AMMRC MS 72-4

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# A REPORT GUIDE TO RADIOGRAPHIC TESTING LITERATURE VOLUME IV

SATRAK DerBOGHOSIAN
MATERIALS TESTING DIVISION

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This report guide covers a portion of the abstracts on radiographic testing included in the holdings of the Nondestructive Testing Information Analysis Center. (Author)

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# A REPORT GUIDE TO RADIOGRAPHIC TESTING LITERATURE – VOLUME IV

Monograph by
*SATRAK DerBOGHOSIAN*

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ARMY MATERIALS AND MECHANICS RESEARCH CENTER
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## PREFACE

The literature survey contained herein has been prepared by the U.S. Army Materials and Mechanics Research Center (AMMRC) and is the fourth volume of a series on radiographic testing. Through necessity, a series of volumes has been planned because of the large amount of literature available in the field of radiography. The volumes will be published as compiled and will appear to be chronological since the oldest publications generally are contained in Volume I, etc. All items included in this volume have been taken from the holdings of the Department of Defense Nondestructive Testing Information Analysis Center (NTIAC) which is housed, staffed, and maintained at AMMRC.

The publications and articles documented herein are in some way related to radiographic testing, hence the use of certain seemingly unrelated descriptors. For the sake of completeness, each item is described by a profusion of descriptors to insure complete and accurate coverage of the subject matter.

The intent of this publication is to make available, under one cover, an exhaustive literature survey of the subject matter. By means of these report guides, items of interest may be rapidly and easily retrieved by industrial and scientific users.

Input to the NTIAC is accomplished by obtaining information from all leading and recognized sources such as the Defense Documentation Center (DDC); NASA; Engineering Index; foreign translations; numerous books, technical journals, etc. Many of the items listed have been taken from reports currently on file at AMMRC, while others may have been taken directly from abstract cards on the subject matter supplied by DDC, World Information Files, etc.

Special thanks go to the Documentation Service of the American Society for Metals, Metals Park, Ohio, and the Engineering Index, Inc., 345-47th Street, New York, New York for their kind and generous permission to reproduce their abstracts. The following copyright holders are also thanked for their courtesy in granting reproduction rights:

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Modern Castings
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Welding Journal

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## INTRODUCTION

Where available, each item in this publication consists of the following information: (1) item, report, or article title, (2) author or authors, (3) source or facility, (4) report number or identification, (5) date, and (6) abstract.

Word descriptors pertinent to each item are listed in alphabetical order and are cross referenced by the AMMRC identification number. Also provided is an author index or, if no author is available, then the issuing organization is listed.

## OBJECTIVE

The main objective of this compilation is to provide a simple and fast access to information on the subject of radiographic testing and also to provide sufficient information in the form of abstracts and word descriptors to make the listing useful.

## SCOPE

This guide is Volume IV of a series of planned report guides consisting of the complete coverage of items in the Department of Defense Nondestructive Testing Information Analysis Center covering the subject of radiographic testing. Subsequent volumes will be published as the work load permits.

The following is a list of report guides previously published by the Department of Defense Nondestructive Testing Information Analysis Center. The guides may be obtained from the National Technical Information Service, Springfield, Virginia 22151.

| | |
|---|---|
| **AMRA MS 64-10** | *A Report Guide to Autoradiographic and Microradiographic Literature, August* 1964, AD-612 047 |
| **AMRA MS 64-11** | *A Report Guide to Gamma Radiographic Literature,* August 1964, AD-612 042 |
| **AMRA MS 64-12** | *A Report Guide to Liquid Penetrant Literature,* August 1964, AD-612 044 |
| **AMRA MS 64-13** | *A Report Guide to Literature in the Fields of Fluoroscopy and Remote Viewing,* August 1964, AD-612 045 |
| **AMRA MS 64-14** | *A Report Guide to Thermal Testing Literature,* August 1964, AD-612 043 |
| **AMRA MS 65-03** | *A Report Guide to Electromagnetic Literature,* April 1965, AD-615 346 |
| **AMRA MS 65-04** | *A Report Guide to Magnetic Particle Testing Literature,* June 1965, AD-617 758 |
| **AMRA MS 65-09** | *A Report Guide to Ultrasonic Attenuation Literature,* December 1965, AD-627 565 |

| | |
|---|---|
| **AMRA MS 66-02** | *A Report Guide to Ultrasonic Testing Literature, Volume I,* March 1966, AD-630 652 |
| **AMRA MS 66-05** | *A Report Guide to Ultrasonic Testing Literature, Volume II,* June 1966, AD-638 749 |
| **AMRA MS 66-11** | *A Report Guide to Ultrasonic Testing Literature, Volume III,* December 1966, AD-648 905 |
| **AMRA MS 67-03** | *A Report Guide to Ultrasonic Testing Literature, Volume IV,* April 1967, AD-650 279 |
| **AMRA MS 67-06** | *A Report Guide to Ultrasonic Testing Literature, Volume V,* June 1967, AD-660 790 |
| **AMMRC MS 67-03** | *A Report Guide to Radiographic Testing Literature, Volume I,* December 1967, AD-664 780 |
| **AMMRC MS 67-05** | *A Report Guide to Fatigue Testing Literature, May 1967, AD-652 881* |
| **AMMRC MS 68-02** | *A Report Guide to Radiographic Testing Literature, Volume II,* February 1968, AD-667 400 |
| **AMMRC MS 68-08** | *A Report Guide to Radiographic Testing Literature, Volume III,* AD-676 835 |
| **AMMRC MS 69-03** | *A Report Guide to Ultrasonic Testing Literature, Volume VI,* April 1969, AD-689 455 |

## USAGE

All word descriptors included in this guide are listed in alphabetical order and are cross referenced to the AMMRC report identification number. Also listed is an author index, or, if no author name is available, then the issuing organization is listed. Users have only to refer to those descriptors that they are concerned with at the time and read only those abstracts which the descriptor cross references.

The abstracts normally refer the reader to the source where the complete report may be obtained.

## ABSTRACTS

AMMRC IDENTIFICATION NUMBER

*3005* **EVALUATION OF THE OHMART GAGE FOR CONTROLLING THE QUALITY OF CAST EXPLOSIVE CHARGES**

Samuel D. Stein and Louis Jablansky
Samuel Feltman Ammunition Labs., Picatinny Arsenal, Dover, N.J., October 1956, 20 p.
AD-111 464

The water-displacement method of determining the specific gravity of the cast explosive charge in a shell was found to be unreliable for production use. In view of the importance of the density factor in some ammunition items, it became necessary to investigate more accurate methods of measurement. On the basis of the satisfactory experience at Milan Arsenal with the Ohmart gage for the quality control of the explosive charges in HEP shell, a contract was let to the Ohmart Corporation to investigate the use of their equipment in measuring the specific gravity of cast explosives. Subsequently a prototype gage was brought to Picatinny Arsenal and evaluated. Tests were also conducted to determine whether the gage could be used to detect and locate cavitation and measure base separations. It was found that the Ohmart gage can be used satisfactorily to determine the average specific gravity of high explosive charges with an accuracy of 0.005. In the cavitation tests, the gage could not detect cavities smaller than 1/2 inch in diameter by 1/2 inch in depth. In the base separation tests, base separations of 0.039 inch were readily detected and there was evidence that smaller separations might be detected if the gage was properly calibrated. The crystal structure of the materials examined did not affect the accuracy of the measurements.

*3030* **IMPROVEMENT IN IONOGRAPHY (A NEW PROCESS OF RADIOGRAPHIC IMAGING)**

R.A. Youshaw, J.A. Holloway and E.L. Criscuolo
Naval Ord Lab., White Oak, Md., February 1960, 22 p.
AD-234 139

The current status of ionography, a process of X-ray imaging on inexpensive vinyl employing electrostatic principles is reviewed to date. Experimental data are presented on the relation between the mesh to vinyl distance and the image quality and speed of exposure. The ionographic phenomenon of image enlargement is discussed. Alternate techniques for forming an ionographic image are described.

*3034* **X-RAY SENSITIVE RECORDING MATERIALS FOR ELECTRON OPTICAL CONTRAST**

Saara K. Asunmaa
W.W. Hansen Labs., of Physics, Stanford U., Cal., 1961, 13 p.

The quantitative properties of an X-ray absorption image can be recorded in electron micrographs if the photographic densities in the EMG's are studied in areas of large dimensions, compared with the resolution attained and if the recording material has uniform thickness and a homogeneous or amorphous structure. A thickness corresponding to the reference thickness or a single electron scattering on the average allows the optimum conditions for quantitative evaluation of the image contrast. Good recording materials must have not only radiosensitivity and minimum structure, but also stability in the electron beam. A chemical reaction of the recording material with an electron stain activated by the irradiation is preferable to dissolution processes, which easily produce swelling, especially in the organic material (e.g., polymers), and consequently can change the distribution of the structural details.

3043 **FLASH RADIOGRAPHIC STUDY OF THE PRODUCTION OF JET ENGINE PARTS BY THE LOST WAX CASTING PROCESS**
R. Meakin
May 1960, 8 p., Armament R&D Establishment (Gt. Brit.)
AD-238 136

The mode of filling of moulds during the casting by the lost wax process of two parts for jet aero engines has been studied using flash radiographic techniques. Anomalies in filling such as turbulent flow of the metal, premature sealing of gas vents, and entrapment of gas could clearly be seen. The method proved a usefool tool in checking mould design.

3048 **GAMMA-RAY PINHOLE TELEVISION CAMERA**
Abraham E. Cohen
Army Signal Res & Devel Lab, Ft Monmouth, N.J. 18 June 1959, rev. 19 October 1959.
AD-241 672

An experimental camera has been devised capable of viewing a gamma-ray or X-ray source both statically and dynamically with a kinescope readout suitable for quantitative measurements. Experiments are described indicating sensitivities to X-rays of about 1 to 2 r/hr.

3050 **RADIOGRAPHIC EXAMINATION, SIDEWINDER (AAM-N-7) GUIDED MISSILE ROCKET MOTOR (MARK 15 MOD 0 AND MARK 17 MOD'S 0, 1, AND 2)**
L.S. Hall
U.S. Naval Ammunition Depot, Concord, Calif.
Test Procedure No. 1000-15, July 1963

The Sidewinder missile is used as a passive air-to-air guided missile. There are at present three types of missiles in the Sidewinder group. Each is launched by its rocket motor which has a solid-propellant grain. It is the purpose of this procedure to describe the technique for radiographic examination of the Sidewinder Guided Missile Rocket Motor selected for nondestructive testing.

3053 **DEVELOPMENT OF THERMAL TEST METHODS**
J.A. Halloway, D.R. Maley
Automation Industries, Inc.
Wright Patterson AFB Contract AF 33 (616)-7725, AF 33 (615)-1531

The 3-year program conducted has resulted in the development of a thermal scanning system utilizing a focused tungsten heat source, radiometer, and oscilloscope readout. Circuitry has been designed to present multiple scans on the oscilloscope, simplifying interpretation. A system for correcting the signal for variations in surface emissivity of the sample surface has been considered. The infrared method of test appears to be particularly sensitive to discontinuities which have a large surface area in relation to their depth and which lie parallel or nearly parallel to the surface of the material. As a system for determining material properties, it appears applicable to those materials or properties producing a change in conductivity.

3054 **OPERATING MANUAL FOR MAGNATEST FM-200 OERSTED METER**
Magnaflux Corp., No Date, 5 p.

The Magnatest Field Meter, Type FM-200, is an electronic instrument for measuring weak magnetic fields. The instrument encompasses a range from 1 - 1000. In the most sensitive range, one scale division represents a field strength of $10^{-5}$ oersted. It will measure the differences in magnetic field intensities between two points. The following subjects are covered by these instructions: Operating principle, description, operation, calibration, service data, miscellaneous information and wiring diagram.

3056 **NEW TEST CHECKS ELECTROPLATING POROSITY**
F. Ogburn
Iron Age, 7 March 1957, p. 123-126

A radiographic method for checking the porosity of plated coatings is presented. The technique is dependable and does no harm to the plated surface.

3061 **CCTV PROVIDES DIRECT X-RAY INSPECTION**
J.A. Rose
EDN - January 1964.

A short article describing closed circuit television as applied to radiography by utilizing a vidicon with a beryllium face plate coated with a photoconductive material for inspection of electronic components. Provides for up to 30x magnification.

3067 **NONDESTRUCTIVE TESTING OF THE EBWR FUEL PLATES**
W.J. McGonnagle and W.N. Beck
USAEC TID-7526P1 File No. 260/7526-(TID)-1(PT) Metallurgy Information Meeting, Ames Laboratory, Iowa State College, p. 1-27

Radiographic technique is used to show the location of the core with respect to end and side clad. Ultrasonic transmission technique is used to test for lack of bonding between the core and clad material and for locating blow holes, porosity and pipe in the core billets. The natural radioactivity of the EBWR core is used in an autoradiographic technique to measure clad thickness.

3076 **RESIDUAL STRESSES AND THEIR RELAXATION ON SURFACES OF SECTIONS CUT FROM PLASTICALLY DEFORMED STEEL SPECIMENS**
C.J. Newton
U.S. Bur Stds - J Res-Eng & Instrumentation v. 67C, n. 2, April-June 1963, p. 101-9.

Measurements carried out using inclined incident X-ray beam procedure; computations based on conventional assumption compared with those based on recently suggested method; conventional calculations indicated axial residual stress opposite in sign to preceding deforming stress; doubt was cast, on validity, except perhaps as to sign, of extending stress values measured on sections cut from specimen to residual stress system existing within specimen before sectioning.

3082 **MEASUREMENT OF ABSORPTION COEFFICIENTS OF ARGON AND NEON FOR SOFT X-RAYS**
F. Wuilleumier
Acad des Sciences CR, v. 257, n. 4, July 22, 1963, p. 855-8

It is believed that it is for the first time that continuous recording of absorption spectra is carried out between 2 and 8 Å; absorption coefficients were calculated every 50 X unit; oscillator power of K shell of argon calculated.

3089 **RADIOGRAPHIC EXAMINATION OF MINUTEMAN SECOND STAGE MISSILE MOTOR AND CLOSURE**
Louis S. Turcios
U.S. Naval Weapons Station, Concord, Calif., Test Procedure 1000-9, October 1963.

This document describes the test procedure developed at NAVWPNSTA, Concord, for the radiographic examination of Second Stage Minuteman Missile propulsion motors and components using the 2-MeV General Electric Resotron X-ray generator and the 10-MeV Varian Associates linear accelerator (linac). The document also includes propellant inspection and evaluation.

3090 **INSPECTION OF THICK POLYETHYLENE SECTIONS BY RADIOGRAPHY AND FLUOROSCOPY**
James Begley
Picatinny Arsenal Tech. Memo #1145, October 1963.

A 12 inch x 12 inch x 1-1/2 inch penetrameter was made from high-density polyethylene containing less than 10% amorphous boron. Fourteen other blocks of the same dimensions and material were fabricated; these blocks were void-free. The total thickness of the test specimen was 22-1/2 inches, including the penetrameter. A series of tests was run to determine the detectability of various size voids through different thicknesses of material. Test results showed that, using a cobalt-60 source; voids 1/2 inch long x 1/8 inch deep were detectable through the entire 22-1/2 inches of borated polyethylene. In an attempt to use a similar technique as a rapid scanning process, X-ray equipment (150 kv) was teamed with image intensification on a fluoroscopic screen. The following results were noted:

| | | | |
|---|---|---|---|
| Total Thickness, Inch | 12 | 9 | 7-1/2 |
| Depth of Smallest Detectable Void, Inch | 0.500 | 0.250 | 0.125 |

3091 **DETECTION OF CRACKS ADJACENT TO SPOTWELDS BY RADIOGRAPHY IN THIN STAINLESS STEEL SHEET**
C. Kropp and L. Girton
General Dynamics Astronautics, MRG-289, 29 January 1962.
AD-405 181

Radiographs were made of two multispot circumferential joint specimens that had been cyclically loaded until cracks formed, ranging in depth from 2 to 100% of the sheet thickness. When using an X-ray tube with a standard glass window, cracks could be detected that were greater in depth than 23% of the sheet thickness (.013"). Using an X-ray tube, with beryllium window, cracks could be detected that were greater in depth than 15% of the sheet thickness (.010"). For thin sheet stainless steel, it was recommended that a beryllium windowed X-ray tube be used because radiographs could be read with greater facility and cracks of shorter depth could be detected.

