852. Ku, H. H., Kullback, S., **Loglinear models in contingency table analysis,** *Amer. Statist.* **28**, No. 4, 115-122 (Nov. 1974).

14856. Filliben, J. J., **The probability plot correlation coefficient test for normality,** *Technometrics* **17**, No. 1, 111-117 (Feb. 1975).

14891. DePrima, C. R., Johnson, C. R., **The range of $A^{-1}A^*$ in $GL(n, C)$,** *Linear Algebra and Its Applications* **9**, 209-222 (1974).

14946. Olver, F. W. J., **Second-order linear differential equations with two turning points,** *Phil. Trans. Roy. Soc. London* **278**, No. 1279, 137-174 (Mar. 20, 1975).

14947. Olver, F. W. J., **Legendre functions with both parameters large,** *Phil. Trans. Roy. Soc. London* **278**, No. 1279, 175-185 (Mar. 20, 1975).

14972. Newman, M., **Congruence subgroups of the modular group,** *Math. Comput.* **29**, No. 129, 207-213 (Jan. 1975).

14998. Hughes, C. E., **The general decision problem for Markov algorithms with axiom,** *Notre Dame J. Formal Logic* **XVI**, No. 2, 208-216 (Apr. 1975).

15006. Newman, M., **Formulas and multiplicative relationships for the parameters of subgroups of the modular group,** *Math. Ann.* **212**, 173-182 (1974).

15172. Johnson, C. R., **Powers of matrices with positive definite real part,** *Proc. Am. Math. Soc.* **50**, 85-91 (July 1975).

15175. Kraft, R., **Finite difference techniques for diffusion and redistribution problems with segregation-type boundary conditions,** (Proc. AICA Int. Symp. on Computer Methods for Partial Differential Equations, Bethlehem, Pa., June 17-19, 1975), Paper in *Advances in Computer Methods for Partial Differential Equations,* R. Vichnevetsky, Ed., pp. 328-333 (AICA Dept. of Computer Science, New Brunswick, N.J., 1975).

15180. Haber, S., **Adaptive integration and improper integrals,** *Math. Comput.* **29**, No. 131, 806-809 (July 1975).

15252. Johnson, C. R., ***D*-stability and real and complex quadratic forms,** *Linear Algebra and Appl.* **9**, 89-94 (1974).

15272. Johnson, C. R., **The Hadamard product of A and A^*,** *Pacific J. Math.* **51**, No. 2, 477-481 (1974).

15307. Newman, M., Pierce, S., **Bounded matrix groups,** *Linear and Multilinear Algebra* **1**, No. 3, 251-256 (1973).

15308. Marcus, M., Newman, M., **Some results on unitary matrix groups,** *Linear Algebra and Appl.* **3**, 173-178 (1970).

15314. Marcus, M., Merris, R., **A relation between the permanental and determinantal adjoints,** *J. Aust. Math. Soc.* **15**, Part 3, 270-271 (May 1973).

15338. Merris, R., Pierce, S., **Elementary divisors of higher degree associated tranformations,** *Linear and Multilinear Algebra* **1**, No. 3, 241-250 (1973).

15341. Johnson, C. R., **Inequalities for a complex matrix whose real part is positive definite,** *Trans. Amer. Math. Soc.* **212**, 149-154 (1975).

15356. Klein, W., **Behavior of distribution functions in the thermodynamic limit,** *J. Math. Phys.* **15**, No. 8, 1181-1185 (Aug. 1974).

15366. Sheingorn, M., **Poincaré series of polynomials bounded away from zero on a fundamental region,** *Amer. J. Math.* **XCV**, No. 4, 729-749 (Winter, 1973).

15414. Olver, F. W. J., **Recent error analysis of asymptotic solutions of linear differential equations,** *Proc. Int. Conf. on Differential Equations, Los Angeles, Calif., Sept. 4-7, 1974*, pp. 636-645 (Academic Press, Inc., New York, N.Y., 1975).

15563. Newman, M., Sheingorn, M., **Continuous solutions of a homogeneous functional equation,** *Aequationes Math.* **13**, No. 1/2, 47-59 (1975).

15616. Hughes, C. E., Singletary, W. E., **Triadic partial implicational propositional calculi,** *Zeitschr. f. math. Logik und Grundlagen d. Math.* **21**, 21-28 (1975).

15640. Cotton, I. W., **Remark on stably updating mean and standard deviation of data,** *Commun. ACM* **18**, No. 8, 458 (Aug. 1975).

Measurement Science and Technology: Policy and State-of-the-Art Surveys

SP418. **National Bureau of Standards, Annual Report,** F. P. McGehan, M. King, and R. S. Franzen, Eds., Nat. Bur. Stand. (U.S.), SP418, 32 pages (Apr. 1975) SD Catalog No. C13.10:418.

SP437. **National Bureau of Standards Annual Report FY 1975,** P. A. Powell and S. A. Washburn, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 437, 32 pages (Dec. 1975) SD Catalog No. C13.10:437.

TN890. **Productivity measurement in R&D: Productivity measurement experiment (PROMEX) in selected research and development programs at the National Bureau of Standards,** J. T. Hall and R. A. Dixon, Nat. Bur. Stand. (U.S.), Tech. Note 890, 52 pages (Dec. 1975) SD Catalog No. C13.46:890.

15051. Roberts, R. W., Hoffman, J. D., **Reducing energy consumption in R&D labs—The NBS experience,** *Res. Manage.* **XVIII**, No. 1, 26-33 (Mar. 1975).

15171. Roberts, R. W., **The national/international measurement system,** *ASTM Stand. News* **2**, No. 11, 8-13 (Nov. 1974).

15198. Davis, R. M., **Technology as a deterrent to dehumanization,** *Science* **185**, 737 (Aug. 30, 1974).

15199. Davis, R., **Impermanent balance between man and computer,** *Science* **186**, 99 (Oct. 11, 1974).

15678. Roberts, R. W., **The other face of the measurement base,** *Anal. Chem.* **47**, No. 7, 648A-656A (June 1975).

Measurement Science and Technology: Physical Standards and Fundamental Constants

Absolute determination of electrochemical equivalent and the atomic weight of zinc I. Method, apparatus, and preliminary experiments, G. Marinenko and R. T. Foley, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 737-745 (Nov.-Dec. 1975).

Absolute determination of the electrochemical equivalent and the atomic weight of zinc. II. Final determination, G. Marinenko and R. T. Foley, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 747-759 (Nov.-Dec. 1975).

Absolute isotopic abundance ratios and the atomic weight of a reference sample of potassium, E. L. Garner, T. J. Murphy, J. W. Gramlich, P. J. Paulsen, and I. L. Barnes, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 713-725 (Nov.-Dec. 1975).

Absolute isotopic abundance ratios and the atomic weight of a reference sample of silicon, I. L. Barnes, L. J. Moore, L. A. Machlan, T. J. Murphy, and W. R. Shields, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 727-735 (Nov.-Dec. 1975).

SP420. **International Bureau of Weights and Measures 1875-1975,** C. H. Page and P. Vigoureux, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 420, 257 pages (May 1975) SD Catalog No. C13.10:420.

TN659. **An earth-based coordinate clock network,** N. Ashby, Nat. Bur. Stand. (U.S.), Tech. Note 659, 35 pages (Apr. 1975) SD Catalog No. C13.46:659.

14765. Jarvis, S., Jr., **Determination of velocity distributions in molecular beam frequency standards from measured resonance curves,** *Metrologia* **10**, No. 3, 87-98 (1974).

14927. Cutkosky, R. D., **New NBS measurements of the absolute farad and ohm,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 305-309 (Dec. 1974).

14929. Olsen, P. T., Williams, E. R., **A more accurate determination of γ_p' through improved dimensional measurement techniques,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 302-305 (Dec. 1974).

15014. Jennings, D. A., Petersen, F. R., Evenson, K. M., **Extension of absolute frequency measurements to 148 THz: Frequencies of the 2.0- and 3.5-μm Xe laser,** *Appl. Phys. Lett.* **26**, No. 9, 510-511 (May 1, 1975).

15294. Deslattes, R. D., Henins, A., Bowman, H. A., Schoonover, R. M., Carroll, C. L., Barnes, I. L., Machlan, L. A., Moore, L. J., Shields, W. R., **Determination of the Avogadro constant,** *Phys. Rev. Lett.* **33,** No. 8, 463-466 (Aug. 19, 1974).

15672. Allan, D. W., Hellwig, H., Glaze, D. J., **An accuracy algorithm for an atomic time scale,** *Metrologia* **11**, No. 3, 133-138 (1975).

15674. Hellwig, H., Wainwright, A. E., **Submicrosecond time transport with a rubidium portable clock,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975*, pp. 384-386 (1975).

15677. Evenson, K. M., **Frequency measurements in the optical region and the speed of light,** (Proc. ICO Conf. Optical Methods in Science and Industrial Measurements, Tokyo, Japan, Aug. 26-30, 1974), *Japan J. Appl. Phys.* **14**, Suppl. 14-1, 1-10 (1975).

15681. Evenson, K. M., Petersen, F. R., Wells, J. S., **Speed of light from direct laser frequency and wavelength measurements: Emergence of a laser standard of length,** *Laser Spectrosc.*, pp. 143-146 (1975).

15683. Glaze, D. J., Hellwig, H., Allan, D. W., Jarvis, S., Jr., Wainwright, A. E., **Accuracy evaluation and stability of the NBS primary frequency standards,** *IEEE Trans. Instrum. Meas.* **IM-23,** 489-501 (Dec. 1974).

15684. Allan, D. W., Daams, H., **Picosecond time difference measurement system,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975*, pp. 404-411 (1975).

15689. Howe, D. A., Salazar, H. F., **A digital 5.00688 MHz synthesizer and squarewave FM servo system for cesium standards,** *Proc. 29th Annual Symp. on Frequency Control, Atlantic City, N.J., May 28-30, 1975*, pp. 387-393 (1975).

15697. Cataland, G., Plumb, H. H., **Fixed points: Superconductive transition temperatures of lead and indium,** *Metrologia* **11**, 161-163 (1975).

Metrology: Physical Measurements

Polarization effects on fluorescence measurements, E. D. Cehelnik, K. D. Mielenz, and R. A. Velapoldi, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 1-15 (Jan.-Feb. 1975).

Precision measurements of the dimensional stability of four mirror materials, B. Justice, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 4, 545-550 (July-Aug. 1975).

Barothermal theory of two devices for measuring absorption coefficients, H. S. Bennett, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 5, 639-648 (Sept.-Oct. 1975).

The use of synchrotron radiation as an absolute source of vuv radiation, D. L. Ederer, E. B. Saloman, S. C. Ebner, and R. P. Madden, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 761-774 (Nov.-Dec. 1975).

Monogr. 125, Suppl. 1. **Thermocouple reference tables based on the IPTS-68: Reference tables in degrees Fahrenheit for thermoelements versus platinum (Pt-67),** R. L. Powell and G. W. Burns, Nat. Bur. Stand. (U.S.), Monogr. 125, Suppl. 1, 46 pages (Jan. 1975) SD Catalog No. C13.44:125/Suppl. 1.

Monogr. 149. **Measurement assurance program—A case study: Length measurements. Part 1. Long gage blocks (5 in to 20 in),** P. E. Pontius, Nat. Bur. Stand. (U.S.), Monogr. 149, 75 pages (Nov. 1975) SD Catalog No. C13.44:149.

Monogr. 152. **A gage block measurement process using single wavelength interferometry,** J. S. Beers, Nat. Bur. Stand. (U.S.), Monogr. 152, 34 pages (Dec. 1975) SD Catalog No. C13.44:152.

TN594-10. **Optical radiation measurements: The NBS 20-, 60-, and 85-degree specular gloss scales,** J. J. Hsia, Nat. Bur. Stand. (U.S.), Tech. Note 594-10, 32 pages (July 1975) SD Catalog No. C13.46:594-10.

TN662. **A review of precision oscillators,** H. Hellwig, Nat. Bur. Stand. (U.S.), Tech. Note 662, 24 pages (Feb. 1975) SD Catalog No. C13.46:662.

TN668. **The use of National Bureau of Standards high frequency**

broadcasts for time and frequency calibrations, N. Hironaka and C. Trembath, Nat. Bur. Stand. (U.S.), Tech. Note 668, 47 pages (May 1975) SD Catalog No. C13.46:668.

TN669. **The measurement of frequency and frequency stability of precision oscillators,** D. W. Allan, Nat. Bur. Stand. (U.S.), Tech. Note 669, 31 pages (May 1975) SD Catalog No. C13.46:669.

TN865. **Critical electrical measurement needs and standards for modern electronic instrumentation,** P. Richman, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 865, 74 pages (May 1975) SD Catalog No. C13.46:865.

TN869. **Temperature section activity summary, 1974,** J. F. Schooley, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 869, 28 pages (June 1975) SD Catalog No. C13.46:869.

NBSIR 74-461. **The calibration of small volumetric laboratory glassware,** J. Lembeck, 34 pages (Dec. 1974). Order from NTIS as PB246623.

NBSIR 74-523. **Preparations for gage block comparison measurements,** C. D. Tucker, 14 pages (July 9, 1974). Order from NTIS as COM 75-11126.

NBSIR 74-586. **Calibration of platinum resistance thermometers using an intercomparison scheme,** R. M. Schoonover and H. H. Ku, 19 pages (Dec. 1974). Order from NTIS as COM 75-10525.

NBSIR 75-682. **Basic considerations of densitometer adjustment and calibration,** R. E. Swing, 18 pages (Feb. 3, 1975). Order from NTIS as COM 75-10524.

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NBSIR 75-774. **Calibration of Kerr systems used to measure high voltage pulses,** R. E. Hebner, Jr., 51 pages (Aug. 7, 1975). Order from NTIS as COM 75-11364.

14797. Hall, K. R., Waxman, M., **Geometrically transformed weights for least squares analyses,** *Cryogenics* **14,** No. 11, 612-614 (Nov. 1974).

14802. Mielenz, K. D., **Spherically corrected reflecting objective for unit magnification,** *Appl. Opt.* **13,** No. 11, 2580-2584 (Nov. 1974).

14817. Kuyatt, C. E., DiChio, D., Natali, S. V., **Third-order asymptotic aberration coefficients of electron lenses. III. Formulas and results for the two-tube electrostatic lens,** *Rev. Sci. Instrum.* **45,** No. 10, 1275-1280 (Oct. 1974).

14825. Andrews, J. R., **Precision picosecond-pulse measurements using a high-quality superconducting delay line,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 468-472 (Dec. 1974).

14827. Gray, J. E., Allan, D. W., **A method for estimating the frequency stability of an individual oscillator,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 243-246 (Electronic Industries Association, Washington, D.C., 1974).

14828. Wainwright, A. E., Walls, F. L., McCaa, W. D., **Direct measurements of the inherent frequency stability of quartz crystal resonators,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 177-180 (Electronic Industries Association, Washington, D.C., 1974).

14829. Howe, D. A., Bell, H. E., Hellwig, H., DeMarchi, A., **Preliminary research and development of the cesium tube accuracy evaluation system,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 362-372 (Electronic Industries Association, Washington, D.C., 1974).

14830. Hellwig, H., **Atomic frequency standards: A survey,** *Proc. 28th Annual Symp. on Frequency Control, Fort Monmouth, N.J., May 29-31, 1974,* pp. 315-339 (Electronic Industries Association, Washington, D.C., 1974).

14836. Hanson, D. W., Hamilton, W. F., **Satellite broadcasting of WWV signals,** *IEEE Trans. Aerosp. Electron. Syst.* **AES-10,** No. 5, 562-573 (Sept. 1974).

14842. Geist, J., Steiner, B., **Report of the workshop on accurate radiometry for solar conversion,** Paper in *Report and Recommendations of the Solar Energy Data Workshop,* pp. 204-208 (Sept. 1974).

14846. Hellwig, H., Bell, H. E., Bergquist, J. C., Glaze, D. J., Howe, D. A., Jarvis, S., Jr., Wainwright, A. E., Walls, F. L., **Results in operation, research, and development of atomic clocks at the National Bureau of Standards,** (Proc. IX Int. Congress of Chronometry, Stuttgart, Germany, Sept. 16-20, 1974), Paper in *Proc. IX International Congress of Chronometry,* G. Glaser, Ed., A, A5-1 – A5-13 (Herausgegeben von der Deutschen Gesellschaft fur Chronometrie E. V., Stuttgart, Germany, 1974).

14881. Lentner, K. J., **A current comparator system to establish the unit of electrical energy at 60 Hz,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 334-336 (Dec. 1974).

14919. Finnegan, T. F., Wilson, J., Toots, J., **Interactions in small systems of coupled Josephson junctions on microwave frequencies,** *Rev. Phys. Appl.* **9,** No. 1, 199-205 (Jan. 1974).

14921. Guildner, L. A., Terrien, J., **Mercury absolute manometers,** Chapter 4 in *Experimental Thermodynamics, Vol. II, Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 1, pp. 115-131 (Butterworth and Co., London, England, 1975).

14924. Shields, J. Q., **Measurement of four-pair admittances with two-pair bridges,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 345-352 (Dec. 1974).

14925. Cutkosky, R. D., Field, B. F., **Standard cell enclosure with 20-μK stability,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 295-298 (Dec. 1974).

14928. Williams, E. R., Olsen, P. T., Field, B. F., **Standard cell calibration via current transfer,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 299-302 (Dec. 1974).

14935. Eicke, W. G., Jr., Auxier, L. M., **Regional maintenance of the volt using NBS volt transfer techniques,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 290-294 (Dec. 1974).

14937. Sullivan, D. B., Dziuba, R. F., **A low-temperature direct-current comparator bridge,** *IEEE Trans. Instrum Meas.* **IM-23,** No. 4, 256-260 (Dec. 1974).

14941. Finnegan, T. F., Wilson, J., Toots, J., **Coupling between Josephson junctions and microstriplines,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 821-824 (Mar. 1975).

14974. DiChio, D., Natali, S. V., Kuyatt, C. E., **A new form for the third-order asymptotic aberration coefficients of electrostatic lenses; application to the two-tube electrostatic lens,** *Rev. Sci. Instrum.* **46,** No. 1, 71-76 (Jan. 1975).

14987. Saloman, E. B., Ederer, D. L., **Absolute radiometric calibration of detectors between 200-600 Å**, *Appl. Opt.* **14**, No. 4, 1029-1034 (Apr. 1975).

14997. Saloman, E. B., Ederer, D. L., Madden, R. P., **Radiometry in the EUV spectral region: Standard source and detectors**, (Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974), Chapter 10.12 in *Proceedings of the IV International Conference on VUV Radiation Physics*, E. Koch, R. Haensel, and C. Kunz, Eds., pp. 798-800 (Friedr. Vieweg Sohn Verlagsgesellschaft, mbH, Braunschweig, West Germany, 1974).

15025. Mohan, K., Schaefer, A. R., Zalewski, E. F., **Measurement of geometrically total spectral radiant power**, *Appl. Opt.* **14**, No. 4, 1035-1038 (Apr. 1975).

15026. Madden, R. P., Ederer, D. L., **SURF-II, a new synchrotron ultraviolet radiation facility at the NBS**, (Extended Abstract), *Proc. IV Int. Conf. on VUV Radiation Physics, Hamburg, Germany, July 17-26, 1974*, No. 10.3, 774-776 (1974).

15052. Schooley, J. F., Soulen, R. J., Jr., **Superconductive fixed points for cryogenic thermometry**, *Instrum. Technol.* **21**, No. 11, 35-39 (Nov. 1974).

15060. Schooley, J. F., **National measurement system temperature—A micro study**, *Nat. Conf. Stand. Lab.—Newsletter* **15**, No. 1, 26-33 (Apr. 1975).

15062. Schooley, J. F., Soulen, R. J., Jr., **Superconductive fixed points for thermometry in cryogenics**, *Instrument Society of America International Instrumentation-Automation Conference and Exhibit, New York, N.Y., Oct. 28-31, 1974*, Paper 74-620, pp. 1-5 (1974).

15085. Piermarini, G. J., Block, S., Barnett, J. D., Forman, R. A., **Calibration of the pressure dependence of the R_1 ruby fluorescence line to 195 kbar**, *J. Appl. Phys.* **46**, No. 6, 2774-2780 (June 1975).

15098. Saylor, C. P., **Microscopical determination of refractive index with an error of about ±0.00001**, *Anal. Chem.* **47**, No. 7, 1114-1120 (June 1975).

15107. Saloman, E. B., **Unfolding first and second order diffracted radiation when using synchrotron radiation sources: a technique**, *Appl. Opt.* **14**, No. 6, 1391-1394 (June 1975).

15119. Beers, J. S., Tucker, C. D., **Procedures for gage block flatness and parallelism measurement**, *J. Appl. Meas.* **2**, No. 4, 82-84 (1974).

15138. Geist, J., Steiner, B., Schaefer, R., Zalewski, E., Corrons, A., **Electrically based spectral power measurements through use of a tunable cw laser**, *Appl Phys. Lett.* **26**, No. 6, 309-311 (Mar. 15, 1975).

15140. Davis, D. D., **Calibrating crystal oscillators with TV color-reference signals**, *Electronics* **48**, No. 6, 107-112 (Mar. 20, 1975).

15146. Cezairliyan, A., **Pulse calorimetry and transient measurement of thermal properties at high temperatures**, *Faraday Symp. Chem. Soc.*, No. 8, 7-17 (1973).

15166. Marshak, H., Soulen, R. J., Jr., **The temperature scale defined by ^{60}Co γ-ray anisotropy and noise thermometry**, Paper in *Low Temperature Physics-LT* **13**, K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **4**, 498-502 (Plenum Publishing Corp., New York, N.Y., 1974).

15179. Hudson, R. P., **Conference report: European conference on temperature measurement**, *Cryogenics* **15**, 486 (Aug. 1975).

15202. Snyder, J. J., **Paraxial ray analysis of a cat's-eye retroreflector**, *Appl. Opt.* **14**, No. 8, 1825-1828 (Aug. 1975).

15215. Bowman, H. A., Schoonover, R. M., Carroll, C. L., **The utilization of solid objects as reference standards in density measurements**, *Metrologia* **10**, 117-121 (1974).

15290. Nyyssonen, D., **Partial coherence in imaging systems**, *Opt. Eng.* **13**, No. 4, 362-367 (July-Aug. 1974).

15291. Ott, W. R., Behringer, K., Gieres, G., **Vacuum ultraviolet radiometry with hydrogen arcs. 2: The high power arc as an absolute standard of spectral radiance from 124 nm to 360 nm**, *Appl. Opt.* **14**, No. 9, 2121-2128 (Sept. 1975).

15326. Swing, R. E., **The sampling aperture for linear microdensitometry**, *Opt. Eng.* **13**, No. 5, 460-470 (Sept.-Oct. 1974).

15337. Furukawa, G. T., Bigge, W. R., Riddle, J. L., Reilly, M. L., **The freezing point of aluminium as a temperature standard**, *Inst. Phys. Conf. Ser. No.* **26**, Chapter 7, 389-397 (1975).

15353. Schooley, J. F., **Solid state phase transitions as thermometric fixed points**, *Inst. Phys. Conf. Ser. No.* **26**, Chapter 2, 49-56 (1975).

15362. Rosasco, G. J., Etz, E. S., Cassatt, W. A., **The analysis of discrete fine particles by Raman spectroscopy**, *Appl. Spectrosc.* **29**, No. 5, 396-404 (Sept.-Oct. 1975).

15368. Young, R. D., Teague, E. C., **The measurement and characterization of surface finish**, Chapter 2 in *Properties of Electrodeposits Their Measurement and Significance*, R. Sard, H. Leidheiser, and F. Ogburn, Eds., pp. 22-49 (Electrochemical Society, Princeton, N.J., 1975).

15377. McCamy, C. S., Derr, A. J., **Microdensitometry**, Article 15.6 in *SPSE Handbook of Photographic Science and Engineering*, W. Thomas, Jr., Ed., pp. 871-877 (John Wiley & Sons, New York, N.Y., 1973).

15394. Swyt, D. A., **National Measurement System: Microstudy of optics**, *Nat. Conf. Stand. Lab. (NCSL) Newsletter* **15**, No. 2, 13-17 (June 1975).

15395. Young, R. D., **National Measurement System micro study**, *Natl. Conf. Stand. Lab. (NCSL) Newsletter* **13**, No. 2, 20-21 (Aug. 1973).

15396. Swing, R. E., **The case for the pupil function**, (Proc. SPIE Seminar on Image Assessment, Rochester, N.Y., May 20-22, 1974), Paper in *Image Assessment and Specification*, D. Dutton, Ed., **46**, 104-113 (Society of Photo-Optical Instrumentation Engineers, Palos Verdes Estates, Calif., 1974).

15412. Ott, W. R., Behringer, K., **Absolute vuv radiometry with hydrogen arcs—comparisons with blackbody calibrations**, *Proc. XIth Int. Conf. on Phenomena in Ionized Gases, Prague, Czechoslovakia, Sept. 10-14, 1973, Paper 4.5.2.7*, p. 412 (Czechoslovak Academy of Sciences, Prague, Czechoslovakia, 1973).

15423. Kuyatt, C. E., **Electron energy analyzer design**, *Proc. 31st Annual Meeting Electron Microscope Society of America, New Orleans, La., Aug. 13-17, 1973*, C. J. Arceneaux, Ed., pp. 280-281 (Claitor's Publ. Div., Baton Rouge, La., 1973).

15437. Bender, P. L., **Laser measurements of the lunar distance**, *Rev. Geophys. Space Phys.* **13**, No. 3, 271-272, 291 (July 1975).

15486. Grum, F., Cameron, J., **Detector intercomparison results,** *Electro-Opt. Systems Design,* pp. 82-84 (Nov. 1974).

15517. Burns, G. W., Hurst, W. S., **Thermocouple thermometry,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement,* B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 144-161 (1975).

15518. Burley, N. A., Burns, G. W., Powell, R. L., **Nicrosil and Nisil: Their development and standardization,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement,* B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 162-171 (1975).

15526. Soulen, R. J., Jr., Marshak, H., **The establishment of an absolute temperature scale using noise and nuclear orientation thermometry,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics-LT 14,* **4,** 60-63 (Am. Elsevier Publ. Co., New York, N.Y., 1975).

15527. Utton, D. B., Soulen, R. J., Jr., Marshak, H., **Intercomparison of temperature scales using low transition-temperature superconductors,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics-LT 14,* **4,** 76-79 (Am. Elsevier Publ. Co., New York, N.Y., 1975).

15557. Cezairliyan, A., Coslovi, L., Righini, F., Rosso, A., **Radiance temperature of molybdenum at its melting point,** (Proc. Symp. European Conf. on Temperature Measurement, Teddington, England, Apr. 9-11, 1975), Chapter 4 in *Temperature Measurement,* B. F. Billing and T. J. Quinn, Eds., Inst. Phys. Conf. Ser. No. 26, pp. 287-296 (Institute of Physics, London, England, 1975).

15564. McCamy, C. S., **Specification of geometric and spectral conditions relating to densitometry,** Paper 15.2 in *SPSE Handbook of Photographic Science and Engineering,* W. Thomas, Jr., Ed., pp. 831-840 (John Wiley & Sons, New York, N.Y., 1973).

15568. Pontius, P. E., **Mass measurement: A study of anomalies,** *Science* **190,** 379-380 (Oct. 24, 1975).

15569. Payne, B. F., Koyanagi, R. S., Federman, C., Jones, E., **Accelerometer calibration at the National Bureau of Standards,** *21st Int. Instrumentation Symp. ASD/TMD, Philadelphia, Pa., May 19-21, 1975,* pp. 1-17 (1975).

15583. Hammond, H. K., Hsia, J. J., **Evaluation of instrument tolerances for 75° gloss,** *Tappi Notes to Editor* **58,** No. 11, 143-144 (Nov. 1975).

15596. Dziuba, R. F., Field, B. F., Finnegan, T. F., **Cryogenic voltage comparator system for 2e/h measurements,** *IEEE Trans. Instrum. Meas.* **IM-23,** No. 4, 264-267 (Dec. 1974).

15597. Dziuba, R. F., Sullivan, D. B., **Cryogenic direct current comparators and their applications,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 716-719 (Mar. 1975).

15599. Finnegan, T. F., Toots, J., Wilson, J., **Frequency-pulling and coherent-locking in thin-film Josephson oscillators,** (Proc. 14th Int. Conf. on Low Temperature Physics, Helsinki, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics* **LT-14,** N. Krusius and N. Vuorio, Eds., **4,** 184-187 (North Holland Publishing Co., Amsterdam, 1975).

15613. Teague, E. C., **Surface finish measurements: An overview,** *Soc. Manuf. Eng. Tech. Pap.* **IQ75-137,** 1-21 (1975).

15634. Hudson, R. P., Pfeiffer, E. R., **Magnetic susceptibility of single-crystal CMN, 0.002K to 2K,** (Proc. 14th Int. Conf. on Low Temperature Physics, Otaniemi, Finland, Aug. 14-20, 1975), Paper in *Low Temperature Physics* **LT-14,** M. Krusius and M. Vuorio, Eds., **3,** 242-245 (North Holland Publishing Co., Amsterdam, 1975).

15646. Zimmerman, J. E., **Phase slip, dissipation, Bernoulli effect, parametric capacitance, and other curious features of the Josephson effect,** *IEEE Trans. Magn.* **MAG-11,** No. 2, 852-855 (Mar. 1975).

Nuclear Physics and Radiation Technology

Monogr. 139. **Interactions of high energy particles with nuclei,** W. Czyż, Nat. Bur. Stand. (U.S.), Monogr. 139, 73 pages (Sept. 1975) SD Catalog No. C13.44:139.

Monogr. 147. **Relativistic many-body bound systems,** M. Danos and V. Gillet, Nat. Bur. Stand. (U.S.), Monogr. 147, 149 pages (Apr. 1975) SD Catalog No. C13.44:147.

SP425, Volumes I and II. **Nuclear cross sections and technology.** Proceedings of a Conference held in Washington, D.C., March 3-7, 1975, R. A. Schrack and C. D. Bowman, Eds., Nat. Bur. Stand. (U.S.), Spec. Publ. 425, Vol. I, 487 pages, Vol. II, 553 pages (Oct. 1975) SD Catalog No. C13.10:425.

The light water reactor industry-nuclear data needs, V. O. Uotinen, J. D. Robertson, and J. S. Tulenko, *SP425,* pp. 7-13 (Oct. 1975).

Radioactive-nuclide decay data in science and technology, C. W. Reich and R. G. Helmer, *SP425,* pp. 14-20 (Oct. 1975).

Radioactive decay heat analyses, R. E. Schenter and F. Schmittroth, *SP425,* pp. 21-28 (Oct. 1975).

