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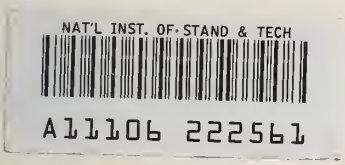
NDE PUBLICATIONS: 1979



Leonard Mordfin, Editor

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
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Washington, DC 20234

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U.S. DEPARTMENT OF COMMERCE, Malcolm Baldrige, *Secretary*
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1. Introduction

This is the third in a series of bibliographies of NBS publications on nondestructive evaluation (NDE). Previous reports in this series have been NBSIR 78-1557, "NDE Publications: 1972-1977" and NBSIR 80-2080, "NDE Publications: 1978". This report provides bibliographic citations for publications that appeared in the open literature during calendar year 1979. Also included are citations for several publications that appeared in previous years but were not listed in the earlier compilations.

Almost all of these publications were authored by members of the NBS staff and include papers published in non-NBS media as well as papers and reports from the NBS publications series. A few were written for NBS media by non-NBS authors. Many of the publications cited are based on research that was supported, in whole or in part, by the NBS Office of Nondestructive Evaluation.

These publications address a wide variety of NDE methods, both those that are well established in industry and some that are relatively new. For completeness, several publications dealing with technologies that directly support NDE, such as radiation gauging and piezoelectricity, have been included.

The format of this report is the same as that used previously. Brief, edited abstracts are provided for most of the publications cited. The bibliography and the abstracts comprise Section 2 of the report. The 114 entries in the bibliography are listed in alphabetical order by the surname of the first author.

Section 3 of the report is a subject index for the publications listed. This index is quite comprehensive and, when used together with the abstracts and the alphabetical bibliography, may be expected to enable readers to locate publications of interest without difficulty.

The last section of the report provides some assistance to readers wishing to obtain copies of specific publications listed.

2. Bibliography and Abstracts

1. Anon., Program and abstracts, First International Symposium on Ultrasonic Materials Characterization, June 7-9, 1978, National Bureau of Standards, Gaithersburg, MD, 150 pages (1978).

   This booklet contains abstracts of all the symposium papers including those presented in the poster session.

2. Anon., NDE, LC 1080, 6 pages (Sept. 1979).

   This brochure, prepared by the NBS Office of Nondestructive Evaluation (NDE), describes the NDE Program at NBS.

3. Behrens, J. W., Schrack, R. A., Bowman, C. D., Resonance neutron radiography using a position-sensitive proportional counter, Trans. Am. Nucl. Soc. 32, 207-208 (American Nuclear Society, Hinsdale, IL, 1979).

   This paper describes progress in the development of resonance neutron radiography as a laboratory reference method for measurements for safeguarding nuclear fuel. To demonstrate and test the method a broad energy spectrum of neutrons and a linear position-sensitive proportional counter were used with time-of-flight techniques to determine the distribution of solder between two silver-brazed metal disks and to measure the thickness of the braze.

4. Berger, H., What are the most urgent standards needs in radiography?, Paper Summaries, ASNT Conference on Innovative and Advanced NDT Radiography, 2 pp. (American Society for Nondestructive Testing, Columbus, OH, Aug. 1977).

5. Berger, H. and Mordfin, L., Eds., Annual Report 1978, Office of Nondestructive Evaluation, NBSIR 78-1581, 58 pages (Jan. 1979). Order from NTIS as PB291946, $7.00.

   This report summarizes the activities of the National Bureau of Standards Nondestructive Evaluation Program. It emphasizes activities over the Fiscal Year 1978. However, since this is the Program's first Annual Report, some material is included to summarize activities since the Program was formally instituted in June 1975.

6. Berger, H., The need for better nondestructive evaluation technology, Dimensions/NBS 63, No. 3, inside cover (Mar. 1979).

7. Berger, H., National and international standards for NDT: To achieve improved repeatability and measures related to performance, Proc. Ninth World Conf. on Non-Destructive Testing, Melbourne, Australia, Nov. 18-23, 1979, 6-3, 12 pages (1979).

   Nondestructive testing (NDT) standards provide a practical procedure to bring some measure of reproducibility to NDT measurements. Nevertheless, better standards are needed both to improve reproducibility and to provide quantitative data for performance-related analyses.

8. Bertocci, U., Detection and analysis of electrochemical noise for corrosion studies, Proc. 7th Int. Conf. on Metallic Corrosion, Rio de Janeiro, Brazil, Oct. 4-11, 1978, pp. 2010-2020 (ABRACO, Rio de Janeiro, Brazil, 1979).

This paper describes the work done at NBS for the study of the fluctuactions in current and potential of electrochemical systems, commonly referred to as electrochemical noise. Two systems of interest to corrosion science have been investigated, iron and aluminum, both in neutral solution. It is shown that anodic polarization above the pitting potential increases the noise generated by a Fe electrode. In the case of Al, addition of small amounts of chlorides was found to enhance the noise current by two orders of magnitude.

9. Birnbaum, G., Report on the symposium on nondestructive testing standards, (Proc. ARPA/AFML Review of Progress in Quantitative NDE, Asilomar, CA, Aug. 31-Sept. 3, 1976), AFML-TR-77-44 Report, p. 158 (Science Center, Rockwell International, Thousand Oaks, CA, Sept. 1977).

A symposium on nondestructive testing (NDT) standards was held at the National Bureau of Standards May 19-21, 1976. The meeting provided the first general forum encompassing discussions on the processes by which NDT codes, standards, and specifications become accepted, and discussions on the status and needs that exist in all NDT methods. Major themes included standards documents, the status of standards in the major methods used in NDT and future directions.

10. Birnbaum, G. and Eitzen, D. G., An appraisal of current and future needs in ultrasonic NDE standards, NBSIR 79-1907, 78 pages (Oct. 1979).

The purpose of this study is to assess the current status of NDE ultrasonic standards and calibrations and to determine current and future needs in this area. The source material includes surveys of the literature and patents, a study of foreign practice, surveys of NBS and consensus standards, and a Workshop on Ultrasonic NDE Standards: "Current Needs and Future Directions," held October 17-18, 1977 for the purpose of implementing the objectives of this study. Recommendations for improvement in existing standards will impact primarily on conventional pulse-echo system and on transducers, the electronic system and reference blocks.

11. Blackburn, D. L., Berning, D. W., Some effects of base current on transistor switching and reverse-bias second breakdown, Technical Digest 1978, pp. 671-675 (Institute of Electrical and Electronics Engineers, New York, NY, 1978).

Some experimental observations of the switching characteristics and second breakdown susceptibility of high-voltage, fast-switching power transistors are discussed. A unique test circuit is described which permits devices to be taken into reverse-bias second breakdown many times with little or no apparent degradation.