3097 **ASSESSMENT OF 5 MeV LINEAR ACCELERATOR. PART 2. DATA FOR PRACTICAL RADIOGRAPHY**

C.G. Pollitt, R.L. Durant, and B.J. Vincent

Armament Research and Development Establishment (Gt. Brit.). April 1959

AD-215 788

Exposure curves and optimum conditions for radiography with the Linear Accelerator are given. Wire penetrameter sensitivity curves and comparison with the sensitivities obtained with other X-ray energies are also given, and these although not an accurate assessment of flaw sensitivity give some indication of the minimum size defect that is likely to be found under a given set of conditions. The various causes of image spread, unsharpness, are dealt with at some length and it is shown that they are significant but not large enough to be of any serious significance when operating under the best conditions. The linear accelerator is particularly useful in the examination of steel thicknesses ranging from 4 to 11 inches where its sensitivity is sensibly equal to that of higher energy betatrons whilst possessing the advantages of greater film coverage and a greatly reduced exposure time, both of which are very important factors in practical radiography. In general it is shown that the 5 MeV linear accelerator is a machine of great potentiality particularly for the radiography of large section specimens and specimens containing a moderate, up to 2 inch steel, change in section.

3099 **STAINLESS STEEL FABRICATION AT WINDSCALE WORKS**

E.H. Wills

United Kingdom-Atomic Energy Authority (Gt. Brit.) 25 August 1953 (Report No. 5006/74)

AD-213 345 (1April 1959)

The report is a record of the practical methods employed by the Engineering Department and Contractors at Windscale Works for the Fabrication, Welding, Installation and Inspection of stainless steel vessels and pipework required for the Separation Group. Emphasis has been placed on the actual methods employed by the craftsmen and inspectors in order that the completed plant would conform to the following Specifications: - D. At. En. 47032A, Fusion Welded Stainless Steel Tanks Group "A"; D. At. En. 42721A, Fabrication of 11/13/1 pipelines at Windscale; D. At. En. 70271, Radiography of Welds; D. At. En. 70003, Stainless Steel 18/13/1 for Rolled Sections; D. At. En. 70004, Seamless Tubes of 18/13/1 Stainless Steel; and D. At. En. 71062, Welding Electrodes for 18/13/1 Stainless Steel.

3102 **MODEL XR-250 HIGH VOLTAGE X-RAY GENERATOR**

High Voltage Engineering Corp., Final report. 16 December 1957 (NAVSHIPS 021-300)

AD-211 022L (4 September 1958)

No abstract available.

3103 **EVALUATION OF PROTOTYPE ULTRASONIC EQUIPMENT**

A.M. Murdoch

Sperry Products, Inc., Phase 3, 1 September - 30 November 1958 (interim rpt. No. 11) (5 February 1959)

AD-226 146

Several groups of test panels, comprising 2-ply laminates and both adhesive bonded and brazed honeycomb sandwich specimens were manufactured. Each group contained panels made under controlled conditions so that qualities of bond ranging from "good bond" to "complete void" were represented. A Nondestructive inspection of this material was performed by the manufacturer for correlative purposes using a STUBmeter on all panels; in addition to this X-ray was used on the brazed honeycomb specimens. Ultrasonic tests using the ATMA-1 were then performed on the 2-ply laminates, on the brazed honeycomb sandwich panels, on certain of the adhesive bonded honeycomb sandwich panels. Additional ultrasonic tests were made using Sperry Reflectoscopes. All results of nondestructive inspection, excepting those of the X-ray tests, are in the form of indicator screen photographs. Destructive tensile shear tests have been initiated on the 2-ply laminate specimens.

3104 **THE RADIOGRAPH OF WELDED PLATES FROM 2 TO 4 INCHES THICK. A NOTE ON THE COMPARATIVE SENSITIVITIES OBTAINED USING 400 kV X-RAY, COBALT 60 GAMMA RADIATION AND 5 MeV X-RAYS**

R. Halmshaw and C.G. Pollitt

Armament Research and Development Establishment (Gt. Brit.) December 1958 (ARDE Memo No. MX 78/58)

AD-209 974

It is shown that for steel thicknesses of up to 2 1/2 inches the best results can be obtained with 400 kV X-rays and that the exposure times are tolerable. For thicknesses of the order of 3 inches substantially equal sensitivities can be obtained with all three sources of radiation, but the exposure time is very much less with the accelerator. For thicknesses above 3 1/2 inches, provided the geometric unsharpness is made negligible. sensibly equal sensitivities can be obtained with a Cobalt 60 source and the accelerator but, even with the multicurie sources at present available, the exposure times with Cobalt 60 will be several hours compared with seconds with the accelerator. For the examination of welds in steel of 4 inches in thickness or over it is necessary to use the 5 MeV Linear Accelerator or some other fine focus ultra high voltage X-ray generator. For these large thicknesses all machines, except the Linear Accelerator, involve a compromise between sensitivity, practical film focal distance and exposure time. The accelerator gives a high sensitivity with a short exposure time.

3107 **HANDBOOK OF INDUSTRIAL RADIOLOGY**

J.J. Hirschfield, N. Modine and others

Naval Ord. Lab., 30 June 1954

AD-208 0745

A general review of industrial radiology is given along with a discussion of the various factors affecting radiographic quality. Gamma ray techniques are discussed, as well as X-ray procedures. A comprehensive compilation of data in tabular and graphic form is included, to serve as a ready reference for radiology and related types of material evaluation.

3108 **OUTPUT CHARACTERISTICS OF A COMMERCIAL X-RAY GENERATOR AT 2000 K.V.P.**
F.W. Chambers, Jr., J.E. Morgan, and J.T. Istock
Naval Medical Res. Inst., 7 December 1949, 12 p. (Proj # NM 006 012.08.26)
AD-206 823

The GE 2000-kv.p. unit, originally designed for metallurgical radiography, proved to be a reliable, flexible, and convenient source of penetrating radiation for medical research. The transmitted beam had a maximum central intensity of 36.3 r/min. in air at 200 cm. (focal skin distance falling to 31.0 r/min. on the periphery of a 60-cm. diameter field. Its half value layer was 7.45-mm. Pb, which gave a value of 0.83 MeV radiation. The half layer for the radial beam was 4.3-mm. Pb, corresponding to 0.53 MeV pure radiation. A cylindrical field of 200-cm. radius, concentric with the vertical tube axis, showed maximum intensity of about 16 r/min. in air between elevations of 30 and 40 cm. above the anode level.

3116 **EVALUATION OF BRAZED HONEYCOMB STRUCTURES**
Robert C. McMaster, Anthony T. D'Annessa and Henry W. Babel
Ohio State U., Eng Experiment Sta, Columbus Rpt for January 1959 - May 1960 on The Chemistry and Physics of Materials, September 1960 (8 March 1961)
AD-251 915

Nondestructive test methods and equipment were evaluated for quality control of brazed and welded joints in honeycomb structures. Test methods included (1) penetrating radiation, (2) ultrasonic, and (3) thermal tests, by which surface-layer defects are reliably detected. Internal defects are detectable only by penetrating radiation associated with (1) X-ray film radiography, xeroradiography, (2) direct fluoroscopy, (3) television fluoroscopic systems, and (4) electrostatic and photoconductive-screen X-ray image amplifiers. Ultrasonic methods included immersion tests with focused transducers, contact tests with resonance transducers and with pulse-reflection systems. Thermal methods included thermal-flash proof tests, heat-repelled fluid coatings, color changing paints, and remote IR sensing systems.

3120 **THE SOFT X-RAY CONTINUOUS SPECTRUM FROM LOW ENERGY ELECTRONS IN THE 80A-180A REGION**
T.J. Peterson, Jr., et al.
Cornell University, June 1961, p. 79
AD-259 025

The intensity distributions in the continuous spectrum of soft X-rays over the wavelength range from 80 A to 180 A have been investigated for various elements and accelerating potentials by means of a grazing incidence vacuum spectrograph with a concave glass grating in a Rowland mounting. Intensity distributions were calculated with the help of previously verified reflecting power coefficients for the grating. The experimental results are compared with the predictions of the basic Sommerfield theory where possible and found to be in good agreement. Details of the apparatus and an outline of the theoretical formulation are presented.

3121 **DEVELOPMENT OF FUSION WELDING TECHNIQUES FOR TWO-INCH-THICK TITANIUM PLATES (GRADE RS-70, COMMERCIALLY PURE)**
J. Savas
Republic Steel Corp., Rpt No. 1, 1 March - 30 April 1961, May 1961, 21 p.
AD-257 813

Testing was completed on the first 2 experimental weldments of 2-in.-thick, commercially pure Ti plate. The 3rd, 4th, and 5th sets of the 2 x 4 x 24-in. plates, which were machined to a number of variations of a modified double-V joint design, were welded, radiographed, sectioned, and tested. An optimum modified double-V joint design was decided upon for the machining and welding of the 2 x 15 x 30-in. plates into a 2 x 30 x 30-in. weldment. The best welding techniques developed during the welding of the first 5 experimental weldments were used. The X-ray radiograph of the weldment showed it to be free from porosity, cracks, and other defects capable of detection by this means of nondestructive inspection.

3125 **A HIGH INTENSITY PULSED X-RADIATION SOURCE**
F.D. Adams
Flight Dynamics Lab., May 1961, 12p.
AD-258 791

A pulsed magnetic X-ray device capable of generating high intensity X-radiation is considered. Such a device will employ high energy electrons from a linear accelerator injected into a pulsed megagauss magnetic field. For a specified spectrum (characterized by the critical wave length), flux level, electron beam width, and observation range, the required parameters, magnetic field intensity, electron energy, and a number of electrons may be approximately determined.

3130 **NONDESTRUCTIVE TESTING, A REPORT BIBLIOGRAPHY (U)**
Elizabethe H. Hall
Defense Documentation Center, Alexandria, Virginia
Bibliography for January 1953 - September 1963, 1 v., 188 refs.
AD-344 080

SECRET REPORT

This is a bibliography covering nondestructive testing, including quality control, ultrasonics, and radiography

3133 **SOLID STATE IMAGE INTENSIFIER FOR INDUSTRIAL APPLICATIONS**
R.W. Christensen
Radio Corp of America, Fin Rpt, 13 March 1959, 12 April 1961
AD-256 664

An investigation was made to study the feasibility of using solid state X-ray image intensifier in the field of industrial radiology. An analysis was made of the particular requirements the intensifier must satisfy to be useful in the field of industrial radiology. The techniques of making fine-grain panels were developed to the point that 6" x 6" intensifiers were made with a satisfactory yield. The technique of electronic erasure was demonstrated with some success. Penetrameter tests performed with 1/2" steel plate and using 350 kv X-rays demonstrated that the fine-grain intensifier has better detail and contrast sensitivity than a typical fluoroscopic screen.

3136 **AN EMPIRICAL APPROACH TO THE DESIGN OF A SPIN-COMPENSATING SHAPED CHARGE LINER**
R. DiPersio, et al.
Ballistic Research Labs., February 1960, 37p.
AD-317 014 (CONFIDENTIAL REPORT)

Analysis of experimental data obtained from shaped charge firings permits the correlation of the positions of the jet elements with their initial locations on the round liner. These data are the results of penetration tests of radioactively traced liner elements, measurements of the depth of target penetration versus time of penetration, and measurements from triple-flash radiographs of the jet. An examination of flash radiographs of the jets from rotated special liners determines the compensated region of the jet as a function of frequency of charge rotation. The compensation frequency for each zonal element of the parent liner is obtained.

3138 **SAFETY CERTIFICATION AND ENGINEERING TEST OF THE T324 SERIES OF VIGILANTE AMMUNITION**
Keith T. Dixon
Aberdeen Proving Ground, September 1960, 1v.
AD-319 762 (CONFIDENTIAL REPORT)

The development of the ammunition for the 37-mm VIGILANTE weapon system has resulted in the Cartridge, HE, T324E23. Safety and certification tests were conducted on the T324 Series.

3140 **NONDESTRUCTIVE EVALUATION OF SUBROC PROPULSION UNITS**
A.A. Bacher
Naval Propellant Plant. 18 November 1959, 19p.
AD-313 992 (CONFIDENTIAL REPORT)

Malfunctions in static firing of Subroc motors 185 and 186 were correlated with defects in the insulation between the propellant and case. Results obtained by the radiographic inspection using a low voltage X-ray machine and placing the film cassette inside the center performation of the motor were easier to interpret than those obtained by the technique previously employed in which an Iridium-192 capsule was used.

3141 **THE DEVELOPMENT OF NONDESTRUCTIVE TEST METHODS FOR THE INSPECTION OF SOLID PROPELLANT**
D. Polansky
Naval Ordnance Lab., 5 October 1959, 1v.
AD-314 860 (CONFIDENTIAL REPORT)

This report presents a review of the work conducted at the Naval Ordnance Laboratory during the past five years in the development of X-ray methods for the inspection of solid propellant. Details on fluoroscopy, fluorography and television methods are given, in addition to the sensitivity limits as applied to various propellant thicknesses. Present plans on methods of inspecting the large diameter motors (greater than 20 inches) and an analysis of an automatic system using a cobalt source, scintillation detector, scaler and IBM computer are given. A long-range program for nondestructive testing at the Laboratory is also presented.

3147 **INDUSTRIAL ENGINEERING STUDY. T34E2 WARHEAD FOR LACROSSE MISSILE**
H. Seavey and O.A. Colitti
Picatinny Arsenal, December 1960, 14 p. w/illus
AD-311 654 (CONFIDENTIAL REPORT)

A single-pour controlled cooling cycle has been developed for cast loading the T34E2 (LaCrosse) Warhead with 99.5/0.5 Composition B/Calcium Silicate Absorbent. The cycle is consistently reproducible and the cast quality meets the radiographic requirements of X-PA-PD-1140. An economic analysis indicated that this method results in 25% savings over the presently used pellet loading method. Since no special arts or techniques are required, this method lends itself readily to mass production. (U)

3150 **DEVELOPMENT AND FABRICATION OF NONDESTRUCTIVE SPECIFIC GRAVITY MEASURING EQUIPMENT RADIATION TECHNIQUE**
Kaman Aircraft Corp., 28 December 1957 - 31 January 1958
AD-161 550

A description is presented of a proposed densitometer which will utilize gamma radiation to measure the density of right circular cylindrical samples whose size range is 1-to 9-in. in diameter and 1- to -12 inches in length, and whose specific gravity range is 1.6 to 1.9. The unit consists of 2 major equipments, the sample test head and the control console. The test head has affixed to it a $Co^{60}$ source surrounded by a Pb shield, a wedge mechanism, a vernier servo, a sample actuating system, and a pair of scintillator detectors together with their buffer amplifiers. The $Co^{60}$ source will be of about 30C. The control console contains power supplies, a relay logic circuit, a mechanical digital calculator, a ratio scaler, a clock programmer, and manual data inputs.

3151 **SOME CONSIDERATIONS ON THE PROBLEM OF THE CALIBRATION OF X-RAY APPARATUS**
G. Moravia
British Ministry of Supply, January 1958, 5 p.
AD-158 833

No abstract available.

3152 **THE PROBLEM OF THE CALIBRATION OF X-RAY APPARATUS**
G. Moravia
British Ministry of Supply, January 1958, 10 p.
AD-159 075

No abstract available.