Sensitivity of the afterheat from ^{235}U and ^{239}Pu thermal fission to errors in fission product nuclear data, C. Devillers, B. Nimal, C. Fiche, J. P. Noël, J. Blachot, and R. de Tourreil, *SP425,* pp. 29-38 (Oct. 1975).

Significance of nuclear data on the development of the LMFBR industry, N. C. Paik, *SP425,* pp. 39-44 (Oct. 1975).

Fast reactor safety, R. Avery, *SP425,* pp. 45-50 (Oct. 1975).

After PHENIX, what is the importance of nuclear data programs for the FBR development?, J. Y. Barré, J. Bouchard, and J. P. Chaudat, *SP425,* pp. 51-61 (Oct. 1975).

NE-213 neutron spectrometry system for measurements to 15 MeV, R. H. Johnson, B. W. Wehring, and J. J. Dorning, *SP425,* pp. 62-65 (Oct. 1975).

Absolute calibration of neutron detectors in the 10-30 MeV energy range, J. A. Cookson, M. Hussian, C. A. Uttley, J. L. Fowler, and R. B. Schwartz, *SP425,* pp. 66-68 (Oct. 1975).

A thick target measurement technique for determining nuclear reaction rates, N. A. Roughton, M. J. Fritts, R. J. Peterson, C. J. Hansen, and C. S. Zaidins, *SP425,* pp. 69-72 (Oct. 1975).

A black detector for 250 keV – 1000 keV neutrons, G. P. Lamaze, M. M. Meier, and O. A. Wasson, *SP425,* pp. 73-74 (Oct. 1975).

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Detector calibration with an associated particle apparatus, M. M. Meier, A. D. Carlson, and G. P. Lamaze, *SP425*, pp. 75-77 (Oct. 1975).

Use of gas proportional counters for neutron flux monitors at the NBS Linac, O. A. Wasson, *SP425*, pp. 78-80 (Oct. 1975).

Fission cross section measurements on short-lived alpha emitters, J. W. T. Dabbs, N. W. Hill, C. E. Bemis, and S. Raman, *SP425*, pp. 81-82 (Oct. 1975).

Systematic discrepancy in photoneutron cross sections for medium and heavy nuclei, T. Tomimasu and S. Sugiyama, *SP425*, pp. 83-88 (Oct. 1975).

The 2-keV filtered beam facility at the NBS reactor, I. G. Schroder, R. B. Schwartz, and E. D. McGarry, *SP425*, pp. 89-92 (Oct. 1975).

The Rensselaer Intense Neutron Spectrometer, R. C. Block, R. W. Hockenbury, D. S. Cramer, E. Bean, and R. E. Slovacek, *SP425*, pp. 93-96 (Oct. 1975).

A modular minicomputer multiparameter data gathering and virtual memory operating system for the NBS neutron standards program, R. A. Schrack, H. T. Heaton II, and D. Green, *SP425*, pp. 97-98 (Oct. 1975).

TUNL fast neutron cross section facility, D. W. Glasgow, F. O. Purser, J. C. Clement, G. Mack, K. Stelzer, J. R. Boyce, D. H. Epperson, H. H. Hogue, E. G. Bilpuch, H. W. Newson, and C. R. Gould, *SP425*, pp. 99-102 (Oct. 1975).

A facility for studying neutron-induced charged particle reactions, F. P. Brady, N. S. P. King, M. W. McNaughton, J. F. Harrison, and B. E. Bonner, *SP425*, pp. 103-105 (Oct. 1975).

After-pulse suppression for 8850 and 8854 photomultipliers, G. P. Lamaze, J. K. Whittaker, R. A. Schrack, and O. A. Wasson, *SP425*, pp. 106-107 (Oct. 1975).

A secondary standard neutron detector for measuring total reaction cross sections, K. K. Sekharan, H. Laumer, and F. Gabbard, *SP425*, pp. 108-111 (Oct. 1975).

Facilities for cross section measurements using Na-D photoneutron sources, J. C. Robertson, M. C. Davis, and J. C. Engdahl, *SP425*, pp. 112-115 (Oct. 1975).

A 25-keV neutron beam facility at NBS, E. D. McGarry and I. G. Schroder, *SP425*, pp. 116-118 (Oct. 1975).

New experimental techniques and results in neutron spectroscopy, C. D. Bowman, *SP425*, pp. 119-128 (Oct. 1975).

Measurement, analysis, and implications of the fission cross section of the important fissionable isotopes, M. S. Moore, *SP425*, pp. 129-138 (Oct. 1975).

Neutron capture cross section measurement techniques, R. E. Chrien, *SP425*, pp. 139-148 (Oct. 1975).

Nuclear models and data for gamma-ray production, P. G. Young, *SP425*, pp. 149-155 (Oct. 1975).

Techniques for the determination of neutron induced charged particle reactions, H. Liskien, *SP425*, pp. 156-160 (Oct. 1975).

Integral measurements to test shielding cross sections, L. Harris, Jr., J. C. Young, N. A. Lurie, D. K. Steinman, S. J, Friesenhahn, D. E. Bryan, W. E. Gober, and L. Schänzler, *SP425*, pp. 161-164 (Oct. 1975).

Evaluation, uncertainty estimation and adjustment of capture cross sections for fission product nuclei, H. Gruppelaar, J. B. Dragt, A. J. Janssen, and J. W. M. Dekker, *SP425*, pp. 165-168 (Oct. 1975).

Integral test of cross sections using neutron leakage spectra from spheres of iron, niobium, beryllium, and polyethylene, R. H. Johnson, J. J. Dorning, and B. W. Wehring, *SP425*, pp. 169-172 (Oct. 1975).

Uncertainties and correlations in evaluated data sets induced by use of standard cross sections, R. W. Peelle, *SP425*, pp. 173-176 (Oct. 1975).

Shielding benchmark experiments and sensitivity studies in progress at some European laboratories, G. Hehn, M. Mattes, W. Matthes, R. Nicks, and H. Rief, *SP425*, pp. 177-183 (Oct. 1975).

Assessment of neutron group constants for iron and stainless steel through measurements and analyses of energy and space distributions of neutrons in test assemblies, I. Kimura, K. Kobayashi, S. A. Hayashi, S. Yamamoto, H. Nishihara, M. Ando, S. Kanazawa, and M. Nakagawa, *SP425*, pp. 184-188 (Oct. 1975).

ENDF/B dosimetry cross section file benchmark neutron flux-spectral uncertainties, W. N. McElroy, *SP425*, pp. 189-192 (Oct. 1975).

Fission-product gamma-ray and photoneutron spectra, M. G. Stamatelatos and T. R. England, *SP425*, pp. 193-198 (Oct. 1975).

Safeguards against theft or diversion of nuclear materials, T. B. Taylor, *SP425*, pp. 199-201 (Oct. 1975).

Fission theory and actinide fission data, A. Michaudon, *SP425*, pp. 202-213 (Oct. 1975).

Nuclear data for actinide recycle, E. J. Hennelly, *SP425*, pp. 214-217 (Oct. 1975).

(n,f) cross sections for exotic actinides, J. B. Wilhelmy, H. C. Britt, A. Gavron, E. Konecny, and J. Weber, *SP425*, pp. 218-221 (Oct. 1975).

A study of the ^{233}U-^{232}Th reactor as a burner for actinide wastes, S. Raman, C. W. Nestor, Jr., and J. W. T. Dabbs, *SP425*, pp. 222-223 (Oct. 1975).

A consistent set of transplutonium multigroup cross sections, R. W. Benjamin, V. D. Vandervelde, T. C. Gorrell, and F. J. McCrosson, *SP425*, pp. 224-228 (Oct. 1975).

Measurement of the neutron capture cross sections of the actinides, L. W. Weston and J. H. Todd, *SP425*, pp. 229-231 (Oct. 1975).

Measurements of the ^{6}Li and ^{10}B partial cross sections from 1 to 1500 keV, S. J. Friesenhahn, V. J. Orphan, A. D. Carlson, M. P. Fricke, and W. M. Lopez, *SP425*, pp. 232-235 (Oct. 1975).

An absolute measurement of the ^{6}Li(n,α) cross section at 964 keV, W. P. Stephany and G. F. Knoll, *SP425*, pp. 236-239 (Oct. 1975).

Angular anisotropy in the ^{6}Li(n,α)^{3}H reaction at 25 keV, I. G. Schroder, E. D. McGarry, G. de Leeuw-Gierts, and S. de Leeuw, *SP245*, pp. 240-243 (Oct. 1975).

Neutron total cross section of ^{6}Li from 10 eV to 10 MeV, J. A. Harvey and N. W. Hill, *SP425*, pp. 244-245 (Oct. 1975).

Observation and analysis of elastic neutron scattering from ^{12}C, R. J. Holt, A. B. Smith, and J. F. Whalen, *SP425*, pp. 246-249 (Oct. 1975).

Fission spectrum neutrons for cross section validation and neutron flux transfer, J. A. Grundl and C. M. Eisenhauer, *SP425*, pp. 250-253 (Oct. 1975).

Fundamental integral cross section ratio measurements in the thermal-neutron-induced uranium-235 fission neutron spectrum, A. Fabry, J. A. Grundl, and C. Eisenhauer, *SP425*, pp. 254-257 (Oct. 1975).

Interlaboratory comparison of absolute fission rate and uranium-238 capture rate measurements in the Mol-ΣΣ secondary intermediate-energy standard neutron field, M. Pinter, W. Scholtyssek, P. Fehsenfeld, H. A. J. van der Kamp, W. H. J. Quaadvliet, A. Fabry, G. De Leeuw, S. De Leeuw, F. Cops, J. A. Grundl, D. Gilliam, and C. Eisenhauer, *SP425*, pp. 258-261 (Oct. 1975).

Manganese bath systematic effects in measurements of nu-bar and eta, J. R. Smith, *SP425*, pp. 262-265 (Oct. 1975).

Absolute ^{235}U fission cross section for ^{252}Cf spontaneous fission neutrons, H. T. Heaton II, J. A. Grundl, V. Spiegel, Jr., D. M. Gilliam, and C. Eisenhauer, *SP425*, pp. 266-269 (Oct. 1975).

Fission cross section ratios in the ^{252}Cf neutron spectrum (^{235}U: ^{238}U: ^{239}Pu: ^{237}Np), D. M. Gilliam, C. Eisenhauer, H. T. Heaton II, and J. A. Grundl, *SP425*, pp. 270-272 (Oct. 1975).

Measurement of cross sections for threshold reactions induced by californium-252 spontaneous fission neutrons, W. G. Alberts, J. Bortfeldt, E. Günther, K. Knauf, M. Matzke, G. Rassl, V. Siegel, and K. F. Walz, *SP425*, pp. 273-276 (Oct. 1975).

Absolute neutron flux determination in fast neutron spectra, I. Schouky, S. Cierjacks, P. Brotz, D. Gröschel, and B. Leugers, *SP425*, pp. 277-280 (Oct. 1975).

Thermal parameters of the fissile isotopes, B. R. Leonard, Jr., *SP425*, pp. 281-285 (Oct. 1975).

The third IAEA evaluation of the 2200 m/s and 20 °C Maxwellian neutron data for U-233, U-235, Pu-239, and Pu-241, H. D. Lemmel, *SP425*, pp. 286-292 (Oct. 1975).

Neutron cross section standards and flux determinations above thermal energies, A. D. Carlson, *SP425*, pp. 293-301 (Oct. 1975).

R-matrix analysis of the light element standards, G. M. Hale, *SP425*, pp. 302-308 (Oct. 1975).

Computer-readable "Nuclear Data Sheets," W. B. Ewbank, *SP425*, pp. 309-312 (Oct. 1975).

Recent evaluation for the German nuclear data library KEDAK-3, B. Goel, H. Küsters, and F. Weller, *SP425*, pp. 313-316 (Oct. 1975).

Description of the ENDF/B-IV silicon evaluation energy distributions of outgoing particles, D. Larson, *SP425*, pp. 317-319 (Oct. 1975).

Evaluation of fission product nuclear data for 28 important nuclides, S. Igarasi, S. Iijima, M. Kawai, T. Nakagawa, Y. Kikuchi, K. Maki, and H. Matsunobu, *SP425*, pp.320-323 (Oct. 1975).

Evaluated decay-scheme data for the ILRR program, R. G. Helmer and R. C. Greenwood, *SP425*, pp. 324-327 (Oct. 1975).

Development of a two-step Hauser-Feshbach code with precompound decays and gamma-ray cascades—a theoretical tool for cross section evaluations, C. Y. Fu, *SP425*, pp. 328-331 (Oct. 1975).

Neutron cross sections and their uncertainties obtained from nuclear systematics, S. Pearlstein, *SP425*, pp. 332-334 (Oct. 1975).

Level density calculation for deformed nuclei, J. P. Felvinci, D. Cacuci, and E. Melkonian, *SP425*, pp. 335-337 (Oct. 1975).

Odd-even fluctuations in neutron strength functions, G. J. Kirouac, *SP425*, pp. 338-341 (Oct. 1975).

Statistical estimation of physical quantities in thermal- and fast-neutron-induced fission, T. Yamamoto and K. Sugiyama, *SP425*, pp. 342-345 (Oct. 1975).

Theoretical estimates of (n,γ) cross sections for 6-15 MeV neutrons, G. Longo and F. Saporetti, *SP425*, pp. 346-349 (Oct. 1975).

Reaction mechanism in the high energy tail of the 14 MeV $^{56}Fe(n,n')$-process, H. Jahn, C. H. M. Broeders, and I. Broeders, *SP425*, pp. 350-353 (Oct. 1975).

Calculations of (n,α) rates for iron-group materials, F. M. Mann and Z. E. Switkowski, *SP425*, pp. 354-356 (Oct. 1975).

Parametric fit of the total cross section of ^{45}Sc, B. A. Magurno and S. F. Mughabghab, *SP425*, pp. 357-359 (Oct. 1975).

Neutron capture mechanism in light and closed shell nuclides, B. J. Allen, J. W. Boldeman, M. J. Kenny, A. R. deL. Musgrove, H. Pe, and R. L. Macklin, *SP425*, pp. 360-362 (Oct. 1975).

Radiation Shielding Information Center data activities, R. W. Roussin, B. F. Maskewitz, and D. K. Trubey, *SP425*, pp. 363-366 (Oct. 1975).

Evaluation of the resonance parameters and capture cross section for chromium up to 600 keV, D. Abramson, J. C. Bluet, and P. Fardeau, *SP425*, pp. 367-370 (Oct. 1975).

Representation of the neutron cross sections in the unresolved resonance region, G. de Saussure and R. B. Perez, *SP425*, pp. 371-379 (Oct. 1975).

Helium production in reactor materials, E. P. Lippincott, W. N. McElroy, and H. Farrar, *SP425*, pp. 375-377 (Oct. 1975).

Fast reactor fission yields for ^{233}U, ^{235}U, ^{238}U, ^{239}Pu, and recommendations for the determination of burnup on FBR mixed oxide fuels, W. J. Maeck, *SP425*, pp. 378-384 (Oct. 1975).

Effects of nuclear data uncertainties upon LMFBR fuel cycle characteristics, R. D. McKnight, L. G. LeSage, and J. M. Christenson, *SP425*, pp. 385-388 (Oct. 1975).

The sensitivity of k_{eff} of metallic assemblies to the parametric representation of the fission and the inelastic scattering spectra, H. Nissimov and J. J. Wagschal, *SP425*, pp. 389-391 (Oct. 1975).

Comparison of Doppler broadening methods, D. E. Cullen, C. R. Weisbin, R. Q. Wright, and J. E. White, *SP425*, pp. 392-397 (Oct. 1975).

Burnup calculations for the KWO reactor, D. C. Lutz, *SP425*, pp. 398-400 (Oct. 1975).

Fission product nuclear data obtained by use of on-line mass spectrometer, P. L. Reeder, J. F. Wright, and R. A. Anderl, *SP425*, pp. 401-404 (Oct. 1975).

Differential cross sections and integral data: The ENDF/B-4 library and "clean" criticals, J. J. Wagschal, A. Ya'ari, and Y. Yeivin, *SP425*, pp. 405-408 (Oct. 1975).

Neutron attenuation in normal and ilmenite concretes, R. J. Adams and K. H. Lokan, *SP425*, pp. 409-414 (Oct. 1975).

Analysis of the BNL ThO_2-^{233}U exponential experiments, D. Dabby, *SP425*, pp. 415-418 (Oct. 1975).

Tabular cross section file generation and utilization techniques, D. E. Cullen, O. Ozer, and C. R. Weisbin, *SP425*, pp. 419-421 (Oct. 1975).

Neutron energy spectrum controlled blanket for fast breeder reactor, L. H. Tang, *SP425*, pp. 422-425 (Oct. 1975).

Use of Monte Carlo method in the estimation of fast neutrons leaked through a concrete-paraffin shielding, L. S. Chuang and K. C. Wong, *SP425*, pp. 426-430 (Oct. 1975).

A comparison of air-over-ground transport calculations using different cross sections, J. C. Saccenti and W. A. Woolson, *SP425*, pp. 431-435 (Oct. 1975).

The sensitivity of neutron air transport to nitrogen cross section uncertainties, A. Niiler, W. B. Beverly, and N. E. Banks, *SP425*, pp. 436-439 (Oct. 1975).

Monte Carlo studies of the effect of cross section characteristics on fast neutron penetration in iron, L. P. Ku and H. Goldstein, *SP425*, pp. 440-443 (Oct. 1975).

Neutron-coupled gamma-ray cross-section requirements for gas-cooled fast breeder reactors, M. Nagel and R. J. Cerbone, *SP425*, pp. 444-446 (Oct. 1975).

Cross section preparation for the continuous-energy Monte Carlo code VIM, R. E. Prael, *SP425*, pp. 447-450 (Oct. 1975).

A comparison of VIM and MC^2-2—Two detailed solutions of the neutron slowing-down problem, R. E. Prael and H. Henryson II, *SP425*, pp. 451-454 (Oct. 1975).

Decay heat analysis for an LMFBR fuel assembly using ENDF/B-IV data, G. W. Morrison, C. R. Weisbin, and C. W. Kee, *SP425*, pp. 455-458 (Oct. 1975).

A two dimensional cross section sensitivity analysis of iron in a concrete shield, T. E. Albert and G. L. Simmons, *SP425*, pp. 459-463 (Oct. 1975).

GCFR benchmarks: Experiments and analysis, S. Seth, W. Heer, M. Jermann, C. McCombie, E. Ottewitte, R. Richmond, and P. Wydler, *SP425*, pp. 464-468 (Oct. 1975).

Biomedical application of shortlived positron emitting isotopes, P. Meyer, E. Behrin, R. Frank, R. Holub, and C. E. McJilton, *SP425*, pp. 469-471 (Oct. 1975).

Energy-dependent pion mean free path length for star formation, C. Werntz and C. W. Lucas, Jr., *SP425*, pp. 472-475 (Oct. 1975).

Spectrum and shielding measurements and calculations of neutrons produced by 800 MeV protons, L. R. Veeser, G. J. Russell, E. D. Arthur, P. A. Seeger, W. F. Sommer, D. M. Drake, R. G. Fluharty, and R. F. Bentley, *SP425*, pp. 476-479 (Oct. 1975).

Nuclear data for assessment of activation of scintillator materials during spaceflight, C. S. Dyer, J. I. Trombka, and S. M. Seltzer, *SP425*, pp. 480-483 (Oct. 1975).

Proton scattering for analysis of atmospheric particulate matter, K. R. Akselsson, J. W. Nelson, and J. W. Winchester, *SP425*, pp. 484-487 (Oct. 1975).

Use of elastic scattering cross section anomalies for depth profiling helium and hydrogen isotopes in solids, R. S. Blewer, *SP425*, pp. 488-491 (Oct. 1975).

Spallation cross sections and the LAMPF medical radioisotope program, B. R. Erdal, P. M. Grant, V. R. Casella, A. E. Ogard, and H. A. O'Brien, Jr., *SP425*, pp. 492-495 (Oct. 1975).

Feasibility of neutron-gamma techniques for field analysis of fresh concrete, M. C. Taylor, J. R. Rhodes, and D. L. Bernard, *SP425*, pp. 496-499 (Oct. 1975).

Cross section requirements for industrial gauging applications, B. Y. Cho and T. P. Sheahen, *SP425*, pp. 500-503 (Oct. 1975).

Li, Be and B production in proton-induced reactions: Implications for astrophysics and space radiation effects, C. T. Roche, R. G. Clark, G. J. Methews, and V. E. Viola, Jr., *SP425*, pp. 504-508 (Oct. 1975).

Long lived isotope production cross sections from proton bombardment of rhenium, A. J. Armini and S. N. Bunker, *SP425*, pp. 509-511 (Oct. 1975).

A need for (p,n) cross sections for selected targets at lower energies, H. S. Ahluwalia, *SP425*, pp. 512-515 (Oct. 1975).

The measurement of thermal neutron constants of the soil; application to the calibration of neutron moisture gauges and to the pedological study of soil, P. Couchat, C. Carre, J. Marcesse, and J. Le Ho, *SP425*, pp. 516-519 (Oct. 1975).

Medical uses of nuclear data, R. S. Tilbury, R. E. Bigler, L. Zeitz, and J. S. Laughlin, *SP425*, pp. 520-526 (Oct. 1975).

Medical use of fast neutrons in radiotherapy and radiography, D. K. Bewley, *SP425*, pp. 527-532 (Oct. 1975).

Biomedical radiation transport calculations as an application of nuclear data, R. G. Alsmiller, Jr., *SP425*, pp. 533-539 (Oct. 1975).

Geochemical mapping of the moon by orbital gamma-ray spectroscopy, R. C. Reedy, *SP425*, pp. 540-545 (Oct. 1975).

A measurement of the fission cross section of ^{235}U from 1 keV to 1 MeV, J. B. Czirr and G. S. Sidhu, *SP425*, pp. 546-548 (Oct. 1975).

The average number of prompt neutrons, ν_p, from neutron induced fission of ^{235}U between 0.2 and 1.4 MeV, F. Käppeler and R. E. Bandl, *SP425*, pp. 549-552 (Oct. 1975).

Monte Carlo analysis of direct measurements of the thermal eta (0.025 eV) for U^{233} and U^{235}, J. J. Ullo and M. Goldsmith, *SP425*, pp. 553-556 (Oct. 1975).

Monte Carlo analysis of manganese bath measurement of eta of ^{233}U and ^{235}U using thermalized neutrons, M. Goldsmith and J. J. Ullo, *SP425*, pp. 557-559 (Oct. 1975).

Parameters of the subthreshold fission structure in ^{240}Pu, G.

F. Auchampaugh and L. W. Weston, *SP425*, pp. 560-563 (Oct. 1975).

Measurement of the ^{239}Pu fission cross-section and its ratio to the ^{235}U fission cross-section in the energy range from 1 keV to 1 MeV, D. B. Gayther, *SP425*, pp. 564-567 (Oct. 1975).

A measurement of the ^{238}U/^{235}U fission cross-section ratio, M. S. Coates, D. B. Gayther, and N. J. Pattenden, *SP425*, pp. 568-571 (Oct. 1975).

Precision measurement of prompt fission neutron spectra of ^{235}U, ^{238}U and ^{239}Pu, P. I. Johansson, B. Holmqvist, T. Wiedling, and L. Jéki, *SP425*, pp. 572-575 (Oct. 1975).

Spin determination of resonances in ^{235}U, G. A. Keyworth, C. E. Olsen, J. D. Moses, J. W. T. Dabbs, and N. W. Hill, *SP425*, pp. 576-579 (Oct. 1975).

Quantum numbers of low lying neutron resonances in U-235, J. P. Felvinci, E. Melkonian, and W. W. Havens, Jr., *SP425*, pp. 580-583 (Oct. 1975).

keV capture cross section of ^{242}Pu, R. W. Hockenbury, A. J. Sanislo, and N. N. Kaushal, *SP425*, pp. 584-586 (Oct. 1975).

Spontaneous fission decay constant of plutonium-238, R. Gay and R. Sher, *SP425*, pp. 587-590 (Oct. 1975).

Neutron-induced fission cross sections of ^{233}U, ^{234}U, ^{236}U, and ^{238}U with respect to ^{235}U, J. W. Behrens, G. W. Carlson, and R. W. Bauer, *SP425*, pp. 591-596 (Oct. 1975).

On sub-barrier fission in ^{238}U, J. A. Wartena, H. Weigmann, and E. Migneco, *SP425*, pp. 597-598 (Oct. 1975).

Capture-to-fission ratio of ^{235}U from the measurement of low-energy γ-rays, F. Corvi and P. Giacobbe, *SP425*, pp. 599-602 (Oct. 1975).

Intermediate structure in the keV fission cross section of ^{235}U, E. Migneco, P. Bonsignore, G. Lanzanò, J. A. Wartena, and H. Weigmann, *SP425*, pp. 607-610 (Oct. 1975).

The ^{241}Pu neutron induced fission cross section from 0.01 eV to 50 eV and its normalization, C. Wagemans and A. J. Deruytter, *SP425*, pp. 603-606 (Oct. 1975).

Energy spectrum of delayed neutrons from photo-fission of ^{238}U, S. Iwasaki, K. Yana, S. Sato, K. Sano, M. Hagiwara, and K. Sugiyama, *SP425*, pp. 611-614 (Oct. 1975).

^{235}U fission cross section measurements relative to neutron-proton scattering, G. S. Sidhu and J. B. Czirr, *SP425*, pp. 615-619 (Oct. 1975).

Measurement of the ^{238}U capture cross section shape in the neutron energy region 20 to 550 keV, R. R. Spencer and F. Käppeler, *SP425*, pp. 620-622 (Oct. 1975).

Intermediate structure in the ^{238}U neutron capture cross section, R. B. Perez and G. de Saussure, *SP425*, pp. 623-626 (Oct. 1975).

A direct comparison of different experimental techniques for measuring neutron capture and fission cross sections for ^{239}Pu, R. Gwin, L. W. Weston, J. H. Todd, R. W. Ingle, and H. Weaver, *SP425*, pp. 627-630 (Oct. 1975).

Fast neutron fission spectrum measurement of ^{235}U at 0.52 MeV incident neutron energy, P. I. Johansson and J. M. Adams, *SP425*, pp. 631-634 (Oct. 1975).

The fission cross section of ^{235}U for Na-Be photoneutrons, D. M. Gilliam and G. F. Knoll, *SP425*, pp. 635-636 (Oct. 1975).

The total cross section and the fission cross section of ^{241}Am in the resonance region, resonance parameters, H. Derrien and B. Lucas, *SP425*, pp. 637-641 (Oct. 1975).

Structures in ^{232}Th(n,f) and ^{238}U(n,f) cross sections, J. Blons, C. Mazur, and D. Paya, *SP425*, pp. 642-645 (Oct. 1975).

Nuclear data needs for fusion reactor design, D. Steiner, *SP425*, pp. 646-650 (Oct. 1975).

Model calculations as one means of satisfying the neutron cross section requirements of the CTR program, D. G. Gardner, *SP425*, pp. 651-658 (Oct. 1975).

Energy from charged particle reactions among light nuclei, T. A. Tombrello, *SP425*, pp. 659-663 (Oct. 1975).

A survey of fast-neutron induced reaction cross-section data, S. M. Qaim, *SP425*, pp. 664-673 (Oct. 1975).

A quantitative assessment of CTR cross section needs, S. A. W. Gerstl, D. J. Dudziak, and D. W. Muir, *SP425*, pp. 674-679 (Oct. 1975).

A sensitivity study of data deficiencies weighting functions, and 14 MeV neutron source spectrum effects in a ^{238}U fueled fusion-fission hybrid blanket, B. R. Leonard, Jr., U. P. Jenquin, D. L. Lessor, D. F. Newman, and K. B. Stewart, *SP425*, pp. 680-682 (Oct. 1975).

Advanced fuels for nuclear fusion reactors, J. R. McNally, Jr., *SP425*, pp. 683-687 (Oct. 1975).

A study of the ^{6}Li(n,α)t reaction between 2-10 MeV, C. M. Bartle, *SP425*, pp. 688-691 (Oct. 1975).

Absolute cross sections for neutrons from ^{6}Li + d reactions at energies between 0.2 and 0.9 MeV, A. J. Elwyn, R. E. Holland, F. J. Lynch, J. E. Monahan, and F. P. Mooring, *SP425*, pp. 692-696 (Oct. 1975).

Cross section measurements for charged particle induced reactions on ^{6}Li, C. R. Gould, J. M. Joyce, and J. R. Boyce, *SP425*, pp. 697-700 (Oct. 1975).

Phase shift analysis of nD, nT, DD, DT, TT, αD and αT cross sections, C. Abulaffio and A. Peres, *SP425*, pp. 701-703 (Oct. 1975).

^{238}U pulsed sphere measurements and CTR fusion-fission blanket calculations, C. Wong, J. D. Anderson, R. C. Haight, L. F. Hansen, and T. Komoto, *SP425*, pp. 704-707 (Oct. 1975).

The ^{94}Nb(n,γ)^{95}Nb, ^{95m}Nb reaction for the CTR reactor technology program, P. J. Persiani, E. M. Pennington, Y. D. Harker, and R. L. Heath, *SP425*, pp. 708-711 (Oct. 1975).

Production cross sections of some micro and millisecond isomers with 14.8 MeV neutrons, G. N. Salaita and P. K. Eapen, *SP425*, pp. 712-715 (Oct. 1975).

Reactivities for two-component fusion calculations, G. H. Miley and H. H. Towner, *SP425*, pp. 716-721 (Oct. 1975).

Application of Bondarenko formalism to fusion reactors, P. D. Soran and D. J. Dudziak, *SP425*, pp. 722-728 (Oct. 1975).

Neutron cross-section measurements on ^{236}U, L. Mewissen, F. Poortmans, G. Rohr, J. Theobald, H. Weigmann, and G. Vanpraet, *SP425*, pp. 729-732 (Oct. 1975).

p-wave assignment of ^{238}U neutron resonances, F. Corvi, G. Rohr, and H. Weigmann, *SP425*, pp. 733-737 (Oct. 1975).

Neutron resonance parameters of ^{238}U, Y. Nakajima, A. Asami, M. Mizumoto, T. Fuketa, and H. Takekoshi, *SP425*, pp. 738-741 (Oct. 1975).

Evidence for structure in the sequence of s-wave levels in ^{238}U, E. Melkonian, J. P. Felvinci, and W. W. Havens, Jr., *SP425*, pp. 742-743 (Oct. 1975).

Total neutron cross section measurements on gross fission products, H. G. Priesmeyer and U. Harz, *SP425*, pp. 744-747 (Oct. 1975).

High resolution total neutron cross-section in ^{54}Fe and ^{56}Fe, M. S. Pandey, J. B. Garg, J. A. Harvey, and W. M. Good, *SP425*, pp. 748-753 (Oct. 1975).