12. Blackburn, D. L., Berning, D. W., Reverse-bias second breakdown in power transistors, Proc. Electrical Overstress/Electrostatic Discharge Symp., Denver, CO, Sept. 24-27, 1979, Ordering No. EOS-1, pp. 116-121 (IIT Research Institute, Chicago, IL, 1979).

The construction and operation of a unique facility for testing power transistors for reverse-bias second breakdown with minimal device degradation are described. Reverse-bias safe operating limits that have been determined nondestructively are shown.

13. Blackburn, D. L., Semiconductor measurement technology: An automated photovoltaic system for the measurement of resistivity variations in high-resistivity circular silicon slices, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-52, 41 pages (Nov. 1979) SN003-003-02138-5, $2.00.

14. Boettinger, W. J., Burdette, H. E., Kuriyama, M., X-ray magnifier, Rev. Sci. Instrum. 50, No. 1, 26-30 (Jan. 1979).

A method for the magnification of x-ray radiographic images is described and demonstrated. This magnifier employs two successive asymmetric diffractions of an x-ray beam from highly perfect silicon crystals. A device with a magnification of 25x is demonstrated for Cu K_a radiation. This device preserves and sometimes improves the resolution inherent in the radiographic technique. The x-ray magnifier is particularly useful in circumventing the relatively poor spatial resolution of electro-optical imaging systems needed for real-time observation.

15. Boyne, H. S., Ellerbruch, D. A., Microwave measurements of snow stratigraphy and water equivalence, Proc. 47th Annual Western Snow Conf., Sparks, NV, Apr. 18-20, 1979, pp. 20-26 (1979).

This paper reports on a study of electromagnetic surface and subsurface scattering properties of snow using an FM-CW radar system operating in the frequency range 8-12 GHz. The scattering properties are interpreted and compared with the measured physical properties of snow such as density, stratigraphy, hardness, and equivalent moisture content.

16. Broadhurst, M. G., Davis, G. T., Piezo- and pyroelectric properties, Chapter 5 in Topics in Applied Physics, G. M. Sessler, 33, 285-319 (Springer-Verlag, Berlin, Germany, 1979).

17. Burch, D. M., The use of aerial infrared thermography to compare the thermal resistances of roofs, Nat. Bur. Stand. (U.S.), Tech. Note 1107, 38 pages (Aug. 1979) SN003-003-02102-4, $2.00.

18. Choi, C. S., Prask, H. J., Trevino, S. F., Nondestructive investigation of texture by neutron diffraction, J. Appl. Cryst. 12, 327-331 (1979).

Texture measurement as a function of depth with a collimated thermal neutron beam is demonstrated for a 'two-layer' plate geometry sample with preliminary results for a copper cone.

19. Chwirut, D. J., Eitzen, D. G., Toward the development of improved reference fatigue cracks for use in ultrasonic nondestructive examination, Int. Adv. Nondestruct. Test 6, 179-197 (Gordon & Breach Science Publishers, NY, 1979).

A rationale for the development of well-characterized fatigue cracks for use as standards for advanced ultrasonic flaw evaluation systems is presented. A loading program to generate controlled cracks and to minimize the effects of some of these parameters is described. As determined by these techniques, measured crack lengths are accurate within a few percent. The specimens are being used as test objects in the development of a new technique for flaw evaluation by ultrasonics, radiography, and penetrants.

20. Chwirut, D. J., Recent improvements to the ASTM-type ultrasonic reference block system, NBSIR 79-1742, 54 pages (Apr. 1979). Order from NTIS as PB296044, $7.00.

Recent activities aimed toward improving the ASTM-type ultrasonic reference block system are described. On the aluminum block system (ASTM E 127 and NBS TN 924), efforts were focused on better definition of the measurement equipment (transducer and instrument), the implementation of a Measurement Assurance Program and Loaner Block Service, and modeling of the distance-amplitude relationship. It is shown that a large increase in the precision of reference block readings is easily achievable by implementing simple changes and controls in the measurement procedure. On steel and titanium blocks (e.g. ASTM E-428), efforts were directed toward quantifying the extent of reproducibility possible among blocks fabricated by both conventional drilling and by diffusion bonding.

21. Chwirut, D. J., Recent improvements to the ASTM-type ultrasonic reference block system, Report AFML TR-79-4080, 57 pp. (Air Force Materials Laboratory, Wright-Patterson Air Force Base, OH, July 1979).

See abstract for No. 20.

22. Chwirut, D. J., A simple technique for visualizing transmitted or reflected sound fields, Mater. Eval. 37, No. 13, 29-32 (Dec. 1979).

A simple apparatus for recording transmitted or reflected ultrasonic fields, in longitudinal or transverse section, is described. This system has been used at the National Bureau of Standards for ultrasonic transducer characterization, material evaluation, and defect detection.

23. Clifton, J. R. and Davis, F. L., Mechanical properties of adobe, Nat. Bur. Stand. (U.S.), Tech. Note 996, 45 pages (May 1979) SN003-003-02066-4, $2.25.

A nondestructive test method, based on measuring the penetration resistance of adobe, was found to give reliable predictions of the compressive strength and moisture content of adobe specimens.

24. DeReggi, A. S. and Edelman, S., Piezoelectric polymer membrane stress gage, U.S. Patent 4,166,229, 5 pages (Aug. 28, 1979).

Apparatus and method for detecting pressure variations by modulating a preset tensile stress in a stretched thin sheet of a piezoelectric polymer. The modulation is provided by the changing stress caused by an impinging acoustic signal or the like. The sheet under preset tension acts effectively as a membrane resulting in a high output combined with a high resonance frequency and a wide operating frequency range.

25. Deutsch, S., A preliminary study of the fluid mechanics of liquid penetrant testing, J. Res. Nat. Bur. Stand. (U.S.), 84, No. 4, 287-292 (July-Aug. 1979).

Some aspects of the fluid mechanics of liquid penetrant testing are considered.

26. Dietz, D. R., Parks, S. I., and Linzer, M., Expanding-aperture annular array, Ultrasonic Imaging 1, No. 1, 56-75 (Jan. 1979).

A dynamically-focused annular array system for contact B-scanning has been developed. The design is based on a constant F-number approach, whereby, at short focal lengths, the aperture is increased in proportion to the focal length. This approach allows the use of larger area array elements, thus increasing the sensitivity of the system. Other major advantages include a substantial reduction in the time delays and refocusing rates required for the lens synthesis with a corresponding reduction in the electronic complexity of the system.