3156 **INVESTIGATION OF THE PHOTOGRAPHIC BLACKENING PRODUCED BY X-RAYS**
H. Tellez-Plasencia
British Ministry of Supply, December 1956
AD-103 026

The density developed as a result of the exposure of a photographic emulsion to X-rays represents various intermediate processes. The first of these is the transformation of the energy of the incident photons into electron energy by the Auger, Compton photoelectric effects and by the partial reabsorption of the secondary photons. The energy balance of these mechanisms, which has been the subject of other works by the author, is developed quantitatively in the presentation of the characteristics. The curves representing the variation of the codensity logarithm as a function of the electron energy liberated by the X-rays in the emulsion are theoretically straight lines, the slope of which is independent of the wavelength, in the case of a homogeneous emulsion of fine grain, and the curves show a certain curvature of heterogeneous emulsions of coarse grain. These effects are connected with the structure of the emulsions.

3157 **PHOTOGRAPHIC BLACKENING PRODUCED BY X-RAYS**
H. Tellez-Plasencia
British Ministry of Supply, March 1956
AD-104 433

The application to sensitometric investigations of the principle of "1 quantum, 1 grain" and of the corresponding formulae shows that the sensitivity constant decreases when the lumination increases. This phenomenon merely appears to take place as a result of the fact that the emulsions are not homogeneous but composed of unequal grains. It is possible however to account for the experimental facts by taking for the quantum threshold a value different from 1. It is a question of an "Apparent Threshold," the "real threshold" remaining, in the case of X-rays, equal to unity. It is easy to deduce therefor the real sensitivity constant.

3158 **PHOTOGRAPHIC BLACKENING PRODUCED BY X-RAYS**
H. Tellez-Plasencia
British Ministry of Supply, May 1956
AD-104 432

This paper follows two others which have been published in this journal. The calculation of the number of grains of given size reached by all the electrons liberated by absorption of a photon, and of the energy lost in these grains gives results confirmed by experiment. It is possible to calculate in this way the energy expended per grain as well as the intrinsic sensitivity of the grain. In the two previous investigations denoted respectively by I and II, it was shown how the divergences between theory and experiment observed when the total energy of the electrons expended in the emulsion is taken for the lumination, can be eliminated if we count only the fraction of this energy expended in the halide grains alone. An attempt was made to verify in the light of experience two methods of approach suggested in II in respect to divergences due to the wavelength. As will be remembered, it was a question of calculating either the number of grains reached by the absorbed photon, or the fraction of the energy expended in these grains. New sensitometric and spectrographic measurements have been made, because some of the radiations used for I had not been employed for such measurements and it is difficult to relate either of the new functions to a mean energy.

3178 **USE OF X-RAY IMAGE INTENSIFIER AS INSPECTION TOOL AND ITS APPLICATION TO STROBOSCOPIC EXAMINATION**
C.E. Paine
Brit J Nondestructive Testing, v. 3, n. 2, June 1961, p. 34 - 38

Need to improve standard of visual X-ray examination, role of X-ray image intensifier and results obtained; examples of practical applications and methods employed to handle components and to avoid screen halation; X-ray stroboscopy for inspecting inside of component without altering construction and details of shutter unit of stroboscopy adapter fitted to standard X-ray tube.

3180 **LOGICAL DEVELOPMENT OF NONDESTRUCTIVE TESTING TECHNIQUE FOR STEEL CASTING**
S. Juby
Brit J Nondestructive Testing, v. 3, n. 2, June 1961, p. 49 - 54

Summary of types of nondestructive tests available in foundries with particular reference to radiology employing X- and gamma-rays and ultrasonics; acid pickling, magnetic flaw detection, oil and chalk method, pressure testing, and proof machining; internal nondestructive testing inspection of castings.

3183 **ENERGY OF ELECTRON HOLE PAIR FORMATION BY X-RAYS IN $PbO_3$**
F. Lappe
Physics & Chem Solids, v. 20, N. 3,4, August 1961, p. 173 - 176

Properties of single crystals of yellow PbO make it promising material as sensitive X-ray detector; crystals were irradiated by CuK alpha-radiation; by comparing X-ray induced with light induced photocurrents average energy necessary to produce electron-hole pair in PbO by X-ray was determined by 8 eV.

3185 **RADIOGRAPHY FOR NUCLEAR POWER**
Nuclear Power v. 6, n. 58, February 1961, p. 90

Completely mobile linear accelerator, designed by Mullard and recently delivered to United Kingdom Atomic Energy Authority, is 4.3 MeV, 2 ton unit; permits welds in 4 in. thick steel walls of pressure vessels to be radiographed on site with minimum disturbance to constructional work; details of design and performance.

*3186* **INDUSTRIAL PREPAREDNESS STUDY ON TIGHTER TOLERANCE CR-(XM-3)U CRYSTAL UNITS**

James M. Ronan

Keystone Electronics Co., Newark, N.J. Final Rpt 1960, DA36-039-sc-72691

The four problem areas in the manufacture of tighter tolerance crystal units were pursued from the standpoint of establishing optimum fabricating techniques and equipment. As a result of investigation into these areas a unique system for automatically X-raying the orientation of crystal blanks was developed; a piece of equipment was designed and developed to automatically solder crystal holder parts together by the induction heat method; and technical requirements were established for a system of temperature testing tighter tolerance crystal units. In accomplishing the above, the design objectives were met which were to establish techniques to that this type of unit could be mass-produced without severe losses, and avoid design applications that would classify it as a highly specialized type of unit.

*3187* **PORTABLE 18 MEV TESTING BETATRON IN INDUSTRIAL FOUNDRIES**

P. Fries

Giessorel v. 48, n. 19, September 21, 1961, p. 586 - 97

Portable 18 MeV testing betatron in industrial foundries; reasons are given why betatron, successfully used in steel [illegible]nts, is also valuable in foundries; relation between wall thickness and radiation energy, movability of betatron, and economics of its use are discussed.

*3191* **SOME RECENT DEVELOPMENTS IN RADIOPHOTOLUMINESCENT DOSIMETRY, INCLUDING TEST RESULTS**

W.C. Bryan and W.P. Schaus

AFSWC, Kirtland AFB, TN, December 1960, 62 p.w/illus, tables, AFSWC TN 61-4

Efforts to improve dosimetry in use by the US Air Force and the US Navy have resulted in the development of a new Navy-sponsored model of the detector Radiac DT-60/PD and an experimental Air Force modification of the Computer-Indicator, CP-95A/PD. In addition, some refinements have been adopted in the calibration procedures associated with this dosimetry and the modification. The results of testing the new dosimeter and the modification of the computer-indicator at the AFSWC are reported and the calibration procedures are discussed. Some comments are made on the compatibility of old and new models of the dosimeter with the CP-95A/PD, and on continuing developments. The new DT-60/PD is considered suitable in a nuclear warfare situation if certain limitations, such as the effects of certain extreme environmental conditions and their limited utility for measuring small doses, are recognized.

3192 **ENGINEERING EVALUATION OF CARTRIDGE, HE, T376E1 for 81-mm MORTAR**
V.H. McCoy (Report No. DPS-195)
Aberdeen Proving Ground, Md. May 1961 Frankford Arsenal (FA TPR #FA-IEP-213-1)
AD-255 811

During production engineering of the 81-mm, HE T376 mortar shell it was found necessary to alter the design by increasing the wall thickness of boat-tail section. The resulting modified T376 shell was designated the T376E1. For the subject test, the T376E1 shell, assembled as Cartridge, HE T376E1, was fired for security of metal parts, safety, and for ballistic match with the standard HE, M362 cartridge. Results of the tests indicate that the T376E1 shell is sufficiently strong and safe to withstand firing between cartridges with the M362 and T376E1 shell. It is recommended that the 81-mm, HE, T376E1 shell be considered for inclusion in the improved family of ammunition for the 81-mm mortar when assembled as Cartridge, HE, T376E1.

3194 **APPLICATION OF NONDESTRUCTIVE TESTING TECHNIQUES TO FIELD TESTING OF MILITARY FOOTWEAR**
James C. Perkins, Jr.
Quartermaster Field Evaluation Agency, Ft Lee, Va., April 1961, 29 p.
AD-254 743

Based on the results of a study conducted to determine the feasibility of the use of nondestructive inspection techniques to detect internal defects in military footwear under field use conditions. It is concluded that the mobile X-ray subsistence inspection van and the portable X-ray footwear inspection unit are both satisfactory for the fluoroscopic and radiographic inspection of footwear items. The quality control exercised by the manufacturers of military footwear is not adequate to insure consistent quality of construction in footwear obtained for test purposes. The frequency and nature of internal defects found in new and worn footwear items, and the possible effect of such defects upon other characteristics of footwear, warrants the nondestructive inspection of all footwear items, in addition to the standard visual inspection method, both before and after test wear. The types of internal defects which are most likely to effect the comfort or durability of footwear are unclinched nails in the sole or heel area and filler voids between the outsole components. Footwear with unclinched nails may be satisfactorily repaired prior to wear, thereby avoiding discomfort or injury to the foot of the wearer in the event that the unclinched nail penetrates the insole.

3199 **A SMALL ANGLE X-RAY SCATTERING APPARATUS USING A SPHERICALLY BENT CRYSTAL**
S. Hagstrom and K. Siegbahn
Upsala U (Sweden) 8 December 1959, 19 p.
AD-254 468

A new method is described for curving a circular quartz lamina to give a point-focusing monochromator for X-rays. This monochromator has been used in an apparatus for studying small-angle scattering of X-rays. The distance between the scattering specimen and the focus can be varied continuously, the maximum distance being 850-mm. The recording of the scattered intensity can be made either photographically or by means of annular slits in front of a counter tube. The instrument is characterized by exceedingly high resolving power and good intensity. Applications have been made on the study of Dow Polystyrene Latex of three different particle sizes with the following diameters: 3400 Angstroms, 2640 Angstroms, and 1340 Angstroms. The secondary maxima in intensity which appear from scattering spheres are very well resolved in all asimuths even for the largest particles. Exposures of collagen from kangaroo tail tendon have been taken. The diffraction pattern from a periodicity of 637 Angstroms in this specimen shows that the different diffraction orders are very well separated. The camera is capable of resolving consecutive orders of spacings as high as 8000 Angstroms.
(Reprint from J of Ultrastructure Research, 3:401-419, 1960, copies not supplied by ASTIA)

3200 **FABRICATION OF ONE-INCH THICK "H" PLATES EMPLOYING LOW-HYDROGEN, INTERMEDIATE FERRITIC ELECTRODES, FOR BALLISTIC EVALUATION**
K. Chesney
Ordnance Tank-Automotive [illegible]nd, Detroit, Mich., 30 December 1960, (Final Report)
#4990
AD-254 244 L

Twelve 36 x 36 1-in. H plates were fabricated with 3/16-in diameter electrodes from 3 suppliers to determine if the low-hydrogen ferritic electrodes with mechanical properties intermediate to the MIL-80 and MIL-230 type of specifications (MIL-E-18038A and MIL-E-986C) had ballistic properties comparable to the MIL-230 type electrodes. The chemical composition of the armor, electrodes, and electrode weld deposits, and moisture content of the electrode coatings are appended. The electrodes operated satisfactorily and produced radiographically acceptable welds. The radiographic results conformed to standard 2 or better, of specification MIL-R-11468.

3201 **OPERATION AND MAINTENANCE MANUAL. CRYSTAL BLANK X-RAY SORTER**
Bulova Res. and Devel. Labs., Inc., Woodside, N.Y. 1961, 46 p.
AD-252 779

The Bulova crystal blank X-ray sorter has been designed to automatically measure the crystal axis orientation of quartz crystal blanks, and to sort the blanks automatically according to orientation measurements, preparatory to final processing of AT crystals. The sorter performs the measuring and sorting operations at a rate of 43 blanks per minute with one standard deviation error of 10 seconds of arc or less. The crystal blanks used in this machine are disk shaped, having a diameter of 0.375 or 0.490 inches, with a flat approximately one-third of the diameter in length. The blanks may range from 0.020 to 0.035 inches in thickness. The blanks are loaded and collected in specially constructed plastic cartridges that are similar in appearance. At the measuring position, an X-ray beam is directed to strike the face of the crystal blank. The blank is then rocked through a small angle to cause a reflection. At only the Bragg angle will there be a reflection. This reflection is received by an X-ray detector. Since the blank is held against a reference surface, its position is recorded electronically when the detector receives the reflected ray. This establishes the angle between the face of the crystal and the atomic structure.

3205 **SMEAR RADIOGRAPHY OF EXPLOSIVE SWITCHES**
E.L. Criscuolo and W.R. Maddy
Naval Ord. Lab., White Oak, Md. 1 October 1960, 11 p.
AD-248 191

A method of X-ray inspection developed to obtain information on the motion of contacts of an explosive switch is described. A smear image indicates displacement of the contacts as a function of time. Using this method, the time required for complete actuation of the explosive switches Mk 74-0 and Mk 83-0 is determined to be 182 and 79.5 microseconds, respectively.

3208 **RADIOGRAPHIC DETECTION OF PARTIAL JOINT PENETRATION IN WELDED SIMPLE LAP CORNER JOINTS**
Daniel Carosiello
Frankford Arsenal, Philadelphia, Pa. 17 June 1958, 13 p.
AD-245 875

An effort was made to determine the extent of partial joint penetration in a welded simple lap joint by radiographically detecting the unfused region or void. The joint was one of several corner joints which were being considered in connection with the development of aluminum armored vehicles. The parameters investigated in this study were root opening and angle of radiation. Three weldments were prepared with zero, 1/16 inch and 1/8 inch root openings respectively. Due to shrinkage during welding, the latter two root openings were reduced to approximately one-half their original dimension. Radiographic exposures were made on each weldment at selected angles of radiation ranging from 0 to 90 degrees. It was found that the optimum direction of radiation was approximately 45 degrees for the procedure described. The void associated with partial joint penetration of the lap joint was barely distinguishable when the void was 1/64 to 1/32 inch wide. It is doubtful whether an opening of this size would be recognized using the X-ray technique covered.

3209 **RADIOGRAPHY OF ROCKET PROPELLANT CHARGES: A COMPARISON OF FILMS FOR ROUTINE INSPECTION**
E.T. Brett and A.M. Mendoza
Explosives R & D Establishment (Gt. Brit.) September 1960, 8 p.
AD-245 778L

Characteristic curves and comparisons of resolution have been prepared for a group of industrial X-ray films. Exposure curves for propellants SUK and PU have been established. Measurements have been carried out on propellant PU to compare sensitivities measured with aluminum wires and propellant penetrameters.

3211 **OPTIMUM INTENSIFICATION AND FLAW DETECTABILITY THROUGH THE USE OF SUITABLE LEAD SCREENS FOR GAMMA-RADIOGRAPHS WITH IR 192 AND CS 137**
W.H. Papke
Ministry of Aviation (Gt. Brit.), September 1960, 10 p. (Trans. No. TIL/T 5126 of Schweiss u Schneid 10:463-466, 1958)

An analysis is made in terms of energy transformations according to several laws of the intensification by means of photo electrons. A series of tests was made with Microtest, fine-grain film; also the effects on flaw detectability are discussed. This shows a useful agreement between theory and test results for the gamma-ray source IR 192 and CS 137. By suitable selection of a screen of 150$\mu$ the contrast is increased, compared with screens of 20$\mu$thickness, and the exposure time reduced, so that the improved flaw sensitivity in welded seam inspection of thicker sheets or pipes enhances the reliability of the welded joint and, through the saving in time, the testing time and also the prescribed time for the necessary radiation protection are reduced.

3221 **AN INTRODUCTION TO NONDESTRUCTIVE TESTING OF WELDS**
H.B. Norris
Welding Engineer, v. 44, n. 6, June 1959, p. 54

Application and effectiveness of nondestructive testing as related to welding in steam turbine generator components.