Thick sample transmission measurement and resonance analysis of the total neutron cross section of iron, S. Cierjacks, G. Schmalz, R. Töpke, R. R. Spencer, and F. Voss, *SP425*, pp. 754-757 (Oct. 1975).

Gamma-ray production measurements due to interactions of neutrons with elements required for nuclear power applications and design, G. T. Chapman, J. K. Dickens, T. A. Love, G. L. Morgan, and E. Newman, *SP425*, pp. 758-761 (Oct. 1975).

Cross sections for the production of low energy photons by neutron interactions with fluorine and tantalum, J. K. Dickens, G. L. Morgan, and F. G. Perey, *SP425*, pp. 762-765 (Oct. 1975).

Spectral gamma-ray production cross-section measurements from threshold to 20 MeV, V. C. Rogers, V. J. Orphan, C. G. Hoot, V. V. Verbinski, D. G. Costello, and S. J. Friesenhahn, *SP425*, pp. 766-769 (Oct. 1975).

Fourteen-MeV, neutron-induced gamma-ray production cross sections for several elements, E. D. Arthur, D. M. Drake, M. G. Silbert, and P. G. Young, *SP425*, pp. 770-773 (Oct. 1975).

The low energy total cross section of ^{36}Ar, S. F. Mughabghab and B. A. Magurno, *SP425*, pp. 774-775 (Oct. 1975).

Neutron cross sections of Ni-59, G. J. Kirouac and H. M. Eiland, *SP425*, pp. 776-779 (Oct. 1975).

Neutron resonance spectroscopy at Nevis laboratories, G. Hacken, H. I. Liou, J. Rainwater, and U. N. Singh, *SP425*, pp. 780-783 (Oct. 1975).

Threshold photoneutron spectroscopy of nuclei near A = 140, R. J. Holt and H. E. Jackson, *SP425*, pp. 784-787 (Oct. 1975).

Analyzing powers of the $^{6}Li(n, t)^{4}He$ reaction, M. Karim and J. C. Overley, *SP425*, pp. 788-791 (Oct. 1975).

Neutron-absorption cross section of sodium-22, R. Rundberg, M. F. Elgart, H. L. Finston, E. T. Williams, and A. H. Bond, Jr., *SP425*, pp. 792-794 (Oct. 1975).

Evidence for valence neutron capture in s-wave neutron capture in ^{36}Ar and ^{54}Fe, S. F. Mughabghab, *SP425*, pp. 795-798 (Oct. 1975).

Neutron resonance spectroscopy. ^{209}Bi, U. N. Singh, J. Rainwater, H. I. Liou, G. Hacken, and J. B. Garg, *SP425*, pp. 799-801 (Oct. 1975).

Measurement of neutron capture cross section near 24 keV, N. Yamamuro, T. Doi, T. Hayase, Y. Fujita, K. Kobayashi, and R. C. Block, *SP425*, pp. 802-805 (Oct. 1975).

Fluctuations in the neutron strength function, C. M. Newstead, *SP425*, pp. 806-809 (Oct. 1975).

Measurements of thermal neutron cross sections for helium production in ^{59}Ni, J. McDonald and N. G. Sjöstrand, *SP425*, pp. 810-812 (Oct. 1975).

Differential cross sections for the 0.847-MeV gamma ray from iron for incident neutrons of 8.5, 10.0, 12.2, and 14.2 MeV, D. M. Drake, L. R. Veeser, M. Drosg, and G. Jensen, *SP425*, pp. 813-815 (Oct. 1975).

High energy γ-ray transitions of ^{56}Fe resonances in the energy range 7-70 keV, H. Beer, R. R. Spencer, and F. Käppeler, *SP425*, pp. 816-818 (Oct. 1975).

Excitation functions of the (n,2n) reactions on ^{12}C and ^{238}U, A. Ackermann, B. Anders, M. Bormann, and W. Scobel, *SP425*, pp. 819-822 (Oct. 1975).

Incoherent neutron scattering cross-sections as determined by diffuse neutron scattering techniques, W. Schmatz, G. Bauer, and M. Löwenhaupt, *SP425*, pp. 823-824 (Oct. 1975).

Cross section and method uncertainties: The application of sensitivity analysis to study their relationship in calculational benchmark problems, C. R. Weisbin, E. M. Oblow, J. Ching, J. E. White, R. Q. Wright, and J. Drischler, *SP425*, pp. 825-833 (Oct. 1975).

Benchmark experiments for nuclear data, E. M. Bohn, R. J. LaBauve, R. E. Maerker, B. A. Magurno, F. J. McCrosson, and R. E. Schenter, *SP425*, pp. 834-841 (Oct. 1975).

Estimated uncertainties in nuclear data—An approach, F. G. Perey, *SP425*, pp. 842-847 (Oct. 1975).

A survey of computer codes which produce multigroup data from ENDF/B-IV, N. M. Greene, *SP425*, pp. 848-854 (Oct. 1975).

Measurement of (n,2n) and (n,3n) cross-sections for incident energies between 6 and 15 MeV, J. Fréhaut and G. Mosinski, *SP425*, pp. 855-858 (Oct. 1975).

Excitation curve for the production of $^{115}In^{m}$ by neutron inelastic scattering, D. C. Santry and J. P. Butler, *SP425*, pp. 859-861 (Oct. 1975).

Inelastic neutron excitation of the ground state rotational band of ^{238}U, P. Guenther and A. Smith, *SP425*, pp. 862-865 (Oct. 1975).

Differential elastic and inelastic scattering of 9-15 MeV neutrons from carbon, F. O. Purser, D. W. Glasgow, H. H. Hogue, J. C. Clement, G. Mack, K. Stelzer, J. R. Boyce, D. H. Epperson, S. G. Buccino, P. W. Lisowski, S. G. Glendinning, E. G. Bilpuch, H. W. Newson, and C. R. Gould, *SP425*, pp. 866-870 (Oct. 1975).

Neutron inelastic scattering cross sections in the energy range 2 to 4.5 MeV, M. A. Etemad, *SP425*, pp. 871-874 (Oct. 1975).

The absolute polarization of fast neutrons elastically scattered from light nuclei, F. W. K. Firk, J. E. Bond, G. T. Hickey, R. J. Holt, R. Nath, and H. L. Schultz, *SP425*, pp. 875-878 (Oct. 1975).

Inelastic scattering of fast neutrons from ^{103}Rh, D. Reitmann, E. Barnard, D. T. L. Jones, and J. G. Malan, *SP425*, pp. 879-882 (Oct. 1975).

ORNL neutron scattering cross section measurements from 4 to 8.5 MeV: A summary, W. E. Kinney and F. G. Perey, *SP425*, pp. 883-885 (Oct. 1975).

Differential elastic scattering cross sections of sulphur for 14.8

MeV neutrons by surface of revolution technique, A. M. Ghose, A. Chatterjee, and S. Nath, *SP425*, pp. 886-888 (Oct. 1975).

Differential cross sections for carbon neutron elastic and inelastic scattering from 8.0 to 14.5 MeV, G. Haouat, J. Lachkar, Y. Patin, J. Sigaud, and F. Coçu, *SP425*, pp. 889-892 (Oct. 1975).

Level and decay schemes of even-A Se and Ge isotopes from (n,n′γ) reaction studies, J. Sigaud, Y. Patin, M. T. McEllistrem, G. Haouat, and J. Lachkar, *SP425*, pp. 893-896 (Oct. 1975).

Symmetry effects in neutron scattering from isotopically enriched Se isotopes, J. Lachkar, G. Haouat, M. T. McEllistrem, Y. Patin, J. Sigaud, F. Coçu, *SP425*, pp. 897-900 (Oct. 1975).

Fast neutron capture and activation cross sections, W. P. Poenitz, *SP425*, pp. 901-904 (Oct. 1975).

Fission product capture cross sections in the keV region, R. W. Hockenbury, H. R. Knox, and N. N. Kaushal, *SP425*, pp. 905-907 (Oct. 1975).

Integral capture cross-section measurements in the CFRMF for LMFBR control materials, R. A. Anderl, Y. D. Harker, E. H. Turk, R. G. Nisle, and J. R. Berreth, *SP425*, pp. 908-911 (Oct. 1975).

Radiative capture of neutrons in the keV region, R. C. Greenwood, R. E. Chrien, and K. Rimawi, *SP425*, pp. 912-915 (Oct. 1975).

Measurement of the γ-ray production cross sections from inelastic neutron scattering in some chromium and nickel isotopes between 0.5 and 10 MeV, F. Voss, S. Cierjacks, D. Erbe, and G. Schmalz, *SP425*, pp. 916-919 (Oct. 1975).

Measurement of 24.3 keV activation cross sections with the iron filter technique, K. Rimawi and R. E. Chrien, *SP425*, pp. 920-922 (Oct. 1975).

Radiative capture gamma rays from the reaction ^{208}Pb(n,γ)^{209}Pb for 11-MeV incident neutrons, D. M. Drake, E. D. Arthur, I. Bergqvist, D. K. McDaniels, and P. Varghese, *SP425*, pp. 923-925 (Oct. 1975).

γ-ray spectra from $l=1$ neutron capture near 24 keV, K. Rimawi and R. E. Chrien, *SP425*, pp. 926-928 (Oct. 1975).

Shape analysis and width correlation studies based on neutron capture data for ^{56}Fe, ^{58}Ni, ^{60}Ni and ^{61}Ni, F. H. Fröhner, *SP425*, pp. 929-933 (Oct. 1975).

γ-ray production cross sections for neutron inelastic scattering from Cr, Ni, ^{92}Zr, and ^{94}Zr from 3 to 6 MeV, G. Tessler and S. S. Glickstein, *SP425*, pp. 934-937 (Oct. 1975).

Scattering of neutrons by nitrogen and oxygen from 5.0 to 9.3 MeV, D. L. Bernard and M. C. Taylor, *SP425*, pp. 938-941 (Oct. 1975).

Deformation effects in neutron scattering from the Sm isotopes, M. T. McEllistrem, J. Lachkar, G. Haouat, C. Lagrange, Y. Patin, R. E. Shamu, J. Sigaud, and F. Coçu, *SP425*, pp. 942-945 (Oct. 1975).

Small-angle scattering of fast neutrons, W. Bucher, C. E. Hollandsworth, and J. E. Youngblood, *SP425*, pp. 946-949 (Oct. 1975).

Elastic and inelastic differential neutron scattering cross sections for ^{238}U from 0.9-2.7 MeV, J. J. Egan, G. H. R. Kegel, G. P. Couchell, A. Mittler, B. K. Barnes, W. A. Schier, D. J. Pullen, P. Harihar, T. V. Marcella, N. B. Sullivan, E. Sheldon, and A. Prince, *SP425*, pp. 950-952 (Oct. 1975).

Absolute measurements of neutron radiative capture cross sections for Na^{23}, Cr, Mn^{55}, Fe, Ni, Rh^{103}, Ta, U^{238} in the keV energy range, C. Le Rigoleur, A. Arnaud, and J. Taste, *SP425*, pp. 953-956 (Oct. 1975).

Capture cross section of ^{197}Au between 10 keV and 500 keV, E. Fort and C. Le Rigoleur, *SP425*, pp. 957-960 (Oct. 1975).

Self shielding factor measurements for natural iron and Na^{23} between 24 keV and 160 keV at 300 K, A. Arnaud, C. Le Rigoleur, and J. P. Marquette, *SP425*, pp. 961-963 (Oct. 1975).

TN871. **Geometrical calibration of the NBS electron scattering apparatus,** S. Penner, S. P. Fivozinsky, J. W. Lightbody, Jr., L. S. Cardman, and W. P. Trower, Nat. Bur. Stand. (U.S.), Tech. Note 871, 79 pages (June 1975) SD Catalog No. C13.46:871.

TN875. **Interlaboratory intercomparisons of radioactivity measurements using National Bureau of Standards mixed radionuclide test solutions,** B. M. Coursey, J. R. Noyce, and J. M. R. Hutchinson, Nat. Bur. Stand. (U.S.), Tech. Note 875, 20 pages (Aug. 1975) SD Catalog No. C13.46:875.

14729. Kline, F. J., Crannell, H., Finn, J. M., Hallowell, P. L., O'Brien, J. T., Werntz, C. W., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Search for the lowest $T=2$ state om ^{14}C by inelastic electron scattering,** *Il Nuovo Cimento* **23A**, No. 1, 137-144 (Sept. 1, 1974).

14734. McLaughlin, W. L., **Solid-phase chemical dosimeters,** (Proc. Int. Conf. on Sterilization by Ionizing Radiation, Vienna, Austria, April 1-4, 1974), Paper in *Sterilization by Ionizing Radiation*, E. R. L. Gaughran and A. J. Goudie, Eds., pp. 219-252 (Multiscience Publication Ltd., Montreal, Quebec, Canada, 1974).

14801. Mann, W. B., **The calibration of the National Bureau of Standards' tritium standards by microcalorimetry and gas counting,** (Proc. Tritium Symp., Las Vegas, Nev., Aug. 30-Sept. 2, 1971), Chapter 3 in *Tritium*, A. A. Moghissi and M. W. Carter, Eds., pp. 86-102 (Messenger Graphics, Las Vegas, Nev., 1971).

14809. Heaton, H. T. II, Menke, J. L., Schrack, R. A., Schwartz, R. B., **Total neutron cross section of carbon from 1 keV to 15 MeV,** *Nucl. Sci. Eng.* **56**, 27-36 (1975).

14811. Hayward, E., Barber, W. C., McCarthy, J. J., **Nuclear scattering of plane-polarized photons,** *Phys. Rev. C* **10**, No. 6, 2652-2653 (Dec. 1974).

14812. Cavallo, L. M., Schima, F. J., Unterweger, M. P., **Decay of ^{133}Xe^{g},** *Phys. Rev. C* **10**, No. 6, 2631-2632 (Dec. 1974).

14813. Lamaze, G. P., Carlson, A. D., Meier, M. M., **A new measurement of the ^{10}B(n,α)^{7}li branching ratio,** *Nucl. Sci. Eng.* **56**, Tech. Note, 94-96 (1975).

14820. Ayres, R. L., Cavallo, L. M., Coursey, B. M., Hutchinson, J. M. R., Mann, W. B., **National Bureau of Standards gamma-ray standards and techniques for gamma-ray measurements, (Abstract),** *Proc. Trans. 1973 Annual Meeting of the American Nuclear Society, Chicago, Ill., June 10-14, 1973*, **16**, 69 (1973).

14845. Harris, F. K., **A cooperative experiment in measurement education,** (Proc. Conf. on Measurement Education, University of Warwick, Coventry, England, July 8-10, 1969), *IEE*

Conf. Publ. No. **56**, pp. 140-141 (Institute Electrical Engineers, London, England, 1969).

14847. Hubbell, J. H., McMaster, W. H., Del Grande, N. K., Mallett, J. H., **X-ray cross sections and attenuation coefficients,** Paper in *International Tables for X-Ray Crystallography, Section 2, Absorption and Scattering,* J. A. Ibers and W. C. Hamilton, Eds., **4**, Paper 2.1, 47-70 (Kynoch Press, Birmingham, England, 1974).

14851. O'Connell, J. S., Lightbody, J. W., Jr., **Momentum transfer sum rules in electron scattering,** *Nucl. Phys.* **A237**, 309-318 (1975).

14938. Saxena, A. N., Weisberg, L. R., Mann, W. B., Schima, F. J., **Implantation of $^{14}N^+$ into monocrystalline GaN films,** *Int. J. Appl. Radiat. Isotop. Tech. Note* **26**, 33-34 (Jan. 1975).

14940. Eisenhauer, C. M., Simmons, G. L., **Point isotropic gamma-ray buildup factors in concrete,** *Nucl. Sci. Eng.* **56**, 263-270 (1975).

14942. Meshkov, S., Rosen, S. P., **Gauge theories and *M*-spin conservation,** *Phys. Rev. D, Comments and Addenda* **10**, No. 10, 3520-3521 (Nov. 15, 1974).

14957. McLaughlin, W. L., Hjortenberg, P. E., Pedersen, W. B., **Low energy scanned electron-beam dose distributions in thin layers,** *Int. J. Appl. Radiat. Isotop.* **26**, No. 3, 95-106 (1975).

14964. Kan, P. T., Peterson, G. A., Webb, D. V., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electroexcitation of ^{11}B,** *Phys. Rev. C* **11**, No. 2, 323-331 (Feb. 1975).

14967. Ensslin, N., Bertozzi, W., Kowalski, S., Sargent, C. P., Turchinetz, W., Williamson, C. F., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electron scattering from excited states in ^{14}N and ^{9}Be,** *Phys. Rev. C* **9**, No. 5, 1705-1717 (May 1974).

14968. Fivozinsky, S. P., Penner, S., Lightbody, J. W., Jr., Blum, D., **Electron scattering from ^{88}Sr and ^{89}Y,** *Phys. Rev. C* **9**, No. 4, 1533-1542 (Apr. 1974).

15018. Biedenharn, L. C., Trivedi, M., Danos, M., **Giant multipole resonances and the three-fluid hydrodynamical model of nuclei,** *Phys. Rev. C* **11**, No. 4, 1482-1484 (Apr. 1975).

15020. Grundl, J. A., Gilliam, D. M., Dudey, N. D., Popek, R. J., **Measurement of absolute fission rates,** *Nucl. Technol.* **25**, 237-257 (Feb. 1975).

15056. Spencer, L. V., **Structure shielding against initial radiations from nuclear explosions. I. Attenuation of air secondary and fission product gamma rays,** *Nucl. Sci. Eng.* **57**, 129-154 (1975).

15073. Meshkov, S., **Current and constituent quarks,** *Proc. XVII Int. Conf. on High Energy Physics, London, England, July 1974,* pp. II-101 – II-112 (1974).

15078. Garfinkel, S. B., Schima, F. J., **Ionization chamber half-life measurement of the 99-minute ^{113}In isomer,** *Int. J. Appl. Radiat. Isotop.* **26**, 314-315 (May 1975).

15083. Alberi, J. L., Wilson, R., Schröder, I. G., **Parity violation in neutron-capture gamma-rays,** *Phys. Rev. Lett.* **29**, No. 8, 518-521 (Aug. 21, 1972).

15097. Danos, M., Weller, H. R., **Correlation between the (d, γ_0) and (p, γ_0) cross sections in the giant dipole resonance of ^{16}O,** *Phys. Rev. C* **10**, No. 6, 2627-2628 (Dec. 1974).

15104. Kline, F. J., Lin, C. L., Peterson, G. A., Penner, S., **Inelastic electron scattering from ^{31}P,** *Nuclear Phys. A* **241**, 299-310 (1975).

15105. Kan, P. T., Peterson, G. A., Webb, D. V., Szalata, Z. M., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Observation of electric monopole strength in the electrodisintegration of ^{3}He,** *Phys. Rev. Lett.* **34**, No. 14, 899-901 (Apr. 7, 1975).

15156. Fano, U., Spencer, L. V., **Quasi-scaling of electron degradation spectra,** *Int. J. Radiat. Phys. Chem. Platzman Memorial Issue* **7**, 63-76 (1975).

15163. Ebert, P. J., Dick, C. E., **Comments on the observation of nondivergent radiation of discrete frequencies,** *Phys. Rev. Lett. Comments* **34**, No. 24, 1537-1539 (June 16, 1975).

15197. Chew, W. M., Xenoulis, A. C., Fink, R. W., Schima, F. J., Mann, W. B., **The L/K electron capture ratio in first-forbidden ^{81g}Kr decay,** *Nucl. Phys.* **A229**, 79-92 (1974).

15211. Casella, R. C., Robertson, B., **Direct tests for violation of *CP* invariance,** *Phys. Rev. D* **8**, No. 3, 968-970 (Aug. 1, 1973).

15220. Chang, C. C., Dodge, W. R., Murphy, J. J. II, **^{3}He$(\gamma$,d$)^{1}$H cross section from 10 to 21 MeV,** *Phys. Rev. C* **9**, No. 4, 1300-1308 (Apr. 1974).

15239. Grundl, J. A., Dudey, N. D., Popek, R. J., **Measurement of absolute fission rates,** *Trans. Amer. Nucl. Soc.* **17**, 516-517 (1973).

15276. Motz, J. W., Dick, C. E., **X-ray scatter background signals in transmission radiography,** *Med. Phys.* **2**, No. 5, 259-267 (Sept.-Oct. 1975).

15277. Miller, A., McLaughlin, W. L., **Absorbed dose distribution in a pulse radiolysis optical cell,** *Int. J. Radiat. Phys. Chem.* **7**, No. 5, 661-666 (1975).

15278. Miller, A., Bjergbakke, E., McLaughlin, W. L., **Some limitations in the use of plastic and dyed plastic dosimeters,** *Int. J. Appl. Radiat. Isotop.* **26**, No. 10, 611-620 (Oct. 1975).

15296. Maximon, L. C., O'Connell, J. S., **Sum rules for forward elastic pion-nucleon scattering,** *Phys. Lett.* **51B**, No. 1, 31-34 (July 8, 1974).

15313. Bowman, C. D., **A shelf in the "subthreshold" photofission cross section,** *Phys. Rev. C* **12**, No. 3, 856-862 (Sept. 1975).

15350. Bowman, C. D., Schröder, I. G., Dick, C. E., Jackson, H. E., **Very low energy photofission of ^{238}U,** *Phys. Rev. C* **12**, No. 3, 863-870 (Sept. 1975).

15360. O'Brien, J. T., Crannell, H., Kline, F. J., Penner, S., **Ionization loss for high-energy electrons in thin targets,** *Phys. Rev. C* **9**, No. 4, 1418-1429 (Apr. 1974).

15407. Caswell, R. S., Coyne, J. J., Randolph, M. L., **Studies of energy deposition by neutrons,** (Proc. 2d Symp. on Neutron Dosimetry in Biology and Medicine, Neuherberg/Munich, Germany, Sept. 30-Oct. 4, 1974), Paper in *Proc. 2d Symp. on Neutron Dosimetry in Biology and Medicine,* B. G. Berger and H. G. Ebert, Eds., **1**, 29-47 EUR 5273 d-e-f (Mar. 1975).

15424. McLaughlin, W. L., **Radiation dosimetry with thin films,** (Proc. Third Conf. on Application of Small Accelerators, North Texas State Univ., Denton, Tex., Oct. 21-23, 1974), Paper in *Application of Small Accelerators. Vol.* **II. Industrial Applications of Small Accelerators,** I. L., Morgan and J. L. Duggan, Eds., pp. 65-85 (U.S. Energy Research and Development Admin. Office of Public Affairs and Technical Information Center, Springfield, Va., 1975).

15429. McLaughlin, W. L., Rosenstein, M., Levine, H., **Bone-and-muscle-equivalent solid chemical dose meters for photon and electron doses above one kilorad,** (Proc. Symp. on Biomedical Dosimetry, IAEA, Vienna, Austria, 1975), Chapter in *Biomedical Dosimetry*, pp. 267-281 (Int. Atomic Energy Agency, Vienna, Austria, 1975).

15453. Simmons, G. L., Eisenhauer, C., Spencer, L. V., **Moments method calculations of neutron and gamma-ray penetration in bulk media,** *Proc. IVth Int. Conf. on Reactor Shielding, Paris, France, Oct. 9-13, 1972*, **2**, 268-283 (Oct. 1972).

15469. Heimbach, C. R., O'Connell, J. S., **Influence on the neutron's charge distribution on nuclear Coulomb energies,** (Proc. Conf. Int. Few Body Problems in Nuclear and Particle Physics, Laval Univ., Quebec City, Canada, Aug. 27-31, 1974), Paper in *Few Body Problems in Nuclear and Particle Physics*. R. J. Slobodrian, B. Cujec, and K. Ramavataram, Eds., pp. 94-95 (Les Presses de L'Université Laval, Quebec, Canada, 1974).

15471. Loevinger, R., **Dosimetry standards for fast electrons,** (Proc. XIII Int. Congress of Radiology, Madrid, Spain, Oct. 15-20, 1973), *International Congress Series No. 339*, **2**, 467-471 (Excerpta Medica, Amsterdam, The Netherlands, 1973).

15482. Radak, B. B., Kosanić, M. M., Šešić, M. B., McLaughlin, W. L., **A calorimetric approach to the calibration of liquid dose meters in high-intensity electron beams,** (Proc. Symp. on Biomedical Dosimetry, IAEA, Vienna, Austria, 1975), Chapter in *Biomedical Dosimetry*, pp. 633-641 (Int. Atomic Energy Agency, Vienna, Austria, 1975).

15529. Miller, A., McLaughlin, W. L., **Imaging and measuring electron beam dose distributions using holographic interferometry,** *Nucl. Instrum. Methods* **128**, 337-346 (1975).

15540. Goodman, L. J., Colvett, R. D., Caswell, R. S., **An international neutron dosimetry intercomparison,** *Proc. Second Symp. on Neutron Dosimetry in Biology and Medicine, Neuherberg/Munchen, Germany, Sept. 30-Oct. 4, 1974*, EUR 5273d-e-f, pp. 627-662 (1974).

15579. Berger, M. J., Seltzer, S. M., Domen, S. R., Lamperti, P. J., **Stopping-power ratios for electron dosimetry with ionization chambers,** (Proc. Int. Symp. on Advances in Biomedical Dosimetry, Vienna, Austria, Mar. 1975), Paper in *Advances in Biomedical Dosimetry*, pp. 589-609 (International Atomic Energy Agency, Vienna, Austria, 1975).

15608. Kan, P. T., Peterson, G. A., Webb, D. V., Szalata, Z. M., O'Connell, J. S., Fivozinsky, S. P., Lightbody, J. W., Jr., Penner, S., **Electrodisintegration of ^{3}He,** *Phys. Rev. C* **12**, No. 4, 1118-1125 (Oct. 1975).

15614. Greenberg, O. W., Nelson, C. A., **Composite models of leptons,** *Phys. Rev. D* **10**, No. 8, 2567-2573 (Oct. 15, 1974).

15695. Danos, M., **Relativistic nuclear physics, why and how?,** (Proc. Int. Conf. on Interaction Studies in Nuclei, Mainz, Germany, Feb. 17-20, 1975), Paper in *Interaction Studies in Nuclei*, H. Jochim and B. Ziegier, Eds., pp. 885-910 (North-Holland Publishing Co., The Netherlands, 1975).

Mechanics: Design, Testing and Measurement

NBSIR 74-482. **An automated system for precision calibration of accelerometers,** B. F. Payne, 196 pages (Apr. 1974). Order from NTIS as COM 75-10147.

NBSIR 75-738. **A method and means of calibrating an air-bearing force plate for use with a towed pavement friction test trailer,** R. W. Kearns and J. F. Ward, 40 pages (Dec. 1974). Order from NTIS as COM 75-11279.

14799. Achenbach, P. R., **Simplified laboratory procedures for simulating the effect of air leakage into refrigerated enclosures,** (Proc. Joint Conf. Office for Research and Experiments of the International Union of Railways and International Institute of Refrigeration, Vienna, Austria, May 6-8, 1969), Chapter in *Refrigerated Vehicles and Containers, Annex 1969-3*, pp. 89-94 (International Union of Railways, Paris, France, 1969).

14949. Clough, R. B., **A new method for determination of proportional limit and machine stiffness,** *J. Test. Eval.* **3**, No. 2, 143-146 (Mar. 1975).

15096. Bloss, R. L., **Evaluation testing of resistance strain gages,** *Proc. Tech. Session on Strain Gaging for Accuracy Conf., Milwaukee, Wis., Oct. 19, 1971*, pp. 1-5 (Society for Experimental Stress Analysis, Westport, Conn., 1975).

15399. Mitchell, R. A., Woolley, R. M., Halsey, N., **High-strength end fittings for FRP rod and rope,** *J. Eng. Mech. Div. ASCE* **100**, No. EM4, 687-706 (Aug. 1974).

15460. Heydemann, P. L. M., **Pressure measurement and calibration,** *Proc. ASME Pressure Vessels and Piping Materials Nuclear Conf., Miami, Fla., June 24-28, 1974*, Paper 74-PVP-43, pp. 1-8 (American Society of Mechanical Engineers, New York, N.Y., 1974).

15508. Mitchell, R. A., Woolley, R. M., Chwirut, D. J., **Analysis of composite-reinforced cutouts and cracks,** *AIAA J.* **13**, No. 6, 744-749 (June 1975).

15550. Haight, W. C., Hawes, H. W., **An automated tuneup—Calibration of jet engine fuel controls,** *Proc. 1974 ASSC Conf. Record on Automated Support Systems for Advanced Maintainability, San Diego, Calif., Oct. 30—Nov. 1, 1974*, 12 pages (IEEE Aerospace and Electronics Systems Society, San Diego, Calif., 1974).

15626. Chwirut, D. J., **Tensile creep of angle-plied boron/epoxy laminates,** *J. Test. Eval.* **3**, No. 6, 442-448 (1975).

Operations Analysis and Applications

NBSIR 74-521. **HATCH—A model for fish hatchery analysis,** F. C. Johnson, 73 pages (July 8, 1974). Order from NTIS as COM 75-10187.

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14788. Goldman, A. J., **Fractional container-loads and topological groups,** *Oper. Res. Letters to Editor* **16,** No. 6, 1218-1221 (Nov.-Dec. 1968).

14790. Goldman, A. J., **The minimax transportation problem,** *Transp. Sci. Letter to Editor* **2,** No. 4, 383-387 (Nov. 1968).

14791. Goldman, A. J., **Optimal locations for centers in a network,** *Transp. Sci.* **3,** No. 4, 352-360 (Nov. 1969).

15430. Harman, G. G., **A metallurgical basis for the nondestructive wire-bond pull-test,** *12th Annual Proc. IEEE Reliability Physics, Las Vegas, Nev., April 2-4, 1974,* pp. 205-210 (Nov. 15, 1974).

Processing and Performance of Materials

BSS65. **Nonmetallic coatings for concrete reinforcing bars,** J. R. Clifton, H. F. Beeghly, and R. G. Mathey, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 65, 41 pages (Aug. 1975) SD Catalog No. C13.29/2:65.

TN862. **Application of ion beam milling to the characterization of cracks in metals,** L. K. Ives, A. Harper, and A. W. Ruff, Nat. Bur. Stand. (U.S.), Tech. Note 862, 29 pages (Apr. 1975) SD Catalog No. C13.46:862.

NBSIR 74-501. **Development of specifications for archival record materials,** W. K. Wilson, 17 pages (May 23, 1974). Order from NTIS as COM 75-10131.

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NBSIR 75-739. **Development of specifications for archival record materials,** W. K. Wilson and E. J. Parks, 19 pages (Mar. 1975). Order from NTIS as COM 75-11189.