27. Edelman, S., Piezoelectric and pyroelectric polymer sensors, Report on Sensor Technology for Battlefield and Physical Security Applications, pp. 204-212 (U.S. Army Mobility Equipment Research and Development Command, Fort Belvoir, VA, July 1977).

28. Edelman, S., Kenney, J. M., Mayo-Wells, J. F. and Roth, S. C., A polymer sensor for monitoring ball-bearing condition, MFPG - Detection, Diagnosis, and Prognosis, T. R. Shives and W. A. Willard, Eds., NBS Spec. Publ. 547, pp. 303-314 (July 1979) SN003-003-02083-4, $7.00.

Noise spectra have been used frequently to detect faulty bearings. This paper describes how piezoelectric polymer sensors coupled with spectrum analyzers make this technique more useful.

29. Eisenhauer, C. M., Gilliam, D. M., Grundl, J. A., Spiegel, V., Utilization of standard and reference neutron fields at NBS, Proc. 2d ASTM-EURATOM Symp. on Reactor Dosimetry: Dosimetry Methods for Fuels, Cladding, and Structural Materials, Palo Alto, CA, Oct. 3-7, 1977, 3, 1177-1191 (Available as NUREG/CP-0004 from the National Technical Information Service, Springfield, VA, Oct. 1977).

30. Eisenhower, E. H., NBS radiation measurement assurance activities, (Proc. 8th Ann. Nat. Conf. on Radiation Control-Radiation Benefits and Risks: Facts, Issues, and Options, Springfield, IL, May 2-7, 1976), HEW Publication (FDA) 77-8021, pp. 391-397 (U.S. Department of Health, Education, and Welfare, Rockville, MD, Apr. 1977).

The role of the National Bureau of Standards as the national reference laboratory for radiation measurements is described.

31. Eisenhower, E. H. (ANSI Subcommittee N43-3.2), American National Standard N538; Classification of industrial ionizing radiation gauging devices, Nat. Bur. Stand. (U.S.), Handb. 129, 29 pages (Oct. 1979) SN003-003-02135-1, $1.75.

This American National Standard applies to the radiation safety aspects of gauging devices, commonly called gauges, which use sealed radioactive sources or x-ray tubes for the determination or control of thickness, density, level, interface location, or qualitative or quantitative chemical composition.

32. Eitzen, D. G., Measurement services for ultrasonic nondestructive evaluation, Dimensions/NBS 63, No. 3, 14-16 (Mar. 1979).

This brief paper describes measurement services available from NBS including ultrasonic transducer power output vs. frequency, ultrasonic transducer and system power output by calorimetry, aluminum ultrasonic reference block calibration, loaner services for transducers and reference blocks.

33. Eitzen, D. G., New services for calibrating ultrasonic test systems, Machine Design, Sept. 6, 1979, pp. 3-4.

34. Eitzen, D. G., Ultrasonic nondestructive evaluation, PMTE Update 1, No. 3, pp. 1, 4 (Dec. 1979).

35. Eitzen, D. G. and Quinn, J., Acoustic emission, Nondestructive Evaluation Program: Progress in 1979, G. J. Dau et al, Eds., Report NP-1234-SR, pp. 9-1 to 9-9 (Electric Power Research Institute, Palo Alto, CA, Dec. 1979).

36. Evans, A. G., Linzer, M. and Russell, L. R., Acoustic emission and crack propagation in polycrystalline alumina, Materials Science and Engineering 15, 253-261 (1974).

37. Fong, J. T. and Johnson, B. M., Eds., Inservice data reporting and analysis, Vol. II, PVP-35, 226 pp (American Society of Mechanical Engineers, NY, 1979).

Together with the first volume of this set of books on inservice data for pressure vessels, piping, pumps and valves, we have a total of eighteen

technical papers complete with extensive discussions and closure and two separate chapters on symposium general discussions.

38. Fong, J. T., Inservice data -- the missing link in the exercise of judgment in engineering decision-making, Inservice Data Reporting and Analysis, Vol. II, PVP-35, J. T. Fong and B. M. Johnson, Eds., pp. 153-162 (American Society of Mechanical Engineers, NY, 1979).

A simple conceptual model to identify the various components of a typical engineering decision-making process is presented. The importance of the documentation of the inservice performance of critical engineering systems or components is discussed within the context of this conceptual model. The critical need for inservice data is illustrated by a case study of a 1976 regulatory decision concerning the integrity of 612 defective girth welds of the Trans-Alaska Oil Pipeline.

39. Garrett, D. A., Electronic imaging applied to neutron radiography, Paper Summaries, ASNT Conference on Innovative and Advanced NDT Radiography, 1 p. (American Society for Nondestructive Testing, Columbus, OH, Aug. 1977).

40. Garrett, D. A., Properties of imaging systems for thermal neutron radiography, Paper Summaries, 1978 ASNT Fall Conference, pp. 64-66 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1978).

Radiography utilizing thermal neutrons as the interrogating probe is employed in the explosives, nuclear, and aerospace industries. The neutron is a nonionizing subatomic particle. It has been this nonionizing property that causes film imaging of spatially-modulated thermal neutron beams to present several problems not encountered in the imaging of other radiation beams such as x- and gamma rays, electrons and protons.

41. Garrett, D. A., The observation of electrolyte phenomena in lithium iodide pacemaker batteries with neutron radiographic interrogation, Paper Summaries, 1979 ASNT Spring Conference, pp. 156-157 (American Society for Nondestructive Testing, Columbus, OH, Apr. 1979).

42. Garrett, D. A. and Ganoczy, M., The observation of electrolyte phenomena in lithium-iodide pacemaker batteries with neutron radiographic interrogation, Semiconductor Measurement Technology: Reliability Technology for Cardiac Pacemakers III -- A Workshop Report, H. A. Schafft, Ed., NBS Spec. Publ. 400-50, pp. 40-42 (June 1979) SN003-003-02076-1, $4.50.

43. Golan, S., A comparison of American and European ultrasonic testing standards, NBSIR 79-1790, 73 pages (Aug. 1979). Order from NTIS as PB298809, $7.00.

In this work twenty-seven general ultrasonic standards from eleven countries and international organizations were reviewed. Thirty-seven ultrasonic product standards from five countries were studied to evaluate the utilization of the general ultrasonic standards, i.e., to what extent the procedures outlined in the general standards are applied by the product standards.

44. Green, R. E., Jr., Electro-optical detectors and flash x-ray generators for dynamic x-ray diffraction investigation of materials, Proc. Workshop on X-ray Instrumentation for Synchrotron Radiation, Stanford University, Stanford, CA, Apr. 3-5, 1978, 165 pages (1978).

This paper gives a brief overview of previous work in rapid imaging of x-ray diffraction patterns using conventional x-ray generators, flash x-ray generators, and electro-optical detectors.