3226 **MEGAVOLT FLASH RADIOGRAPHY**
R. Meakin
Royal Armament R&D Establishment, Fort Halstead, Kent. RARDE Memo (M) 17/63

Results are given of tests on a 1.4 MeV flash radiographic system using a Marx impulse generator and a cold-cathode two electrode X-ray tube. The effect of changing various tube parameters was investigated and data on effective steel penetration obtained. Some comparison is made with results from a 4 MeV linear accelerator working in a flash exposure role.

3233 **RADIOGRAPHIC EXAMINATION OF MAINSTAGE GRAIN ASSEMBLY FOR GAS GENERATOR MARK 10 MOD 0**
Lee S. Hall
QE/Concord Test Procedure No. 1000-21, October 1963

This document contains procedures for low energy radiographic examination of the integrity of the fuel grain and fuel grain/inhibitor interface of Generator, Gas Pressure, Propellant Actuated - Mark 10 Mod 0 (Hyd). The procedures are only applicable to the mainstage grain, inhibitor, and insulator, shown in Figures 1 and 2, prior to insertion into the metal case of the generator, shown in Figure 3. The thick metal portions at the nozzle end of the case would preclude radiographic resolution of the integrity of the fuel grain/inhibitor interface near the hemihead were the grain installed in the case before radiographic testing.

3242 **GENERAL OPERATING ACCURACIES IN FLUORESCENT X-RAY SPECTROSCOPY**
H.R. Erard and G.L. Underhill, Springfield Armory
Tech Rpt SA-TR20-2405, 21 October 1957, 55 p. incl illus. Proj IPM Contract DA-19-059-504-ORD-2548

An investigation was made of general operating accuracies in fluorescent X-ray spectroscopy. Various types of random and systematic errors were studied. Techniques developed for minimizing random error were based upon statistical methods and electrical or mechanical averaging. Techniques used for minimizing systematic error involved either proper choice of apparatus and operating parameters to reduce bias or calibration to compensate for it. Techniques compared with respect to precision of measurements and time required for quantitative analysis were (a) working curve method, (b) ratio method, and (c) two-standard method. This evaluation indicated that the two-standard method generally affords the greatest precision of measurement in quantitative X-ray spectroscopy and is, therefore, recommended. Relative standard deviations calculated from results of this method were equal to those attainable from results of painstaking optical spectrographic methods and routine wet method.

3243 **TECHNIQUE OF MEASURING LOW PERCENTAGES OF RETAINED AUSTENITE WITH THE USE OF FILTERED X-RADIATION AND AN X-RAY DIFFRACTOMETER**
H.R. Erard, Springfield Armory, Springfield, Mass.
Tech Rpt SA-TR20-2408, 2 January 1963, 18 p. incl illus, CMS Code 5010.11.83800.08

An investigation was made to develop a more accurate technique for measurement of low percentage or retained austenite. Greater accuracy was secured by measurement of integrated intensities of selected martensitic and austenitic diffraction lines within a known probable error. This operation was performed automatically by a step-scanning diffraction lines with the use of a counting-rate computer. Retained austenite behavior in carburized 9310 steel was successfully studied by this technique. The subject technique of applying the X-ray method extends the range of measuring retained austenite to comparatively low percentages without requiring the use of a crystal monochromater. The measurement of retained austenite can be performed on the surface of the specimen. The same area can be given subsequent treatments and then be re-evaluated. The technique is described and an application of this technique is discussed.

3251 **X-RAY METHOD OF DETERMINING RESIDUAL STRESS DISTRIBUTIONS**
H.R. Erard
Springfield Armory, Springfield, Mass., Tech Rpt SA-TR20-2404, 13 December 1956, 33 p.

This report describes X-ray methods of determining residual stress distributions in steel at all hardness levels. The experimental techniques are described in detail, and the results obtained with them are compared with one another and with conditions of equilibrium that apply to thick walled cylinders. These methods were applied to the determination of tangential and radial stress distributions in barrel sections that had been rifled by various techniques. A precision of better than ±10,000 psi in measuring the absolute magnitude of macro-stress and of ±5000 psi in measuring a change in stress level was obtained. Factors limiting the precision of measurement are evaluated.

3258 **WHAT THE WELDING INDUSTRY REQUIRES FROM NONDESTRUCTIVE TESTING**
Jay Bland
Welding Journal, v. 39, n. 9, September 1960, p. 915

A discussion is presented of the interrelation of nondestructive testing and weldment quality. The characteristics of several nondestructive testing methods to provide information necessary for the evaluation of weld quality are reviewed briefly. The views of several interested groups as interpreted by the author, are considered.

3263 **ACTIVITIES OF COMMISSION V INTERNATIONAL INSTITUTE OF WELDING**
R.A. Pulk
Welding Journal, v. 39, n. 9, September 1960, p. 908

Work of the subcommissions of this commission are described in radiography, ultrasonics, magnetic and penetrant test methods. Working documents have been produced which can be used in establishing standard techniques, such as the reference radiographs collection, radiographic methods for pipes, flat plates, boilers and pressure vessels, and reference block for ultrasonics and techniques for its usage. General informative works such as "Possible and Impossible in Radiography" and the "Handbook on Radiography" are available. Work to date indicates international standardization in critical fields can be accomplished.

3268 **MEASURING THE INTENSITY OF SOFT X-RAYS WITH A SECONDARY ELECTRON MULTIPLIER**
A. Lukirskii, M. Rumsh, and J. Karpovich
Industrial Lab., v. 29, n. 4, April 1963, p. 468-470

Experience in using a secondary electron multiplier for recording soft and ultra-soft X-rays is described. The conditions required for absolute intensity measurements are specified. Tables of the quantum efficiencies for several photocathodes are presented.

3270 **GEIGER COUNTERS FOR RECORDING SOFT AND ULTRASOFT X-RAY RADIATION**
A. Lukirski, M. Rumsh, and J. Karpovich
Industrial Laboratory, v. 29, n. 4, October 1963, p. 508-509

Special Geiger counters have been constructed for recording radiation with wavelengths of 23.6-280A and 1.5-18.3A. The counters are of coaxial design and have a narrow lateral window along the generatrix. Such a position of the entrance window eliminates the "dead region" of the counter. Moreover, this method of mounting the film makes it possible to measure experimentally the transmission factor of the film, which, in turn, provides the possibility of measuring the absolute number of quanta, since the efficiency of such a counter, when filled with a nonhalogen mixture is determined only by the absorption of radiation in the counter's gaseous volume if the transmission value of the window is known.

3273 **250 KVP AND 2 MEV RADIOGRAPHIC EXAMINATION - JATO UNITS 15KS-1000 MARK 6 MODS 0 AND 1 QE TEST PROCEDURE 1000-25**
Howard T. Goodman, U.S. Naval Weapons Station, Concord, Calif.
October 1964

This document delineates 2 MeV reflected beam and 250 kVp radiographic procedures for solving the integrity of the propellant grain and internal component array of JATO units.

3294 **BASIC RESEARCH IN X-RAY SPECTROMETRY**
Hartmut Kallmann
Washington Sq. (Coll.) New York U., N.Y. 1 June 31-August 1956, December 1956, 20 p.
AD-121 332

The rise in light emission, under irradiation by a constant X-ray intensity, was investigated for various phosphors and X-ray wavelengths in order to check how constant the light output is with time. The shapes of the rise curves varied with the size of the X-ray quantum. The increase of light emission with time must be considered in counting measurements with soft X-rays. For ZnS-D, which was previously found to be the most efficient soft X-ray detector, the increase in light emission was about 20% when irradiated for several hours with intensities of the order of $10^{-4}$ ergs/cm$^2$/sec; this intensity corresponds to counting rates of about $10^4$ counts/sec for soft X-rays. In order to eliminate this difficulty, the phosphor should be exposed to X-rays only when a measurement is actually being performed. The phosphors 2150 and 1508 showed a light-emission increase which was greater than that for Zn-D. The rise in light emission of ZnO with time was small; ZnO exhibited almost no phosphorescence, which indicates that it remains in an excited state for a long time after being irradiated by X-rays or other ionizing radiation.

3295 **A CALORIMETER FOR MEASURING THE POWER IN A HIGH-ENERGY X-RAY BEAM**
John McElhinney
Nat'l Bureau of Stds., Wash., D.C. 1 June 1955, 8 p.
AD-116 371

The design and calibration of a calorimeter to measure the power in X-ray beams having peak energies between 1 and 180 million electron volts are described. The calorimeter included two thermally balanced lead cylinders, 4 centimeters in diameter by 7.5 centimeters long, one irradiated by an X-ray beam. The lead cylinder was large enough to absorb almost completely the X-ray beam. The absorbed energy resulted in an unbalance of temperature of the two cylinders, which was measured by the change in resistance of embedded thermistors. Calibration of the calorimeter consisted in observing the temperature rise due to a measured quantity of electric energy dissipated in the same cylinder. The results are given for five calibration runs, each using about 70 microwatts of power for approximately 20 minutes. The probable error of the mean was about $\pm 1$ percent. Separate reports of measurements of X-ray-beam powers at 1.4 and 36 million electron volts are in preparation.

3298 **PLANE AND CURVED CRYSTAL SPECTROGRAPHS FOR X-RAY FLUORESCENCE ANALYSIS BY PHOTOGRAPHIC RECORDING**

E.F. Priestley
Armament Research and Development Establishment (Gt. Brit)
London Rpt No. ASTIA 19-56, January 1956
AD-90 690

The two spectrographs for X-ray fluorescence analysis described in this report employ photographic recording and may be used with lithium fluoride analyzing crystals to detect all the elements from potassium to uranium. The plane crystal spectrograph may also be used with a pentaerythirtol crystal to detect the lighter elements from potassium to aluminum. Exposure times vary from a few seconds to several hours according to the element it is desired to detect, its concentration and the nature of the other constituents of the sample. The limit of detection depends upon the element sought and the nature of the other element present in the specimen, but in general is of the order of 0.01% and in specially favourable cases may be better than 0.001%. Quantitative analysis of a minor constituent demands a close comparison standard if an accuracy better than about ±50% of the actual amount present is required. With a suitable standard an accuracy of better than ±5% of the actual amount present is attainable in favourable cases to facilitate rapid and unambiguous identification of spectra in qualitative analysis. Tables of the Bragg angles of reflection for the principle spectral lines of the elements are given for (200) reflections from lithium fluoride together with charts to enable reflections other than those from (200) planes to be used for identification without calculation. (RDE Summary and conclusions) (See also AD-83 870).

3304 **THE DETECTION AND MEASUREMENT OF SOFT X-RAYS BY MEANS OF PHOTOCONDUCTIVE CRYSTALS AND LUMINESCENT MATERIALS**

New York U.
Quart Prog Rpt No. 7, 1 September, 30 November 1955, April 1956, p. 8
AD-94 209

An experiment is described for measuring the amount of radiation available at the detector and for estimating the amount of impurity which may be detected. A Zn target was irradiated with X-rays from a Machlett A-2 X-ray tube with an Mo anode operated at a 40kV peak and 10 mA. The secondary X-rays from the Zn were passed through a collimator and impinged on an analyzer consisting of an NaCl crystal cut along the (22) planes. The path length from the surface of the Zn target to the detector was 14cm. A curve shows the number of counts/min as the analyzing crystal is set at various angles near the position of maximum intensity. The number of quanta of Zn K radiation available from the analyzing crystal was 400 quanta/sq cm/sec. The lower limit of detection is dependent on the matrix in which the Zn impurity is contained. Absolute calibration for the amount of an impurity in an arbitrary matrix would be difficult, but the apparatus can be calibrated by using standard samples containing known amounts of impurity. The increase in the lower limit of detection caused by self-absorption can be compensated for by using a higher intensity in the primary X-ray beam (see also AD-81 783).

3305 **X-RAY CAMERA FOR USE WITH UNICAM S.25 OSCILLATION GONIOMETER FOR MICRO BEAM APPLICATIONS**

Kaj Drenck
X-ray and Crystal Analysis Lab, Penn. State Univ., Univ. Park
Tech Rpt No. 6, 1 February 1956, p. 9
AD-104 811

A miniaturized single crystal X-ray diffraction camera was constructed as an attachment for the Unicam S.25 oscillation rotation goniometer. A new base accomodates a camera of 28.6-mm diameter. The camera is designed for use with the previously reported high brilliance microfocus X-ray diffraction tube. The tube was modified by eliminating the insulating support between high and low voltage electrodes and using a directly heated Ta emitter of 0.6-mm diameter. The new emitter design resembles the unipotential cathode described by F. Nicoll. With the camera in place at the X-ray tube, the distance from the focal spot (25u diam) to the film is 43-mm. The electron optical system in the tube results in negligible focal spot wandering. A rotation pattern, taken of 30 x 40 x 50u PbZr03 crystal with filtered CuKa radiation (38 kv and 300 ua) in a 5 hr exposure, shows maximum with excellent resolution. Equivalent intensities but with lower resolution were obtained in 25 hr with a standard 60-mm diameter camera and a GE CA-6 Cu target tube, operated at 35 kv peak and 15 ma. The focal spot to film distance was 175-mm. The microbeam system is also advantageous for the reduction of effects of fluorescent radiation in anomalous dispersion studies such as those discussed by R. Pepinsky and Y. Okaya. A micro Weissenberg camera was also constructed for use with the microbeam tube.

3307 **IMAGE-QUALITY INDICATORS FOR WELD RADIOGRAPHY**

R. Halmshaw
Welding and Metal Fabrication, March 1963

This paper discusses the penetrameter as used here and abroad. The article is critical in its appraisal of the different types and is very informative. Points out the need for standardization of design of an acceptable penetrameter.

3308 **DEVELOPMENT OF 6 MEV LINEAR ACCELERATOR FOR MEDICAL AND RADIOGRAPHICAL APPLICATIONS**

Edward.L. Ginzton
Microwave Lab., Stanford U., Calif., 1 March 31 August 1952
AD-139 421

Problems essential to the development of a cheap and reliable source of penetrating X-rays for medical and radiographical uses include: (1) sealing off the accelerator wave guide; (2) increasing the electron beam intensity; (3) efficient low-voltage electron injection systems; (4) compact design; (5) beam focusing; and (6) radiation shielding. The accelerator is a disk-loaded wave guide very similar to other Stanford accelerators, having a length of 6 ft., an RF free space wavelength of 10.55 cm., and an RF peak power input of 0.6 to 0.7 mega-watts. A bunching section was designed which traps all the electrons injected during $180^{o}$ of the RF cycle. To prevent the beam from spreading appreciably as a result of radial defocusing forces, a longitudinal magnetic field is employed with a field strength of about 500 gauss. Construction errors and mechanical tolerances can be maintained so that the reduction in electron energy is only 0.5%. The calculation of the dimensions of several test cavities was completed. An electron gun was designed in which the voltage between electrodes 1 and 2 provides the 100 kv. necessary for injection. A new process for producing a sealed accelerator by means of electroforming was developed.

*3313* **CONTINUOUS SCANNING X-RAY ATTENUATION TECHNIQUE FOR DETERMINING FUEL INHOMOGENEITIES IN DISPERSION CORE FUEL PLATES**

B.E. Foster, S.D. Synder, and R.W. McClung

Oak Ridge Nat'l Lab., U.S. Atomic Energy Comm., ORNL-3737, January 1965

A sophisticated technique has been developed and successfully used for high-speed homogeneity evaluation of reactor fuel plates. Industrial X-ray equipment is used as the irradiation source, while a NaI (Tl) crystal optically coupled to a photomultiplier tube serves as the radiation detector. The system is provided with recording capabilities for go-no-go operation. A detailed explanation is given on the techniques for fabricating the equivalent attenuation standards.

*3315* **INVESTIGATION OF X-RAY AND MECHANICAL ANALYSIS OF RESIDUAL STRESSES**

V. Weiss and E.P. Klier

Metallurgical Res. Labs., Syracuse U., N.Y., 1 October 1955 - 1 January 1956, February 1956, 30 p.