14743. Ogburn, F., **Methods of testing,** Chapter 30 in *Modern Electroplating,* 3d Edition, pp. 673-709 (July 1974).

14747. Ruff, A. W., Fraker, A. C., **Investigation of the anisotropic anodic polarization behavior of titanium,** *Corrosion* **30,** No. 7, 259-264 (July 1974).

14781. Iverson, W. P., **Microbial corrosion of iron,** Chapter 19 in *Microbial Iron Metabolism,* Dr. Neilands, Ed., pp. 475-513 (Academic Press, Inc., New York, N.Y., 1974).

14882. Ambrose, J. R., Kruger, J., **Tribo-ellipsometric studies of the relationship between repassivation kinetics and stress corrosion of low carbon steel,** (Proc. 5th Int. Congress on Metallic Corrosion, Tokyo, Japan, May 21-27, 1972), Paper in *5th International Congress on Metallic Corrosion,* pp. 406-409 (National Association of Corrosion Engineers, Houston, Texas, 1974).

14886. Wachtman, J. B., Jr., **Highlights of progress in the science of fracture of ceramics and glass,** *J. Amer. Ceram. Soc.* **57,** No. 12, 509-519 (Dec. 12, 1974).

14973. Ekin, J. W., Deason, V. A., **Technique for preparing homogeneous bulk samples of concentrated alloys,** *Rev. Sci. Instrum. Notes* **46,** No. 3, 327-328 (Mar. 1975).

15028. Clifton, J., Frohnsdorff, G., **Fiber-reinforced cementitious materials,** Special Review in *Cements Research Progress 1974,* F. Young, Ed., pp. 201-234 (American Ceramic Society, Columbus, Ohio, 1975).

15081. Ambrose, J. R., Kruger, J., **Breakdown of passive films on iron by chloride ion,** *Proc. 4th Int. Congress on Metallic Corrosion, Houston, Tex., Sept. 1969,* pp. 698-704 (National Association of Corrosion Engineers, Houston, Tex., 1972).

15112. Clifton, J. R., Beeghly, H. F., Mathey, R. G., **Protecting reinforcing bars from corrosion with epoxy coatings,** Chapter SP 49-10 in *Corrosion of Metals in Concrete,* pp. 115-132 (American Concrete Institute, Detroit, Mich., 1975).

15125. Evans, A. G., **Analysis of strength degradation after sustained loading,** *J. Amer. Ceram. Soc.* **57,** No. 9, 410-411 (Sept. 1974).

15142. Heinrich, K. F. J., Newbury, D. E., Yakowitz, H., **New techniques for the surface analysis of nonmetallic solids,** (Proc. 20th Sagamore Army Materials Research Conf., Sagamore Conference Center, Raquette Lake, New York, Sept. 11-14, 1973), Chapter 4 in *Characterization of Materials in Research Ceramics and Polymers* **20,** 73-102 (Syracuse University Press, Syracuse, N.Y., 1975).

15148. Berger, H., Motz, J. W., **A qualitative discussion of quantitative radiography,** (Proc. 2nd ASM Materials/Design Forum, Port St. Lucie, Fla., Apr. 8-11, 1974), Paper in *Prevention of Structural Failure,* T. D. Cooper, P. F. Packman, and B. G. W. Yee, Eds., No. 5, 37-47 (American Society for Metals, Metals Park, Ohio, 1975).

15212. Howell, B. F., Simmons, J. H., Haller, W., **Loss of chemi-**

cal resistance to aqueous attack in a borosilicate glass due to phase separation,** *Am. Ceram. Soc. Bull.* **54,** No. 8, 707-709 (Aug. 1975).

15233. Iverson, W. P., **Anaerobic corrosion: Metals and microbes in two worlds,** *Dev. Ind. Microbiol.* **16,** 1-10 (1975).

15274. Lashof, T. W., **A calibration check service for paper and board test instruments,** *TAPPI* **57,** No. 1, 5 (Jan. 1974).

15317. Young, J. P., **Codeposition of particulate matter with chromium,** *Plat. Surf. Finish. Tech. Brief* **62,** No. 4, 348-349 (Apr. 1975).

15322. Wiederhorn, S. M., Evans, A. G., **A new method for the design of structural ceramic components,** *Nav. Res. Rev.* **XXVII,** No. 2, 18-25 (Feb. 1974).

15391. Tighe, N. J., **Examination of fracture interfaces in silicon nitride,** *Proc. 33d Annual Electron Microscopy Society of America, Las Vegas, Nev., Aug. 10-14, 1975,* G. W. Bailey, Ed., pp. 60-61 (Claitor's Publ. Div., Baton Rouge, La., 1975).

15400. Hockey, B. J., Lawn, B. R., **Electron microscopy of microcracking about indentations in aluminium oxide and silicon carbide,** *J. Mater. Sci.* **10,** 1275-1284 (1975).

15419. Wiederhorn, S. M., **Reliability, life prediction and proof testing of ceramics,** (Proc. Second Army Materials Technology Conf., Hyannis, Mass., Nov. 13-16, 1973), Chapter 29 in *Ceramics for High-Performance Applications,* pp. 633-663 (Army Materials and Mechanics Research Center, Watertown, Mass., 1974).

15426. Wiederhorn, S. M., Johnson, H., **Effect of zeta potential on crack propagation in glass in aqueous solutions,** *J. Am. Ceram. Soc.* **58,** No. 7-8, 342 (July-Aug. 1975).

15432. Wiederhorn, S. M., **Strength of glass—A fracture mechanics approach,** (Proc. 10th Int. Congress on Glass, Kyoto, Japan, July 8-13, 1974), Paper in *Tenth International Congress on Glass,* pp. 11-1/11-15 (The Ceramic Society of Japan, Kyoto, Japan, July 1974).

15464. Kahles, J. F., Field, M., Young, R. D., Whitehouse, D. J., **Survey on surface roughness and surface integrity requirements for machined components,** *CIRP Annals* **23,** No. 1, 185-186 (1974).

15523. Weston, W. F., **Low-temperature elastic constants of a superconducting coil composite,** *J. Appl. Phys.* **46,** No. 10, 4458-4465 (Oct. 1975).

15528. Naimon, E. R., Ledbetter, H. M., Weston, W. F., **Low-temperature elastic properties of four wrought and annealed aluminium alloys,** *J. Mater. Sci.* **10,** No. 8, 1309-1316 (Aug. 1975).

15559. Ogburn, F., Johnson, C. E., **Mechanical properties of electrodeposited brass,** *Plating* **62,** 141-148 (Feb. 1975).

15560. Ogburn, F., **Coating thickness—its measurement and its significance,** Chapter 14 in *Properties of Electrodeposits—Their Measurement and Significance,* pp. 229-245 (Electrochemical Society, Princeton, N.J., 1975). 340

15580. Ogburn, F., **Density of electrodeposited metal, its significance and measurement,** Chapter 5 in *Properties of Electrodeposits Their Measurement and Significance,* R. Sard, H. Leidheiser, Jr., and F. Ogburn, Eds., pp. 71-79 (The Electrochemical Society, Inc., Princeton, N.J., 1975).

15624. Masters, L. W., Reichard, T. W., **Evaluation of adhesive-bonded joints in housing components of glass fiber-reinforced polyester laminate,** (Proc. American Society for Testing and Materials Conf. on Composite Reliability, Las Vegas, Nev., Apr. 15-16, 1974), Paper in *Composite Reliability, Am. Soc. Test. Mater. Spec. Tech. Publ.* **580,** pp. 146-156 (American Society for Testing and Materials, Philadelphia, Pa., Aug. 1975).

15638. Clough, R. B., **The effects of specimen size and microstructure on the Larson-Miller parameter,** *Scr. Metall.* **9,** No. 12, 1325-1329 (1975).

Properties of Materials: Electronic, Magnetic and Optical

On the differential cross section for x-ray inelastic scattering, M. Kuriyama, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 415-417 (Mar.-Apr. 1975).

Simultaneous measurements of specific heat, electrical resistivity, and hemispherical total emittance by a pulse heating technique: Hafnium-3 (wt. %) zirconium, 1500 to 2400 K, A. Cezairliyan and J. L. McClure, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 431-436 (Mar.-Apr. 1975).

Radiance temperature (at 653 nm) of iron at its melting point, A. Cezairliyan and J. L. McClure, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 4, 541-544 (July-Aug. 1975).

NBSIR 75-639. **Optical materials characterization,** A. Feldman, D. Horowitz, R. M. Waxler, I. Malitson, M. J. Dodge, 17 pages (Jan. 1975). Order from NTIS as COM 75-10135.

NBSIR 75-781. **Optical materials characterization,** A. Feldman, D. Horowitz, R. M. Waxler, I. H. Malitson, and M. J. Dodge, 24 pages (Aug. 1975). Order from NTIS as COM 75-11375.

NBSIR 75-787. **Piezo- and pyroelectric properties of electrets,** M. G. Broadhurst and G. T. Davis, 55 pages (Oct. 1975). Order from NTIS as COM 75-11471.

14744. Carter, G. C., Kahan, D. J., **NMR, soft x-ray, and other physical properties of rare earth metals and alloys—an annotated bibliography,** (Proc. 11th Rare Earth Research Conference, Traverse City, Mich., Oct. 7-10, 1974), Paper in *Proceedings of the 11th Rare Earth Research Conference,* J. M. Haschke and H. A. Eick, Eds., **II,** 1014-1018 (1974).

14746. Zhukov, V. V., Weisman, I. D., Bennett, L. H., **Nuclear magnetic resonance in cadmium alloys,** *J. Magn. Resonance* **16,** 29-34 (1974).

14780. Melmed, A. J., Carroll, J. J., Meclewski, R., **Dependence of work function on coverage for aluminum/tungsten in the field electron microscope,** *Surface Sci.* **45,** 649-656 (1974).

14798. Johannesen, R. B., Peake, S. C., Schmutzler, R., **The fluorine-19 NMR spectrum of methylthiotetrafluorophosphorane,** *Z. Naturforsch. B* **29b,** 699-700 (1974).

14816. Debye, N. W. G., Linzer, M., **Correlation of nuclear quadrupole resonance and ^{119m}Sn Mössbauer spectral parameters,** *J. Chem. Phys.* **61,** No. 11, 4770-4776 (Dec. 1974).

14833. Ambler, E., Mangum, B. W., Pfeiffer, E. R., Utton, D. B., **Magnetic ordering of crystalline and vitreous $Gd(PO_3)_3$,** *Phys. Lett.* **50A,** No. 4, 249-250 (Dec. 16, 1974).

14834. Hudson, R. P., Pfeiffer, E. R., **Dipolar heat capacity of CMN,** *J. Low Temp. Phys.* **16,** Nos. 3/4, 309-316 (1974).

14854. Rowe, J. M., Rush, J. J., Smith, H. G., **"In-band" modes of vibration of $PdH_{0.03}$,** *Phys. Rev. B* **8,** No. 12, 6013-6014 (Dec. 15, 1973).

14860. Utton, D. B., **Proton spin-lattice relaxation in cerous magnesium nitrate hydrate,** *J. Chem. Phys.* **62,** No. 2, 670-674 (Jan. 15, 1975).

14862. Feeney, J. J., Meijer, P. H. E., **Magnetic properties of paramagnetically doped crystals Fe^{3+}, Nd^{3+} and Ho^{3+} in various compounds,** *J. Phys. Chem. Solids* **36,** 175-185 (1975).

14876. Frederikse, H. P. R., **Electrons in oxides: A summary,** *J. Solid State Chem.* **12,** 411-415 (1975).

14889. Weisman, I. D., Bennett, L. H., McAlister, A. J., Watson, R. E., **$LaNi_{5-x}Pt_x$: NMR investigation of structural and electronic properties,** *Phys. Rev. B* **11,** No. 1, 82-91 (Jan. 1, 1975).

14911. Niemeijer, T., Meijer, P. H. E., **Quantum-mechanical ground state of crystals with dipole-dipole and exchange interactions,** *Phys. Rev. B* **10,** No. 7, 2962-2967 (Oct. 1, 1974).

15011. Bennett, L. H., Cuthill, J. R., McAlister, A. J., Erickson, N. E., Watson, R. E., **Electronic and catalytic properties of tungsten carbide,** *Science* **187,** 858-859 (Mar. 7, 1975).

15016. Swartzendruber, L. J., Evans, B. J., **Electronic structure and ^{121}Sb hyperfine fields in the Heusler alloys $Ni_{1-x}Cu_xMnSb$,** *J. Phys.* **35,** No. 12, C6-265/C6-268 (Dec. 1974).

15036. Rowe, J. M., Rush, J. J., Smith, H. G., Mostoller, M., Flotow, H. E., **Lattice dynamics of a single crystal of $PdD_{0.63}$,** *Phys. Rev. Lett.* **33,** No. 21, 1297-1300 (Nov. 18, 1974).

15092. Bennett, A. J., Penn, D., **Optical properties of adsorbate atoms,** *Phys. Rev. B* **11,** No. 10, 3644-3657 (May 15, 1975).

15108. Cezairliyan, A., Righini, F., **Measurements of heat capacity, electrical resistivity and hemispherical total emittance of two grades of graphite in the range 1,500 to 3,000 K by a pulse heating technique,** *Rev. Int. Hautes Temp. Refract.* **12,** No. 2, 124-131 (1975).

15115. Howell, B. F., Velapoldi, R. A., Travis, J. C., **Fluorescence of commercial porous high silica glasses,** *Amer. Ceram. Soc. Bull.* **54,** No. 5, 503-505, 509 (May 1975).

15121. Franklin, A. D., Crissman, J. M., Young, K. F., **Defect-complex reorientation processes in GdF_3-doped CaF_2,** *J. Phys. C* **8,** 1244-1266 (1975).

15133. Gadzuk, J. W., Sunjić, M., **Excitation energy dependence of core-level x-ray photoemission-spectra line shapes in metals,** *Phys. Rev. B* **12,** No. 2, 524-530 (July 15, 1975).

15137. Olson, J. D., **The refractive index and Lorenz-Lorentz function of fluid methane,** *J. Chem. Phys.* **63,** No. 1, 474-484 (July 1, 1975).

15187. Weinstein, B. A., Piermarini, G. J., **Raman scattering and phonon dispersion in Si and GaP at very high pressure,** *Phys. Rev. B* **12,** No. 4, 1172-1186 (Aug. 15, 1975).

15207. Copley, J. R. D., Rowe, J. M., **Short-wavelength collective excitations in liquid rubidium observed by coherent neutron scattering,** *Phys. Rev. Lett.* **32,** No. 2, 49-52 (Jan. 14, 1974).

15263. Rowe, J. M., Price, D. L., Ostrowski, G. E., **Inelastic neutron scattering from a liquid ^3He-^4He mixture,** *Phys. Rev. Lett.* **31,** No. 8, 510-513 (Aug. 20, 1973).

15320. Mopsik, F. I., Broadhurst, M. G., **Molecular dipole electrets,** *J. Appl. Phys.* **46,** No. 10, 4204-4208 (Oct. 1975).

15324. VanderHart, D. L., **Study of molecular reorientation: Pressure and temperature dependence of deuterium relaxation in liquid $CDCl_3$,** *J. Chem. Phys.* **60,** No. 5, 1858-1870 (Mar. 1, 1974).

15327. Cox, J. E., Waterstrat, R. M., **Anticorrelation of atomic ordering with superconductivity in vanadium-based transition metal A15 alloys,** *Phys. Lett.* **46A,** No. 1, 21-22 (Nov. 19, 1973).

15332. Stampfl, P. P., Travis, J. C., Bielefeld, M. J., **Mössbauer spectroscopic studies of iron-doped rutile,** *Phys. Status Solidi A* **15,** No. 1, 181-189 (1973).

15339. Soulen, R. J., Jr., Gubser, D. U., **Superconducting properties of iridium,** (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT* **13,** K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3,** 498-502 (Plenum Publishing Corp., New York, N.Y., 1974).

15342. Schooley, J. F., **The superconductive transition in cadmium,** (Proc. 13th Int. Conf. on Low Temperature Physics-LT 13, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics-LT 13,* K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **3,** 382-386 (Plenum Publishing Corp., New York, N.Y., 1974).

15359. Reneker, D. H., Martin, G. M., Broadhurst, M. G., **Search for correlations between dielectric relaxation and polymerization in trioxane crystals,** *J. Appl. Phys.* **45,** No. 10, 4172-4174 (Oct. 1974).

15361. Ekin, J. W., Clem, J. R., **Magnetic coupling force of the superconducting dc transformer,** *Phys. Rev. B* **12,** No. 5, 1753-1765 (Sept. 1, 1975).

15387. Speller, L. C., Mendlowitz, H., **Characteristic electron energy losses in germanium,** *J. Phys. Chem. Solids* **36,** No. 11, 1229-1232 (1975).

15388. Rhyne, J. J., Pickart, S. J., Alperin, H. A., **Magnetism in amorphous terbium-iron,** (Proc. 19th AIP Conf. on Magnetism and Magnetic Materials, Boston, Mass., Nov. 13-16, 1973), Chapter in *Magnetism and Magnetic Materials,* C. D. Graham, Jr., and J. J. Rhyne, Eds., pp. 563-577 (American Institute of Physics, New York, N.Y., 1974).

15389. Rowe, J. M., Vagelatos, N., Rush, J. J., Flotow, H. E., **Acoustic modes of the phonon dispersion relation of NbD_x alloys,** *Phys. Rev. B* **12,** No. 8, 2959-2964 (Oct. 15, 1975).

15402. Frederikse, H. P. R., Hosler, W. R., **High temperature electrical conductivity of aluminum oxide,** Chapter in *Mass Transport Phenomena in Ceramics,* A. R. Cooper and A. H. Heuer, Eds., **9,** 233-251 (Plenum Press, New York, N.Y., March 1975).

15439. Roth, R. S., Brower, W. S., Parker, H. S., Minor, D. B., Waring, J. L., **Alkali oxide-tantalum, niobium and antimony oxide ionic conductors,** *NASA CR-134869,* 76 pages (National Technical Information Service, Springfield, Va., 1975).

15475. Utton, D. B., **Nonchemical applications of NQR,** *Proc. Second Int. Symp. on Nuclear Quadrupole Resonances Spectroscopy, Viareggio, Italy, Sept. 3-7, 1973,* pp. 341-350 (A. Vallerini, Pisa, Italy, 1975).

15476. Peterlin, A., **ESR investigation of chain rupture in mechanically strained crystalline polymer solids,** (Proc. Sixth Southeastern Magnetic Resonance Conf., Clemson, S.C., Oct. 1974), *J. Magn. Reson.* **19,** 83-98 (1975).

15520. Ekin, J. W., **Critical currents in granular superconductors,** *Phys. Rev. B* **12,** No. 7, 2676-2681 (Oct. 1, 1975).

15525. Arora, V. K., Peterson, R. L., **Quantum theory of Ohmic galvano- and thermomagnetic effects in semiconductors,** *Phys. Rev. B* **12,** No. 6, 2285-2296 (Sept. 15, 1975).

15612. Cezairliyan, A., Righini, F., **Measurement of melting point, radiance temperature (at melting point), and electrical resistivity (above 2,100 K) of zirconium by a pulse heating method,** *Rev. Int. Hautes Temp. Refract.* **12,** No. 3, 201-207 (1975).

15690. Casella, R. C., Rowe, J. M., Trevino, S. F., **Determining the number of independent real parameters in the phonon dynamical matrix,** *Phys. Rev. B* **12,** No. 10, 4573-4574 (Nov. 15, 1975).

15701. Rosasco, G. J., Prask, H. J., **Polarized Raman study of lattice modes in ammonium perchlorate at low temperatures,** *Solid State Commun.* **16,** No. 1, 135-138 (1975).

15705. Forman, R. A., Thurber, W. R., Aspnes, D. E., **Second indirect band gap in silicon,** *Solid State Commun.* **14,** No. 10, 1007-1010 (1974).

Properties of Materials: Structural and Mechanical

Simplification of van der Poel's formula for the shear modulus of a particulate composite, J. C. Smith, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 419-423 (Mar.-Apr. 1975).

Surface films on polyoxymethylene single crystals, J. E. Breedon and P. H. Geil, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 5, 609-611 (Sept.-Oct. 1975).

On the origin of the amorphous component in polymer single crystals and the nature of the fold surface, J. D. Hoffman and G. T. Davis, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 5, 613-617 (Sept.-Oct. 1975).

Homogeneous nucleation in polyethylene: molecular weight dependence, G. S. Ross and L. J. Frolen, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 707-711 (Nov.-Dec. 1975).

On the growth rate of spherulites and axialites from the melt in polyethylene fractions: regime I and regime II crystallization, J. D. Hoffman, L. J. Frolen, G. S. Ross, and J. I. Lauritzen, Jr., *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 6, 671-699 (Nov.-Dec. 1975).

Monogr. 25, Section 12. **Standard x-ray diffraction powder patterns. Section 12-data for 57 substances,** H. F. McMurdie, M. C. Morris, E. H. Evans, B. Paretzkin, J. H. de Groot, C. R. Hubbard, and S. J. Carmel, Nat. Bur. Stand. (U.S.), Monogr. 25-Sec. 12, 90 pages (Feb. 1975) SD Catalog No. C13.44:25/Sec. 12.

TN854. **A system of Fortran IV computer programs for crystal structure computations,** L. W. Finger and E. Prince, Nat. Bur. Stand. (U.S.), Tech. Note 854, 133 pages (Feb. 1975) SD Catalog No. C13.46:854.

NBSIR 73-415. **Noble metal constitution diagrams: Part II,** R. M. Waterstrat and R. C. Manuszewski, 170 pages (Aug. 1975). Order from NTIS as COM 75-11448.

14724. Davis, G. T., Weeks, J. J., Martin, G. M., Eby, R. K., **Cell dimensions of hydrocarbon crystals: Surface effects,** *J. Appl. Phys.* **45,** No. 10, 4175-4181 (Oct. 1974).

14728. Raveché, H. J., Mountain, R. D., Streett, W. B., **Freezing and melting properties of the Lennard-Jones system,** *J. Chem. Phys.* **61,** No. 5, 1970-1984 (Sept. 1, 1974).

14736. Streett, W. B., Raveché, H. J., Mountain, R. D., **Monte Carlo studies of the fluid-solid phase transition in the Lennard-Jones system,** *J. Chem. Phys.* **61,** No. 5, 1960-1969 (Sept. 1, 1974).

14745. Das, E. S. P., deWit, R., Armstrong, R. W., Marcinkowski, M. J., **Kinks, jogs, and a regeneration mechanism for Volterra disclinations,** *J. Appl. Phys.* **44,** No. 11, 4804-4806 (Nov. 1973).

14748. Boettinger, W. J., **The structure of directionally solidified two-phase Sn-Cd peritectic alloys,** *Met. Trans.* **5,** 2023-2031 (Sept. 1974).

14750. Reed, R. P., Schramm, R. E., **Relationship between stacking-fault energy and x-ray measurements of stacking-fault probability and microstrain,** *J. Appl. Phys.* **45,** No. 11, 4705-4711 (Nov. 1974).

14752. Farmer, B. L., Eby, R. K., **Methyl branches in hydrocarbon crystals: Calculation of relaxation effects,** *J. Appl. Phys.* **45,** No. 10, 4229-4238 (Oct. 1974).

14754. Sanchez, I. C., Peterlin, A., Eby, R. K., McCrackin, F. L., **Theory of polymer crystal thickening during annealing,** *J. Appl. Phys.* **45,** No. 10, 4216-4219 (Oct. 1974).

14758. Choi, C. S., Bulusu, S., **The crystal structure of dinitropentamethylenetetramine (DPT),** *Acta Crystallogr. B30,* Part 6, 1576-1580 (June 1974).

14779. Kuriyama, M., Early, J. G., Burdette, H. E., **An immobile dislocation arrangement in as-grown copper single crystals observed by x-ray topography,** *J. Appl. Crystallogr.* **7,** 535-540 (Dec. 1974).

14853. Prince, E., Dickens, B., Rush, J. J., **A study of one-dimensional hindered rotation in NH_3OHClO_4,** *Acta Crystallogr.* **B30,** Part 5, 1167-1172 (May 1974).

14864. Schroeder, L. W., Prince, E., Dickens, B., **Hydrogen bonding in $Ca(H_2PO_4)_2 \cdot H_2O$ as determined by neutron diffraction,** *Acta Crystallogr.* **B31,** Part 1, 9-12 (Jan. 1975).

14871. Ledbetter, H. M., **Elastic constants of polycrystals: Equivalence of Laurent-Eudier and Voigt averaging methods,** *Phys. Status Solidi A* **26,** K67-K70 (1974).

14895. Mauer, F. A., Hubbard, C. R., Piermarini, G. H., Block, S., **Measurement of anisotropic compressibilities by a single crystal diffractometer method,** Paper in *Advances in X-Ray Analysis,* W. L. Pickles, C. S. Barrett, J. B. Newkirk, and C. O. Ruud, Eds., **18,** 437-453 (Plenum Press, New York, N.Y., 1975).

14902. Manghnani, M. H., Brower, W. S., Parker, H. S., **Anomalous elastic behavior in Cu_2O under pressure,** *Phys. Status Solidi* **25,** 69-76 (1974).

14913. Yakowitz, H., **Role of the divergent beam (Kossel) x-ray technique in scanning electron microscopy,** (Proc. Seminar on Quantitative Scanning Electron Microscopy, London, England, Sept. 13-15, 1972), Chapter 13 in *Quantitative Scanning Electron Microscopy,* M. D. Muir, E. M. Boswarba and D. B. Holt, Eds., pp. 451-486 (Academic Press, London, England, Dec. 1974).

14976. Jordan, T. H., Dickens, B., Schroeder, L. W., Brown, W. E., **The crystal structure of $Ca(BF_4)_2$,** *Acta Crystallogr.* **B31,** Part 3, 669-672 (Mar. 1975).

15015. Fong, J. T., **Construction of a strain-energy function for an**

isotropic elastic material, *Trans. Soc. Rheol.* **19,** Issue 1, 99-113 (1975).

15032. Livingston, R. C., Rowe, J. M., Rush, J. J., **Neutron quasielastic scattering study of the ammonium ion reorientations in a single crystal of NH_4Br at 373 K,** *J. Chem. Phys.* **60,** No. 11, 4541-4546 (June 1, 1974).

15053. Laughlin, D. E., Cahn, J. W., **Spinodal decomposition in age hardening copper-titanium alloys,** *Acta Met.* **23,** 329-339 (Mar. 1975).

15063. Laughlin, D. E., **On the imaging of composition modulations,** *J. Appl. Crystallogr.* **7,** Part 6, 635 (Dec. 1974).

15109. Prask, H. J., Trevino, S. F., Rush, J. J., **Quasielastic neutron scattering study of ammonium-ion reorientations in ammonium perchlorate,** *J. Chem. Phys.* **62,** No. 10, 4156-4160 (May 15, 1975).

15114. Wang, F. W., **Viscoelasticity of dilute chain-molecule solutions: Evaluation of hydrodynamic interaction,** *J. Polym. Sci., Polym. Phys. Ed.* **13,** 1215-1231 (1975).

15122. Evans, A. G., Wiederhorn, S. M., Hockey, B. J., **Comments on "Dependence of Room Temperature Fracture Strength on Strain-Rate in Sapphire,"** *J. Mater. Sci. Lett.* **9,** 1367-1370 (1974).

15123. Wiederhorn, S. M., Roberts, D. E., **Influence of normal alcohols on the abrasive wear of glass,** *Wear* **32,** 51-72 (1975).

15124. Rowe, J. M., Rush, J. J., Vagelatos, N., Price, D. L., Hinks, D. G., Susman, S., **Crystal dynamics of KCN and NaCN in the disordered cubic phase,** *J. Chem. Phys.* **62,** No. 11, 4551-4554 (June 1, 1975).

15139. Schramm, R. E., Reed, R. P., **Stacking fault energies of seven commercial austenitic stainless steels,** *Metall. Trans. A* **6A,** 1345-1351 (July 1975).

15143. Peterlin, A., **Intrinsic stress tensor of polymer solutions in laminar flow,** *Makromol. Chem. Suppl.* **1,** 453-470 (1975).

15144. Bertocci, U., **Computer simulation of crystal growth on a fcc surface,** *J. Cryst. Growth* **26,** No. 2, 219-232 (Dec. 1974).

15223. Choi, C. S., Prask, H. J., Prince, E., **Crystal structure of NH_4ClO_4 at 298, 78, and 10 K by neutron diffraction,** *J. Chem. Phys.* **61,** No. 9, 3523-3529 (Nov. 1, 1974).

15225. Weston, W. F., Ledbetter, H. M., Naimon, E. R., **Dynamic low-temperature elastic properties of two austenitic nickel-chromium-iron alloys,** *Mater. Sci. Eng.* **20,** 185-194 (1975).

15235. Ito, J., **Synthetic indium silicate and indium hydrogarnet,** *Am. Mineral.* **53,** 1663-1673 (Sept.-Oct. 1968).

15237. Peterlin, A., **Dependence of diffusive transport on morphology of crystalline polymers,** *J. Macromol. Sci. Phys.* **B-11,** No. 1, 57-87 (1975).

15271. Prince, E., Trevino, S. F., Choi, C. S., Farr, M. K., **A refinement of the structure of deuterium peroxide,** *J. Chem. Phys.* **63,** No. 6, 2620-2624 (Sept. 15, 1975).

15280. Prince, E., Mighell, A. D., Reimann, C. W., Santoro, A., **Hexakis(imidazole)cobalt(II) nitrate, $[Co(C_3H_4N_2)_6](NO_3)_2$,** *Cryst. Struct. Commun.* **1,** 247-252 (1972).

15284. Choi, C. S., Abel, J. E., Dickens, B., Stewart, J. M., **The crystal structure of 1,3,5,7-tetraceto-1,3,5,7-tetrazacyclo-octane,** *Acta Crystallogr.* **B29,** Part 4, 651-656 (Apr. 1973).

15288. Bishop, M., Dimarzio, E. A., **Models of diffusion in lyotropic liquid crystals,** *Mol. Cryst. Liq. Cryst.* **28,** 311-333 (1975).

15297. Pickart, S., Rhyne, J., Alperin, H., Savage, H., **Neutron diffraction study of sputtered and annealed Tb-Fe alloys,** *Phys. Lett.* **47A,** No. 1, 73-74 (Feb. 25, 1974).

15343. Ledbetter, H. M., Weston, W. F., Naimon, E. R., **Low temperature elastic properties of four austenitic stainless steels,** *J. Appl. Phys.* **46,** No. 9, 3855-3860 (Sept. 1975).

15346. Yakowitz, H., **Use of divergent-beam x-ray diffraction to measure lattice expansion in LiF as a function of thermal-neutron dose up to 6×10^{16} nvt,** *J. Appl. Phys.* **43,** No. 11, 4793-4794 (Nov. 1972).