45. Greenspan, M., Piston radiator: Some extensions of the theory, J. Acoust. Soc. Am. 65, No. 3, 608-621 (Mar. 1979).

Those results of the theory of the baffled, uniform-piston radiator that can be calculated exactly are extended to some other cases, especially the simplest case of a simply supported radiator, the simplest case of a clamped-edge radiator and a Gaussian radiator. It is also shown that from the solution to a problem with boundary conditions framed in terms of velocity, the solution to a corresponding problem, having boundary conditions framed in terms of pressure, can be obtained very easily.

46. Gubernatis, J. E., Krumhansl, J. A., Thomson, R. M., Interpretation of elastic-wave scattering theory for analysis and design of flaw-characterization experiments: The long-wavelength limit, J. Appl. Phys. 50, No. 5, 3338-3345 (May 1979).

We discuss long-wavelength scattering results for volume flaws and idealized cracks and compare some of the results with those of the Born approximation, which has already been calibrated by comparison to exact calculations and experiment.

47. Harman, G. G., Semiconductor measurement technology: Nondestructive tests used to insure the integrity of semiconductor devices, with emphasis on acoustic emission techniques, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-59, 72 pages (Sept. 1979) SN003-003-02166-4, $3.50.

The discussion is divided into two major sections. The first consists of an introduction to device assembly techniques and problems followed by a review of six important nondestructive tests used during and after device packaging to insure the mechanical integrity of completed electronic devices. The second section begins with an introduction to acoustic emission,

the status of theory as it can be applied to microelectronics. Then the published papers that have applied AE as a nondestructive test in electronics applications will be reviewed. Finally, passive AE techniques are applied to establishing the mechanical bond integrity of beam lead, flip chip, and tape-bonded integrated circuits as well as components in hybrid microcircuits.

48. Harman, G. G., Non-destructive tests used to insure the integrity of semiconductor devices with emphasis on passive acoustic techniques, Chapter 13 in Nondestructive Evaluation of Semiconductor Materials and Devices, J. N. Zemel, Ed., pp. 677-738 (Plenum Press, New York, NY, 1979).

See abstract for No. 47.

49. Harrje, D. T., Grot, R. A., Instrumentation for monitoring energy usage in buildings at Twin Rivers, Energy and Buildings, 1, 293-299 (Elsevier Sequoia S. A., Lausanne--The Netherlands, 1977/1978).

The measurement systems used at Twin Rivers for determining energy usage are described. These include a weather station, systems for the measurement of temperatures and energy-related events in a house, automated devices to measure the air infiltration rate, and infrared thermography.

50. Hayward, E., Dodge, W. R., Patrick, B. H., Some experiences using a positron annihilation beam, Nucl. Instrum. Methods 159, 289-299 (1979).

The NBS positron annihilation-in-flight facility is described, along with the procedure for the calibration of the positron beam energy. Details are also given of a large NaI(Tl) spectrometer used with the annihilation photon beam.

51. Hilten, J. S., Lederer, P. S., Mayo-Wells, J. F. and Vezzetti, C. F., Loose-particle detection in microelectronic devices, NBSIR 78-1590, 73 pages (Jan. 1979). Order from NTIS as PB290679, $7.00.

The work described constitutes an evaluation of the test procedures and apparatus specified in MIL-STD-883, Test Method 2020, Particle Impact Noise Detection Test.

52. Hust, J. G., Kirby, R. K., Standard reference materials for thermophysical properties, Advances in Cryogenic Engineering 24, K. D. Timmerhaus, R. P. Reed, and A. F. Clark, Eds., 232-239 (Plenum Press, New York, NY, 1978).

The National Bureau of Standards has prepared over 50 certified Standard Reference Materials for use in the area of thermophysical properties of solids. The properties that have been certified include elasticity, electrical resistivity, emittance, specific heat, thermal

conductivity, thermal expansion, vapor pressure, and fixed points of the International Practical Temperature Scale. The materials include aluminum, copper, gold, iron, tungsten, several high-temperature alloys, alumina, silica, and several glasses.

53. Hust, J. G., Graphite as a standard reference material, Thermal Conductivity 15, V. V. Mirkovich, Ed., pp. 161-167 (Plenum Press, New York, NY, 1978).

A large number of isotropic, fine-grained graphite rods in various diameters have been obtained for homogeneity and stability investigations. Electrical resistivity and density measurements have been performed on numerous rods at temperatures from 4 to 300 K. Thermal conductivity measurements have been performed on thirteen specimens at about 20°C. These measurements show that transport property variations both between and within these rods is relatively large. However, a correlation is shown to exist which will allow the calculation of thermal conductivity from simple and inexpensive electrical resistivity and density measurements to within about ± 2%.

54. Ives, L. K., Microstructural changes in copper due to abrasive, dry and lubricated wear, Proc. Int. Conf. on Wear of Materials, Dearborn, MI, Apr. 16-18, 1979, pp. 246-255 (American Society of Mechanical Engineers, New York, NY, 1979).

Copper was exposed to wear under conditions of abrasive, dry, and lubricated sliding contact in air. An examination of surface morphology and subsurface microstructure was conducted by scanning and transmission electron microscopy methods in order to study the detailed nature of the wear process on a microscopic level. Wear debris fragments were also examined and the results correlated with surface and subsurface observations.

55. Johnson E. G., Jr., Laser beam profile measurements using spatial sampling, Fourier optics, and holography, Nat. Bur. Stand. (U.S.), Tech. Note 1009, 96 pages (Jan. 1979) SN003-003-02019-2, $2.75.

Using appropriate holography, lenses, mirrors, and a two-dimensional array of small holes to sample the electric field of a laser pulse, we demonstrate a technique for beam profile measurements at a preselected observation plane.

56. Johnson, E. G., Jr., Design of a reflection apparatus for laser beam profile measurements, Nat. Bur. Stand. (U.S.), Tech. Note 1015, 124 pages (July 1979) SN003-003-02103-2, $4.00.

Measurement of both the irradiance and phase front (the beam profile) in real time from the output of a laser has interest for control of that beam and for efficient energy and economic design of the source and the

resulting optical systems. The National Bureau of Standards has begun a program to build a unit that can measure, at numerous wavelengths from 1.06 μm to 10.6 μm, a selected spatial sample of the beam profile.

The Hartmann plate method is described briefly so that a comparison between it and the holographic method can be made. The comparison shows why the holographic method is best for a standard for irradiance and phase-front measurements.

57. Kaiserlik, J., Berger, H., McGogney, C., Timber pilings: Maintenance and inspection; summary of a panel discussion, Proc. 4th Nondestructive Testing of Wood Symp., Vancouver, WA, Aug. 28-30, 1978, pp. 155-159 (Washington State Univ., Engineering Extension Service, Pullman, WA, 1979).