AD-102-056

Part 1: A literature survey is summarized on line geometry and problems encountered with materials giving diffuse diffraction lines. The topics include (1) steep gradients; (2) microstresses; (3) selective nature of the X-ray diffraction process; (4) elastic anisotoropy; (5) diffuse lines; and (6) stress-measurement techniques. Part II: Measurements are being made to determine the effect of slit system and specimen curvature on the line geometry of the (211) diffraction line of steels. This line has an approximate $2\theta$ value of $156^{o}$ for Cr $K_{a_1}$ treated to a hardness of 50 $R_c$. Specimens were designed for convex and concave radii of 3, 2, 1, and 0.5 inches. Residual stress measurements on a 2 x 2-inch. Ti specimen, are being made. Optical curvature measurements were made of the Ti specimen. A bibliography is appended which lists 325 X-ray studies on the measurement of stress for the period from 1925 to 1955.

*3319* **X-RAY INSPECTION OF XF-1 FLEXIBLE LEADS**

R.A. Youshaw, E. Criscuolo

Naval Ord. Lab., White Oak, Md., 30 January 1958, 19 p.

AD-157 274

Two nondestructive inspection methods for the XF-1 flexible leads have been studied. Radiography is found to be suitable for inspection of all defects except for the detection of explosives within the confining sleeve. With the counter method one is able to detect the presence of the explosive charge but the system does not reveal such defects as crimps, tears, punctures or defective cord. For complete nondestructive inspection of the fully assembled lead, a combination of these two methods should be used -- the radiographic method to inspect all points except the confining sleeve and the counter method to inspect the confining sleeve. If the production numbers are small (less than 100,000 units, where it is uneconomical to purchase counting apparatus) then a visual subassembly inspection can be employed to inspect the confining sleeve. The inspection procedure can be satisfactorily designed to insure a sound product.

*3334* ***2 MEV* RADIOGRAPHIC EXAMINATION OF TALOS GUIDED MISSILE BOOSTER (U)**

L.S. Hall

Quality Evaluation Laboratory, U.S. Naval Weapons Station, Concord, Calif.

This is a confidential document for the radiographic examination of Talos Guided Missile Boosters.

3343 **DESIGNING OF ROTATING TARGET X-RAY TUBE AND DISCUSSION OF ITS MAXIMUM SAFE LOADING**
S. Kiyono, et al.
Tohoku Univ-Faculty Eng-Technology Reports v. 27, n. 2, 63, p. 103-15

In newly designed tube cylindrical target rotates around its axis and, at same time, moves up and down in direction of its axis; curved surface of cylinder is bombarded vertically with accelerated electron beam; 2 Wilson seals maintain vacuum around vertical shaft which rotates at 600 to 2000 rpm; maximum load of this target runs up to 5 kw/sq-mm; it is thought possible to put it to various uses as high intensity X-ray source, focus of which is minute (about 0.1-mm in width).

3346 **NONDESTRUCTIVE TESTING OF CONCRETE**
Nat. Research Council-Highway Research Board-Bibliography 33, 1963, p. 44

Included in this bibliography are references to pulse velocity and sonic test methods used for measuring dynamic modulus of elasticity and for estimating strength and other properties of concrete; some historical data and information regarding instrumentation and test procedures are also included; related references on locating reinforcing steel in concrete by X-ray and other methods.

3347 **COMPARISON OF INTERNATIONAL STANDARDS FOR EVALUATION OF X-RAY FILMS IN NONDESTRUCTIVE TESTING OF WELDS, PARTICULARLY CIRCULAR WELDS, IN OIL PIPE LINES**
W. Zitzelsberger
Schweissen u Schneiden, v. 15, n. 11, November 1963, p, 487-92

Standards described, compared, and rated were those of API, IIW, and German GW-1; it is recommended that IIW X-ray catalog be more generally used; methods of protection against radiation are outlined.

3350 **AUTOMATIC INSPECTION OF SILVER BRAZED PIPE JOINTS WITH A PULSE ULTRASONIC SYSTEM**
Tracy W. McFarlan
Materials Evaluation, November 1965, Magnaflux Corp.
Presented at the 24th National Convention of SNT; October 19, 1964, Phila. Pa.

The bond integrity of silver brazed joints is currently being determined with a pulse ultrasound inspection system that propagates longitudinal sound waves into the bond area and indicates percent of bond on a cathode ray tube pattern. The automatic system approach, although not finalized, provides a rapid, reasonable accurate, and reliable test method with recorder readout of instantaneous and total information. Instrumentation is described.

3367 **RADIOGRAPHY WITH HIGH-ENERGY RADIATION**
C.G. Pollitt - The War Office, Armament R&D Establishment Ft. Halstead, U.K.
Reprint from Journal of the British Steel Casting, Research Association,
No. 65, February 1962 Varian Associates Selected Papers Publication

This article contains brief details on the MeV generators and their characteristics, and of the factors governing the information content of radiographs, with special reference to MV X-rays. Techniques are described and a comparison is given of the radiographic merits of betatrons and linear accelerators.

*3368* **10-MEV X-RAY TECHNIQUE**

D.T. O' Connor, E.L. Criscuolo and A.L. Pace
Naval Ordnance Lab., White Oak, Maryland, General Electric X-Ray, Milwaukee, Wis.
Reprint from ASTM Publication No. 96 Varian Associates Selected Papers Publication

This article discusses 10 MeV radiography and presents data on beam intensity distribution, lead screen efficiency, absorption of radiation by steel plate, and penetrameter sensitivity. In addition, ionization shield thickness data is discussed.

*3369* **RADIOLOGY WITH HIGH-ENERGY X-RAYS**

R. Haimshaw and C.G. Politt
Armament R&D Est., Fort Halstead, U.K., Varian Associates Selected Papers Publication - Reprint from Progress in Nondestructive Testing (2)*

This paper gives an excellent review of all the various types of high energy X-ray equipment presently in use for industrial work. A very complete document with an extensive bibliography.
*Macmillan Co., N.Y. 1960

*3370* **SOME ASPECTS OF ELECTRON BEAM OPTICS AND X-RAY PRODUCTION WITH THE LINEAR ACCELERATOR**

J. Haimson
Varian Associates, Palo Alto, Calif.
Reprint from I.R.E. Transactions on Nuclear Science, v. NS9, n. 2,
April 1962 - Varian Associates Selected Papers Publication

A mathematical presentation of linear accelerator fundamental design. Some consideration is given to electron source optics and an analysis of a chopped pre-bunched injection system.

*3371* **10 MEV ROTATING TARGET LINEAR ACCELERATOR FOR RADIOGRAPHY OF LARGE ROCKET MOTORS**

J.H. Cusick, J. Haimson
U.S. Naval Ammunition Depot, Concord, California
Varian Associates, Palo Alto, California
Reprint from Missiles and Rockets Symposium
1961, U.S. Naval Supply Depot, Concord, California
Varian Associates Selected Papers Publication

This paper gives some information on the development, installation, and preliminary testing of the Varian Associates 10 MeV radiographic linac.

*3373* **NONDESTRUCTIVE TESTING OF SOLID PROPELLANT MISSILE MOTORS**

Frank C. Hund, U.S. Naval Weapons Station, Concord, California
Reprint ASTM Special Technical Publication No. 350. (1962)

Requirements, techniques, and procedures for nondestructive testing of large solid propellant motors for the Polaris, Minuteman, Skybolt, and other missiles are discussed. Among the applications covered are: radiography, magnetic particle, and ultrasonic examination of welded steel cases; radiography, penetrant, eddy current, and ultrasonic testing of refractory metal nozzle; ultrasonic testing of case-liner bond; and radiography of the completely assembled solid propellant motor for integrity of the grain, insulation, and bonded surfaces.

3375 **X-RAY MOTION PICTURES CHECK MISSILE PARTS**
Hal Reavley
General Dynamics/Astronautics, Test Engineering, December 1963

This paper describes briefly the use of high speed X-ray motion pictures for checking internal moving parts of missiles.

3380 **NONDESTRUCTIVE TESTING IN THE QUALITY LABORATORIES**
The Martin Company, ER-11566, December 1960

This document outlines the capabilities and equipment pertinent to nondestructive testing maintained and utilized at the Quality Laboratories of the Martin Company. Coverage includes: eddy currents, Ultrasonics, X-ray, penetrants, thermographics, etc.

3390 **OPERATING CHARACTERISTICS OF SOLID STATE IMAGE INTENSIFYING SCREENS**
J.A. Halloway
Aeronautical Systems Division, Wright-Patterson AFB. Ohio, Materials Evaluation, March 1964, p. 118-125

The operating characteristics of solid state image intensifier screens are shown and discussed. Actual screen performance is given for several prototype screens. This includes brightness response as a function of X-ray intensity and energy, as well as screen voltage and frequency. X-ray intensity was varied from 0.1 to 10 r/min within the energy range from 90 kvp to 10 MeV. One of the screens exhibited a brightness gain of 25 over a standard fluorescent screen at low energies. A gain greater than 5 (compared to a NaI crystal) was obtained at 2000 kvp and 10 MeV. Resolution was found to be comparable to a standard fluorescent screen, but decay time was much longer. This and other limitations are reviewed.

3392 **RADIOGRAPHIC PROCEDURES FOR PWR TYPE FUEL ELEMENTS**
David E. Stutz, Merle L. Rhoten, Kenneth D. Cooley, Samuel A. Wenk
Battelle Memorial Institute, July 1955
U.S. AEC Contract W-7405 Eng. -92 BMI-1016

For examination of the core at the welded interface and elsewhere, cesium 137 is recommended as the source of radiation. Examination of the zircoloy 2 end cap at the weld interface as well as the core upset and cladding thickness can best be obtained by using a low voltage X-ray machine. Typical exposure data included in report.

3399 **GLOSSARY OF TERMS USED IN INDUSTRIAL RADIOGRAPHY AND FLUOROSCOPY**
Picker X-Ray Corporation, Picker Industrial Inspector, v. VII, n. 2, July 10, 1963

Fifty-two terms used in the field of industrial radiography and fluoroscopy are defined.
Picker X-Ray Corp., 1275 Mamaroneck Ave., White Plains, N.Y.

3403 **RADIOGRAPHIC FILM READING AND ANALYZING BY ELECTRONIC METHODS***

Sheldon Leonard, Walter G. Eppler
Lockheed Missiles and Space Center, Sunnyvale, California

Experiments to date indicate that electronic reading and analyzing of radiographs will in special cases, process data with greater speed and reliability than the manual method. Automatic fusion welds of aluminum and magnesium alloys are at present the most suitable subject materials. The electronic method is generally similar to the human perception system but does not suffer from those human defects which is motivating this research and development task.
*Talk given before Spring SNT Society, L.A., 1964

3408 **SUPPLEMENTING RADIOGRAPHY WITH ULTRASONIC INSPECTION ON SHIP WELDS**

George M. Bonnett
Newport News Shipbuilding & Drydock Company, Newport News, Virginia
Presented at the 1964 Spring National Convention of the Society for Nondestructive Testing, Los Angeles, California

This paper covers the background leading to the use of ultrasonic inspection to supplement the required radiographic inspection of ship welds. Complete substitution of ultrasonic inspection for radiography has recognized limitations. The advantage of localizing defects in tnick welds is apparent. A brief description of the ultrasonic technique to be sufficiently accurate for this purpose is included. Techniques are covered to convey information regarding exact location of defects present in welds requiring repair. The cost of the inspection versus the savings realized are estimated and indicate an economic advantage by use of this combination of inspection methods.

3409 **INVESTIGATION OF XERORADIOGRAPHY FOR RADIOGRAPHIC INSPECTION WITH 1000 KV X-RAY AND COBALT 60 SOURCES**

R.E. Cofield, H.D. Whitehead, L.E. Burkhart
Atomic Energy Commission, AECD-3461 (November 1952), Carbide & Carbon Chemical Company, Oak Ridge

Experimental equipment and techniques have been employed to investigate the radiography of uranium with images recorded on photoconductive selenium-coated plates by high-voltage X-rays and high energy gamma rays. Resolution and penetrameter sensitivity of 2 - 4% have been obtained through 1/2-inch of uranium, equivalent radiographically to about 3-1/2 inches of steel. The resolution is satisfactory, but the general appearance of the images, dependent upon the condition of the selenium coating and the development process, is not satisfactory. Results obtained and cost evaluations make xeroradiography highly promising.

3411 **SAFETY STANDARD FOR NON-MEDICAL X-RAY AND GAMMA-RAY SOURCES**

National Bureau of Standards - U.S. Department of Commerce
Part 1, General, Handbook 93, 3 January 1964, (AMRA Library No. QC100 U3 H93)

Safety Standards for the manufacture, installation, operation, use, and maintenance of industrial equipment which may give off radiations from radioactive materials or X-rays.

3412 **NOT AS APPLIED IN THE MANUFACTURE OF HEAVY MACHINERY**
F.H. Pennell
DeLaval Turbine Inc., Trenton, New Jersey (1964)

This paper makes a distinction between nondestructive tests and nondestructive testing. It also deals with the extensive testing that goes on in producing finished parts for heavy machinery such as steam turbines, centrifugal compressors, pumps, gears, etc. The author includes tensile, charpy, and impact tests as nondestructive testing while the concensus of opinion places this group in the mechanical testing field; however, the articles is diversified and has good coverage while still striving for the end results of good quality.

3419 **NONDESTRUCTIVE TEST METHODS FOR CORROSION DETECTION**
C.E. Lautzenheiser
Southwest Research Institute, San Antonio, Texas
Inhibitors Materials Protection, 1963, v. 8, n. 8

This article discusses the use of visual inspection, radiographic, ultrasonic, dynamic pressure testing, hydrogen evolution, and corrosion probes as means of detecting extent and location of corrosion in operating equipment. Stress corrosion cracking, strain measuring devices, and eddy current measurements are included.

3423 **PRECISION AND MAGNIFICATION RADIOGRAPHY OF MINIATURE ELECTRONIC COMPONENTS**
Justin G. Schneeman
X-Ray Products Corporation, Pico Rivera, California
Materials Evaluation, April, 1964

Radiographic techniques are outlined for inspection of semiconductors. Types of conditions detected include misaligned crystals, improperly fused crystals, getting rings misaligned or shifted, loose wires, solder balls, foreign materials, weld sputter, excessive solder, fractures of twisted materials and inadequate clearances.

3459 **COATING THICKNESS MEASUREMENT BY ELECTRON PROBE MICROANALYSIS**
G.H. Cockett, C.D. Davis
Brit J Applied Physics v. 14, n. 11, November 1963, p. 813-16

Two methods of measuring in electron probe microanalyzer without aid of standards; thickness calibration curves in terms of X-ray intensity from coating or substrate material are illustrated; for 29 kv electrons, range of measurable thickness is $2 \times 10^{-4}$ to 1.5 mg sq cm; coating intensity method is more accurate for coatings up to 0.25 electron range while substrate method is better for thicker coatings.

3465 **MEASUREMENT OF THICKNESS OF FOILS AND FILMS BY MEANS OF SOFT X-RAYS**
S.I. Lobov, V.A. Tsukerman
Instruments & Experimental Techniques (English translation of Pribory i Tekhnika Eksperimenta) n. 4 July-August 1963, p. 757-61

Soft bremsstrahlung and characteristic X-ray emission excited by tritium are used to measure thin foils and films in thickness range $10^{-2}$ -$10^{-5}$ cm; Geiger counter is used as detector; sensitivity of 3 x $10^{-6}$ g/sq cm can be obtained with method when wavelength of characteristic emission is chosen to correspond with selective absorption at K, L, or M levels of foil materials; method is effective for measurement of metal foils and opaque films in mass range (5-30) $10^{-6}$ g/sq cm.