15383. Prince, E., **Dimethyl sulfone diimine, a neutron study,** *Acta Crystallogr. Short Structural Papers* **B31,** Part 10, 2536-2537 (1975).

15433. Green, R. E., Jr., Farabaugh, E. N., Crissman, J. M., **X-ray topographic examination of large paraffin single crystals,** *J. Appl. Phys.* **46,** No. 10, 4173-4180 (Oct. 1975).

15452. Tighe, N., **Microstructure of oxidized silicon nitride,** (Proc. 32d Annual Proc. Electron Microscopy Society of America, St. Louis, Mo., 1974), Paper in *32d Annual Proc. Electron Microscopy Society of America,* C. J. Arceneaux, Ed., pp. 470-471 (Claitor's Publ. Div., Baton Rouge, La., 1974).

15506. DeGraaf, L. A., Rush, J. J., Livingston, R. C., **Neutron scattering study of the rotational motions and phase transitions in sodium- and caesium-hydrosulfides,** (Proc. IAEA 5th Symp. on Neutron Inelastic Scattering, Grenoble, France, March 1972), Paper IAEA-SM-155/B-6 in *Neutron Inelastic Scattering,* pp. 247-258 (International Atomic Energy Agency, Vienna, Austria, 1972).

15554. Peterlin, A., **Plastic deformation of polymers with fibrous structure,** *Colloid Polym. Sci.* **253,** No. 10, 809-823 (1975).

15555. Peterlin, A., **Structural model of mechanical properties and failure of crystalline polymer solids with fibrous structure,** *Int. J. Fract.* **11,** No. 5, 761-780 (Oct. 1975).

15561. Sanchez, I. C., Eby, R. K., **Thermodynamics and crystallization of random copolymers,** *Macromolecules* **8,** No. 5, 638-641 (Sept.-Oct. 1975).

15572. Mighell, A. D., Santoro, A., **Geometrical ambiguities in the indexing of powder patterns,** *J. Appl. Crystallogr.* **8,** Part 3, 372-374 (June 1975).

15574. Santoro, A., Choi, C. S., Abel, J. E., **1,5-diacetyl-3,7-dinitro-1,3,5,7-tetraazacyclooctane (DADN),** *Acta Crystallogr.* **B31,** Part 8, 2126-2128 (Aug. 1975).

15578. Mighell, A., Santoro, A., Prince, E., Reimann, C., **Neutron diffraction structure determination of dichlorotetrapyrazolecopper(II), $Cu(C_3H_4N_2)_4Cl_2$,** *Acta Crystallogr.* **B31,** Part 10, 2479-2482 (Oct. 15, 1975).

15622. Rubin, R. J., Mazur, J., **Ordered spans of unrestricted and self-avoiding random-walk models of polymer chains. I. Space-fixed axes,** *J. Chem. Phys.* **63,** No. 12, 5362-5374 (Dec. 15, 1975).

15692. Vagelatos, N., Rowe, J. M., Rush, J. J., **Lattice dynamics of ND_4I in the NaCl phase (I) at 296 °K,** *Phys. Rev. B* **12,** No. 10, 4522-4529 (Nov. 15, 1975).

Properties of Materials: Thermodynamic and Transport

Thermodynamic studies of the $\alpha \rightarrow \beta$ phase transformation in zirconium using a subsecond pulse heating technique, A. Cezairliyan and F. Righini, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 81-84 (Jan.-Feb. 1975).

Thermal conductivity of gases. III. Some values of the thermal conductivities of argon, helium, and nitrogen from 0 °C to 75 °C at pressures of 1×10^5 to 2.5×10^7 Pascals, L. A. Guildner, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 407-413 (Mar.-Apr. 1975).

Heat capacities of polyethylene III. One linear and one branched sample from 5 to 350 K, S-S. Chang, E. F. Westrum, Jr., and H. G. Carlson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 437-441 (Mar.-Apr. 1975).

NBSIR 74-628. **Mass transport and physical properties of large crystals of calcium apatites: Studies of $Ca(OH)_2$ crystals for use in electrolytic conversion of calcium fluorapatite crystals to calcium hydroxyapatite,** A. D. Franklin and K. F. Young, 22 pages (Sept. 1, 1973-Aug. 31, 1974). Order from NTIS as COM 75-10514.

14732. Jednačak, J., Pravdić, V., Haller, W., **The electrokinetic potential of glasses in aqueous electrolyte solutions,** *J. Colloid Interface Sci.* **49,** No. 1, 16-23 (Oct. 1974).

14749. Radebaugh, R., Siegwarth, J. D., **Heat transfer between fine copper powders and dilute ^3He in superfluid ^4He,** (Proc. 13th Int. Conf. on Low Temperature Physics, Boulder, Colo., Aug. 21-25, 1972), Paper in *Low Temperature Physics LT 13,* K. D. Timmerhaus, W. J. O'Sullivan, and E. F. Hammel, Eds., **1,** 401-405 (Plenum Press, New York, N.Y., 1974).

14777. McKinney, J. E., **PVT behavior of polymeric liquid-glass systems,** *Proc. 30th National Conf. on Fluid Power, Philadelphia, Pa., Nov. 12-14, 1974,* **XXVIII,** 393-411 (1974).

14850. McKinney, J. E., Simha, R., **Configurational thermodynamic properties of polymer liquids and glasses. I. Poly(vinyl acetate),** *Macromolecules* **7,** No. 6, 894-901 (Nov.-Dec. 1974).

14906. Garn, P. D., Diamondstone, B. I., Menis, O., **Variations in the cooling transitions of potassium nitrate,** *J. Therm. Anal.* **6,** 623-630 (1974).

14914. Wu, Y. C., **Thermodynamics of mixtures of aqueous electrolyte solutions—a viewpoint on the structure of electrolyte solutions,** (Proc. Int. Symp. on Structure of Water and Aqueous Solutions, Marburg, West Germany, July 1973), Chapter II, Section 6, in *Structure of Water and Aqueous Solutions,* W. A. P. Luck, Ed., pp. 189-206 (Verlag Chemie and Physik Verlag, Weinheim/Bergstr., Germany, 1974).

14915. Huang, J. S., Goldburg, W. I., Moldover, M. R., **Observation of anomalously large supercooling in carbon dioxide,** *Phys. Rev. Lett.* **34,** No. 11, 639-642 (Mar. 17, 1975).

14944. Greer, S. C., Block, T. E., Knobler, C. M., **Concentration gradients in nitroethane + 3-methylpentane near the liquid-liquid critical solution point,** *Phys. Rev. Lett.* **34,** No. 5, 250-253 (Feb. 3, 1975).

14979. Clough, R. B., Simmons, J. A., **Thermodynamics of dislocation motion in multiaxial stress fields,** (Proc. from the John E. Dorn Symp., Cleveland, Ohio, Oct. 1972), Paper in *Rate Processes in Plastic Deformation of Materials,* J. C. M. Li and A. K. Mukherjee, Eds., pp. 266-283 (American Society for Metals, Metals Park, Ohio, 1975).

15130. Manning, J. R., Stark, J. P., **General matrix equations for diffusion drift velocity in a driving force,** *Phys. Rev. B* **12,** No. 2, 549-556 (July 15, 1975).

15264. Rush, J. J., Livingston, R. C., de Graaf, L. A., Flotow, H. E., Rowe, J. M., **Study of hydrogen diffusion in tantalum hydrides by inelastic neutron scattering,** *J. Chem. Phys.* **59,** No. 12, 6570-6576 (Dec. 15, 1973).

15333. Paule, R. C., **Calculation of complex equilibria involving vaporization into vacuum,** *High Temp. Sci.* **6,** No. 4, 267-275 (Dec. 1974).

15367. Stark, J. P., Manning, J. R., **Correlated complete-path equations for diffusion in an electric field,** *Phys. Rev. B* **9,** No. 2, 425-434 (Jan. 15, 1974).

15398. Franklin, A. D., Dragoo, A. L., **Calculation of defect-formation energies in alkaline-earth oxides: Interionic forces,** Paper in *Defects and Transport in Oxides,* M. S. Seltzer and R. I. Jaffee, Eds., pp. 141-158 (Plenum Press, New York, N.Y., 1974).

15421. Manning, J. R., **Diffusion kinetics and mechanisms in simple crystals,** (Proc. Conf. Geochemical Transport and Kinetics, Warrenton, Va., June 4-6, 1973), Chapter in *Geochemical Transport and Kinetics,* pp. 3-13 (Academic Press Inc., New York, N.Y., 1974).

15539. Manning, J. R., **Theory of diffusion,** (Proc. American Society for Metals Seminar on Diffusion, Cleveland, Ohio, Oct. 13-14, 1972), Chapter 1 in *Diffusion,* pp. 1-24 (American Society for Metals, Metals Park, Ohio, 1973).

15542. Manning, J. R., **Non-random diffusion in ionic crystals,** (Proc. Conf. on Mass Transport Phenomena in Ceramics, Cleveland, Ohio, June 3-5, 1974), Chapter in *Mass Transport Phenomena in Ceramics,* A. R. Cooper and A. H. Heuer, Eds., pp. 1-15 (Plenum Press, New York, N.Y., 1975).

Standard Reference Data

JANAF Thermochemical Tables, 1975 supplement, M. W. Chase, J. L. Curnutt, H. Prophet, R. A. McDonald, and A. N. Syverud, *J. Phys. Chem. Ref. Data* **4,** No. 1, 1-176 (1975).

Diffusion in copper and copper alloys. Part III. Diffusion in systems involving elements of the groups IA, IIA, IIIB, IVB, VB, VIB, and VIIB, D. B. Butrymowicz, J. R. Manning, and M. E. Read, *J. Phys. Chem. Ref. Data* **4,** No. 1, 177-250 (1975).

Ideal gas thermodynamic properties of ethylene and propylene, J. Chao and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4,** No. 1, 251-261 (1975).

Atomic transition probabilities for scandium and titanium. (A critical data compilation of allowed lines), W. L. Wiese and J. R. Fuhr, *J. Phys. Chem. Ref. Data* **4,** No. 2, 263-352 (1975).

Energy levels of iron, Fe I through Fe XXVI, J. Reader and J. Sugar, *J. Phys. Chem. Ref. Data* **4,** No. 2, 353-440 (1975).

Ideal gas thermodynamic properties of six fluoroethanes, S. S. Chen, A. S. Rodgers, J. Chao, R. C. Wilhoit, and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4,** No. 2, 441-456 (1975).

Ideal gas thermodynamic properties of the eight bromo- and iodomethanes, S. A. Kudchadker and A. P. Kudchadker, *J. Phys. Chem. Ref. Data* **4,** No. 2, 457-470 (1975).

Atomic form factors, incoherent scattering functions, and photon scattering cross sections, J. H. Hubbell, W. J. Veigele, E. A. Briggs, R. T. Brown, D. T. Cromer, and R. J. Howerton, *J. Phys. Chem. Ref. Data* **4,** No. 3, 471-538 (1975).

Binding energies in atomic negative ions, H. Hotop and W. C. Lineberger, *J. Phys. Chem. Ref. Data* **4,** No. 3, 539-576 (1975).

A survey of electron swarm data, J. Dutton, *J. Phys. Chem. Ref. Data* **4,** No. 3, 577-856 (1975).

Ideal gas thermodynamic properties and isomerization of *n*-butane and isobutane, S. S. Chen, R. C. Wilhoit, and B. J. Zwolinski, *J. Phys. Chem. Ref. Data* **4,** No. 4, 859-870 (1975).

Molten salts: Volume 4, part 2, chlorides and mixtures. Electrical conductance, density, viscosity, and surface tension data, G. J. Janz, R. P. T. Tomkins, C. B. Allen, J. R. Downey, Jr., G. L. Gardner, U. Krebs, and S. K. Singer, *J. Phys. Chem. Ref. Data* **4,** No. 4, 871-1178 (1975).

Monogr. 145, Part I. **Tables of spectral-line intensities. Part I—Arranged by elements,** W. F. Meggers, C. H. Corliss, and B. F. Scribner, Nat. Bur. Stand. (U.S.), Monogr. 145, Part I, 403 pages (May 1975) SD Catalog No. C13.44:145/I.

Monogr. 145, Part II. **Tables of spectral-line intensities. Part II—Arranged by wavelengths,** W. F. Meggers, C. H. Corliss, and B. F. Scribner, Nat. Bur. Stand. (U.S.), Monogr. 145, Part II, 228 pages (May 1975) SD Catalog No. C13.44:145/II.

SP396-2. **Critical surveys of data sources: Ceramics,** D. M. Johnson and J. F. Lynch, Nat. Bur. Stand. (U.S.), Spec. Publ. 396-2, 52 pages (Dec. 1975) SD Catalog No. C13.10:396-2.

NSRDS-NBS3, Section 5. **Selected tables of atomic spectra. A: Atomic energy levels—Second edition. B: Multiplet tables. N I, N II, N III,** C. E. Moore, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 3, Sec. 5, 67 pages (May 1975) SD Catalog No. 13.48:3/Sec.5.

NSRDS-NBS43. Supplement. **Selected specific rates of reactions of transients from water in aqueous solution. Hydrated electron, supplemental data,** A. B. Ross, Nat. Stand. Ref. Data. Ser., Nat. Bur. Stand. (U.S.), 43, Suppl., 43 pages (June 1975) SD Catalog No. C13.48:43, Suppl.

NSRDS-NBS51. **Selected specific rates of reactions of transients from water in aqueous solution, II. hydrogen atom,** M. Anbar, Farhataziz, and A. B. Ross, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 51, 56 pages (May 1975) SD Catalog No. C13.48:51.

NSRDS-NBS53. **Crystal structure transformations in inorganic nitrites, nitrates, and carbonates,** C. N. R. Rao, B. Prakash, and M. Natarajan, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 53, 54 pages (May 1975) SD Catalog No. C13.48:53.

NSRDS-NBS55. **Property index to NSRDS data compilations, 1964-1972,** D. R. Lide, Jr., G. B. Sherwood, C. H. Douglass, Jr., and H. M. Weisman, Nat. Stand. Ref. Data. Ser., Nat. Bur. Stand. (U.S.), 55, 15 pages (June 1975) SD Catalog No. C13.48:55.

NSRDS-NBS56. **Crystal structure transformations in inorganic sulfates, phosphates, perchlorates, and chromates,** C. N. R. Rao and B. Prakash, Nat. Stand. Ref. Data Ser., Nat. Bur. Stand. (U.S.), 56, 38 pages (Nov. 1975) SD Catalog No. C13.48:56.

TN881. **Critical evaluation of data in the physical sciences—A status report on the National Standard Reference Data System, April 1975,** S. A. Rossmassler, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 881, 53 pages (Sept. 1975) SD Catalog No. C13.46:881.

14831. Harris, K. R., Mills, R., Hanley, H. J. M., Woolf, L. A., **The self-diffusion of simple fluids: Tabulated values for argon and methane,** *Aust. Nat. Univ. Rev.* **DRU-RR 2,** pp. 1-32 (The Australian National University Press, Canberra, A.C.T. Australia, 1974).

15084. Donnay, J. D. H., Ondik, H. M., **Crystal data determinative tables, Vol. 1. Organic compounds,** 999 pages (1972); **Vol. 2. Inorganic compounds,** 2106 pages (1972).

15266. Hilsenrath, J., **The utility and economics of an on-line reference data network,** (Proc. Conf. on Mechanism of Explosions and Blast Waves, Naval Weapons Station, Yorktown, Va., Nov. 13-15, 1973), Paper in *Proceedings of the Conference on Mechanism of Explosions and Blast Waves,* Section XVII, 1-21 (Picatinny Arsenal, Dover, N.J., 1973).

15300. Martin, W. C., **Atomic spectroscopy—Some data centers and compilations,** (Proc. 4th Int. CODATA Conf. on Generation, Compilation, Evaluation and Dissemination of Data for Science and Technology, Tsakhcadzor, U.S.S.R., June 24-27, 1974), *CODATA Bull.* **14,** 112-115 (CODATA Secretariat, Paris, France, 1974).

15301. Lide, D. R., Jr., **The NSRDS experience,** (Proc. 4th Int. CODATA Conf. on Generation, Compilation, Evaluation and Dissemination of Data for Science and Technology, Tsakhcadzor, U.S.S.R., June 24-27, 1974), *CODATA Bull.* **14,** 6-9 (CODATA Secretariat, Paris, France, 1974).

15305. Lide, D. R., Jr., **The Standard Reference Data System,** *Chem. Eng. Prog.* **67,** No. 11, 77-78 (Nov. 1971).

15483. Lide, D. R., Jr., **Preface,** *Proc. Conf. Critical Evaluation of Chemical and Physical Structural Information, Dartmouth College, Hanover, N.H., June 24-29, 1973,* D. R. Lide, Jr. and M. A. Paul, Eds., pp. iii-vii (National Academy of Sciences, Washington, D.C., 1974).

15512. White, H. J., Jr., **Data centers and data evaluation,** *Proc. Conf. on Thermodynamics and National Energy Problems, Warrenton, Va., June 10-12, 1974,* pp. 372-382 (National Academy of Sciences, Washington, D.C., 1975).

Standard Reference Materials

Monogr. 148. **The role of standard reference materials in measurement systems,** J. P. Cali, T. W. Mears, R. E. Michaelis, W. P. Reed, R. W. Seward, C. L. Stanley, H. T. Yolken, and H. H. Ku, Nat. Bur. Stand. (U.S.), Monogr. 148, 54 pages (Jan. 1975) SD Catalog No. C13.44:148.

SP260, 1975-76 Edition. **Catalog of NBS Standard Reference Materials 1975-76 Edition,** R. W. Seward, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-1975-76 catalog, 92 pages (June 1975) SD Catalog No. C13.10:260-1975-76 cat.

SP260-46. **Standard reference materials: Thermal conductivity and electrical resistivity. Standard reference materials: Austenitic stainless steel, SRM's 735 and 798, from 4 to 1200 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-46, 42 pages (Mar. 1975) SD Catalog No. C13.10:260-46.

SP260-50. **Standard reference materials: Thermal conductivity and electrical resistivity standard reference materials: Electrolytic iron SRM's 734 and 797 from 4 to 1000 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-50, 41 pages (June 1975) SD Catalog No. C13.10:260-50.

SP260-51. **Standard reference materials: Glass filters as a Standard Reference Material for spectrophotometry—selection, preparation, certification, use, SRM 930,** R. Mavrodineanu and J. R. Baldwin, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-51, 118 pages (Nov. 1975) SD Catalog No. C13.10:260-51.

SP260-52. **Standard reference materials: Thermal conductivity and electrical resistivity standard reference materials: Tungsten SRM's 730 and 799, from 4 to 3000 K,** J. G. Hust and P. J. Giarratano, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-52, 47 pages (Sept. 1975) SD Catalog No. C13.10:260-52.

SP260-53. **Standard Reference Materials: Standardization of pH measurements,** R. A. Durst, Nat. Bur. Stand. (U.S.), Spec. Publ. 260-53, 48 pages (Dec. 1975) SD Catalog No. C13.10: 260-53.

SP408. **Standard reference materials and meaningful measurements,** R. W. Seward, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 408, 820 pages (Mar. 1975) SD Catalog No. C13.10:408.

Standard reference materials and meaningful measurements—An overview, R. D. Huntoon, *SP408*, pp. 4-56 (Mar. 1975).

Possibilities for international cooperative efforts in standard reference materials, J. P. Cali, *SP408*, pp. 57-67 (Mar. 1975).

Activity by the International Organization for Standardization with respect to standard reference materials, F. L. LaQue, *SP408*, pp. 68-73 (Mar. 1975).

The analytical quality control programme of the International Atomic Energy Agency, O. Suschny and D. M. Richman, *SP408*, pp. 74-102 (Mar. 1975).

The activities of the European economic community in the field of reference materials and methods, K. F. Lauer and H. Laurent, *SP408*, pp. 103-117 (Mar. 1975).

Calibration and test materials for physicochemical measurements, H. Kienitz, *SP408*, pp. 118-126 (Mar. 1975).

Selection criteria of a material as standard reference material and steps for certification, G. Milazzo, *SP408*, pp. 127-145 (Mar. 1975).

Statistics and standard reference materials, J. Mandel, *SP408*, pp. 146-160 (Mar. 1975).

National SRM program in France, G. Denegre and A. Marschal, *SP408*, pp. 161-166 (Mar. 1975).

National RM program in Germany (FRG), R. J. A. Neider, *SP408*, pp. 167-188 (Mar. 1975).

The current status of SRM activities in Japan, T. Tsuchiya, *SP408*, pp. 189-200 (Mar. 1975).

National SRM programs in Poland, T. Plebanski, *SP408*, pp. 201-223 (Mar. 1975).

Reference materials in the United Kingdom, J. D. Cox, *SP408*, pp. 224-236 (Mar. 1975).

The national standard reference materials program in the U.S.A., H. T. Yolken, *SP408*, pp. 237-245 (Mar. 1975).

The SRM story at NBS, R. E. Michaelis, *SP408*, pp. 246-257 (Mar. 1975).

The role of the American National Standards Institute in national and international consensus standards programs, R. P. Trowbridge, *SP408*, pp. 258-266 (Mar. 1975).

ASTM in the U.S. measurement system, W. T. Cavanaugh, *SP408*, pp. 267-274 (Mar. 1975).

Chemical composition control problems and solutions related to metals and alloys, R. S. Cremisio, *SP408*, pp. 275-297 (Mar. 1975).

Measurement problems in physical and mechanical properties of industrial metals and the use of SRM's, J. Convey, *SP408*, pp. 298-319 (Mar. 1975).

High-purity compounds: An overview, A. J. Barnard, Jr., *SP408*, pp. 320-335 (Mar. 1975).

Industrial SRM needs and measurement problems in inorganic materials—chemical properties, V. A. Stenger, *SP408*, pp. 336-354 (Mar. 1975).

Industrial standard reference material (SRM) needs: Organic materials, J. Mitchell, Jr., *SP408*, pp. 355-365 (Mar. 1975).

"Meaningful Measurement" in clinical chemistry, J. H. Boutwell, *SP408*, pp. 366-386 (Mar. 1975).

Standard reference materials and environmental monitoring, E. W. Bretthauer, G. B. Morgan, and R. E. Jaquish, *SP408*, pp. 387-394 (Mar. 1975).

SRM needs and measurement problems in science—chemical properties, T. W. Mears, *SP408*, pp. 395-410 (Mar. 1975).

14905. Hubbard, C. R., Swanson, H. E., Mauer, F. A., **A silicon powder diffraction standard reference material,** *J. Appl. Crystallogr.* **8**, Part 1, 45-48 (Feb. 1975).

15012. Epstein, M. S., Rains, T. C., Menis, O., **Determination of cadmium and zinc in standard reference materials by atomic fluorescence spectrometry with automatic scatter correction,** *Can. J. Spectrosc.* **20**, No. 1, 22-26 (Jan.-Feb. 1975).

15265. Cali, J. P., Stanley, C. L., **Measurement compatibility and Standard Reference Materials,** Chapter in *Annual Review of Materials Science* **5**, 329-343 (Annual Reviews Inc., Palo Alto, Calif., 1975).

15344. Maienthal, E. J., **Analysis of botanical standard reference materials by cathode ray polarography,** *J. Assoc. Off. Anal. Chem.* **55**, No. 5, 1109-1113 (1972).

15392. Carpenter, B. S., Gilliam, D. M., Reimer, G. M., **Induced fission tracks in glass from monoenergetic and thermal neutrons,** *ANS Trans.* **18**, 90 (1974).

15441. Armstrong, G. T., Johnson, W. H., **Standard reference materials for combustion calorimetry,** *Proc. Third Int. Conf. on Chemical Thermodynamics, Baden near Vienna, Austria, Sept. 3-7, 1973*, **VIII**, 55-72 (International Union of Pure and Applied Chemistry, Oxford, England, 1974).

15447. Hughes, E. E., **Development of standard reference materials for air quality measurement,** (Proc. Int. Instrumentation-Automation Conf. & Exhibit, New York, N.Y., Oct. 28-31), *ISA Reprint 74-704*, 13 pages (Instrument Society of America, Pittsburgh, Pa., 1974).

15509. Reneker, D. H., Martin, G. M., Rubin, R. J., Colson, J. P., **Effect of polymeric structure on the permeation rate in standard reference material sulfur dioxide permeation tubes,** (Proc. Society of Plastics Engineers ANTEC Conf., San Francisco, Calif., May 1974), *Polym. Eng. Sci.* **15**, No. 1, 11-15 (Jan. 1975).

595-079 OL - 76 - 22

15573. Cali, J. P., **Reference materials in clinical chemistry,** *Fed. Proc.* **34,** No. 12, 2123-2126 (Nov. 1975).

Surfaces and Interfaces

Unbound water content from application of adsorption theory, W. V. Loebenstein, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 4, 565-576 (July-Aug. 1975).

14806. Gadzuk, J. W., **Angular distributions of electrons photoemitted from chemisorbed atoms,** *Solid State Commun.* **15,** No. 6, 1011-1016 (1974).

14807. Plummer, E. W., Waclawski, B. J., Vorburger, T. V., **Photoelectron spectra of the decomposition of ethylene on (110) tungsten,** *Chem. Phys. Lett.* **28,** No. 4, 510-515 (Oct. 15, 1974).

14887. Klein, R., Yates, J. T., Jr., **Nitric oxide and its decomposition on the (110) plane of tungsten,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 461-464 (1974).

14945. Madey, T. E., Menzel, D., **Adsorption of CO on (001) ruthenium at temperatures $\geqslant$ 300 K,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 229-235 (1974).

14975. Gadzuk, J. W., **Relaxation energies in chemisorption spectroscopy,** *J. Vac. Sci. Technol.* **12,** No. 1, 289-292 (Jan.-Feb. 1975).

14978. Gadzuk, J. W., **Electron spectroscopy of chemisorbed atoms and surface molecules,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 851-858 (1974).

14981. Gadzuk, J. W., **Surface molecules and chemisorption, II. Photoemission angular distributions,** *Phys. Rev. B* **10,** No. 12, 5030-5044 (Dec. 15, 1974).

14982. Plummer, E. W., Waclawski, B. J., Vorburger, T., **Experimental observations of electronic energy levels at a solid-vacuum interface,** (Proc. Symp. on Electrocatalysis, San Francisco, Calif., May 13-15, 1974), Paper in *Electrocatalysis,* M. W. Breiter, Ed., pp. 43-57 (Electrochemical Society Inc., Princeton, N.J., 1974).

14984. Sunjić, M., Sokčević, D., Gadzuk, J. W., **Determination of electron attenuation lengths in metals: Transmission through thin adsorbed films,** (Proc. 2nd Int. Conf. on Solid Surfaces, Kyoto, Japan, March 25-29, 1974), *Jap. J. Appl. Phys. Suppl.* **2,** Part 2, 753-756 (1974).

15061. Kucirek, J., Melmed, A. J., **Influence of an initial (contamination) film on the determination of film properties by ellipsometry,** *J. Opt. Soc. Amer.* **65,** No. 5, 611-612 (May 1975).

15089. Waclawski, B. J., Vorburger, T. V., Stein, R. J., **Angular dependence of uv photoelectron distributions for oxygen adsorbed on W(100),** *J. Vac. Sci. Technol.* **12,** No. 1, 301-304 (Jan.-Feb. 1975).

15090. Penn, D. R., **Determination of the spin-polarized surface density of states in strongly correlated metals by field emission: Theory,** *Phys. Rev. B* **11,** No. 8, 3208-3209 (Apr. 15, 1975).

15091. Vorburger, T. V., Penn, D., Plummer, E. W., **Field emission work functions,** *Surface Sci.* **48,** 417-431 (1975).

15095. Plummer, E. W., Gadzuk, J. W., Penn, D. R., **Vacuum-tunneling spectroscopy,** *Phys. Today* **28,** No. 4, 63-71 (Apr. 1975).

15135. Penn, D. R., **The dependence of the tunneling current on density of states in non-superconducting junctions,** *Surface Sci.* **50,** 125-136 (1975).

15147. Fuggle, J. C., Madey, T. E., Steinkilberg, M., Menzel, D., **X-ray photoelectron satellites from adsorbed species,** *Chem. Phys. Lett.* **33,** No. 2, 233-236 (June 1, 1975).

15201. Dresser, M. J., Madey, T. E., Yates, J. T., Jr., **The adsorption of xenon by W(111), and its interaction with preadsorbed oxygen,** *Surface Sci.* **42,** 533-551 (1974).

15283. Wyatt, D. M., Gray, R. C., Carver, J. C., Hercules, D. M., Masters, L. W., **Studies of polymeric bond failure on aluminum surfaces by x-ray photoelectron spectroscopy (ESCA),** *Appl. Spectrosc.* **28,** No. 5, 439-445 (Sept.-Oct. 1974).

15318. Yates, J. T., Jr., **Catalysis,** *Chem. Eng. News* **52,** No. 34, 19-22, 24-29 (Aug. 26, 1974).

15347. Yates, J. T., Jr., Erickson, N. E., **X-ray photoelectron spectroscopic study of the physical adsorption of xenon and the chemisorption of oxygen on tungsten (111),** *Surface Sci.* **44,** No. 2, 489-514 (1974).

15480. Harvey, W. W., Kruger, J., **The passivity of gallium arsenide,** (Proc. 3d Int. Conf. on Passivity of Metals, Cambridge, England, July 1970), Paper in *Electrochim. Acta* **16,** 2017-2037 (1971).

Thermodynamics and Chemical Kinetics

Equation of state for thermodynamic properties of fluids, R. D. Goodwin, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 1, 71-79 (Jan.-Feb. 1975).

The enthalpies of combustion and formation of nicotinic acid and creatinine, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 2, 425-430 (Mar.-Apr. 1975).

The enthalpies of combustion and formation of ortho- and parafluorobenzoic acid, W. H. Johnson and E. J. Prosen, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 3, 481-486 (May-June 1975).

The enthalpies of combustion and formation of acetanilide and urea, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 3, 487-491 (May-June 1975).

The enthalpies of combustion and formation of cholesterol [cholest-5-en-3-ol (3β)], W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 3, 493-496 (May-June 1975).

A correlation for the second interaction virial coefficients and enhancement factors for moist air, R. W. Hyland, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 4, 551-560 (July-Aug. 1975).

The enthalpies of combustion and formation of thianthrene, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 4, 561-564 (July-Aug. 1975).

Some thermodynamic properties of bromobenzene from 0 to 1500 K, J. F. Masi and R. B. Scott, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 5, 619-628 (Sept.-Oct. 1975).

The enthalpies of combustion and formation of 2,2′-dichloroethyl sulfide, W. H. Johnson, *J. Res. Nat. Bur. Stand. (U.S.),* **79A** (Phys. and Chem.), No. 5, 634-638 (Sept.-Oct. 1975).