Timber pilings are used in bridge structures and for harbor and navigational facilities. The topic for discussion was the inspection and maintenance of these pilings in order to prevent failures such as the collapse of the Coos Bay bridge in Oregon in 1977 due to damage caused by marine borers.

58. Kenney, J. M. and Roth, S. C., Room temperature poling of poly(vinylidene fluoride) with deposited metal electrodes, J. Res. Nat. Bur. Stand. (U.S.), 84, No. 6, 447-453 (Nov.-Dec. 1979).

59. Kessler, E. G., Jr., Deslatte, R. D., Sauder, W. C., Henins, A., Precise γ-ray energy standards, Neutron Capture Gamma-ray Spectroscopy, R. E. Chrien and W. R. Kane, Eds., pp. 427-440 (Plenum Publ. Corp., New York, NY, 1979).

A number of γ-ray energy standards have recently been remeasured with respect to a visible standard wavelength with an accuracy of about 0.5 ppm. These measurements, which were made on a double axis flat crystal spectrometer, established the γ-ray energy scale in the 50 keV to 1 MeV region about 40 times more accurately than it was previously known.

60. Kirby, R. K., Standard reference materials for thermophysical properties, Proc. 7th Symp. on Thermophysical Properties, Gaithersburg, MD, May 10-12, 1977, A. Cezairliyan, Ed., pp. 949-965 (American Society for Mechanical Engineers, New York, NY, 1977).

Standard Reference Materials can be used to develop test methods and to calibrate measurement equipment thereby insuring the compatibility of measurements among laboratories and assuring the long-term integrity of quality control in manufacturing processes.

61. Koukhar, V. A., Maksimov, A. A., Berger, H., A comparison of NDT standards in the US and USSR, Proc. Ninth World Conf. on Non-Destructive Testing, Melbourne, Australia, Nov. 18-23, 1979, 6-3, 9 pages (1979).

An initial comparison and analysis is given for several radiographic and ultrasonic standards of the US (ASTM) and the USSR (GOST). Differences between standards are pointed out.

62. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., X-ray residual stress evaluation, Paper Summaries, 1978 ASNT Fall Conference, pp. 49-50 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1978).

63. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., X-ray image magnification technique developed, Dimensions/NBS 63, No. 3, 18-19 (Mar. 1979).

Certain limitations of radiography may be overcome by use of a method developed for magnifying x-ray images.

64. Kuriyama, M., Boettinger, W. J. and Burdette, H. E., Real-time radiographic system performance standards, Paper Summaries, 1979 ASNT Fall Conference, pp. 81-85 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1979).

65. Lapinski, N. P., Reimann, K. J. and Berger, H., Fuel subassembly inspection by three-dimensional neutron radiography, Paper Summaries, 1979 ASNT Fall Conference, pp. 235-238 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1979).

66. Ledbetter, H. M., Collings, E. W., Low-temperature magnetic and elastic-constant anomalies in three manganese stainless steels, The Metal Science of Stainless Steels, E. W. Collings, H. W. King, Eds., pp. 22-40 (The Metallurgical Society of AIME, Warrendale, PA, 1978).

Elastic properties of three austenitic stainless steels were studied between room temperature and either liquid-nitrogen or liquid-helium temperature. A dynamic (pulse-echo, 10 MHz) method was used to determine longitudinal and transverse sound-wave velocities, which were converted to elastic constants.

67. Ledbetter, H. M. and Collings, E. W., Sound velocity anomalies near the spin glass transition in an austenitic stainless steel alloy, Phys. Lett. 72A, 53-56 (1979).

68. Ledbetter, N. M. and Moulder, J. C., Laser-induced Rayleigh waves in aluminum, J. Acoust. Soc. Am. 65, No. 3, 840-842 (Mar. 1979).

69. Ledbetter, H. M., Orthotropic elastic stiffnesses of a boron-aluminum composite, J. Appl. Phys. 50, No. 12, 8247-8248 (Dec. 12, 1979).

Measuring 18 separate ultrasonic velocities in a boron-fiber-reinforced aluminum-matrix composite by a 10-MHz pulse-echo technique provides nine independent elastic-stiffness constants.

70. Linzer, M., Ed., Ultrasonic Imaging 1 (Academic Press, NY, 1979).

This quarterly journal provides rapid publication for original papers concerned with the development and application of ultrasonic techniques with emphasis on medical diagnosis. Papers deal with theoretical and experimental aspects of advanced methods and instrumentation for imaging, computerized tomography, Doppler measurements, signal processing, pattern recognition, microscopy, and measurements of ultrasonic parameters.

71. Linzer, M., Ed., Ultrasonic tissue characterization II, Nat. Bur. Stand. (U.S.), Spec. Publ. 525, 339 pages (Apr. 1979) SN003-003-02058-3, $5.50.

The Second International Symposium on Ultrasonic Imaging and Tissue Characterization was held at the National Bureau of Standards on June 13-15, 1977. This volume contains papers based on 43 of the 53 talks presented. Topics covered include techniques for measurement of ultrasonic tissue parameters, Doppler signatures, computerized tomography, signal processing and pattern rocognition.

72. Linzer, M., Parks, S. I., Norton, S. J., Higgins, F. P., Dietz, D. R., Shideler, R. W., Shawker, T. H. and Doppman, J. L., A comprehensive ultrasonic tissue analysis system, Ultrasonic Tissue Characterization II, M. Linzer, Ed., NBS Spec. Publ. 525, pp. 255-259 (Apr. 1979) SN003-003-02058-3, $5.50.

Major elements of the system include: computerized tomography studies; opto-acoustic visualization of ultrasonic fields, studies of propagation through inhomogeneous media, and transducer calibration; electronic focusing, especially annular array imaging; sensitivity enhancement, using digital signal averaging and pulse compression techniques; computer and chirp waveform techniques for compensation of frequency-dependent attenuation; the SonoChromascope, a digital device for real-time acquisition, processing, and display of B-scan images; and computer-based image processing.

73. Linzer, M. and Parks, S. I., The SonoChromascope, Proc. IFIP TC-4 Working Conf. on Computer-Aided Tomography and Ultrasound in Medicine, J. Raviv, J. F. Greenleaf and G. T. Herman, Eds., pp. 73-76 (North Holland Publishing Co., Amsterdam, 1979).

74. Matula, R. A., Electrical resistivity of copper, gold, palladium, and silver, J. Phys. Chem. Ref. Data 8, No. 4, 1147-1298 (1979).