3474 **TRANSACTIONS OF SEVENTH SCIENTIFIC-TECHNICAL CONFERENCE ON APPLICATION OF X-RAYS TO INVESTIGATION OF MATERIALS (Leningrad 22-29 June 1961)**
Acad Sciences USSR-Bul-Phys Ser (English Translation) v. 26, n. 3, 1962, p. 327-434
(Columbia Tech Translations, New York, NY)

Twenty papers devoted to application of X-ray absorption, diffraction, scattering and emission spectra to investigation of crystal, block, and surface structure of metals, metallic and nonmetallic compounds; determination of mechanical properties and chemical composition; X-ray spectrometry and spectrography; X-ray microanalyzers; several papers are indexed separately.

3475 **USE OF COMPUTERS FOR ANALYSIS OF CRYSTAL STRUCTURES**
M.A. Porai-Koshits
Acad Sciences USSR-Bul-Phys Ser (English Translation) v. 26, n. 3, 1962, p. 328-36
(Columbia Tech Translations, New York, NY)

Use of computers (programming) for crystal structure calculations on basis of X-ray diffraction data; state of art in Soviet Union (at first BESM computer was used in 1953) with use of "Strela-4" and "Setun" computers in various centers; technical development of programming for "routine" structure analysis, for "experimental" assignments different from conventional approach, and solution of structural problems with specifically computer technical approach.

3478 **GENERATION AND BEHAVIOR OF X-RAY IN THICKNESS MEASUREMENTS**
W.R. Baarck
Iron & Steel Ingr v. 40, n. 11, November 1963, p. 108-10

Physical principles attendant to creation and absorption of X-radiation presented by Weston Instruments and Electronics Div., in application to gaging process; X-ray absorption in matter; secondary radiation; absorption coefficients of chemical compounds; variation of mass absorption coefficient with X-ray tube voltage; discontinuous X-ray absorption, i.e., absorption "edge"; general design criteria discussed.

3479 **QUALITY CONTROL AND NONDESTRUCTIVE TESTING IN CONSTRUCTION OF MARINE NUCLEAR POWER PLANT**
W.H. Sansom
Shipbldr & Mar. Engine-Bldr. v. 71, n. 676, January 1964, p. 34-8, February p. 77-81, Pt 2

Techniques for detection of leaks in containment structures and for determining leak rate from components that are as leakproof as available engineering techniques can make them; developments in radiography as applied to nuclear engineering, including special X-ray units for examination of welds or steel over 3 in. thick, particle accelerators, mega voltage radiography, carbon tetrachloride for examination of beryllium and graphite. Pt 3, Ultrasonic methods; research on welds., 36 refs. Pt 1 indexed from Dec 1963 Issue.

3481 **STEREOSCOPIC RADIOGRAPHY IN STUDY OF ORE TEXTURES**
W.K. Hamblin, C.A. Salotti
Am Mineralogist v. 49, n. 1-2, January-February 1964, p. 17-29

Technique is based upon same principles as stereoscopic vision and consists of taking 2 radiographs with different focal positions; when resulting X-ray pictures are oriented in their proper relative positions and viewed under stereoscope, stereoscopic model is produced showing 3-dimensional relations of size, shape, and orientation of minerals within specimen.

3484 **FILM THICKNESS MEASUREMENT BY X-RAY EMISSION AND BETA RAY BACKSCATTER TECHNIQUES**
G.J. Basl, L.L. Soffa
Rocketdyne Division, North American Aviation, Inc., Canoga Park, Calif.
Materials Evaluation, October 1965

Film thickness measurements were made on printed circuit board material plated with gold over copper. Nondestructive test methods were investigated, consisting of X-ray emission, absorption techniques, and beta ray backscatter test methods. X-ray methods were found to be accurate and easily reproducible. Optical examination of the specimens indicates that the plating thickness is 10 to 30 percent thicker than found by beta ray test methods. Extreme inconsistencies of thickness measurement were found by beta ray test methods.

3491 **RADIOGRAPHIC EXAMINATION OF AIRCRAFT STRUCTURES**
T.H. Norriss
Aircraft Eng. v. 36, n. 2, February 1964, p. 32-7

In 1958, X-ray departments in each of main de Havilland production factories were installed for examination of aircraft structures in production and during repair and overhaul; principles involved in radiography of production aircraft and main types of defect that can be detected, namely, foreign matter in enclosed areas and structural defects; radiography of aircraft in service and types of defect that can be successfully detected--metal corrosion, fatigue cracking, damage to skin joints and rivets, etc., and foreign matter that has entered structure during routine maintenance.

3494 **MECHANISATION OF PROCESSES FOR X-RAY INSPECTION OF WELDED JOINTS**
S.T. Nazarov
Welding Production (English translation of Svarochnoe Proizvodstvo) n. 4, April 1963, p. 32-6

Results of investigations on sensitivity of X-ray method for inspecting aluminum, titanium and steel using electron-optical transducer; advantages of new X-ray methods over conventional radiography for inspecting welded components at works are shown.

3497 **METALLOGRAPHIC EXAMINATION OF RADIOGRAPHICALLY DETECTED DEFECTS IN RESISTANCE SPOT WELDS IN 0.010" THICK 301 STAINLESS STEEL CENTAUR INTERMEDIATE BULKHEADS**
C.J. Kropp
General Dynamics, Astronautics, AR-592-1-374, 11 December 1962
AD-405 199

Resistance spot welds (from longitudinal weld joints) were chosen for microscopic examination on the basis of radiographically detected defects on the periphery or within the spot welds. The study's main objective is the correlation of the defect detected with the defect actually found to be present by microscopic examination of a cross section of the spot weld. It was found that the location of the defect indication relative to both the light halo image which encompasses the resistance spot weld and the weld nugget image may serve as an aid in the radiographic interpretation of the type of defect present.

3498 **INTERPRETATION OF RADIOGRAPHIC IMAGES OF NICKEL FOIL REINFORCED RESISTANCE SPOT WELDS IN TYPE 301 STAINLESS STEEL**
C.J. Kropp
General Dynamics Astronautics, AR-592-1-434
AD-405 196

Several samples of nickel reinforced resistance spot welds in type 301 stainless steel sheet were radiographed using a beryllium window tube. A few spot welds which were prepared for microscopic examination were chosen on the basis of dark internal X-ray images appearing within the weld image as well as some dark line images on the periphery of the spot weld. The spot weld samples were obtained from both fractured fatigue test specimens and unstressed weld test panels.

3499 **ULTRASONIC WAVE BEHAVIOR IN THIN-WALLED PIPE**
James F. Lovelace
General Dynamics, Electric Boat, Groton, Conn.

Theoretical and experimental work directed at pipe weld inspection by use of ultrasonics. Angle beam pulse-echo methods considered most applicable. Occurrence of multiple signals caused by too large a diameter transducer thereby receiving the signal on several reflections. Steep angles of incidence recommended to avoid extraneous signals from weld reinforcement.

3501 **AN EVALUATION OF AN ULTRASONIC INSPECTION SYSTEM EMPLOYING TELEVISION TECHNIQUES**

Dr. J.E. Jacobs and W.J. Collis, Northwestern University
Harold Berger, Argonne National Laboratory, Materials Evaluation, May 1964

An ultrasonic imaging system employing a newly developed television camera tube which responds directly to ultrasonic energy is described. The camera tube, having a 2 inch dia. piezoelectric target and faceplate, converts an ultrasonic image into an electronic signal which can then be displayed by standard television methods. The capabilities of this imaging system for nondestructive testing applications are demonstrated by comparing the test results obtained by the cinesonographic techniques against those obtained using a mechanically scanned ultrasonic imaging system and X-radiography. In addition the advantages of the television imaging system over conventional ultrasonic inspection methods are discussed.

3503 **DEVELOPMENT OF SPECIALIZED X-RAY TECHNIQUES AND EQUIPMENT FOR INSPECTION OF OCEAN CABLE SPLICES**

J.W. Nalencz, M.E. Campbell
Bell Telephone Labs, Inc. N.J.
Materials Evaluation, May 1964

Radiographic inspection of the overmold of a cable joint was found to provide a means of nondestructive examination for concentricity of the center conductor, for the detection of voids in the dielectric, and for detection of metallic inclusions and high density spots. Problems encountered and techniques involved are discussed.

3507 **INVESTIGATION OF X-RAY BEAM DENSITY PROBE**

R.B. Morrow
Thesis, Air Force Institute of Technology, Wright-Patterson AFB, Ohio, August 1963

A method for measuring the localized average density of a gas or plasma by directing a narrow X-ray beam from an X-ray analysis unit through the gas and counting the induced fluorescent characteristic X-rays of the gas is investigated. Plots of the count rate of the characteristic X-rays, detected by a flow-type gas proportional counter, versus the argon density were used for calibration. A differential pulse height analyzer was used to selectively count only X-rays corresponding to the Argon K fluorescence X-rays. A linear relationship was consistently observed between count rate and argon density for a range of argon densities from $10^{17}$ to $2 \times 10^{18}$ atoms/cc.

3509 **A COMPARISON OF COMPLETE VERSUS SELECTIVE PROGRAMMED INSTRUCTION IN A NONDESTRUCTIVE TESTING LABORATORY**

R.T. Bell
Union Carbide Corp., Nuclear Div. Y-12 Plant, Oak Ridge, Tenn. Report No. Y-1442

This report describes the objectives and requirements of a nondestructive testing training program in which programmed instruction was employed. A determination was made of what areas should be taught, then the material was programmed (conventionally and selectively) and presented to a group of 34 presently engaged in industrial radiography. Based on a statistical analysis of the data collected, it was concluded that both groups significantly improved their knowledge in industrial radiography, but there was no significant difference in the achievement, retention, or training time using a conventional program and a selective program.

3526 **REPORT NO. 2 OF THE AEROSPACE MANUFACTURING TECHNIQUES PANEL**
Material Advisory Board of the Div. of Eng. & Indus. Research
National Academy of Sciences, National Research Council, Wash., D.C.
Report MAB-139-M (AMT-2), October 1963, 396 p.

This report consists of recommended applied R & D programs in each of the following listed major manufacturing areas. (1) Materials Forming, (2) Joining & Mechanical Fastening, (3) Materials Treatment, (4) Surface Conditioning & Treatment, (5) Electrical & Electronic Component Fabricating Techniques, (6) Nonmetallic Fabrication, (7) Insp. & Evaluation Techniques (NDT). Under NDT the requirements from the Aircraft & Astronautics Applications Panel were listed for various materials as mere general R & D requirements & specific R & D requirements. Specific R & D requirements listed the various NDT methods, advantages & disadvantages of each, requirements beyond the state-of-the-art, and possible solutions. The report is fairly inclusive and points out many areas where NDT is wanted and needed.

3533 **METALS & CERAMICS DIV. ANNUAL PROGRESS REPORT, PERIOD ENDING 31 MAY 1963**
Oak Ridge National Laboratory, Oak Ridge, Tenn
ORNL-3470, Available OTS $3.50
(only the NDT portion of the report is considered here)

NDT is under continuous development for testing nuclear components, esp. w/ electromagnetics, ultrasonics, and penetrating radiation. A new phase-sensitive eddy current instrument has greater applicability to thickness measurements than more conventional instruments. A mathematical model for improved electromagnetic probe design is being programmed. A new device for ultrasonic inspection of brazed heat-exchanger joints has been developed. Low voltage radiography extended to contact radiography capable of 500 X magnification. Improved gamma- and X-ray transmission techniques are being developed for the determination of fuel-loading variations on fuel plates and rods.

3548 **THE NONDESTRUCTIVE TESTING OF BRAZED JOINTS**
Akira Kanno
Argonne Nat'l Lab., Argonne, Ill., U.S. Atomic Energy Comm
Contract #W-31-109-eng-38

A correlation study of X-ray radiography, neutron radiography, and ultrasonic testing as applied to brazed joint inspection is presented. Ultrasonic methods were found superior for non-bond detection although resolution is poor, particularly near edges. Precise information is obtained by neutron radiography for thermal neutron sensitive brazing alloys.

3551 **METALS TESTING, NONDESTRUCTIVE**
K.F. Stuehmeier
Ein roentgenographisches Verfahren zum Messen von Eigenspannungen in technischen Bauteilen, Schweissen u Schneiden, v. 16, n. 3, March 1964, p. 92-7

X-ray photographic method for determination of internal stresses at surface of metallic structural members is described, including specially developed equipment used, exposure time is short, evaluation of interference lines and necessary calculations are simple; procedure is demonstrated on example of stress determination in welded tube section.

3564 **THE INSPECTION OF THIN-WALLED STAINLESS STEEL REACTOR GRADE TUBING**
R.S. Sharpe and S. Aveyard
Journal of the Iron and Steel Institute, 201, n. 10 (1963), Ultrasonics, April-June 1964

A comprehensive study of a number of nondestructive testing techniques. It is based on detailed examination of some 2,000 specimens ranging in diameter between 0.25 in. and 1.25 in. and in wall thickness between 0.010 in. and 0.35 in. Ultrasonic, radiographic, eddy current, fluorescent penetrant, and optical methods are compared and as primary inspection for ultrasonic micrometer capable of measuring $2 \times 10^{-5}$ in. thickness variations in 0.015 in. walled-tube is described.

3597 **PROPORTIONAL COUNTER FOR X-RAY DIFFRACTION STUDIES**
D.M. Kheiker et al.
Acad Sciences USSR-Bul-Phys Ser (English Translation) v. 26, n. 3, 1962, p. 392-8
(Columbia Tech Translations, New York, NY)

Amplitude resolution of proportional counters is 4 times better than that of scintillation counters and use of proportional counter allows reducing of relative background; diffraction pattern is enhanced, despite lower efficiency of proportional counters as compared with scintillation counters; counter design; associated circuitry; recording in presence of fluorescent radiation; enhancement of quality of diffraction patterns.

3598 **MEASURING STRESS IN STEEL PARTS BY X-RAY DIFFRACTION**
D.A. Bolstad et al.
Metal Progress v. 84, n. 1, July 1963, p. 88-92, 118, 120, 122, 124

Nondestructive testing method employing portable X-ray unit plus special techniques can determine residual stresses in high-strength steel parts; importance of method of surface preparation which is dictated by type of stress information required, is emphasized; film exposure technique; measuring diffraction line positions; analysis of data; calibration of stress measurements; method is used at Boeing to insure that no residual stresses are induced in components during installation.

3606 **INVESTIGATION OF SECONDARY PHENOMENA FOR USE IN CHECKOUT**
Gilbert S.H. Hwang
Air Force Aero Propulsion Lab Wright-Patterson Air Force Base Contract No. AF 33(657)-9913 Systems Research Laboratories, Inc.
APL-TDR 64-4 - January 1964
AD-431 821

This report discusses the experimental work, results and conclusions of the investigation of secondary phenomena for use in checkout of electrical components and circuitry. Detection techniques cover X-ray absorption, infrared using a thermistor, infrared using fluorescence, radio frequency emission, magnetic fields, and electrical fields. Most promising are X-ray absorption, infrared and radio frequency.

3607 **NONDESTRUCTIVE TESTING**
*Warren McGonnagle, Ford Park
International Science and Technology Journal, July 1964
*Southwest Research Institute, San Antonio, Texas
Also Materials Evaluation, December 1964, p. 561

This paper is of a general, yet wide, coverage of the field of nondestructive testing and covers such topics as radiography, neutrons, thermal testing, liquid penetrant, magnetic techniques, Ultrasonics, etc. Some ideas for further advancing the state-of-the-art are also included.

3610 **INVESTIGATION OF THE FABRICATING PROPERTIES OF HIGH-STRENGTH STEELS**
D.E. Young
Babcock and Wilcox Co., Alliance Ohio, January 1965, 70 p.
AD-460 161

A vessel has been fabricated of croloy 2-1/4 material (2-14% Chromium 1% Molybdenum) to the configuration of other vessels tested under the direction of the subcommittee on plastic fatigue of the pressure vessel research committee of the welding research council. The base material has been quenched and tempered to a room temperature yield strength in excess of 80,000 psi and a charpy V-notch impact strength in excess of 3-ft.-lb, at +10F. The vessel has been partially tested in accordance with a parallel program conducted by the pressure vessel research committee of the welding research council on A-201, A302-B, and T-1 steel vessels. Fatigue testing of the vessel at Southwest Research Institute in San Antonio, Texas has been halted due to insufficient funds remaining in the contract appropriation.