Corrections to paper entitled "Third Virial Coefficient for Air-Water Vapor Mixtures," R. W. Hyland and E. A. Mason, *J.*

Res. Nat. Bur. Stand. (U.S.), **79A** (Phys. and Chem.), No. 6, 775-776 (Nov.-Dec. 1975).

SP371-1. **Supplementary bibliography of kinetic data on gas phase reactions of nitrogen, oxygen, and nitrogen oxides (1972-1973),** F. Westley, Nat. Bur. Stand. (U.S.), Spec. Publ. 371-1, 88 pages (June 1975) SD Catalog No. C13.10:371-1.

NBSIR 74-398. **Provisional values for the thermodynamic functions of ethane,** R. D. Goodwin, 342 pages (June 1, 1974). Order from NTIS as COM 75-10130.

NBSIR 74-600. **Thermodynamics of chemical species important to rocket technology,** C. W. Beckett, 200 pages (Oct. 1, 1974). Order from NTIS as ADA008935.

NBSIR 75-763. **Thermodynamic and transport properties of ethylene and propylene,** I. A. Neduzhii (Principal Author), 210 pages (June 1972). Order from NTIS as COM 75-11276.

NBSIR 75-770. **The equation of state for ammonia,** L. Haar and J. Gallagher, 27 pages (Sept. 1975). Order from NTIS as COM 75-11370.

14772. Sengers, J. M. H. L., Greer, W. L., Sengers, J. V., **Scaled parametric equation of state for oxygen in the critical region,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper in *Advances in Cryogenic Engineering,* K. D. Timmerhaus, Ed., **19,** 358-364 (Plenum Press, New York, N.Y., 1974).

14775. Ely, J. F., McQuarrie, D. A., **Calculation of dense fluid transport properties via equilibrium statistical mechanical perturbation theory,** *J. Chem. Phys.* **60,** No. 11, 4105-4108 (June 1, 1974).

14870. Parrish, W. R., Hiza, M. J., **Liquid-vapor equilibria in the nitrogen-methane system between 95 and 120 K,** (Proc. 1973 Cryogenic Engineering Conf., Atlanta, Ga., Aug. 8-10, 1973), Paper H-2 in *Advances in Cryogenic Engineering* **19,** 300-308 (Plenum Press, New York, N.Y., 1974).

14899. Lias, S. G., Ausloos, P., **Structure and reactivity of $C_4H_8^+$ ions formed in the radiolysis of cycloalkanes in the gas phase,** *J. Amer. Chem. Soc.* **92,** No. 7, 1840-1847 (Apr. 8, 1970).

14931. Heydemann, P. L. M., Welch, B. E., **Piston gages,** Chapter 4 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 3, pp. 147-202 (Butterworth and Co., London, England, 1975).

14932. Sengers, J. M. H. L., **Thermodynamic properties near the critical state,** Chapter 14 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 657-724 (Butterworth and Co., London, England, 1975).

14933. Ruthberg, S., **Pressure measurements for the range 1 kPa to 100 μPa,** Chapter 4 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., Part 6, pp. 229-271 (Butterworth and Co., London, England, 1975).

14934. Cezairliyan, A., Beckett, C. W., **Electrical discharge techniques for measurements of thermodynamic properties of fluids at high temperatures,** Chapter 24 in *Experimental Thermodynamics, Vol. II. Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 1161-1192 (Butterworth and Co., London, England, 1975).

15022. Weber, L. A., **Thermodynamic and related properties of parahydrogen from the triple point to 300 K at pressures to 1000 bar,** *NASA Spec. Publ. 3088,* 100 pages (National Aeronautics and Space Administration, Washington, D.C., Mar. 1975). (Available from the National Technical Information Service, Springfield, Va. 22161).

15132. McCarty, R. D., **Determination of thermodynamic properties from the experimental *p-V-T* relationships,** Chapter 10 in *Experimental Thermodynamics, Vol. II—Experimental Thermodynamics of Non-Reacting Fluids,* B. Le Neindre and B. Vodar, Eds., pp. 501-526 (Butterworth and Co., Ltd., London, England 1975).

15150. Mountain, R. D., **A geometrical description of critical phenomena,** *J. Wash. Acad. Sci.* **64,** No. 3, 195-198 (1974).

15174. Goldberg, R. N., **Thermodynamics of hexokinase-catalyzed reactions,** *Biophys. Chem.* **3,** 192-205 (1975).

15234. Herron, J. T., Huie, R. E., **Rate constants for the reactions of ozone with ethene and propene, from 235.0 to 362.0 K,** *J. Phys. Chem.* **78,** No. 21, 2085-2088 (1974).

15310. Hanley, H. J. M., Watts, R. O., **Molecular dynamic calculation of the thermodynamic properties of methane,** *Aust. J. Phys.* **28,** 315-324 (1975).

15328. Laufer, A. H., Bass, A. M., **Rate constants of the combination of methyl radicals with nitric oxide and oxygen,** *Int. J. Chem. Kinet.* **VII,** No. 5, 639-648 (1975).

15355. Huie, R. E., Herron, J. T., **Temperature dependence of the rate constants for reactions of ozone with some olefins,** (Proc. Symp. on Chemical Kinetics Data for the Upper and Lower Atmosphere, Warrenton, Va., Sept. 15-18, 1974), *Int. J. Chem. Kinet. Symp.,* No. 1, 165-181 (John Wiley & Sons, Inc., New York, N.Y., 1975).

15357. Phillips, J. C., Wall, L. A., Aldridge, M. H., **Liquid (melt) heat capacities and heats of vaporization of oligomers of poly(hexamethylene sebacate),** *Polym. Eng. Sci.* **15,** No. 2, 73-78 (Feb. 1975).

15450. Armstrong, G. T., **The infrastructure of the thermochemical measurement system,** (Proc. Quatrieme Conf. Int. de Thermodynamique Chimique, Montpellier, France, Aug. 26-30, 1975), Chapter in *Thermochimie* **I,** 11-18 (Centre de Recherches de Microcalorimétrie et de Thermochimie du C.N.R.S., Marseille, France, 1975).

15601. Sengers, J. M. H. L., Sengers, J. V., **Universality of critical behavior in gases,** *Phys. Rev. A* **12,** No. 6, 2622-2627 (Dec. 1975).

15691. Greer, S. C., Hocken, R., **Thermal expansion near a critical solution point,** *J. Chem. Phys.* **63,** No. 12, pp. 5067-5072 (Dec. 15, 1975).

Technology Incentives

NBSIR 75-696. **Proceedings of GSA/ETIP Symposium on Procurement Practices, May 29-31, 1974,** 96 pages (Jan. 1975). Order from NTIS as COM 75-10527.

NBSIR 75-716. **Proceedings of procurement practices symposium, Federal, State and local, January 28-30, 1975,** T. J. Fody and J. G. Berke, 168 pages (May 1975). Order from NTIS as COM 75-11210.

NBSIR 75-721. **Economic objectives of utility companies and developers in evaluating a MIUS,** B. J. Bartter, 39 pages (Nov. 1975). Order from NTIS as PB246864.

NBSIR 75-778. **ETIP: THE FIRST 18 MONTHS. A progress report of the experimental technology incentives program, National Bureau of Standards,** J. D. Lewis, 74 pages (Aug. 1975). Order from NTIS as PB246435.

15595. Berke, J. G., **Procurement—The pull side of technology transfer,** (Proc. ASME 5th Intersociety Conf. on Environmental Systems, San Francisco, Calif., July 21-24, 1975), *75-ENAs-3*, pp. 1-4 (The American Society of Mechanical Engineers, New York, N.Y., 1975).

Other Subjects of General Interest

SP304A, Revised August 1975. **Brief history of measurement systems with a chart of the modernized metric system,** Nat. Bur. Stand. (U.S.), Spec. Publ. 304A, 4 pages (Aug. 1975).

SP305. Supplement 6. **Publications of the National Bureau of Standards 1974 catalog. A compilation of abstracts and key word and author indexes,** B. L. Hurdle, Ed., Nat. Bur. Stand. (U.S.), Spec. Publ. 305 Suppl. 6, 523 pages (June 1975) SD Catalog No. C13.10:305 Suppl. 6.

SP410. **NBS metric kit,** Nat. Bur. Stand. (U.S.), Spec. Publ. 410, envelope containing 7 items (1975) SD Catalog No. C13.10:410.

SP430. **Household weights and measures,** Nat. Bur. Stand. (U.S.), Spec. Publ. 430, 2 pages (Sept. 1975) SD Catalog No. C13.10:430.

BSS70. **Windows and people: A literature survey. Psychological reaction to environments with and without windows,** B. L. Collins, Nat. Bur. Stand. (U.S.), Bldg. Sci. Ser. 70, 92 pages (June 1975) SD Catalog No. C13.29/2:70.

FIPS PUB 41. **Computer security guidelines for implementing The Privacy Act of 1974,** T. C. Lowe, Standards Coordinator, Nat. Bur. Stand. (U.S.), Fed. Info. Process. Stand. Publ. (FIPS PUB) 41, 20 pages (1975) SD Catalog No. C13.52:41.

TN860. **NBS reactor: Summary of activities July 1973 to June 1974,** R. S. Carter, Nat. Bur. Stand. (U.S.), Tech. Note 860, 143 pages (Apr. 1975) SD Catalog No. C13.46:860.

TN888. **Nuclear Science Education Day,** F. J. Shorten, Ed., Nat. Bur. Stand. (U.S.), Tech. Note 888, 95 pages (Nov. 1975) SD Catalog No. C13.46:888.

Nuclear power: Everyone's involved, J. L. Liverman, *TN888*, pp. 1-2 (Nov. 1975).

Energy research and the Electric Power Research Institute, R. L. Loftness, *TN888*, pp. 13-33 (Nov. 1975).

The role of the public in the evaluation process, G. Charnoff, *TN888*, pp. 34-37 (Nov. 1975).

Assessing environmental effects, the risk and benefit concept, B. E. Leonard, *TN888*, pp. 38-45 (Nov. 1975).

Ecological monotoring techniques, B. Jensen, *TN888*, pp. 46-49 (Nov. 1975).

Radiation utilization in medicine and biology, V. P. Bond, *TN888*, pp. 50-61 (Nov. 1975).

Advanced concepts in applied nuclear science, G. A. Graves, *TN888*, pp. 62-76 (Nov. 1975).

Projected national and regional manpower needs for environmental and nuclear scientists, R. L. Murray, *TN888*, pp. 77-80 (Nov. 1975).

Educational opportunities at institutions of higher learning, D. Duffy, *TN888*, pp. 81-84 (Nov. 1975).

NBSIR 75-687. **Effective use of computing technology in vote-tallying,** R. G. Saltman, 140 pages (Mar. 1975). Order from NTIS as COM 75-11137.

NBSIR 75-689. **The Shirley Highway Express Bus-on-Freeway demonstration project/a study of park-and-riding,** J. T. McQueen, G. K. Miller, and C. Harrison, 51 pages (Mar. 1975). Order from NTIS as COM 75-11190.

NBSIR 75-785. **The review of standardization and measurement services at the Ecuadorian Institute for Standardization,** R. Estrada and H. S. Peiser, 17 pages (June 27-29, 1974). Order from NTIS as PB246345.

14751. Mihalas, D., Hummer, D. G., **Theory of extended stellar atmospheres. I. Computational method and first results for static spherical models,** *Astrophys. J. Suppl. Ser.* **28,** No. 265, 343-372 (Oct. 1974).

14815. Molino, J. A., **Measuring human aversion to sound without verbal descriptors,** *Percept. Psychophys.* **16,** No. 2, 303-308 (Oct. 1974).

14821. Molino, J. A., Zerdy, G. A., Frome, F. S., **Toward a more musical foghorn,** *Hum. Factors.* **16,** No. 6, 567-575 (Dec. 1974).

14822. Eisenhart, C., **Karl Pearson,** Paper in *Dictionary of Scientific Biography,* **X,** 447-473 (Charles Scribner's Sons, New York, N.Y., 1974).

14837. Dalke, J. L., **Why metric and when?,** *Tappi* **57,** No. 12, 72-75 (Dec. 1974).

14841. Ayres, T. R., Linsky, J. L., Shine, R. A., **A possible width-luminosity correlation of the Ca II K_1 and Mg II k_1 features,** *Astrophys. J.* **195,** No. 3, L121-L124 (Feb. 1, 1975).

14892. Mulholland, J. D., Plotkin, H. H., Silverberg, E. C., Wilkinson, D. T., Alley, C. O., Bender, P. L., Currie, D. G., Dicke, R. H., Faller, J. E., Kaula, W. M., Williams, J. G., **A self-consistent set of surface coordinates for the Apollo lunar laser retroreflectors deduced from laser range measures,** (Proc. 15th Planetary Meeting of COSPAR, Madrid, Spain, May 1972), Paper in *Space Research* **XIII,** M. J. Rycroft and S. K. Runcorn, Eds., **2,** 1009-1013 (Akademie-Verlag, Berlin, Germany, Dec. 1973).

14912. Brill, R. H., Barnes, I. L., Adams, B., **Lead isotopes in some ancient Egyptian objects,** Paper in *Recent Advances in Science and Technology of Materials,* A. Bishay, Ed., **3,** 9-27 (Plenum Publishing Corp., New York, N.Y., 1974).

15017. Eisenhart, C., **A supplementary list of publications of S. S. Wilks,** *Amer. Statist.* **29,** No. 1, 25-27 (Feb. 1975).

15131. Cotton, I. W., **Microeconomics and the market for computer services,** *Comput. Surv.* **7,** No. 2, 95-111 (June 1975).

15145. Lofquist, K. E., **An effect of permeability on sand transport by waves (Abstract only),** *EOS, Trans. Amer. Geophys. Union* **56,** No. 6, 370 (June 1975).

15151. Prosen, E. J., Cole, K. S., **Heat production of Arbacia eggs revisited (Extended Abstract),** *Biol. Bull.* **145,** No. 2, 450-451 (Oct. 1973).

15260. Hagan, L., **Reports of observatories for 1973/74, National Bureau of Standards, Washington, D.C.,** *Bull. Am. Astron. Soc.* **7,** No. 1, 165-169 (1975).

15282. Zahn, J. P., **The dynamical tide in close binaries,** *Astron. Astrophys.* **41,** No. 314, 329-344 (July 1975).

15363. Marshall, H. E., **"Cost sharing for recreation: Efficiency and equity:" Comment,** *Land Economics* **LI,** No. 3, 300-303 (Aug. 1975).

15378. Brown, C. P., Yeates, E. J., Van Hoesen, M. J., **Use and cost of on-line systems at the National Bureau of Standards Library,** *Proc. Am. Soc. Inf. Sci. Annual Meeting, Boston, Mass., Oct. 26-30, 1975,* **12,** 132-133 (Oct. 1975).

15428. Albus, J. S., **A new approach to manipulator control: The cerebellar model articulation controller (CMAC),** *Trans. ASME—J. Dyn. Syst. Meas. Control* **97,** No. 3, 220-227 (Sept. 1975).

15434. Prask, H., Trevino, S., Tsai, D. H., MacDonald, R. A., Kemmey, P., Yip, S., **Computer simulation studies of the microscopic behavior of shocked solids,** *Proc. Conf. on Mechanisms of Explosion and Blast Waves, Naval Weapons Station, Yorktown, Va., Nov. 13-15, 1973,* 1-21 (1974).

15435. McLaughlin, W. L., **Radiation sources and dosimetry,** *Food Irradiation Information* **4,** 44-45, 58 (Mar. 1975).

15481. Stiehler, R. D., **Measurement units in engineering and SI,** *Proc. Symp. on Standardization and Metric Conversion for Tunneling, Underground Construction, and Mining, Washington, D.C., May 21, 1974,* pp. 42-48 (Available from the National Technical Information Service, Springfield, Va., 1975).

15499. Miller, G. K., **Shirley Highway Bus-On-Freeway Project evaluation study,** (Proc. Social Experiments & Social Program Evaluation Symp., Gaithersburg, Md., May 22, 1972), Paper in *Social Experiments and Social Program Evaluation,* pp. 40-53 (Ballinger Publ. Co., 1974).

15513. Eisenhart, C., **Samuel S. Wilks and the army experiment design conference series,** *Proc. Twentieth Conf. on the Design of Experiments in Army Research Development and Testing, Ft. Belvoir, Va., Oct. 23-25, 1974,* ARO Report 75-2, Pt. 1, 1-47 (Army Dept., Chief of Research, Development and Acquisition, 1974).

15587. Shank, R., Henderson, M., **Federal Library cooperation,** *Library Trends* **24,** No. 2, 277-292 (Oct. 1975).

15607. Goldman, A. J., **The adequacy of management science technology for nonmilitary applications in the Federal Government,** (Proc. Workshop on Management Science in the Federal Government, Washington, D.C., Sept. 18, 1969), Chapter 6 in *Management and Policy Science in American Government,* M. J. White, M. Radnor, and D. A. Tansik, Eds., Part III, pp. 135-170 (Lexington Books, D. C. Heath & Co., Lexington, Mass., 1975).

15699. Fechter, J. V., Pezoldt, V. J., Persensky, J. J., Lepkowski, J. R., **Study of the National Standards for Directional and Other Official Signs. Overview of their adequacy,** *Report No. FHWA-RD-75-118,* 75 pages (Available from the National Technical Information Service, Springfield, Va., 22161, Oct. 1975).

6. INDEXES

6.1 HOW TO USE THE INDEXES

In addition to the usual author index, a subject index is provided in the form of a permuted key word index. In this type of index the key words in each publication or paper are arranged by shifting each group of key words along the horizontal printing line so that each key word in turn has an opportunity to appear alphabetically. The user is thus able to locate papers of interest to him through the subject-related words he finds in the key word index.

The index symbols used in the author and key word indexes are explained in the following three tables. These tables also give the pages on which the abstracts of the various publication series begin.

Table A. Symbols for the Periodicals

NBS Journal of Research	Index Symbol			Issue Date	Page Number
	Vol.	Sec.	No.		
Section A	J79	A	1	January–February 1975	29
	J79	A	2	March–April 1975	29
	J79	A	3	May–June 1975	30
	J79	A	4	July–August 1975	31
	J79	A	5	September–October 1975	32
	J79	A	6	November–December 1975	33
Section B	J79	B	1&2	January–June 1975	35
	J79	B	3&4	July–December 1975	36

DIMENSIONS/NBS	Index Symbol		Issue Date	Page Number
	Vol.	No.		
DIM	59	1	January 1975	37
DIM	59	2	February 1975	37
DIM	59	3	March 1975	37
DIM	59	4	April 1975	37
DIM	59	5	May 1975	38
DIM	59	6	June 1975	38
DIM	59	7	July 1975	38
DIM	59	8	August 1975	38
DIM	59	9	September 1975	38
DIM	59	10	October 1975	39
DIM	59	11	November 1975	39
DIM	59	12	December 1975	39

Journal of Physical and Chemical Reference Data	Index Symbol		Issue Date	Page Number
	Vol.	No.		
J. Phys. Chem. Ref. Data	4	1	1975	40
	4	2	1975	40
	4	3	1975	41
	4	4	1975	41

Table B. Symbols for the Nonperiodicals

NBS Nonperiodical Series	Index Symbol	Page Number
Monographs	Monogr.	43
Handbooks	H	45
Special Publications	SP	46
Applied Mathematics Series	AMS	90
National Standard Reference Data Series	NSRDS	91
Building Science Series	BSS	92
Federal Information Processing Standards	FIPS PUBS	98
Product Standards	PS	100
Technical Notes	TN	101
Consumer Information Series	CIS	110
NBS Interagency Reports	NBSIR	111
JPCRD		

Table C. Symbols for the Papers Published by Others (1975)

NBS Papers Published by Others (1975)	Index Symbol	Page Number
Professional Journals, Books, Book Chapters, Proceedings, etc.	Five-Digit numbers, 14720 through 15706	139

6.2. AUTHOR INDEX

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Rodgers, A. S., Chao, J., Wilhoit, R. C., Zwolinski, B. J., Chen, S. S., *J. Phys. Chem. Ref. Data* **4,** No. 2, 441-456 (1975).
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Ross, G. S., Lauritzen, J. I. Jr., Hoffman, J. D., Frolen, L. J., *J.79A No. 6, 671-699 (1975).*
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Scott, R. B., Masi, J. F., *J.***79A** *No. 5, 619-628 (1975).*
Scott, W. W., Adams, J. W., Bensema, W. D., Dobroski, H., *NBSIR 74-391.*
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Seward, R. W., *SP408.*
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Sigaud, J., Coçu, F., McEllistrem, M. T., Lachkar, J., Haouat, G., Lagrange, C., Patin, Y., Shamu, R. E., *SP425,* pp. 942-945.

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Singh, U. N., Hacken, G., Liou, H. I., Rainwater, J., *SP425,* pp. 780-783.

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Wilhoit, R. C., Zwolinski, B. J., Chen, S. S., *J. Phys. Chem. Ref. Data* **4**, No. 4, 859-870 (1975).
Wilkinson, D. T., Alley, C. O., Bender, P. L., Currie, D. G., Dicke, R. H., Faller, J. E., Kaula, W. M., Williams, J. G., Mulholland, J. D., Plotkin, H. H., Silverberg, E. C., *14892*.
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Thermal storage; thermal test; solar energy; standard; standard test; thermal performance; *NBSIR 74-634.*

Thermal test; solar energy; standard; standard test; thermal performance; thermal storage; *NBSIR 74-634.*

Thermal transient; transducer; calibration; dynamic; photo flashbulb; pressure; pressure measurement; pressure transducer; *NBSIR 75-654.*

Thermal transient; transducer; calibration; dynamic, electronic flash; photoflash bulb; pressure; pressure transducer response; *NBSIR 75-732.*

Thermal transient; zero shift; accelerometer; performance characteristics; piezoelectric; test method; thermal radiation; *TN855.*

Thermal transmittance; windows; acoustics; air infiltration; air leakage; architectural acoustics; building acoustics; doors; energy conservation; heat loss from buildings; heat transfer; sound transmission loss; thermal resistance; *BSS77.*

Thermal transpiration; vapor-stream pumping; viscosity gauge; capacitance-diaphragm gauge; Knudsen radiometer; McLeod gauge; micromanometry; quartz Bourdon gauge; static expansion; *14933.*

Thermally stimulated capacitance; thermally stimulated current; ultrasonic bonding; voltage contrast mode; wire bonds; Boron redistribution; Darlington pairs; dopant profiles; electrical properties; electronics; epitaxial layer thickness; flying-spot scanner; *SP400-8.*

Thermally stimulated current; ultrasonic bonding; voltage contrast mode; wire bonds; Boron redistribution; Darlington pairs; dopant profiles; electrical properties; electronics; epitaxial layer thickness; flying-spot scanner; gold-doped silicon; hermeticity; *SP400-8.*

Thermally stimulated current; thermal resistance; thermal response; ultrasonic bonding; wire bonds; x-ray photoelectron spectroscopy; acoustic emission; beam-lead bonds; boron redistribution; Darlington pairs; dopant profiles; electrical properties; electronics; *SP400-12.*

Thermally stimulated current; thermal resistance; thermal response; ultrasonic bonding; wire bonds; x-ray photoelectron spectroscopy; boron nitride; boron redistribution; capacitance-voltage methods; Darlington pairs; deep depletion; dopant profiles; electrical properties; *SP400-17.*

Thermal/structural performance of piping; thermoplastic piping in plumbing; fire performance of piping; functional performance of piping; performance characteristics for piping; *BSS68.*

Thermesthesiometer; thermometry; burn hazard; consumer products; contact temperature; *15285.*

Thermesthesiometer; thermometry; consumer products; contact temperature; *15303.*

Thermionic emission; vaporization; viscosity; coal slags; MHD; *15449.*

Thermochemical; thermochemical standards; thianthrene; urea; acetanilide; bomb calorimetry; calorimetry; chlorobenzoic acid; combustion; creatinine; fluorobenzoic acid; nicotinic acid; reference materials; *15441.*

Thermochemical standard; combustion; enthalpy; formation; heat; secondary standard; ***J.*79A** *No. 3, 487-491 (1975).*

Thermochemical standards; thianthrene; urea; acetanilide; bomb calorimetry; calorimetry; chlorobenzoic acid; combustion; creatinine; fluorobenzoic acid; nicotinic acid; reference materials; thermochemical; *15441.*

Thermochemical tables; critically evaluated data; enthalpy; entropy; equilibrium constant of formation; free energy of formation; Gibbs energy function; heat capacity; heat of formation; *J. Phys. Chem. Ref. Data* **4**, No. 1, 1-176 (1975).

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Thermochemistry; thermodynamics; adenosine-5′-triphosphate; biochemistry; enzyme catalyzed reactions; glucose; heat mea-

Thermometry; base metals alloys; noble metal alloys; temperature scale; temperature standards; thermoelements; *Monogr. 125, Suppl. 1.*

Thermometry; base-metal thermocouples; cryogenic thermocouples; noble-metal thermocouples; nonstandardized thermocouples; refractory metal thermocouples; standardization; temperature measurement; thermocouples; *15517.*

Thermometry; burn hazard; consumer products; contact temperature; thermesthesiometer; *15285.*

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Thermometry; carbon resistors; cryogenics; liquid helium; millikelvin; *15537.*

Thermometry; conference; temperature; *15179.*

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Thermometry; measurement accuracy; national temperature measurement system; temperature scale; thermometer calibration; thermometer production; *15060.*

Thermometry; time constant; time response; oceanographic temperature measurements; temperature measurement; temperature sensors; *15074.*

Thermometry; vacuum deposition; calibration; carbon films; low temperature; *NBSIR 74-355.*

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Thermophysics; capacitor discharges; high-speed measurements; high temperatures; thermodynamics; *14934.*

Thermoplastic pipe; chlorinated polyvinyl chloride; hardness; internal stress; polyvinyl chloride; thermal mechanical analysis (TMA); thermal properties; thermogravimetric analysis (T-GA); *NBSIR 74-610.*

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Thermoplastic piping in plumbing; fire performance of piping; functional performance of piping; performance characteristics for piping; thermal/structural performance of piping; *BSS68.*

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Thermopower; tungsten; electrical resistivity; high temperature; Lorenz ratio; low temperature; standard reference materials; thermal conductivity; *SP260-52.*

Thermostat setback; transient heat flows; air leakage measurement; building heat transfer; computer programs; dynamic thermal performance; heat flow analysis; heating and cooling loads; temperature predictions; thermal analysis; *BSS57.*

Thianthrene; combustion; enthalpy; formation; heat; secondary standard; sulfur compound; *J.***79A** *No. 4, 561-564 (1975).*

Thianthrene; urea; acetanilide; bomb calorimetry; calorimetry; chlorobenzoic acid; combustion; creatinine; fluorobenzoic acid; nicotinic acid; reference materials; thermochemical; thermochemical standards; *15441.*

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Yield; actinide burnup; cross section sets; neutron spectrum; transplutonium; waste management; *SP425*, pp. 214-217.

Yields; ^{235}U; ^{239}Pu; decay heat; E_β; E_γ; ENDF/B-IV; fission products; half lives; *SP425*, pp. 21-28.

Yields vs. energy; ^{233}U, ^{235}U, ^{238}U, ^{239}Pu; burnup monitors; capture-to-fission; dilution mass spectrometry; fast fission yields; *SP425*, pp. 378-384.

Y-modulation; black level suppression; nonlinear amplification; scanning electron microscope; signal differentiation; signal processing; *15425*.

Young's modulus; aluminium; aluminium alloys; bulk modulus; compressibility; Debye temperature; elastic constants; elasticity; Poisson ratio; pulse-echo method; sound velocity; *15528*.

Young's modulus; aluminum alloy; bulk modulus; compressibility; Debye temperature; elastic constant; nickel steels; Poisson's ratio; shear modulus; sound velocity; *15522*.

Young's modulus; bulk modulus; compressibility; elastic constants; elasticity Lamé constant; Poisson ratio polycrystals; shear modulus; single crystals; *14871*.

Young's modulus; bulk modulus; compressibility; Debye temperature; elastic constant; nickel-chromium-iron alloys; Poisson's ratio; shear modulus; sound velocity; *15225*.

Young's modulus; bulk modulus; chromium alloys; compressibility; Debye temperature; Doring effect; elastic constants; iron alloys; magnetic transition; nickel alloys; Poisson's ratio; pulse-echo method; sound velocity; *15343*.

Young's modulus; bulk modulus; composite; compressibility; elastic compliance; elastic stiffness; piezoelectric oscillator; Poisson's ratio; shear modulus; *15523*.

Young's modulus; bulk modulus; compressibility; Debye temperature; elastic constants; nickel-base alloys; Poisson's ratio; shear modulus; sound velocity; *15533*.

Y_2O_3; IPTS-68; melting point; secondary temperature standards; temperature scales; *14735*.

Z

Zeeman; effect; laser; magnetic resonance; oxygen; rotational structure; *15335*.

Zeeman spectrum; asymmetric rotors; doublet states; HO_2; laser magnetic resonance; least squares fit; rotational analysis; *14910*.

Zeeman spectrum; asymmetric rotor levels; HO_2; laser magnetic resonance; rotational constants; spectral assignments; spin splitting; *15067*.

Zero range approximation; continuum; electron scattering; helium-3; monopole state; multipole decomposition; *15608*.

Zero shift; accelerometer; performance characteristics; piezoelectric; test method; thermal radiation; thermal transient; *TN855*.

Zeta potential; crack propagation; fracture; glass; *15426*.

Zeta-potential; electrokinetic potential glass; interface; liquid/solid interface; solid/liquid interface; surfaces; *14732*.

Zimm theory; bead-spring model; chain molecules; chain stiffness; deoxyribonucleic acid; dilute solutions; hydrodynamic interaction; polystyrene; viscoelasticity; *15114*.

Zimm theory; bead-spring model; block-copolymers; dilute solutions; dynamics; limiting viscosity number; solution properties; viscoelasticity; *15373*.

Zinc; accuracy; atomic fluorescence; automatic scatter correction; cadmium; chemical interferences; data evaluation; precision; production of atomic vapor; *15012*.

Zinc atomic weight; atomic weight; coulometry; electrochemical equivalent; *J.***79A** *No. 6, 737-745 (1975)*.

Zinc atomic weight; atomic weight; coulometry; electrochemical equivalent; *J.***79A** *No. 6, 747-759 (1975)*.

Zinc point; aluminium point; calibration; freezing point; freezing-point cell; platinum resistance thermometer; tin point; *15337*.

Zirconium; alloy diffusion; beryllium; cerium; cesium; chromium; copper; diffusion; electromigration; europium; grain boundary diffusion; hydrogen; impurity diffusion; interdiffusion; lanthanum; *J. Phys. Chem. Ref. Data* **4**, No. 1, 177-250 (1975).