In this work, recommended values for the electrical resistivity as a function of temperature from the cryogenic region to well beyond the melting point are given for bulk pure copper, gold, palladium, and silver.

75. Miller, E. B. and Thurstone, F. L., Linear ultrasonic array design for echosonography, J. Acoust. Soc. Am. 61, No. 6, 1481-1491 (June 1977).

Phased-array echosonographic systems, currently in use in medical diagnosis, employ pulses that are a few wavelengths long at the center frequency. Design of such systems requires that arrays be composed of as few elements as are consistent with acceptable resolution and low side lobes. This paper outlines the development of a model for the field of an idealized phased array. Arrays designed by this method offer advantages over uniform linear arrays because of the smaller number of elements required for given azimuthal resolution and side-lobe level, and because of reduced element interaction.

76. Miller, E. B., Eitzen, D. G., Ultrasonic transducer characterization at the NBS, IEEE Trans. Sonics Ultrason. SU-26, No. 1, 28-37, 63-64 (Jan. 1979).

Four methods for characterizing ultrasonic transducers are reviewed. These methods have been or are being developed for characterizing the performance of ultrasonic devices operating into a water load. The principles upon which these methods are based are electrical measurements related to the equivalent circuit of a quartz transducer, a thermal equivalent calorimetric method, a measurement of total radiation force, and an electroacoustic method involving sampling the acoustic field of a directive device.

77. Mordfin, L., Evaluating pipeline welds, Dimensions/NBS 63, No. 3, 19-20 (Mar. 1979).

The Department of Transportation is sponsoring work at the National Bureau of Standards on the inspection and evaluation of girth welds of the kind used in cross-country pipelines for oil and gas.

78. Norton, S. J. and Linzer, M., Ultrasonic reflectivity tomography: reconstruction with circular transducer arrays, Ultrasonic Imaging 1, No. 2, 154-184 (Apr. 1979).

An analysis is presented of backprojection methods for reconstructing cross-sectional images of ultrasonic reflectivity from scattering measurements. A circular array of transducer elements is considered, using three basic modes of data acquisition and image reconstruction. The point spread function for each of these cases is derived and is shown to depend on the shape of the acoustic pulse used.

79. Norton, S. J. and Linzer, M., Ultrasonic reflectivity imaging in three dimensions: reconstruction with spherical transducer arrays, Ultrasonic Imaging 1, No. 3, 210-231 (July 1979).

Three-dimensional backprojection for reconstructing acoustic reflectivity within a volume is examined. The reflectivity data are acquired by means of a spherical array of point sources-receivers which encloses the object under study. Reconstruction of the image is obtained by backprojecting the recorded pulse echo data over spherical surfaces in image

space. An analytical expression for the point spread function generated by the backprojection process has been derived. This expression was evaluated for several different choices of the acoustic pulse: a narrowband pulse, wideband pulse, and two analytically derived optimum pulses which provide the best sidelobe response.

80. Nyyssonen, D., Optical linewidth measurements on wafers, SPIE Semin. Proc. 135, 115-119 (1978).

An optical scanning microscope system for accurate measurement of linewidth on wafers is described.

81. Nyyssonen, D., Jerke, J. M., Linewidth measurement: From fine art to science, Proc. Int. Electron Devices Meeting, Washington, DC, Dec. 4-6, 1978, 78CH1324-3ED, pp. 437-440 (Electron Devices Society of Institute of Electrical and Electronics Engineers, New York, NY, 1978).

Traditional methods of linewidth measurement on integrated circuit photomasks and wafers have employed an optical microscope with some type of measuring eyepiece. In recent years, the push to finer line geometries has revealed systematic measurement differences between instruments as large as 1.0 μm. Modeling of linewidth measurement systems has shown that these differences may be attributed to differences in edge detection criteria. New techniques have been developed at the NBS for accurate optical edge detection and calibration of other optical linewidth measurement systems.

82. Nyyssonen, D., Jerke, J. M., Optical linewidth measurement--A basic understanding, Proc. Microelectronics Measurement Technology Seminar, San Jose, CA, Feb. 6-7, 1979, pp. 251-266 (1979).

New techniques for accurate edge detection and calibration of optical linewidth measurement systems are discussed.

83. Nyyssonen, D., Spatial coherence: The key to accurate optical micrometrology, Applications of Optical Coherence 194, 34-44 (Society of Photo-Optical Instrumentation Engineers, Bellingham, WA, 1979).

The theory and instrumentation which have been developed for measurements on both photomasks and wafers are described. Linewidths as small as 0.5 μm can be measured with a sensitivity of 0.01 μm and an estimated uncertainty of 0.05 μm.

84. Parks, S. I., Linzer, M. and Shawker, T. H., Further development and clinical evaluation of the expanding-aperture annular array system, Ultrasonic Imaging 1, pp. 378-383 (1979).

85. Peterlin, A., Acoustic emission of polymers under tensile load, Probing Polymer Structures, Advances in Chemistry 174, J. L. Koenig, Ed., pp. 15-23 (1979).

The crazes in ductile materials propagate so smoothly that the acoustical signal is not strong enough to be separated from the noise level. It is only in very brittle material that the jumpwise craze propagation yields acoustic bursts strong enough to be recorded easily.

86. Pielert, J. H., Gross, J. G., Technical evaluation needs for building rehabilitation, Proc. 2d Canadian Building Congress--Rehabilitation of Buildings, Toronto, Canada, Oct. 15-17, 1979, pp. 93-99 (National Research Council of Canada, Ottawa, Canada, 1979).

CBT is developing manuals which will include technical data for building components and specific health, safety and general welfare attributes; e.g., strength and stability, accident safety, health and sanitation, and energy conservation. These manuals will cover: (1) test methods for destructive and nondestructive evaluation of existing construction, (2) methods of analyses to predict the performance of existing construction, (3) field inspection and evaluation methodologies, (4) data on the performance of systems no longer used, and (5) data on rehabilitation experiences.

87. Placious, R. C., Film classification standards and activities -- summary, Paper Summaries, ASNT Conference on Innovative and Advanced NDT Radiography, 2 pp. (American Society for Nondestructive Testing, Columbus, OH, Aug. 1977).

88. Placious, R. C., Moser, E. S., Holland, R. S., Masi, F., Status report: A standard method for determining the efficacy of fluorescent x-ray intensifying screens, J. Appl. Photogr. Eng. 5, 157-159 (1979).

A proposed ANSI standard for classifying radiographic intensifying screens has been under test at the National Bureau of Standards. This standard establishes procedures for characterizing, on an absolute basis, the optical spectral output of fluorescent screens per unit of incident x-ray exposure. The testing procedure has undergone revision since an earlier status report was given. Calcium tungstate screens, however, still form the basis of comparison in this procedure because of the long acceptability and stable output qualities of this screen.