3615 **X-RAY UNIT MADE POCKET SIZE**
Iron Age, v. 193, n. 2, January 9, 1964, p. 60-1

Study made by Ill Research Institute, Chicago for Atomic Energy Commission concluded that compact, $\beta$-excited X-ray sources are practical for field inspections; several radiographs were made of thin materials using regular Polaroid X-ray film and 250 curie Promethium-147 source; this $\beta$- emitting fission product was fabricated into pellet 7 mm in diam and 2-mm thick; it was placed in stainless steel and Hevimet housing with movable shutter; when used with Polaroid developer unit, this equipment represents ideal system for on spot radiographic inspection; it requires no external power supply, dark room, and chemicals.

3618 **WHEN TO RADIOGRAPH PRESSURE VESSELS AND WHEN NOT TO**
R. Chuse
Welding Design & Fabrication, v. 36, n. 11, November 1963, p. 44

Recommendations given are based on ASME Unfired Pressure Vessel Code and on changes made in 1962; code insists that pressure vessels for certain jobs should be radiographed; effect of metal, its thickness, joint efficiency, and design of vessel on how to carry out radiography.

3625 **X-RAY SCATTERING BY POINT DEFECTS**

A. Guinier
Project 9763(802A), Grant AF-AFOSR 62-51, SRPS, AFOSR, University of Paris
Paris, France

This study will attempt to use X-ray scattering to observe point defects and will utilize the fact that the X-ray scattering by point defects varies very slowly with the angle of scattering. Hence it is possible to obtain reliable data by measuring the scattering in a solid angle much larger than usual. A preliminary study will be made for the selection of the most advantageous wave length. The observation of defects will begin with those defects for which the expected scattering is high, a solid solution containing a small percentage of solute, and progressively move to the more difficult cases.

3629 **2-MEV RADIOGRAPHIC EXAMINATION ASROC (RUR-5) 11.65-INCH-ROCKET-MOTORS, MARK 1 MOD 0 AND MARK 37 MOD 0**

Howard T. Goodman
U.S. Naval Weapons Station, QE/Concord Test Procedure 1000-20 (May 1964)

This document sets forth procedures for radiographically resolving the integrity of the ASROC(RUR-5) 11.65 inch Rocket Motors. These motors provide the propulsion for the unguided atmospheric flight of the surface launched, anti-submarine, rocket-boosted torpedo, delivering either a nuclear warhead or conventional depth charge. The test technique provides radiographs demonstrating propellant grain separation; dislocation of felt spacers seating the cruciform grain; and weldment discontinuities such as undercutting; incomplete penetration and cracking.

3645 **X-RAY METHOD FOR DETERMINING ORIENTATION OF SELECTED CRYSTAL PLANES IN POLYCRYSTALLINE AGGREGATES**

J. Starkey
Am J Science, v. 262, n. 6, June 1964, p. 735-52

In new technique, specimen is standard petrographic thin-section which is easily prepared and can be used for both optical and X-ray study; camera produces photograph that can be interpreted directly, but it is also possible to transfer data onto spherical projection; for most practical purposes one photograph furnishes complete data; absorption factor does not detract seriously from value of method.

3649 **AN EVALUATION OF THE NO. 3000 POLAROID FILM FOR INDUSTRIAL RADIOGRAPHY**

N.S. Beyer, K. Balaramamoorthy
Argonne National Laboratory
Materials Evaluation, February 1964

The Polaroid 3000 film which is now available shows promise for certain radiographic applications. Lead screen and Patterson screen exposure techniques each have specific advantages. For the average application, the lead screen technique is to be preferred over the salt screen technique, even though the slope of the curve is less at the working density range. The radiographic quality attainable with Polaroid 3000 is acceptable for many applications, and it has the advantage of rapid and simple processing as compared to conventional X-ray film.

3657 **INSPECTION OF THICK POLYETHYLENE SECTIONS BY RADIOGRAPHY AND FLUOROSCOPY**
James Begley
Picatinny Arsenal, Dover, N.J., October 1963

A series of tests were made to determine the detectability of various size voids through different thicknesses of polyethylene material. Results show that a cobalt 60 source could detect voids 1/2 inch long by 1/8 inch deep through 22-1/2 inches of borated polyethylene. Fluoroscopy is not as sensitive because of low image contrast.

3667 **ULTRASONIC TESTING UREA FORMALDEHYDE INSULATORS - ELECTRIC INSULATORS**
Rubber and Plastics Age v. 44, n. 12, December 1963, p. 1498

British Insulated Calender's Cables Ltd., in cooperation with Ultrasonics Dept of Smith's Industrial Div., recently introduced 100% testing for its large urea-formaldehyde insulators; accuracy of flaw detection compares favorably with X-ray methods and requires only semi-skilled operator.

3671 **METHODS OF ELIMINATING OFF-FOCUS X-RAYS IN ROTATING-ANODE X-RAY TUBE**
K. Shiga, M. Yoshida
Toshiba Rev n. 16 Winter 1963 p. 41-8

Description is given of characteristics of off-focus X-rays, ways of eliminating them, and of construction of X-ray tube using specially sealed shield plate with small hole in its center to pass main X-ray beam right in front of focal spot.

3674 **PLANNING NONDESTRUCTIVE TESTING PROGRAM FOR SOLID PROPELLANT ROCKET MOTORS**
W.W. Mills, Jr.
ASTM-Special Tech. Publ. 350, 1963, p. 3-8

Review of solid propellant rocket motor development and nondestructive testing as used therein, coupled with anticipated and predicted changes, affords insight into need for and role of nondestructive testing now and in future; first, X-ray radiography and fluoroscopy were applied; as need for evaluation of case-propellant bond became evident, ultrasonic methods and later others including thermal and sonic tests, and tangential radiography were tried; items to be considered in planning nondestructive testing program for use in design development and production of solid propellant rocket motor are listed.

3688 **SYMPOSIUM ON NONDESTRUCTIVE TESTING OF WOOD**
Madison, Wisconsin 1964
U.S. Forest Products Laboratory, Madison, Wisconsin October 7-9 1963
National Lumber Manufacturers Association, Madison, Wisconsin FPL 1964
AD-434 815

A discussion of scientific means for testing wood without impairing the usefulness of the piece tested, including methods based on mechanical and electrical devices, nuclear radiation, sound, and vibration. Contains summaries of over 22 papers on the subject matter.

3694 **STANDARD-INSPECTION PROCESS-RADIOGRAPHIC**
Aerojet-General Corp., AGC-STD 4818
2 August 1963, DDC
AD-427 506

This standard covers radiographic inspection of materials and parts for the presence of cracks, porosity, blowholes, inclusions and similar discontinuities.

3700 **SMALL ANGLE X-RAY SCATTERING: METHODS & CONSIDERATIONS**
John A. Williams, Bert Phillips
TEM-PRES Research Inc., State College, Pennsylvania
Contract No. NONR 4089 (00)
Metallurgical Branch, Office of Naval Research

This report discusses in a general manner the factors which must be considered in small angle X-ray scattering experimentations. It is intended primarily to assist those who wish to use this technique as an analytical tool, but who will not be greatly interested in the mathematical and theoretical aspects. Various experimental considerations such as collimation systems, monochromalization of the X-ray beam and detection of the scattered X-rays are described, especially with reference to the kratky collimation arrangement. The effects of parasitic scattering investigation are indicated.

3702 **RADIOGRAPHY IN THE PRESENCE OF BACKGROUND RADIATION**
R.W. McClung, Oak Ridge National Laboratory, Oak Ridge, Tenn.
Materials Evaluation, January 1965

With proper procedures through shielding of film and minimizing time for the film handling in the radiation field before and after the image-forming exposure, useful radiography can be performed despite the presence of formidable radiation background.

3704 **AN EVALUATION OF COLOR RADIOGRAPHY FOR INDUSTRIAL USE: THE RE-EXPOSURE METHOD**
Carl Blackman, Physicist, Report No. WVT-11-6410, May 1964

Although no color film is specifically manufactured for radiographic purposes, attempts have been made to produce color radiographs by modifying the producer's suggested film development procedure. Step wedges of aluminum, steel, zirconium, and uranium were radiographed and the film developing process was modified according to procedures established at Argonne National Laboratories. The results, using a positive and a negative type film, and a detailed record of the procedures are presented. The results indicate that color radiographs are difficult to produce, and the process time-consuming and expensive. Areas of possible future investigations are suggested.

3710 **A REVIEW OF 100% X-RAY INSPECTION OF SEMICONDUCTORS**
Sheldon Leonard
Lockheed Missiles and Space Co., Sunnyvale, Calif., Materials Evaluation, February 1965

This article discusses the inspection procedure for all semiconductors in stock. This data spurred development of X-ray television equipment and prompted quality control and reliability engineers to take a more critical view of semiconductor devices.

3711 **X-RAY – NECESSARY TOOL FOR DETECTING INCIPIENT STRUCTURAL FAILURES IN SERVICE AIRCRAFT**
A.D. Edwards
SAE – Paper 854A for meeting April 27-30 1964 5 p.

Examples of applying X-rays to inspection of DC-6 and DC-7 aircraft structural components at Delta Air Lines; tests of fuselage frame, horizontal stabilizer, oil coolers, lubrication tanks, fuel injection lines, honeycomb panels and fuselage circumferentials and stringers are reported; method described is pointed out as indispensable aid in locating and determining extent of incipient failures in structure which is inaccessible by position or covered by multiple layers of metal.

3720 **DEVELOPMENT OF INSPECTION CRITERIA FOR THIN-WALLED PRESSURE VESSELS**
Satrak Derboghosian
Technical Note AMRA TN 64-12, August 1964, AMCMS Code 4230.19.2510

Radiographic techniques and acceptance criteria for the nondestructive examination of the Hawk missile accumulator pressure vessel are presented. A review of welding defects detected by employing various radiographic techniques and radiographic reference standards specifically developed for this work are outlined. An analysis of destructive tests is also discussed.

3723 **RADIOGRAPHY OF LARGE SOLID PROPELLANT ROCKET MOTORS**
Paper from Symposium on NDT Testing in Missile Industry
American Society for Testing Materials, STP no. 278, p. 3-11

Experimental data on the radiography of the Polaris motor. Discontinuities can be detected from 30-60 inches in diameter. 7 ref.

3732 **METHOD OF ASSESSING INTERNAL QUALITY OF STEEL TUBES AND WELDS**
J.S. Blair
Paper from "Conference on Internal Steel Quality and Methods of Its Assessment". West of Scotland Iron and Steel Institute, Journal, v. 68, Glasgow, Scotland, 1960-1961, p. 25-40

Review and comparison of nondestructive testing techniques for steel tubes and welds including radiography, ultrasonic, eddy current, and diverted magnetic flux.

3733 **A STUDY OF SLIT DETECTION BY RADIOGRAPHY**
E.L. Criscoulo, D.P. Case
U.S. Naval Ord. Lab. White Oak, Maryland
NOLTR 64-55, 10 April 1964

Slit detection by radiography is dependent upon image contrast, dimensions of the slit and unsharpness. Experiments show that the contrast reductions factor for narrow slits is not a linear relation with unsharpness. Thus the equations based upon theory are valid for slit widths either several times smaller or larger than the unsharpness. For conditions where the unsharpness and slit width are of the same order of magnitude, an empirical formula must be used.

3745 **MONITORING OF THE FUSION WELDING PROCESS**
Frank Joseph Sattler
The Ohio State University, Columbus, Ohio
A Thesis - 1963

The purpose of this paper was to show that the Ohio State - Watertown Arsenal Television X-Ray Image Enlargement System can be used to monitor the fusion arc welding process. Discussion deals with equipment considerations and modifications as well as the operation of the combined welding, X-ray, and television systems for in process inspection of fusion welding.

3748 **X-RAY IMAGE CONTRAST**
Robert C. McMaster, Frank J. Sattler
The Ohio State University, Columbus, Ohio

Elementary methods of predicting X-ray image contrast and exposure techniques are presented in this paper. Overall image contrast is shown to be the product of the specimen contrast factor and the X-ray film contrast factor. Experimental methods of measuring these factors are presented as a guide to development of radiographic techniques.

3749 **NEW DEVELOPMENTS IN X-RAY IMAGE ENLARGEMENT SYSTEMS**
Robert C. McMaster, John P. Battema, Jr., The Ohio State University
Columbus, Ohio, Philips Electronics Instruments, Mount Vernon, N.Y.

New industrial and military applications of X-ray nondestructive testing are made feasible by a high resolution, closed-enlargement system. The new system provides enlargements of 30x to 50x with stationary or in motion X-ray inspection. It is particularly effective on small components and thin gage materials and weldments, including printed circuit electronic assemblies, semiconductor devices such as diodes and transistors, aerospace and nuclear weldments, missile case wall materials, brazed honeycomb structures, and other critical components.

3753 **EVALUATION OF NONDESTRUCTIVE INSPECTION PROCEDURES**
P.W. Bergstedt, H.C. Turner, W.M. Sutherland
Convair, San Diego
Rpt. No. 56-216 Contract AF33 (657) - 8926 March 1957

The object of this report was to determine the efficiency of dye-penetrant and radiographic inspection as methods of rating magnesium AZ91 Castings. Conclusions drawn indicate that dye-penetrant inspection is inadequate for determining acceptable limits of casting porosity but X-rays correlated very well with tensile properties.

3769 **NONDESTRUCTIVE TEST PROCEDURE BULLPUP GUIDED MISSILE (AGM-12) SUSTAINERS, MARK 8 MODS 0 AND 1**
Ernest Colifro
U.S. Naval Weapons Station, Concord, California
QE/Concord Test Procedure, No. 1000-23, August 1964

This procedure provides visual and radiographic inspection of Navy-held sustainers for damage as a result of mishandling, water damage on shipboard, or adverse storage conditions; in addition, to determination of defects which may occur in the propellant due to aging, which would adversely affect the reliability and serviceability of the missile.

3771 **NONDESTRUCTIVE TESTING AS APPLIED TO AIRCRAFT**
T.H. Norris, M.S.R. Hawker-Siddeley Aviation
De-Havilland Div., Chester, Gr. Britain, British Journal of NDT, June 1964

A general discussion of inspection and quality control methods used on raw materials, structural assemblies and aircraft.

3772 **NONDESTRUCTIVE TESTING FOR ROUTINE SERVICING IN THE ROYAL AIR FORCE**
J.C. Drury,
C.S.D.E. Swanton Morley, Norfolk, Great Britain
British Journal of NDT

This article is devoted to nondestructive testing of aircraft by the aircraft operators in the Royal Air Force after predetermined periods of time or after minor accidents. Techniques discussed cover radiography, ultrasonics, eddy currents, electromagnetics, and dye penetrants.

3777 **RESEARCH AND DEVELOPMENT ON ADVANCED GRAPHITE MATERIALS VOL. XVII - RADIOGRAPHY OF CARBON AND GRAPHITE**
Thomas C. Furnas and M.R. Rosumny
Picker X-ray Corp., Cleveland 12, Ohio, Wright-Patterson Air Force Base
Contract AF 33(616)-6915, Report #WADD TR 61-72, April 1964
AD-600 339

A study to establish optimum exposure conditions for the radiographic detection of minimum size defects in thicknesses of graphite varying from four to sixteen inches. Through the use of grids and associated technique 0.5 percent sensitivity or better was attained on high density graphite. The use of grids made the greatest contribution towards an increase in sensitivity. Exposure techniques using both X-ray and gamma ray sources are included.

3780 **INSPECTION OF PIPELINE WELDS**
G. Razzini
SAIPEM Division, SNAM, Milano, Italy
Materials Evaluation, August, 1964

This is a general article on pipeline weld inspection in Europe and describes X-ray, gamma ray, and ultrasonic techniques used in the field.