Zirconium; bibliography on spectroscopy of fluorides and oxides of the lanthanide series; calculation of dissociation energies; electrical resistivity; enthalpy of transition; graphite; infrared matrix isolation spectroscopy; melting point; radiance temperature; *NBSIR 74-600*.

Zirconium; electrical resistivity; high-speed measurements; high temperature; melting point; normal spectral emittance; radiance temperature; *15612*.

Zirconium; electrical resistivity; high-speed measurements; high temperature; solid-solid phase transformation; thermodynamics; *J.***79A** *No. 1, 81-84 (1975)*.

ZnSe; birefringence; elastic constants; infrared-laser window materials; interferometry; KCl; photoelasticity; polycrystalline ZnSe; refractive index; stress-optical constants; thermal coefficient of refractive index; *NBSIR 75-781*.

0.001 to 30 MeV; fission cross section ratios; linear accelerator; time-of-flight technique; uranium isotopes—^{233}U, ^{234}U, ^{235}U, ^{236}U, ^{238}U; *SP425*, pp. 591-596.

0.335-14.7 MeV; excitation curve; neutron elastic scattering; $^{115}In^m$; *SP425*, pp. 859-861.

1 keV – 1 MeV; ^{239}Pu; ^{235}U; cross-sections; fission; measured; neutrons; *SP425*, pp. 564-567.

1-butene; far ultraviolet; free radical reactions; ion-molecule reactions; photochemistry; primary processes; *14773*.

$1 \leq F_n \leq 30$ MeV; gas scintillation transmission counters; neutron flux determination; *SP425*, pp. 277-280.

^{10}B; cross sections; light elements; R-matrix; standards; ^{6}Li; *SP425*, pp. 302-308.

^{10}B; ^{6}Li; neutron cross section; standard; *SP425*, pp. 232-235.

^{10}B(n,α); ^{235}U(n,f); ^{237}Np(n,f); Au(n,γ); C(n,n); H(n,n); neutron flux determination; standard cross sections; ^{3}He(n,p); ^{6}Li(n,α); *SP425*, pp. 293-301.

^{10}B(n,α)^{7}Li reaction; branching ratio; gas proportional counter; neutrons; nuclear physics; T(p,n) neutrons; *14813*.

(100) surface of copper; heat transfer to helium II; interfacial thermal resistance; Kapitza conductance of copper; Kapitza conductance of indium; Kapitza conductance of niobium; x-ray diffraction examination of single crystal lattice damage; *NBSIR 75-812*.

^{101,102,104}Ru; ^{127}I; adjustment; evaluation; fission products; sensitivity analysis; σ_c; *SP425*, pp. 165-168.

$^{115}In^m$; 0.335-14.7 MeV; excitation curve; neutron elastic scattering; *SP425*, pp. 859-861.

11-6-8 potential; Axilrod-Teller correction; dense liquid; excess function; hydrodynamic limit; molecular dynamics; rare gases; velocity autocorrelation function; *15168*.

11-6-8 potential function; correlation function; experimental data; hydrodynamic behavior; methane; molecular dynamics; potential function; self-diffusion coefficient; *15173*.

^{12}C data; 56 MeV; facility; neutron-induced reactions; *SP425*, pp. 103-105.

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APPENDIX A. LIST OF DEPOSITORY LIBRARIES IN THE UNITED STATES

ALABAMA

Alexander City: Alexander City State Junior College, Thomas D. 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).
- Samford University, Harwell G. Davis Library (1884).

Enterprise: Enterprise State Junior College Library (1967).
Florence: Florence State University, Collier Library (1932).
Gadsden: Gadsden Public Library (1963).
Huntsville: University of Alabama, Huntsville Campus Library (1964).
Jacksonville: Jacksonville State University, Ramona Wood Library (1929).
Maxwell A.F. Base: Air University Library (1963).
Mobile:
- Mobile Public Library (1963).
- Spring Hill College, Thomas Byrne Memorial Library (1937).
- University of South Alabama Library (1968).

Montgomery:
- Alabama State Department of Archives and History Library (1884).
- Alabama Supreme Court Library (1884).
- Auburn University at Montgomery Library (1971).

Normal: Alabama Agricultural and Mechanical College, Drake Memorial Library (1963).
St. Bernard: St. Bernard College Library (1962).
Troy: Troy State University, Lurleen B. Wallace Educational Resources Center (1963).
Tuskegee Institute: Tuskegee Institute, Hollis Burke Frissell Library (1907).
University:
- University of Alabama, School of Law Library (1967).
- University of Alabama Library (1860) – REGIONAL

ALASKA

Anchorage:
- Anchorage Higher Consortium Library (1961).
- Alaska Methodist University Library (1963).
- Supreme Court of Alaska Library (1973).

College: University of Alaska, Elmer E. Rasmuson Library (1922).
Juneau: Alaska State Library (1964).
Ketchikan: Ketchikan Community College Library (1970).

ARIZONA

Coolidge: Central Arizona College, Instructional Materials Center (1973).
Flagstaff: Northern Arizona University Library (1937).
Phoenix:
- Department of Library and Archives (unknown) – REGIONAL.
- Phoenix Public Library (1917).

Prescott: Prescott College Library (1968).
Tempe: Arizona State University, A. J. Matthews Library (1944).
Thatcher: Eastern Arizona Junior College Library (1963).
Tucson:
- Tucson Public Library (1970).
- University of Arizona Library (1907) – REGIONAL.

Yuma: Yuma City-County Library (1963).

ARKANSAS

Arkadelphia: Quachita Baptist University, Riley Library (1963).
Batesville: Arkansas College Library (1963).
Clarksville: College of the Ozarks Library (1925).
Conway: Hendrix College, O. C. Bailey Library (1903).
Fayetteville: University of Arkansas Library (1907).
Little Rock:
- Arkansas Supreme Court Library (1962).
- Little Rock Public Library (1953).
- University of Arkansas at Little Rock Library (1973).

Magnolia: Southern State College, J. M. Peace Library (1956).
Monticello: University of Arkansas at Monticello Library (1956).
Pine Bluff: Arkansas Agricultural, Mechanical and Normal College Library (pending).
Russellville: Arkansas Polytechnic College, Tomlinson Library (1925).
Searcy: Harding College, Beaumont Memorial Library (1963).
State College: 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.
Arcata: Humboldt State College Library (1963).
Bakersfield:
- California State College, Bakersfield Library (1974).
- Kern County Library System (1943).

Berkeley:
- University of California, General Library (1907).
- University of California, Law Library, Earl Warren Legal Center (1963).

Carson: Carson Regional Library (1973).
Chico: Chico State University Library (1962).
Claremont: Pomona College Documents Collection, Honnold Library (1913).
Compton: Compton Library (1972).
Culver City: Culver City Library (1966).
Davis:
- University of California at Davis Library (1953).
- University of California at Davis, School of Law Library (1972).

Dominguez Hills: California State College, Dominguez Hills, Educational Resources Center (1973).
Downey: Downey City Library (1963).
Fresno:
Fresno County Free Library (1920).
Fresno State University Library (1962).
Fullerton: California State College at Fullerton Library (1963).
Garden Grove: Garden Grove Regional Library (1963).
Gardena: Gardena Public Library (1966).
Hayward: California State College at Hayward Library (1963).
Huntington Park: Huntington Park Library, San Antonio Region (1970).
Inglewood: Inglewood Public Library (1963).
Irvine: University of California at Irvine Library (1963).
La Jolla: University of California, San Diego, University Library (1963).
Lakewood: Angelo Iacoboni Public Library (1970).
Lancaster: Lancaster Regional Library (1967).
Long Beach:
California State College at Long Beach Library (1962).
Long Beach Public Library (1933).
Los Angeles:
California State College at Los Angeles, John F. Kennedy Memorial Library (1956).
Los Angeles County Law Library (1963).
Los Angeles Public Library (1891).
Loyola University of Los Angeles Library (1933).
Occidental College, Mary Norton Clapp Library (1941).
Pepperdine University Library (1963).
University of California at Los Angeles Library (1932).
University of California at Los Angeles, Law Library (1958).
University of Southern California Library (1933).
Menlo Park: U.S. Geological Survey Library (1962).
Montebello: Montebello Library (1966).
Monterey: U.S. Naval Postgraduate School Library (1963).
Monterey Park: Bruggemeyer Memorial Library (1964).
Northridge: California State University at Northridge Library (1958).
Norwalk: Los Cerritos Regional Library (1973).
Oakland:
Mills College Library (1966).
Oakland Public Library (1923).
Ontario: Ontario City Library (1974).
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 Public Library (1947).
University of California at Riverside Library (1963).
Sacramento:
California State Library (1895) – REGIONAL.
Sacramento City-County Library (1880).
Sacramento County Law Library (1963).
Sacramento State College Library (1963).
San Bernardino: San Bernardino County Free Library (1964).
San Diego:
San Diego County Library (1966).
San Diego Public Library (1895).
San Diego State University, Love Library (1962).
San Diego County Law Library (1973).
San Francisco:
Mechanics' Institute Library (1889).
San Francisco Public Library (1889).
San Francisco State College, Social Science and Business Library (1955).
Supreme Court of California Library (1972).
U.S. Court of Appeals for Ninth Circuit Library (1971).
University of San Francisco, Richard A. Gleeson Library (1963).
San Jose: San Jose State College Library (1962).
San Leandro: San Leandro Community Library Center (1961).
San Luis Obispo: California State Polytechnic University Library (1969).
Santa Ana: 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 Library (1963).
Santa Rosa: Santa Rosa-Sonoma County Public Library (1896).
Stanford: Stanford University Libraries (1895).
Stockton: Public Library of Stockton and San Joaquin County (1884).
Thousand Oaks: California Lutheran College Library (1964).
Torrance: Torrance Civic Center Library (1969).
Turlock: Stanislaus State College Library (1964).
Valencia: Valencia Regional Library (1972).
Van Nuys: Los Angeles Valley College Library (1970).
Visalia: Tulare County Free Library (1967).
Walnut: Mount San Antonio College Library (1966).
West Covina: West Covina Library (1966).
Whittier: Whittier College, Wardman Library (1963).

CANAL ZONE

Balboa Heights: Canal Zone Library-Museum (1963).

COLORADO

Alamosa: Adams State College Learning Resources Center (1963).
Boulder: University of Colorado Libraries (1879) – REGIONAL.
Colorado Springs: Colorado College, Charles Leaming Tutt Library (1880).
Denver:
Colorado State Library (unknown).
Denver Public Library (1884) – REGIONAL.
Regis College, Dayton Memorial Library (1915).
University of Denver, Penrose Library (1909).
U.S. Bureau of Reclamation Library (1962).
U.S. Court of Appeals for Tenth Circuit Library (1973).
Fort Collins: Colorado State University Library (1907).
Golden:
Colorado School of Mines, Arthur Lakes Library (1939).
Jefferson County Public Library, Bonfils-Stanton Regional Library (1968).
Greeley: University of Northern Colorado Library (1966).
Gunnison: Western State College, Leslie J. Savage Library (1932).
La Junta: Otero Junior College, Wheeler Library (1963).
Pueblo:
Pueblo Regional Library (1893).
Southern Colorado State College Library (1965).
U.S. Air Force Academy: Academy Library (1956).

CONNECTICUT

Bridgeport: Bridgeport Public Library (1884).
Danbury: Western Connecticut State College Library (1967).
Enfield: Enfield Public Library (1967).
Hartford:
- Connecticut State Library (unknown)—REGIONAL.
- Hartford Public Library (1945).
- Trinity College Library (1895).

Middletown: Wesleyan University, Olin Library (1906).
Mystic: Marine Historical Association, Inc., Mystic Seaport Library (1964).
New Britain: Central Connecticut State College, Elihu Burritt Library (1973).
New Haven:
- Southern Connecticut State College Library (1968).
- Yale University, Sterling Memorial Library (1859).

New London:
- Connecticut College Library (1926).
- U.S. Coast Guard Academy Library (1939).

Pomfret: Pomfret School, du Pont Library (1968).
Stamford: Stamford Public Library (1973).
Storrs: University of Connecticut, Wilbur Cross Library (1907).
Waterbury: Silas Bronson Library (1869).
West Haven: University of New Haven Library (1971).

DELAWARE

Dover:
- Delaware State College, William C. Jason Library (1962).
- State Department of Community Affairs and Economic Development, Division of Libraries (1972).
- State Law Library in Kent County (unknown).

Georgetown: Delaware Technical and Community College, Southern Branch Library (1968).
Newark: University of Delaware, Morris Library (1907).
Wilmington:
- New Castle County Law Library (1974).
- Wilmington Institute and New Castle County Library (1861).

DISTRICT OF COLUMBIA

Washington:
- Advisory Commission on Intergovernmental Relations Library.
- Department of Agriculture, National Agricultural Library (1895).
- Department of Commerce Library (1955).
- Department of Health, Education, and Welfare Library (1895).
- Department of Housing and Urban Development Library (1969).
- Department of the Interior Central Library (1895).
- Department of Justice Main Library (1895).
- Department of State Library (1895).
- Department of State, Office of Legal Advisor, Law Library (1966).
- Department of Transportation, National Highway Traffic Safety Administration Library (1968).
- District of Columbia Public Library (1943).
- District of Columbia Court of Appeals Library (1973).
- Federal City College Library (1970).
- Federal Deposit Insurance Corporation Library (1972).
- General Accounting Office Library.
- Georgetown University Library (1969).
- Indian Claims Commission Library (1968).
- National War College Library (1895).
- Navy Department Library (1895).
- Office of the Judge Advocate General Library, Department of Navy (1963).
- Office of Management and Budget Library, Executive Office of the President (1965).
- Office of the Adjutant General, Department of Army Library (1969).
- Treasury Department Library (1895).
- U.S. Postal Service Library (1895).
- U.S. Civil Service Commission Library (1963).
- U.S. Geological Survey Library (1962).
- Veterans Administration, Central Office Library (1967).

FLORIDA

Boca Raton: Florida Atlantic University Library (1963).
Clearwater: Clearwater Public Library (1972).
Coral Gables: University of Miami Library (1939).
Daytona Beach: Volusia County Public Libraries (1963).
DeLand: Stetson University, duPont-Ball Library (1887).
Fort Lauderdale:
- Fort Lauderdale Public Library (1967).
- Nova University Library (1967).

Gainesville: University of Florida Libraries (1907)—REGIONAL.
Jacksonville:
- Haydon Burns Library (1914).
- Jacksonville University, Swisher Library (1962).
- University of North Florida Library (1972).

Lakeland: Lakeland Public Library (1928).
Leesburg: Lake-Sumter Community College Library (1963).
Melbourne: Florida Institute of Technology Library (1963).
Miami:
- Florida International University Library (1970).
- Miami Public Library (1952).

Opa Locka: Biscayne College Library (1966).
Orlando: Florida Technological University Library (1966).
Palatka: St. Johns River Junior College Library (1963).
Pensacola: University of West Florida, John C. Pace Library (1966).
Port Charlotte: Charlotte County Library System (1973).
St. Petersburg: St. Petersburg Public Library (1965).
Sarasota: Sarasota Public Library (1970).
Tallahassee:
- Florida Agricultural and Mechanical University, Coleman Memorial Library (1936).
- Florida State Library (1929).
- Florida State University, R. M. Strozier Library (1941).

Tampa:
- Tampa Public Library (1965).
- University of South Florida Library (1962).
- University of Tampa, Merle Kelce Library (1953).

Winter Park: Rollins College, Mills Memorial Library (1909).

GEORGIA

Albany: Albany Public Library (1964).
Americus: Georgia Southwestern College, James Earl Carter Library (1966).
Athens: University of Georgia Libraries (1907).
Atlanta:
- Atlanta Public Library (1880).
- Atlanta University, Trevor Arnett Library (1962).
- Emory University, Robert W. Woodruff Library (1928).
- Emory University, School of Law Library (1968).
- Georgia Institute of Technology, Price Gilbert Memorial Library (1963).

Georgia State Library (unknown).
Georgia State University Library (1970).
Augusta: Augusta College Library (1962).
Brunswick: Brunswick Public Library (1965).
Carrollton: West Georgia College, Sanford Library (1962).
Columbus: Simon Schwob Memorial Library, Columbus College.
Dahlonega: North Georgia College Library (1939).
Decatur: Dekalb Community College-South Campus, Learning Resources Center (1973).
Gainesville: Chestatee Regional Library (1968).
Macon: Mercer University, Stetson Memorial Library (1964).
Marietta: Kennesaw Junior College Library (1968).
Milledgeville: Georgia College at Milledgeville, Ina Dillard Russell Library (1950).
Mount Berry: Berry College, Memorial Library (1970).
Savannah: Savannah Public and Chatham-Effingham Liberty Regional Library (1857).
Statesboro: Georgia Southern College, Rosenwald Library (1939).
Valdosta: Valdosta State College, Richard Holmes Powell Library (1956).

GUAM

Agana: Nieves M. Flores Memorial Library (1962).

HAWAII

Hilo: University of Hawaii, Hilo Campus Library (1962).
Honolulu:
Chaminade College of Honolulu Library (1965).
Hawaii Medical Library, Inc. (1968).
Hawaii State Library (1929).
Municipal Reference Library of the City and County of Honolulu (1965).
Supreme Court Law Library (1973).
University of Hawaii Library (1907).
Laie: Church College of Hawaii, Woolley Library (1964).
Lihue: Kauai Public Library (1967).
Pearl City: Leeward Community College Library (1967).
Wailuku: Maui Public Library (1962).

IDAHO

Boise:
Boise State College Library (1966).
Boise Public Library and Information Center (1929).
Idaho State Law Library (unknown).
Idaho State Library (1971).
Caldwell: College of Idaho, Terteling Library (1930).
Moscow: University of Idaho Library (1907) – REGIONAL.
Pocatello: Idaho State University Library (1908).
Rexburg: Ricks College, David O. McKay Library (1946).
Twin Falls: College of Southern Idaho Library (1970).

ILLINOIS

Bloomington: Illinois Wesleyan University Libraries (1964).
Carbondale: Southern Illinois University, Morris Library (1932).
Carlinville: Blackburn College Library (1954).
Carterville: Shawnee Library System (1971).
Champaign: University of Illinois Law Library, College of Law (1965).
Charleston: Eastern Illinois University, Booth Library (1962).
Chicago:
Field Museum of Natural History Library (1963).
Chicago Public Library (1876).
Chicago State University Library (1954).
John Crerar Library (1909).
Loyola University of Chicago, E. M. Cudahy Memorial Library (1966).
Newberry Library (1890).
Northeastern Illinois University Library (1961).
University of Chicago Law Library (1964).
University of Chicago Library (1897).
University of Illinois, Chicago Circle Campus Library (1957).
Decatur: Decatur Public Library (1954).
De Kalb: Northern Illinois University, Swen Franklin Parson Library (1960).
Edwardsville: Southern Illinois University, Lovejoy 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, Memorial Library (1946).
Lake Forest: Lake Forest College, Donnelley Library (1962).
Lebanon: McKendree College, Holman Library (1968).
Lisle: Illinois Benedictine College, Theodore F. Lownik Library (1911).
Lockport: Lewis College of Science and Technology Library (1952).
Macomb: Western Illinois University Memorial Library (1962).
Moline: Black Hawk College, Learning Resources Center (1970).
Monmouth: Monmouth College Library (1860).
Normal: Illinois State University, Milner Library (1877).
Oak Park: Oak Park Public Library (1963).
Palos Hills: Moraine Valley Community College Library (1972).
Peoria:
Bradley University, Cullom Davis Library (1963).
Peoria Public Library (1883).
River Forest: Rosary College Library (1966).
Rockford: Rockford Public Library (unknown).
Springfield: Illinois State Library (unknown) – REGIONAL.
Urbana: University of Illinois Library (1907).
Wheaton: Wheaton College Library (1964).
Woodstock: Woodstock Public Library (1963).

INDIANA

Anderson: Anderson College, Charles E. Wilson Library (1959).
Bloomington: Indiana University Library (1881).
Crawfordsville: Wabash College, Lilly Library (1906).
Evansville:
Evansville and Vanderburgh County Public Library (1928).
Indiana State University, Evansville Campus Library (1969).
Fort Wayne:
Indiana-Purdue University Regional Campus Library (1965).
Public Library of Fort Wayne and Allen County (1896).
Franklin: Franklin College Library (pending).
Gary:
Gary Public Library (1943).
Indiana University, Northwest Campus Library (1966).
Greencastle: De Pauw University, Roy O. West Library (1879).
Hammond: Hammond Public Library (1964).

Hanover: Hanover College Library (1892).
Huntington: Huntington College Library (1964).
Indianapolis:
Butler University, Irwin Library (1965).
Indiana State Library (unknown) – REGIONAL.
Indiana University, Law Library (1967).
Indianapolis-Marion County Public Library (1967).
Jeffersonville: Indiana University, Southeastern Campus Library (1965).
Kokomo: Indiana University, Kokomo Regional Campus Library (1969).
Lafayette: Purdue University Library (1907).
Muncie:
Ball State University Library (1959).
Muncie Public Library (1906).
Notre Dame: University of Notre Dame, Memorial Library (1883).
Rensselaer: St. 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).

IOWA

Ames: Iowa State University of Science and Technology Library (1907).
Cedar Falls: University of Northern Iowa Library (1946).
Council Bluffs:
Free Public Library (1885).
Iowa Western Community College, Hoover Media Library (1972).
Davenport: Davenport Public Library (1973).
Des Moines:
Drake University, Cowles Library (1966).
Drake University Law Library (1972).
Iowa State Traveling Library (unknown).
Public Library of Des Moines (1888).
Dubuque:
Carnegie-Stout Public Library (unknown).
Loras College, Wahlert Memorial Library (1967).
Fayette: Upper Iowa College, Hemdeerson-Wilder Library.
Grinnell: Grinnell College, Burling Library (1874).
Iowa City:
University of Iowa, Law Library (1968).
University of Iowa Library (1884) – REGIONAL.
Lamoni: Graceland College, Frederick Madison Smith Library (1927).
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 Library (1908).
Colby: Colby Community Junior College Library (1968).
Emporia: Kansas State Teachers College, William Allen White Library (1909).
Hays: Fort Hays Kansas State College, Forsyth Library (1926).
Hutchinson: Hutchinson Public Library (1963).
Lawrence:
University of Kansas, Watson Library (1869).
University of Kansas Law Library (1971).
Manhattan: Kansas State University, Farrell Library (1907).
Pittsburg: Kansas State College of Pittsburg, Porter Library (1952).
Salina: Kansas Wesleyan University, Memorial Library (1930).
Topeka:
Kansas State Historical Society Library (1877).
Kansas State Library (unknown).
Washburn University of Topeka, Law Library (1971).
Wichita: Wichita State University Library (1901).

KENTUCKY

Ashland: Ashland Public Library (1946).
Barbourville: Union College, Abigail E. Weeks Memorial Library (1958).
Bowling Green: Western Kentucky University, Cravens Graduate Center and Library (1934).
Covington: Thomas More College Library (1970).
Danville: Centre College, Grace Doherty Library (1884).
Frankfort:
Kentucky Department of Libraries (1967).
Kentucky State University, Blazer Library (1972).
State Law Library (unknown).
Highland Heights: Northern Kentucky State College Library (1973).
Lexington:
University of Kentucky, Law Library (1968).
University of Kentucky, Margaret I. King Library (1907) – REGIONAL.

Louisville:
Louisville Free Public Library (1904).
University of Louisville, Belknap Campus Library (1925).
Morehead: Morehead State University, Johnson Camden Library (1955).
Murray: Murray State University Library (1924).
Newport: Northern Kentucky State College Library.
Owensboro: Kentucky Wesleyan College Library (1966).
Pikeville: Pikeville College Library (1947).
Richmond: Eastern Kentucky University, John Grant Crabbe Library (1966).

LOUISIANA

Baton Rouge:
Louisiana State University Law Library (1929).
Louisiana State University Library (1907) – REGIONAL.
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, Frazar Memorial Library (1941).
Monroe: Northeast Louisiana University, Sandel Library (1963).
Natchitoches: Northwestern State University, Watson Memorial Library (1887).
New Orleans:
Isaac Delgado College, Moss Technical Library (1968).
Law Library of Louisiana (unknown).
Loyola University Library (1942).

New Orleans Public Library (1883).
Southern University in New Orleans Library (1962).
Tulane University, Howard-Tilton Memorial Library (1942).
University of New Orleans Library (1963).
U.S. Court of Appeals for Fifth Circuit Library (1973).
Pineville: Louisiana College, Richard W. Norton Memorial Library (1969).
Ruston: Louisiana Technical University Library (1896)—REGIONAL.
Shreveport:
Louisiana State University at Shreveport Library (1967).
Shreve Memorial Library (1923).
Thibodaux: Francis T. Nicholls State University, Leonidas Polk Library (1962).

MAINE

Augusta:
Maine Law and Legislative Reference Library (1973).
Maine State Library (unknown).
Bangor: Bangor Public Library (1884).
Brunswick: Bowdoin College, Hawthorne-Longfellow Library (1884).
Castine: Maine Maritime Academy, Nutting Memorial Library (1969).
Lewiston: Bates College Library (1883).
Orono: University of Maine, Raymond H. Fogler Library (1907)—REGIONAL.
Portland:
Portland Public Library (1884).
University of Maine Law Library (1964).
Springvale: Nasson College Library (1961).
Waterville: Colby College Library (1884).

MARYLAND

Annapolis:
Maryland State 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 College, Soper Library (1940).
University of Baltimore, Langsdale Library (1973).
University of Maryland, Baltimore County Library (1971).
University of Maryland, School of Law Library (1969).
Bel Air: Harford Community College Library (1967).
Chestertown: Washington College, Chester M. Miller Library (1891).
College Park: University of Maryland, McKeldin Library (1925)—REGIONAL
Cumberland: Allegany Community College Library.
Frostburg: Frostburg State College Library (1967).
Germantown: U.S. Atomic Energy Commission Headquarters Library (1963).
Patuxent River: U.S. Naval Air Station Library (1968).
Rockville: Montgomery County Department of Public Libraries (1951).
Salisbury: Salisbury State College, Blackwell Library (1965).
Towson: Goucher College, Julia Rogers Library (1966).
Westminster: Western Maryland College Library (1896).

MASSACHUSETTS

Amherst:
Amherst College Library (1884).
University of Massachusetts, Goodell Library (1907).
Belmont: Belmont Memorial Library (1968).
Boston:
Boston Athenaeum Library (unknown).
Boston Public Library (1859)—REGIONAL.
Curry College Library (1972).
Northeastern University, Robert G. Dodge Library (1962).
State Library of Massachusetts (unknown).
Tufts University Library (1899).
Brookline: Public Library of Brookline (1925).
Cambridge:
Harvard College Library (1860).
Massachusetts Institute of Technology Libraries (1946).
Chestnut Hill: Boston College, Bapst Library (1963).
Chicopee: Our Lady of the Elms College Library (1969).
Lowell: Lowell Technological Institute, Alumni Memorial Library (1952).
Lynn: Lynn Public Library (1953).
Marlborough: Marlborough Public Library (1971).
New Bedford: New Bedford Free Public Library (1858).
North Dartmouth: Southeastern Massachusetts University Library (1965).
North Easton: Stonehill College, Cushing-Martin Library (1962).
Springfield: Springfield City Library (1966).
Waltham: Brandeis University, Goldfarb Library (1965).
Wellesley: Wellesley College Library (1943).
Wenham: Gordon College, Winn Library (1963).
Williamstown: Williams College Library (unknown).
Wilmington: Wilmington Memorial Library (1971).
Worcester:
American Antiquarian Society Library (1814).
University of Massachusetts, Medical Center Library (1972).
Worcester Public Library (1859).

MICHIGAN

Albion: Albion College, Stockwell Memorial Library (1966).
Allendale: Grand Valley State College Library (1963).
Alma: Alma College, Monteith Library (1963).
Ann Arbor:
Great Lakes Basin Library (1971).
University of Michigan, Harlan Hatcher Library (1884).
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 Public Library (1868)—REGIONAL.
Marygrove College Library (1965).
Mercy College of Detroit Library (1965).
University of Detroit Library (1884).
Wayne County Public Library (1957).
Wayne State University Law Library (1971).
Wayne State University, G. Flint Purdy Library (1937).
Dowagiac: Southwestern Michigan College Library (1971).
East Lansing:
Michigan State University, Law Library (1971).
Michigan State University Library (1907).
Escanaba: Michigan State Library, Upper Peninsula Branch (1964).
Farmington: Martin Luther King Learning Resources Center, Oakland Community College (1968).
Flint:
Charles Stewart Mott Library (1959).
Flint Public Library (1967).
Grand Rapids:
Grand Rapids Public Library (1876).

Calvin College Library (1967).
Houghton: Michigan Technological University Library (1876).
Jackson: Jackson Public Library (1965).
Kalamazoo:
Kalamazoo Library System (1907).
Western Michigan University, Dwight B. Waldo Library (1963).
Lansing: Michigan State Library (unknown) – REGIONAL.
Livonia: Schoolcraft College Library (1962).
Marquette: Northern Michigan University, Olson Library (1963).
Monroe: Monroe County Library System (pending).
Mt. Clemens: Macomb County Library (1968).
Mt. Pleasant: Central Michigan University Library (1958).
Muskegon: Hackley Public Library (1894).
Olivet: Olivet College Library.
Petoskey: North Central Michigan College Library (1962).
Port Huron: Saint Clair County Library System (1876).
Rochester: Oakland University, Kresge Library (1964).
Saginaw: Hoyt Public Library (1890).
Traverse City: Northwestern Michigan College, Mark Osterlin Library (1964).
University Center: Delta College Library (1963).
Warren: Warren Public Library, Arthur J. Miller Branch (1973).
Ypsilanti: Eastern Michigan University Library (1965).

MINNESOTA

Bemidji: Bemidji State College, A. C. Clark Library (1963).
Collegeville: St. John's University, Alcuin Library (1954).
Duluth: Duluth Public Library (1909).
Edina: Hennepin County Library.
Mankato: Mankato State College Memorial Library (1962).
Minneapolis:
Anoka County Library (1971).
Southdale-Hennepin Area Library (1971).
Minneapolis Public Library (1893).
University of Minnesota, Wilson Library (1907) – REGIONAL.
Moorhead: Moorhead State College Library (1956).
Morris: University of Minnesota at Morris Library (1963).
Northfield:
Carleton College Library (1930).
St. Olaf College, Rolvaag Memorial Library (1930).
St. Cloud: St. Cloud State College Library (1962).
St. Paul:
Minnesota Historical Society Library (1867).
Minnesota State Law Library (unknown).
St. Paul Public Library (1914).
University of Minnesota, St. Paul Campus Library (1974).
Saint Peter: Gustavus Adolphus College Library (1941).
Stillwater: Stillwater Public Library (1893).
Willmar: Crow River Regional Library (1958).
Winona: Winona State College, Maxwell Library (1969).