89. Placious, R. C., Garrett, D. A., Berger, H. and Kasen, M. B., Sizing pipeline girth weld flaws from field radiographs (abstract only), Paper Summaries, 1979 ASNT Spring Conference, p. 97 (American Society for Nondestructive Testing, Columbus, OH, Apr. 1979).

90. Placious, R. P., ASTM activity in industrial radiographic film characterization, Paper Summaries, 1979 ASNT Fall Conference, pp. 86-87 (American Society for Nondestructive Testing, Columbus, OH, Oct. 1979).

91. Prosen, E. J. and Colbert, J. C., A microcalorimeter for measuring characteristics of pacemaker batteries, Semiconductor Measurement Technology: Reliability Technology for Cardiac Pacemakers III -- A Workshop Report, H. A. Schafft, Ed., NBS Spec. Publ. 400-50, pp. 23-26 (June 1979) SN003-003-02076-1, $4.50.

A microcalorimeter has been designed and constructed to measure the self-discharge (or shelf life) of pacemaker batteries under load and to measure the energy dissipation of the completed pacemaker. The design is based on previous work using our earlier biological microcalorimeter which could handle only small camera or watch batteries.

92. Reed, R. P., McHenry, H. I., and Kasen, M. B., A fracture-mechanics evaluation of flaws in pipeline girth welds, Welding Research Council Bulletin No. 245, 23 pp. (Jan. 1979).

Fracture-mechanics methods were used to provide a basis for assessing the significance of flaws in girth welds in a buried arctic oil pipeline. Methods were assessed for estimating weld-flaw depths and arc-burn depths from field radiographs. Various fracture-mechanics analyses were used to calculate a series of allowable flaw-size curves. Such curves were used to assess the significance of girth-weld flaws and arc burns.

93. Reneker, D. H., Edelman, S., Dereggi, A., Vanderhart, D. L., A nondestructive evaluation method using piezoelectric polymer transducers and Fourier transform vibrational spectroscopy, Science and Technology of Polymer Processing, N. P. Suh and N. H. Sung, Eds., pp. 844-856 (MIT Press, Cambridge, MA, 1979).

The normal mode vibrational spectrum of a particular object contains a wealth of information about the mechanical integrity of the object. The nondestructive evaluation of objects by observation of such vibrational spectra is facilitated by the combination of recently developed low mass, high compliance piezoelectric polymer transducers, a synchronized method for exciting the sample, and a small minicomputer capable of making digital Fourier transforms.

94. Reno, R. C., Swartzendruber, L. J., Bennett, L. H., Positron annihilation study of defects in titanium, NDT Int., pp. 224-227 (Oct. 1979).

Positron annihilation linewidth measurements have been used to study defect behaviour in titanium samples which were first cold-worked and then annealed. The line width for a highly deformed high purity sample showed a gradual increase with increasing annealing temperature up to recrystallization temperature, above which there was a rapid increase. In contrast, a commercially pure sample displayed a smooth increase in linewidth over the entire annealing range. Hardness measurements correlate reasonably well with the overall trend of the positron lineshape parameter.

95. Rosasco, G. J., Roedder, E., Application of a new Raman microprobe spectrometer to nondestructive analysis of sulfate and other ions in individual phases in fluid inclusions in minerals, Geochim. Cosmochim. Acta 43, 1907-1915 (1979).

We report here the results of the application of a new instrument, based on back-scattering, that greatly expands the range of applicability of Raman spectroscopy to fluid inclusions.

96. Ruff, A. W., Measurements and standards for dry wear, Proc. Natl. Symp. on Wear and Corrosion, Washington, DC, June 1979, 4 pages (American Chemical Society, Washington, DC, 1979).

Activities currently underway to develop and provide reference materials for wear testing, to improve wear measurement procedures and to obtain meaningful wear data will be described.

97. Sachse, W., Hsu, N. N., Ultrasonic transducers for materials testing and their characterization, Chapter 4 in Physical Acoustics XIV, 277-405 (Academic Press, Inc., New York, NY, 1979).

The paper is a comprehensive review of ultrasonic transducers which are being used for materials testing and flaw detection. Emphasis is placed on the characterization of these transducers.

The scope of this review is four-fold: (1) to consider the ultrasonic transducer coupled to various test media as an element in an ultrasonic system; (2) to survey the various methods of ultrasound transduction; (3) to summarize some of the techniques by which the characteristics of a transducer are modified; and (4) to review the techniques for transducer characterization. The emphasis is on transduction devices of bulk waves propagating in solids including contact, immersion and angle beam transducers.

98. Sato, T. and Linzer, M., Engineering aspects of medical ultrasonic imaging -- a few new directions, Japanese J. Clinical Medicine 37, No. 1, 148-152 (1979).

99. Schafft, H. A., Ed., Semiconductor measurement technology: Reliability technology for cardiac pacemakers III--A workshop report, Nat. Bur. Stand. (U.S.), Spec. Publ. 400-50, 134 pages (June 1979) SN003-003-02076-1, $4.50.

The workshop, third in a series, served as a forum for pacemaker manufacturers and other interested parties to address technical questions relevant to the enhancement and assurance of cardiac pacemaker reliability. Extended summaries are provided on the following topic areas: microcalorimetric measurements to evaluate nondestructively

batteries used in pacemakers; neutron radiography interrogation of lithium-based batteries; measurement of moisture; automated testing of pacemakers; and conformal coatings for pacemaker applications.

100. Seltzer, S. M., X-ray source characteristics and detection efficiencies of prototype Lixiscopes, (Proc. Lixiscope Conf., NASA Goddard Space Flight Center, Greenbelt, MD, July 27-28, 1978), NASA Conf. Publ. 2112, Preliminary Applications and Evaluation Results, pp. 11-14 (NASA Goddard Space Flight Center, Greenbelt, MD, 1978).

Important components used in the prototype Lixiscope (low-intensity x-ray-imaging scope) are the radioactive x-ray source and the scintillator screen. Calculated data are given pertinent to the spectra and intensity of x-rays emitted by the encapsulated sources used. Detection efficiencies for a rare-earth and a CsI scintillator screen are compared.

101. Shives, T. R. and Willard, W. A., Eds., MFPG - Detection, diagnosis, and prognosis, (Proceedings of the 28th Meeting of the Mechanical Failures Prevention Group, held at San Antonio, TX, Nov. 28-30, 1978) Nat. Bur. Stand. (U.S.), Spec. Publ. 547, 368 pages (July 1979) SN003-003-02083-4, $7.00.