MISSISSIPPI

Columbus: Mississippi State College for Women, J. C. Fant Memorial Library (1929).
Hattiesburg: University of Southern Mississippi Library (1935).
Jackson:
Jackson State College Library (1968).
Millsaps College, Millsaps-Wilson Library (1963).
Mississippi Library Commission (1947).
Mississippi State Law Library (unknown).
Lorman: Alcorn Agricultural and Mechanical College Library (1970).
State College: Mississippi State University, Mitchell Memorial Library (1907).
University:
University of Mississippi Library (1883).
University of Mississippi, School of Law Library (1967).

MISSOURI

Cape Girardeau: Southeast Missouri State College, Kent Library (1916).
Columbia: University of Missouri Library (1862).
Fayette: Central Methodist College Library (1962).
Fulton: Westminster College, Reeves Library (1875).
Jefferson City:
Lincoln University, Inman E. Page Library (1944).
Missouri State Library (1963).
Missouri Supreme Court Library (unknown).
Joplin: Missouri Southern State College Library (1966).
Kansas City:
Kansas City Public Library (1881).
Rockhurst College Library (1917).
University of Missouri at Kansas City, General Library (1938).
Kirksville: Northeast Missouri State Teachers College, Pickler Memorial Library (1966).
Liberty: William Jewell College Library (1900).
Rolla: University of Missouri at Rolla Library (1907).
St. Charles: Lindenwood College, Margaret Leggat Butler Library (1973).
St. Joseph: St. Joseph Public Library (1891).
St. Louis:
St. Louis County Library (1970).
St. Louis Public Library (1866).
St. Louis University, Law Library (1967).
St. Louis University, Pius XII Memorial Library (1866).
University of Missouri at St. Louis, Thomas Jefferson Library (1966).
U.S. Court of Appeals, Eighth Circuit Library (1972).
Washington University, John M. Olin Library (1906).
Springfield:
Drury College, Walker Library (1874).
Southwest Missouri State College Library (1963).
Warrensburg: Central Missouri State College, Ward Edwards Library (1914).

MONTANA

Billings: Eastern Montana College Library (1924).
Bozeman: Montana State University Library (1907).
Butte: Montana College of Mineral Science and Technology Library (1901).
Helena:
Montana Historical Society Library (unknown).
Montana State Library (1966).
Missoula: University of Montana Library (1909) – REGIONAL.

NEBRASKA

Blair: Dana College, Dana-LIFE Library (1924).
Crete: Doane College, Whitin Library (1944).
Fremont: Midland Lutheran College Library (1924).
Kearney: Kearney State College, Calvin T. Ryan Library (1962).
Lincoln:
Nebraska Publications Clearinghouse, Nebraska Library Commission (1972).

Nebraska State Library (unknown).
University of Nebraska, Don L. Love Memorial Library (1907).

Omaha:
Creighton University, Alumni Library (1964).
Omaha Public Library (1880).
University of Nebraska at Omaha, Gene Eppley 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.

Las Vegas:
Clark County Library District (pending).
University of Nevada at Las Vegas, James R. Dickinson Library (1959).

Reno:
Nevada State Historical Society Library (1974).
University of Nevada Library (1907) – REGIONAL

NEW HAMPSHIRE

Concord:
Franklin Pierce Law Center Library (1973).
New Hampshire State Library (unknown).

Durham: University of New Hampshire Library (1907).
Franconia: Franconia College Library (1972).
Hanover: Dartmouth College, Baker Library (1884).
Henniker: New England College Library (1966).
Manchester:
Manchester City Library (1884).
St. Anselm's College, Geisel Library (1963).

Nashua: Nashua Public Library (1971).

NEW JERSEY

Bayonne: Bayonne Free Public Library (1909).
Bloomfield: Free Public Library of Bloomfield (1965).
Bridgeton: Cumberland County Library (1966).
Camden: Rutgers University-Camden Library (1966).
Convent Station: College of St. Elizabeth, Mahoney Library (1938).
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: Free Public Library of Irvington (1966).
Jersey City:
Free Public Library of Jersey City (1879).
Jersey City State College, Forrest A. Irwin Library (1963).

Madison: Drew University, Rose Memorial Library (1939).
Mahwah: Ramapo College Library (1971).
Mount Holly: Burlington County Library (1966).
New Brunswick:
Free Public Library (1908).
Rutgers University Library (1907).

Newark:
Newark Public Library (1906) – REGIONAL.
Rutgers-The State University, John Cotton Dana Library (1966).

Passaic: Passaic Public Library (1964).
Plainfield: Plainfield Public Library (1971).
Princeton: Princeton University Library (1884).
Rutherford: Fairleigh Dickinson University, Messler Library (1953).
Shrewsbury: Monmouth County Library (1968).
South Orange: Seton Hall University, McLaughlin Library (1947).
Teaneck: Fairleigh Dickinson University Library, Teaneck Campus (1963).
Toms River: Ocean County College Learning Resources Center (1966).
Trenton:
New Jersey State Library, Law and Reference Bureau, Department of Education (unknown).
Trenton Free Public Library (1902).

Union: Newark State College, Nancy Thompson Library (1973).
Upper Montclair: Montclair State College, Harry A. Sprague Library (1967).
Wayne: Wayne Public Library (1972).
West Long Branch: Monmouth College, Guggenheim Memorial Library (1963).
Woodbridge: Free Public Library of Woodbridge (1965).

NEW MEXICO

Albuquerque:
University of New Mexico, Medical Science Library (1973).
University of New Mexico, School of Law Library (1973).
University of New Mexico, Zimmerman 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 Library (1962).
Santa Fe:
New Mexico State Library (1960) – REGIONAL.
Supreme Court Law Library (unknown).

Silver City: Western New Mexico University, Miller Library (1972).

NEW YORK

Albany:
New York State Library (unknown) – REGIONAL.
State University of New York at Albany Library (1964).

Auburn: Seymour Library (1972).
Bayside: Queensborough Community College Library (1972).
Binghamton: State University of New York at Binghamton Library (1962).
Brockport: State University of New York, Drake Memorial Library (1967).
Bronx:
Herbert H. Lehman College Library (1967).
New York Public Library, Mott Haven Branch (1973).

Bronxville: Sarah Lawrence College Library (1969).
Brooklyn:
Brooklyn College Library (1936).
Brooklyn Law School Library.
Brooklyn Public Library (1908).
Polytechnic Institute of Brooklyn, Spicer Library (1963).
Pratt Institute Library (1891).
State University of New York, Downstate Medical Center Library (1958).

Buffalo:
Buffalo and Erie County Public Library (1895).

State University of New York at Buffalo, Lockwood Memorial Library (1963).
Canton: St. 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).
Douglaston: Cathedral College Library (1971).
East Islip: East Islip Public Library (1973).
Elmira: Elmira College, Gannett-Tripp Learning Center (1956).
Farmingdale: State University Agricultural and Technical Institute at Farmingdale Library (1917).
Flushing: Queens College, Paul Klapper Library (1939).
Garden City:
Adelphi University, Swirbul Library (1966).
Nassau Library System (1965).
Geneseo: State University College, Milne Library (1967).
Great Neck: U.S. Merchant Marine Academy Library.
Greenvale: C. W. Post College, B. Davis Schwartz Memorial Library (1964).
Hamilton: Colgate University Library (1902).
Hempstead: Hofstra University Library (1964).
Huntington: Huntington Public Library (1966).
Ithaca:
Cornell University Library (1907).
New York State Colleges of Agriculture and Home Economics, Albert R. Mann Library (1943).
Jamaica:
Queens Borough Public Library (1926).
St. John's University Library (1956).
Kings Point: U.S. Military Academy Library (1962).
Mount Vernon: Mount Vernon Public Library (1962).
New Paltz: State University College Library (1965).
New York City:
City University of New York, City College Library (1884).
College of Insurance, Ecker Library (1965).
Columbia University Libraries (1882).
Cooper Union Library (1930).
Fordham University Library (1937).
New York Law Institute Library (1909).
New York Public Library (Astor Branch) (1907).
New York Public Library (Lenox Branch) (1884).
New York University Law Library (1973).
New York University Libraries (1967).
State University of New York, Maritime College Library (1947).
Newburgh: Newburgh Free Library (1909).
Oakdale: Dowling College Library (1965).
Oneonta: State University College, James M. Milne Library (1966).
Oswego: State University College, Penfield Library (1966).
Plattsburgh: State University College, Benjamin F. Feinberg Library (1967).
Potsdam:
Clarkson College of Technology, Harriet Call Burnap Memorial Library (1938).
State University College, 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 Library (1880).
St. Bonaventure: St. Bonaventure University, Friedsam Memorial Library (1938).
Saratoga Springs: Skidmore College Library (1964).
Schenectady: Union College, Schaffer Library (1901).
Southampton: Southampton College Library (1973).
Staten Island: Wagner College, Horrmann Library (1953).
Stony Brook: State University of New York at Stony Brook Library (1963).
Syracuse: Syracuse University Library (1878).
Troy: Troy Public Library (1869).
Utica: Utica Public Library (1885).
West Point: U.S. Military Academy Library (unknown).
Yonkers:
Yonkers Public Library (1910).
Sarah Lawrence College Library.

NORTH CAROLINA

Asheville: University of North Carolina at Asheville (1965).
Boiling Springs: Gardner-Webb College, Dover Memorial Library (1974).
Boone: Appalachian State University Library (1963).
Buies Creek: Campbell College, Carrie Rich Memorial Library (1965).
Chapel Hill: University of North Carolina Library (1884)—REGIONAL.
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, Hugh A. & Jane Grey Memorial Library (1893).
Durham:
Duke University, William R. Perkins Library (1890).
North Carolina Central University, James E. Shepard Memorial Library (1973).
Elon College: Elon College Library (1971).
Fayetteville: Fayetteville State University, Chestnutt 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: St. Andrews Presbyterian College, DeTamble Library (1969).
Lexington: Davidson County Public Library System (1971).
Mount Olive: Mount Olive College, Moye Library (1971).
Murfreesboro: Chowan College, Whitaker Library (1963).
Pembroke: Pembroke State University Library (1965).
Raleigh:
North Carolina State Library (unknown).
North Carolina State University, R. H. Hill Library (1923).
North Carolina Supreme Court Library (1972).
Wake County Public Libraries (1969).
Rocky Mount: North Carolina Wesleyan College Library (1969).
Salisbury: Catawba College Library (1925).
Wilmington: University of North Carolina at Wilmington, William M. Randall Library (1965).
Wilson: Atlantic Christian College, Clarence L. Hardy Library (1930).

Winston-Salem:
Forsyth County Public Library System (1954).
Wake Forest University, Z. Smith Reynolds Library (1902).

NORTH DAKOTA

Bismarck:
State Historical Society of North Dakota (1907).
North Dakota State Law Library (unknown).
North Dakota State Library Commission Library (1971).
Veterans Memorial Public Library (1968).
Dickinson: Dickinson State College 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: State College Library (1913).

OHIO

Ada: Ohio Northern University College of Law, J. P. Taggart Library (1965).
Akron:
Akron Public Library (1952).
University of Akron Library (1963).
Alliance: Mount Union College Library (1888).
Ashland: Ashland College Library (1938).
Athens: Ohio University Library (1886).
Batavia: Clermont General and Technical College Library (1973).
Bluffton: Bluffton College, Musselman Library (1951).
Bowling Green: Bowling Green State University 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 Library (1929).
Cleveland:
Case Western Reserve University, Freiberger Library (1913).
Cleveland Heights-University Heights Public Library (1970).
Cleveland Public Library (1886).
Cleveland State University Library (1966).
John Carroll University, Grasselli Library (1963).
Municipal Reference Library (1970).
Columbus:
Capital University Library (1968).
Columbus Public Library (1885).
Ohio State Library (unknown)—REGIONAL.
Ohio State University Library (1907).
Ohio Supreme Court Law Library (1973).
Dayton:
Dayton and Montgomery County Public Library (1909).
University of Dayton, Albert Emanuel Library (1969).
Wright State University Library (1965).
Delaware: Ohio Wesleyan University, L. A. Beeghly Library (1845).
Elyria: Elyria Public Library (1966).
Findlay: Findlay College, Shafer Library (1969).
Gambier: Kenyon College Library (1873).
Granville: Denison University Library (1884).
Hiram: Hiram College, Teachout-Price Memorial Library (1874).
Kent: Kent State University Library (1962).
Marietta: Marietta College, Dawes Memorial Library (1884).
Middletown: Miami University at Middletown, Gardner-Harvey Library (1970).
New Concord: Muskingum College Library (1966).
Oberlin: Oberlin College Library (1858).
Oxford: Miami University, Alumni Library (1909).
Portsmouth: Portsmouth Public Library (unknown).
Rio Grande: Rio Grande College, Jeanette Albiez Davis Library (1966).
Springfield: Warder Public Library (1884).
Steubenville:
College of Steubenville, Starvaggi Memorial Library (1971).
Public Library of Steubenville and Jefferson County (1950).
Tiffin: Heidelberg College, Beeghly Library (1964).
Toledo:
Toledo-Lucas County Public Library (1884).
University of Toledo Library (1963).
Westerville: Otterbein College, Centennial Library (1967).
Wooster: College of Wooster, Andrews Library (1966).
Youngstown:
Public Library of Youngstown and Mahoning County (1923).
Youngstown State University Library (1971).

OKLAHOMA

Ada: East Central State College, Linscheid Library (1914).
Alva: Northwestern State College Library (1907).
Bartlesville: U.S. Bureau of Mines, Energy Research Center Library (1962).
Bethany: Bethany Nazarene College, R. T. Williams Library (1971).
Durant: Southeastern State College Library (1929).
Edmond: Central State University Library (1934).
Enid: Public Library of Enid and Garfield County (1908).
Langston: Langston University, G. Lamar Harrison Library (1941).
Muskogee: Muskogee Public Library (1971).
Norman: University of Oklahoma Libraries (1893).
Oklahoma City:
Oklahoma City University Library (1963).
Oklahoma County Library System.
Oklahoma Department of Libraries (1893)—REGIONAL.
Shawnee: Oklahoma Baptist University Library (1933).
Stillwater: Oklahoma State University Library (1907).
Tahlequah: Northeastern State College, John Vaughan Library (1923).
Tulsa:
Tulsa City-County Library (1963).
University of Tulsa, McFarlin Library (1929).
Weatherford: Southwestern State College Library (1958).

OREGON

Ashland: Southern Oregon College Library (1953).
Corvallis: Oregon State University Library (1907).
Eugene: University of Oregon Library (1883).
Forest Grove: Pacific University Library (1897).
La Grande: Eastern Oregon College, Walter M. Pierce Library (1954).
McMinnville: Linfield College, Northup Library (1965).
Monmouth: Oregon College of Education Library (1967).
Portland:
Department of the Interior, Bonneville Power Administration Library (1962).
Lewis and Clark College, Aubrey R. Watzek Library (1967).

Library Association of Portland (1884).
Portland State University Library (1963)—REGIONAL.
Reed College Library (1912).

Salem:
Oregon State Library (unknown).
Oregon Supreme Court Library (1974).
Williamette University Library (1969).

PENNSYLVANIA

Allentown: Muhlenberg College, Haas Library (1939).
Altoona: Altoona Public Library (1969).
Bethlehem: Lehigh University, Linderman Library (1876).
Carlisle: Dickinson College, Boyd Lee Spahr Library (1947).
Cheyney: Cheyney State College, Leslie Pinckney Hill Library (1947).
Collegeville: Ursinus College, Myrin Library (1963).
Doylestown: Bucks County Free Library, Center County Library (1970).
East Stroudsburg: East Stroudsburg State College, Kemp Library (1966).
Erie: Erie Public Library (1897).
Greenville: Thiel College, Langenheim Memorial Library (1963).
Harrisburg: State Library of Pennsylvania (unknown)—REGIONAL.
Haverford: Haverford College Library (1897).
Hazleton: Hazleton Area Public Library (1964).
Indiana: Indiana University of Pennsylvania, Rhodes R. Stabley Library (1962).
Johnstown: Cambria County Glosser Memorial Library (1965).
Lancaster: Franklin and Marshall College, Fackenthal Library (1895).
Lewisburg: Bucknell University, Ellen Clarke Bertrand Library (1963).
Mansfield: Mansfield State College Library (1968).
Meadville: Allegheny College, Reis Library (1907).
Millersville: Millersville State College, Ganser Library (1966).
Monessen: Monessen Public Library (1969).
New Castle: New Castle Free 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).
Temple University, Samuel Paley Library (1947).
University of Pennsylvania Library (1886).
U.S. Court of Appeals for Third Circuit Library (1973).

Pittsburgh:
Carnegie Library of Pittsburgh, Allegheny Regional Branch (1924).
Carnegie Library of Pittsburgh (1895).
University of Pittsburgh, Hillman Library (1910).
U.S. Bureau of Mines, Pittsburgh Research Center Library (1962).

Pottsville: Pottsville Free Public Library (1967).
Reading: Reading Public Library (1901).
Scranton: Scranton Public Library (1895).
Shippensburg: Shippensburg State College, Ezra Lehman Memorial Library (1973).
Slippery Rock: Slippery Rock State College, Maltby Library (1965).
Swarthmore: Swarthmore College Library (1923).
University Park: Pennsylvania State University Library (1907).
Villanova: Villanova University, School of Law Library (1964).
Warren: Warren Library Association, Warren Public Library (1885).
Washington: Washington and Jefferson College, Memorial Library (1884).
Waynesburg: Waynesburg College Library (1964).
West Chester: West Chester State College, Francis Harvey Green Library (1967).
Wilkes-Barre: King's College, Corgan Library (1949).
Williamsport: Lycoming College Library (1970).
York: York Junior College Library (1963).
Youngwood: Westmoreland County Community College, Learning Resource Center (1972).

PUERTO RICO

Mayaguez: University of Puerto Rico, Mayaguez Campus Library (1928).
Ponce: Catholic University of Puerto Rico Library (1966).
Rio Piedras: University of Puerto Rico General Library (1928).

RHODE ISLAND

Kingston: University of Rhode Island Library (1907).
Newport: U.S. Naval War College Library (1963).

Providence:
Brown University Library (unknown).
Providence College, Phillips Memorial Library (1969).
Providence Public Library (1884).
Rhode Island College, James P. Adams Library (1965).
Rhode Island State Library (before 1895).

Warwick: Warwick Public Library (1966).
Westerly: Westerly Public Library (1909).

SOUTH CAROLINA

Charleston:
Baptist College at Charleston Library (1967).
College of Charleston Library (1869).
The Citadel Memorial Library (1962).

Clemson: Clemson University Library (1893).

Columbia:
Benedict College, Starks Library (1969).
Columbia College, Edens Library (1966).
South Carolina State Library (before 1895).
University of South Carolina, Undergraduate Library (1884).

Conway: University of South Carolina, Coastal Carolina Regional Campus 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 Library (1967).
Orangeburg: South Carolina State College, Whittaker Library (1953).
Rock Hill: Winthrop College, Dacus Library (1896).
Spartansburg: Spartansburg County Public Library (1967).

SOUTH DAKOTA

Aberdeen: Northern State College Library (1963).
Brookings: South Dakota State University, Lincoln Memorial Library (1889).

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Pierre: South Dakota State Library (1973).
Rapid City:
Rapid City Public Library (1963).
South Dakota School of Mines and Technology Library (1963).
Sioux Falls:
Augustana College, Mikkelsen Library and Learning Resources Center (1969).
Sioux Falls Public Library (1903).
Spearfish: Black Hills State College Library (1942).
Vermillion: University of South Dakota, I. D. Weeks Library (1889).
Yankton: Yankton College Library (1904).

TENNESSEE

Bristol: King College Library (1970).
Chattanooga: Chattanooga Public Library (1907).
Clarksville: Austin Peay State University, Felix G. Woodward Library (1945).
Cleveland: Cleveland State Community College Library (1973).
Columbia: Columbia State Community College, Finney Memorial Library (1973).
Cookeville: Tennessee Technological University, Jere Whitson Memorial Library (1969).
Jackson: Lambuth College, Luther L. Gobbel Library (1967).
Jefferson City: Carson-Newman College Library (1964).
Johnson City: East Tennessee State University, Sherrod Library (1942).
Knoxville:
Public Library of Knoxville and Knox County, Lawson McGhee Library (1973).
University of Tennessee Law Library (1971).
University of Tennessee Library (1907).
Martin: University of Tennessee at Martin Library (1957).
Memphis:
Memphis and Shelby County Public Library and Information Center (1896).
Memphis State University, John W. Brister Library (1966).
Morristown: Morristown College, Carnegie Library (1970).
Murfreesboro: Middle Tennessee State University, Andrew L. Todd Library (1912).
Nashville:
Fisk University Library (1965).
Joint University Libraries (1884).
Public Library of Nashville and Davidson County (1884).
Tennessee State Library and Archives, State Library Division (unknown).
Tennessee State University, Martha M. Brown Memorial Library (1972).
Sewanee: University of the South, Jesse Ball duPont Library (1873).

TEXAS

Abilene: Hardin-Simmons University 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 Library (1884).
University of Texas, Lyndon B. Johnson School of Public Affairs Library (1966).
University of Texas, School of Law Library (1965).
Baytown: Lee College Library (1970).
Beaumont: Lamar University Library (1957).
Brownwood: Howard Payne College, Walker Memorial Library (1964).
Canyon: West Texas State University Library (1928).
College Station: Texas Agricultural and Mechanical University Library (1907).
Commerce: East Texas State University Library (1937).
Corsicana: Navarro Junior College Library (1965).
Dallas:
Bishop College, Zale Library (1966).
Dallas Baptist College Library (1967).
Dallas Public Library (1900).
Southern Methodist University, Fondren Library (1925).
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 Couts Burnett Library (1916).
Galveston: Rosenberg Library (1909).
Houston:
Houston Public Library (1884).
Rice University, Fondren Library (1967).
University of Houston Library (1957).
Huntsville: Sam Houston State University, Estill Library (1949).
Irving: Irving Municipal Library.
Kingsville: Texas Arts and Industries University Library (1944).
Lake Jackson: Brazosport College Library (1969).
Laredo: Laredo Junior College, Harold R. Yeary Library (1970).
Longview: Nicholson Memorial Public Library (1961).
Lubbock: Texas Tech University Library (1935)—REGIONAL.
Marshall: Wiley College, Cole Library (1962).
Nacogdoches: Stephen F. Austin State University Library (1965).
Plainview: Wayland Baptist College, Van Howeling Memorial Library (1963).
Richardson: University of Texas at Dallas Library (1972).
San Angelo: Angelo State University, Porter Henderson Library (1964).
San Antonio:
San Antonio College Library (1972).
San Antonio Public Library, Business and Science Department (1899).
St. Mary's University Library (1964).
Trinity University Library (1964).
University of Texas at San Antonio Library (1973).
San Marcos: Southwest Texas State University Library (1955).
Seguin: Texas Lutheran College, Blumberg Memorial Library (1970).
Sherman: Austin College, Arthur Hopkins Library (1963).
Texarkana: Texarkana Community College, Palmer Memorial Library (1963).
Victoria: University of Houston, Victoria Center Library (1973).
Waco: Baylor University Library (1905).
Wichita Falls: Midwestern 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 Library (1962).
Provo:
Brigham Young University Library (1908).
Brigham Young University, Law Library (1972).
Salt Lake City:
University of Utah, Law Library (1966).
University of Utah, Eccles Medical Sciences Library (1970).
University of Utah, Marriott Library (1893).
Utah State Library Commission, Documents Library (unknown).

VERMONT

Burlington: University of Vermont, Bailey Library (1907).
Castleton: Castleton State College, Calvin Coolidge Library (1969).
Christiansted: Christiansted Public Library.
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 (before 1895).
Northfield: Norwich University Library (1908).
Putney: Windham College, Dorothy Culbertson Marvin Memorial Library (1965).

VIRGIN ISLANDS

Charlotte Amalie: College of the Virgin Islands, Ralph M. Paiewonsky Library.
St. Croix: Christiansted Public Library (1974).
St. Thomas:
College of the Virgin Islands, Ralph M. Paiewonsky Library (1973).
St. Thomas Public Library (1968).

VIRGINIA

Blacksburg: Virginia Polytechnic Institute, Newman Library (1907).
Bridgewater: Bridgewater College, Alexander Mack Memorial Library (1902).
Charlottesville:
University of Virginia, Alderman Library (1910)—REGIONAL.
University of Virginia Law Library (1964).
Chesapeake: Chesapeake Public Library System (1970).
Danville: Danville Community College Library (1969).
Emory: Emory and Henry College Library (1884).
Fairfax: George Mason College of the University of Virginia, Fenwick Library (1960).
Fredericksburg: Mary Washington College, E. Lee Trinkle Library (1940).
Hampden-Sydney: Hampden-Sydney College, Eggleston Library (1891).
Harrisonburg: Madison College, Madison Memorial Library (1973).
Hollins College: Hollins College, Fishburn Library (1967).
Lexington:
Virginia Military Institute, Preston Library (1874).
Washington and Lee University, Cyrus Hall McCormick Library (1910).
Martinsville: Patrick Henry Community College Library (1971)
Norfolk:
Armed Forces Staff College Library (1963).
Norfolk Public Library (1895).
Old Dominion University, Hughes Memorial Library (1963).
Petersburg: Virginia State College, Johnston Memorial Library (1907).
Quantico:
Federal Bureau of Investigation Academy Library (1970).
Marine Corps Schools, James Carson Breckinridge Library (1967).
Reston: U.S. Geological Survey Library.
Richmond:
State Law Library (1973).
University of Richmond, Boatright Memorial Library (1900).
U.S. Court of Appeals for Fourth Circuit Library (1973).
Virginia Commonwealth University, James Branch Cabell Library (1971).
Virginia State Library (unknown).
Roanoke: Roanoke Public Library (1964).
Salem: Roanoke College Library (1886).
Williamsburg: College of William and Mary, Swem Library (1936).
Wise: Clinch Valley College, John Cook Wyllie Library (1971).

WASHINGTON

Bellingham: Western Washington State College, Wilson Library (1963).
Cheney: Eastern Washington State College Library (1966).
Ellensburg: Central Washington State College Library (1962).
Everett: Everett Public Library (1914).
Olympia:
Evergeen State College Library (1972).
Washington State Library (unknown)—REGIONAL.
Port Angeles: Port Angeles Public Library (1965).
Pullman: Washington State University Library (1907).
Seattle:
Seattle Public Library (1908).
University of Washington Library (1890).
University of Washington, School of Law Library (1969).
Spokane: Spokane Public Library (1910).
Tacoma:
Tacoma Public Library (1894).
University of Puget Sound, Collins Memorial Library (1938).
Vancouver: Fort Vancouver Regional Library (1962).
Walla Walla: Whitman College, Penrose Memorial Library (1890).

WEST VIRGINIA

Athens: Concord College Library (1924).
Bluefield: Bluefield State College Library (1972).
Charleston:
Kanawha County Public Library (1952).
West Virginia Department of Archives and History Library (unknown).
Elkins: Davis and Elkins College Library (1913).
Fairmont: Fairmont State College Library (1884).
Glenville: Glenville State College, Robert F. Kidd Library (1966).
Huntington: Marshall University Library (1925).
Institute: West Virginia State College Library (1907).
Morgantown: West Virginia University Library (1907)—REGIONAL.

Salem: Salem College Library (1921).
Shepherdstown: Shepherd College Library (1971).
Weirton: Mary H. Weir Public Library (1963).

WISCONSIN

Appleton: Lawrence University, Samuel Appleton Library (1869).
Beloit: Beloit College Libraries (1888).
Eau Claire: University of Wisconsin-Eau Claire, William D. McIntyre Library (1951).
Fond du Lac: Fond du Lac Public Library (1966).
Green Bay: University of Wisconsin at Green Bay Library (1968).
La Crosse:
  La Crosse Public Library (1883).
  University of Wisconsin-La Crosse, Murphy Library (1965).
Madison:
  Department of Public Instruction, Division for Library Services, Reference and Loan Library (1965).
  Madison Public Library (1965).
  State Historical Society Library (1870) – REGIONAL.
  University of Wisconsin, Memorial Library (1939).
  Wisconsin State Library (unknown).
Milwaukee:
  Alverno College Library (1971).
  Milwaukee County Law Library (1934).
  Milwaukee Public Library (1961) – REGIONAL.
  Mount Mary College Library (1964).
  Oklahoma Neighborhood Library (1965).
  University of Wisconsin-Milwaukee Library (1960).
Oshkosh: University of Wisconsin-Oshkosh, Forrest R. Polk Library (1956).
Platteville: University of Wisconsin-Platteville, Karrmann Library (1964).
Racine: Racine Public Library (1898).
River Falls: University of Wisconsin-River Falls, Chalmer Davee Library (1962).
Stevens Point: University of Wisconsin-Stevens Point, Learning Resources Center (1951).
Superior:
  Superior Public Library (1908).
  University of Wisconsin-Superior, Jim Dan Hill Library (1935).
Waukesha: Waukesha Public Library (1966).
Wausau: Wausau Public Library (1971).
Whitewater: University of Wisconsin-Whitewater, Harold Andersen Library (1963).

WYOMING

Casper: Natrona County Public Library (1929).
Cheyenne: Wyoming State Library (unknown).
Laramie: University of Wyoming, Coe Library (1907).
Powell: Northwest Community College Library (1967).
Riverton: Central Wyoming College Library (1969).
Rock Springs: Western Wyoming College Library (1969).
Sheridan: Sheridan College, Mary Brown Kooi Library (1963).

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Regional Office FTS 404 526-6565

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4. TITLE AND SUBTITLE

Publications of the National Bureau of Standards 1975 Catalog

5. Publication Date: June 1976

6. Performing Organization Code

7. AUTHOR(S)

Betty L. Hurdle, Editor

8. Performing Organ. Report No.

9. PERFORMING ORGANIZATION NAME AND ADDRESS

NATIONAL BUREAU OF STANDARDS
DEPARTMENT OF COMMERCE
WASHINGTON, D.C. 20234

10. Project/Task/Work Unit No.

11. Contract/Grant No.

12. Sponsoring Organization Name and Complete Address *(Street, City, State, ZIP)*

Same as Item 9

13. Type of Report & Period Covered

January-December 1975

14. Sponsoring Agency Code

15. SUPPLEMENTARY NOTES

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Document Number (If ordered by title, see reverse side first)	Routing Code (Details on Reverse)	Check one: Paper Copy	Check one: Micro fiche	Check one: Other (specify)	Quantity	Unit Price	Total Price

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National Technical Information Service
U. S. DEPARTMENT OF COMMERCE
5285 Port Royal Road, Springfield Va. 22151

Date ____________________,

Ship to: (Enter if different from address at left.)

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