These proceedings consist of twenty-five papers from the 28th meeting of the Mechanical Failures Prevention Group. Special emphasis is on aerospace, land based, marine and industrial applications.

102. Shorten, F. J., Ed., NBS Reactor: Summary of activities - July 1977 to June 1978, Nat. Bur. Stand. (U.S.), Tech. Note 995, 147 pages (May 1979) SN003-003-02070-2, $4.50.

This report summarizes all those programs which depend on the NBS reactor. The programs range from the use of neutron beams to study the structure and dynamics of materials through neutron radiography and nondestructive evaluations.

103. Spal, R., Kahn, A. H., Eddy currents in a conducting cylinder with a crack, J. Appl. Phys. 50, No. 10, 6135-6138 (Oct. 1979).

We report calculations for the impedance of a long solenoid which surrounds a cylinder of conducting material containing a radial surface crack of constant depth. The calculation is accomplished by solving for the longitudinal ac magnetic field in the interior of the "cracked" cylinder in terms of an infinite series of cylindrical Bessel functions. The results are tabulated in a form useful for nondestructive testing purposes.

104. Sulouff, R. L., Investigation of moisture measurements, failure rate and leak rate and a study of moisture infusion, NBS-GCR-79-170, 57 pages (Aug. 1979). Order from NTIS as PB299172, $7.00.

A preliminary study of the relationships between moisture infusion, leak size, and device reliability has been completed. Two sets of experiments were conducted. In one, packages constructed with a controlled leak were placed in a controlled humidity environment and the water vapor content measured as a function of time. The second experiment was a life test in which packages were subjected to an atmosphere with 85-percent relative humidity at 85°C. The results exhibited a great amount of scatter. Nevertheless, it can be safely concluded that present leak rate limits for large packages are not low enough to insure that the maximum permissible moisture level will not be exceeded during a reasonable service life.

105. Swartzendruber, L., Magnetic leakage and force fields for artificial defects in magnetic particle test rings, Proceedings of the Twelfth Symposium on Nondestructive Evaluation, W. W. Bradshaw, Ed., pp. 150-162 (Southwest Research Institute, San Antonio, TX, 1979).

The magnetic leakage fields caused by artificial defects have been calculated for the case of a linear isotropic magnetic material, and determined approximately for a non-linear material near saturation. The force fields acting on small magnetic particles have been calculated. Using these results, the magnetic particle surface density which evolves around the artificial defects from a uniform low density cloud of magnetic particles is estimated for the case of dry particles. The calculated fields and powder patterns are compared with those obtained on a typical test ring. The ability of such test rings to accurately gauge system performance is discussed.

106. Treado, S. J. and Burch, D. M., Evaluation of hand-held infrared thermometers for wall thermal resistance determination, NBSIR 79-1736, 26 pages (July 1979). Order from NTIS as PB298057, $6.00.

107. VanderBrug, G. J., Nagel, R. N., Vision systems for manufacturing, Proc. 1979 Joint Automatic Control Conf., Denver, CO, June 17-21, 1979, pp. 760-770 (American Institute of Chemical Engineers, New York, NY, 1979).

Digital image processing and pattern recognition are providing the basis for a growing number of attempts to achieve an automated vision system. This paper begins with a brief historical perspective on image processing and pattern recognition. Next a series of state of the art examples of visual inspection systems, and then robot vision systems is presented. The paper contains a list of other areas in manufacturing for the application of vision systems, and concludes with an assessment of the future of vision systems in manufacturing.

108. Vanderbrug, G. J. and Nagel, R. N., Image pattern recognition in industrial inspection, NBSIR 79-1764, 48 pages (Sept. 1979). Order from NTIS as PB80-108871, $6.00.

See abstract for No. 107.

109. Vorburger, T. V., Teague, E. C., Scire, F. E., Rosberry, F. W., Measurements of stylus radii, Wear 57, 39-49 (1979).

In stylus measurements of surface texture the measured results for roughness depends on the stylus radius. Since stylus tips are not perfectly spherical, the local radius of curvature varies significantly over the surface which makes the determination of an effective radius difficult. Comparisons are made between three techniques: sharp-edge traces, optical microscopy and scanning electron microscopy. It is concluded that the radius scale method is accurate, unambiguous and easy to use for routine measurements in the laboratory.

110. Yin, L. I., Seltzer, S. M., The Lixiscope: A pocket-size x-ray imaging system, Phys. Med. Biol. 23, No. 5, 993-997 (1978).

This note describes a low-intensity x-ray imaging device with the acronym Lixiscope. The high sensitivity and large gain of the Lixiscope not only allows safe fluoroscopic examinations, but also enables the use of radioactive sources in lieu of x-ray machines. Furthermore, because the Lixiscope produces a visible-light output image, it can be easily recorded on fast instant-processing films or used in conjunction with any other image recording and processing devices. As will be shown, the small format of the Lixiscope in conjunction with a minute radioactive source provides a truly portable, nearly pocket-size fluoroscopic system.

111. Yin, L. I., Trombka, J. I., Seltzer, S. M., A portable x-ray imaging system for small-format applications, Nucl. Instrum. Methods 158, 175-180 (1979).

A prototype low-intensity x-ray imaging system with the acronym LIXIscope was built to demonstrate the feasibility of a modular approach toward x-ray imaging in small-format applications. The prototype, including its own x-ray source, is shown to be fully portable, rugged and pocket-sized. Preliminary results and performance characteristics are presented.

112. Young, M., Conference on optical scattering standards, SPIE J. 181, 133-134 (1979).

NBS should consider providing measurement services (such as well characterized surfaces) based on a state-of-the-art facility for precision scattering measurements and calibrations.

113. Younglove, B. A., Thermodynamic properties of nitrogen gas from sound velocity measurements, Proc. 1st Int. Symp. on Cryogenic Wind Tunnels, Southampton, England, Apr. 3-5, 1979, pp. 16.1-16.6 (1979).

Thermodynamic properties of nitrogen gas have been calculated from sound velocity measurements using multiproperty fitting techniques.

These new data are intended to improve existing predictive capability of the equation of state in the low density region needed for use with the NASA-Langley National Transonics Facility.

114. Zimmerman, J. E., Sullivan, D. B., Superconducting devices, McGraw-Hill Yearbook of Science and Technology, pp. 378-380 (McGraw-Hill Book Company, New York, NY, 1979).

The history of the SQUID is reviewed with emphasis on recent developments.

3. Subject Index

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This is the third in a series of bibliographies of NBS publications on nondestructive evaluation (NDE). It provides bibliographic citations, with selected abstracts, for 114 publications that appeared in the open literature, primarily during calendar year 1979. A detailed subject index is included as well as information on how copies of many of the publications may be obtained.

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