3781 **THE MASKING LIQUID "ASL" FOR RADIOGRAPHY**
Wataru Ichikawa, Tomio Senda
Asahi Glass Co., Ltd., Yokahama, Japan; Tokyo Metropolitan Indus Research Institute, Tokyo, Japan
Materials Evaluation, August 1964

It was theoretically presumed that a highly concentrated aqueous solution of zinc-iodide would have an X-ray absorption coefficient similar to that of iron, and could be used as a masking liquid for radiography. In view of the practical applications, the solution was improved to be resistant to air oxidation and to be inactive in iron. The solution, now called "ASL" proved to have large masking effects for scattered radiation. In practice "ASL" made it easy to take radiographs of cast articles with irregular shape, and obtain clear radiographs which show the details.

3784 **CONTINUOUS X-RAY TIN-COATING WEIGHT GAGE**
G. Dykeman, S.B. Prellwitz
ISA--Nat Conference Instrumentation for Iron & Steel Industry, v. 14, Proc 1964, paper 12, 14 p.

Improved version of United States Steel's 2-sided, continuous X-ray tin-coating weight gage with traversing mechanism is described, tested in areas that were, or at least simulated, mill environment conditions; calibration of gage is based on use of mylar films of various thickness on steel base to represent tin coating.

3790 **250 KVP AND 2 MEV RADIOGRAPHIC EXAMINATION JATO UNITS 5KS-4500 MARK 7 MODS 0, 1, 2, AND 3**
Howard T. Goodman
U.S. Naval Weapons Station, Concord, Calif., QE/Concord Test Procedure 1000-22, July 1964

This document sets forth procedures for the radiographic examination of Jato Units. These solid propellant grain units are used to augment aircraft power plants and to propel test vehicles and sleds.

3796 **RADIOGRAPHY: ITS PURPOSES AND PRACTICES**
R.C. Barry
Atomics International, No. American Aviation, Inc., Canoga Park, Calif.
NDT Testing for Management American Society for Metals, Metals Park, Ohio

Metal parts of all shapes and sizes can be inspected for internal flaws through the use of radiation from X-ray sources or radioactive isotopes. This report on the fundamentals of radiographic practice includes a typical step-by-step test procedure and information on safety precautions.

3806 **10 MEV AND 25 MEV RADIOGRAPHIC EXAMINATION POLARIS A2P SECOND STAGE MISSILE MOTORS**
Howard T. Goodman
U.S. Naval Weapons Station, Concord, California
QE/Concord Test Procedure 1000-17, January 1964

The purpose of this report is to demonstrate and explain the plans and techniques developed by the Quality Evaluation Laboratory, U.S. Naval Weapons Station, for the 10 and 25 MeV radiographic inspection on a vertical stand of Polaris A2P second stage missile motors.

3825 **X-RAY ABSORPTION - EDGE SPECTROMETRY**

Charles G. Dodd, Owens, Illinois
Proceedings of the Symposium on Physics and NDT Testing, October 1962
Southwest Research Institute, San Antonio, Texas

X-ray absorption edge spectrometry, in the general sense, is that branch of X-ray spectroscopy that is characterized by an emphasis on measurements made at portions of X-ray spectra adjacent to critical absorption discontinuities. The reason for the considerable interest in spectral measurements at X-ray absorption edges is the peculiar wealth of chemical and structural information that may be harvested from these studies. This article discusses two separate and independent branches of XAES, chemical analysis by monochromatic X-ray absorptiometry at each side of an absorption edge, and second, in less detail, studies of the fine structure revealed by either high or moderate resolution monochromatic X-ray absorptiometry at an absorption edge, usually on the short wavelength or high energy side of the edge.

3826 **THE PHOTOGRAPHIC LATENT IMAGE**

George M. Corney
Eastman Kodak Company
Proceedings of the Symposium of Physics and NDT Testing, October 1962
Southwest Research Institute, San Antonio, Texas

The nature of the change which renders a photographic grain developable upon exposure to radiation is discussed, with respect to both light and x-ray exposures. The mechanism of a few photographic effects which may be of significance in technical photography - e.g., reciprocity-law failure and the Clayden ("Black Lightning") effect are considered, as are some theories on the action of photographic developers.

3847 **DIVERGENT BEAM X-RAY MICROSCOPY AND CRYSTAL ANALYSIS**

R.S. Scharpe, United Kingdom Atomic Energy Research Establishment
Proceedings of the Symposium on Physics and NDT Testing, October 1963
Southwest Research Institute, San Antonio, Texas

From a study of local variations in X-ray transmission through thin specimens, a considerable amount of information can be obtained on the distribution and composition of microstructural detail. In general, it is complementary to that obtained by optical micrography. By using a source of X-rays of about 1 $\mu$m diameter, projection microradiographic techniques have been developed, which have many advantages over contact microradiography, for NDT measuring coating thicknesses and studying inclusions and microdefects. When examining single crystals with the projecting X-ray microscope, an additional effect due to diffraction occurs which can be used as the basis for a highly sensitive method of determining lattice parameters without the need for a precision camera or any accurate film measurements. Emphasis of paper is on applications to materials of interest in the nuclear energy field.

*3848* **BASIC RADIATION PHYSICS DATA FOR INSPECTION SYSTEM DESIGN**

David L. Dye
The Boeing Company
Proceedings of the Symposium on Physics and NDT Testing, October 1963
Southwest Research Institute, San Antonio, Texas

A number of gaps in understanding exist in the basic physics of high energy radiography. Using the 10 or 25 MeV research Linac at the Boeing Radiation Effects Lab, experiments are being planned to fill in some of these gaps and to study high energy radiographic parameters. Experimental planning to measure X-ray and secondary electron spectra is discussed and preliminary results presented. Means are indicated of relating these basic data to actual inspection systems.

*3849* **APPLICATIONS OF BACKSCATTERED RADIATION**

Raymond R. Nydegger, Southwest Research Institute
Proceedings of the Symposium on Physics and NDT Testing, October 1963
Southwest Research Institute, San Antonio, Texas

Although the radiation backscatter method of investigation may not be the ultimate in material evaluation, some of the difficulties encountered when using other types of inspection may be circumvented by proper choice of radiation type and energy. Backscattered radiation may be defined as scattered radiation which leaves the material through the same surface that the incident radiation enters the material. One immediate apparent advantage of the backscatter radiation technique is that only one surface of the material need be accessible.

*3861* **PIPE WALL THICKNESS MEASUREMENTS USING TANGENTIAL RADIOGRAPHIC TECHNIQUES**

N.O. Cross, Esso Research & Engineering Co.,
Madison, New Jersey

The tangential radiographic technique for inspecting piping has been successfully used for a number of years. This method is particularly valuable to the chemical and refining industries for measuring the wall thickness of pitted and corroded process equipment. An additional advantage of this system is the measurements can be made on piping filled with liquids, solids, and at elevated operating temperatures. Various limitations and applications as determined by wall thickness, pipe diameter, and gamma ray energy are discussed. A method for calculating true wall thickness from projected wall thickness on the radiographic film is also described.

*3863* **OPTICAL ILLUSIONS IN RADIOGRAPHY**
M.H. Jacoby
Aerojet General Corp.
Presented at 24th Annual Meeting of the Society For NDT Testing, October 1964

Optical illusions are usually thought of as entertaining tricks. Not many writers who deal with the subject have ever considered these illusions as having any real significance in radiography. Above threshold levels, however, some illusions can influence visual perception to a greater degree than the more well-known stimulus variables of size, contrast, brightness, and duration of viewing. This paper presents several examples of optical illusions and background interactions found in radiography. It emphasizes the point that these illusions are troublesome only when observers fail to measure and rely strictly on visual interpretations. Some light is thrown on the psychological mechanisms at work in the illusions, the errors in evaluation produced, and how measuring instruments explode the illusions and erase the errors.

*3867* **COMPLEMENTING THE ACCEPTANCE CRITERIA**
Raymond E. Alie
Newport News Shipbuilding and Dry Dock Co., Newport News, Virginia
Presented at the 24th Annual Meeting of the Society for NDT Testing, October 1964

This paper treats of the difficulty facing nondestructive testing personnel in proving the value of employing complementary "inspection methods to take over" where the test methods used for acceptance criteria have exceeded their limitations. Ultrasonic inspection, the use of which is not prescribed by the applicable specification, is effectively employed to quickly and economically detect rejectable defects left undiscovered by poor radiography orientation on welded vessels which have heretofore received only the firmly established radiographic inspection.

*3893* **RADIOGRAPHY--BOTTLENECK OR BLESSING**
George O'Brien
Nondestructive Testing, v. 19, July-August 1961, p. 265-266

Use of Kodak Industrial X-Omat Processor, an automatic film processing machine, to speed up X-ray inspection of nuclear reactor and missile components.

*3895* **PRACTICAL IMAGE FORMATION IN INDUSTRIAL FLUOROSCOPY**
Donald W. Bowman, Raymond A. Pulk
NDT Testing, v. 19, July-August, 1961, p. 267-273, 275

Brightness and definition as influenced by X-ray output, image former absorption, light amplifier, image magnification, scanning speed, contrast and resolution. 7 ref.

*3896* **ULTRASONIC INSPECTION OF SUBMARINE STEEL WELDMENTS**
N.A. Sinclair and M.M. Nanda
NDT Journal, v. 19, January-February, p. 58-64

Inspection procedures on prepared defective test steel weldments are contrasted with radiographic inspection methods. Techniques and acceptance-rejection standards are established for longitudinal crack detection only.

3897 **THE RADIOGRAPHIC EXAMINATION OF A THIN OBJECT**
C. Casswell, E. Eisner
NDT Testing, v. 19, March-April. 1961, p. 108-109

Measurement of variation of wall thickness in a small metal cylinder of precipitation hardened DTD683A Al alloy by X-radiography.

3899 **INSPECTION OF NEW EQUIPMENT IN STEAM POWER PLANTS**
J.A. Klapper
NDT Testing, v. 19, March-April, 1961, p. 131-127

Review of penetrant, magnetic particle, radiographic and other test methods. General quality control considerations for turbine spindles and generator rotors.

3904 **THE BOEING 600-KV FLASH X-RAY FACILITY**
W.E. Spencer
The Boeing Co., Seattle, Washington
Document No. D2-90311, April 1964
AD-435 262

This report describes the 600-KV Flash X-ray facility constructed at the Boeing plant as an aid in conducting X-radiation damage studies on electronic components. Schematics and techniques are included.

3908 **EVALUATION OF FILM AND FILMLESS RADIOGRAPHIC SYSTEMS FOR THE NDT TESTING OF THIN MATERIALS AND ELECTRONIC ASSEMBLIES**
James M. Baker
The Boeing Company, Seattle, Washington
Rpt. No. T2-2988
AD-435 383

An equipment and techniques evaluation and correlation of filmless and film radiographic methods as applied to testing and inspection of electronic components and thin materials. Image enlargement, using a closed circuit television system, with 16-mm movie film to record images on the monitor were compared with film techniques. Advantages of the filmless technique are cited.

3914 **EVALUATION OF NONDESTRUCTIVE INSPECTION METHODS; CAPABILITIES OF MAKING PRECISION PHYSICAL MEASUREMENTS**
W.B. Hallmark and R.E. Anderson
North American Aviation Inc., Downey, California, December 1963

A radiographic method is described and recommended for measuring physical dimensions of enclosed land areas of Apollo coldplates.

*3917* **CORRELATION STUDIES BETWEEN DESTRUCTIVE AND NONDESTRUCTIVE TESTS OF ELECTRONIC COMPONENTS**
D.D. Seltzer
Nondestructive Testing, v. 19, July-August, 1961, p. 243-251

Comparison of radiographic, ultrasonic, optical micrometric and stereomicroscopic testing and visual, macroscopic and microscopic examination of time delay relays, Hg relays, thermal batteries, transducers, printed circuits and pyrotechnic components.

*3918* **DEVELOPMENT OF NONDESTRUCTIVE TESTS FOR THE EGCR FUEL ASSEMBLY**
Robert W. McClung
NDT Testing, v. 19, September-October 1961, p. 352-358

Test techniques for Experimental Gas-Cooled Reactor (EGCR) include penetrants, pulse-echo and resonance ultrasonics, radiography, eddy currents, helium-leak and others. Capabilities and limitations with reference to specific inspection problems. 10 ref

*3919* **DETECTING SERVICE FAILURES IN POWER PLANTS**
Helmut Thielsch
Nondestructive Testing, v. 19, July-August 1961, p. 252-259

Radiographic, ultrasonic, dye penetrant and magnetic particle inspection of boilers, turbines, piping, pipe supports and hangers, valves, fittings and shafts to prevent failures caused by thermal or mechanical shock or fatigue, corrosion, erosion, creep, cracking or rupture. 5 ref.

*3938* **CAST NUCLEAR COMPONENTS RADIOGRAPHY BY MEANS OF KILOCURIE COBALT SOURCES**
Richard Lent
Modern Castings, v. 40, October 1961, p. 118

Heavy section radiography of steel sections up to 12 inches thick using a newly developed Co isotopes enriched to a high specific activity in high neutron flux reactors.

*3944* **RADIOGRAPHIC IMAGE QUALITY INDICATORS (French)**
Soudage et Techniques Connexes, v. 15, January-February 1961, p. 39-42

Characteristics and application of wire- and hole-type image quality indicators. Determination of visibility index of radiographic image.

*3945* **COST CUTTING IDEAS**
Welding Design and Fabrication, v. 34, March 1961, p. 54-69

Applications, advantages and limitations of nondestructive metal testing by ultrasonic, radiographic, penetrant, magnetic particle, eddy current, thermographic, magnetographic, thermal and tensile techniques.

3947 **TEN-MILLION-VOLT X-RAY IMPROVES MISSILE INSPECTION FOR NAVY**
Western Machinery and Steel World, v. 52, March 1961, p. 48

Design of an electron linear accelerator for industrial radiography which penetrates up to 15 inches of steel in minutes.

3950 **RECENT DEVELOPMENTS IN THE RADIOGRAPHY OF HIGHLY RADIOACTIVE SPECIMENS AT AERE., HARWELL**
R.W. Parish, D.W. Pullen
Atomic Energy, Research Establishment, Harwell, Eng.
The British Journal of Nondestructive Testing, v. 7, n. 1, March 1965

This report covers techniques developed which make possible the X-ray of highly radioactive materials. By the use of projection radiography no elaborate or extensive set up is required other than standard X-ray equipment. Two methods are covered, one being that of color film and the other by utilizing chemical film density reducing agents. Good quality X-ray films are said to be attainable.

3952 **NDT TEST DEVELOPMENT**
J.W. Allen, Jr., and R.A. Nance
(ORNL-2988) Oak Ridge Nat'l. Lab., Tenn., p. 406-420

A new transistorized eddy-current instrument, the Metal-Identification Meter, for sorting metals and alloys according to electrical conductivity & magnetic permeability designed & built by the Instrumentation & Controls Division in conjunction with the NDT Test Development Group. New eddy-current instrument was designed & developed for use with probe-coil techniques. Investigation of the fabrication of realistic reproducible standards for tubing inspection. Equipment and techniques were developed for using the eddy-current "lift off" effect for measurement of fuel-element spacing. Studies of ultrasonic behavior in thin sections are being expanded to include quantitative measurements of reflection, transmission and Lamb-wave propagation as a function of variation in metal thickness & the ultrasonic frequency & incident angle. Studies of exposure requirements for helium & air atmospheres for low voltage radiography demonstrated the advantage of the helium atmosphere. Ultrasonic techniques used to measure the wall thickness of Zircaloy-2 core vessel. Use of ultrasonics for weld inspection in thick plates.

3960 **TRENDS IN THE DEVELOPMENT OF NDT TESTING OF LIGHT METALS WITH X-RAYS AND RADIOISOTOPES (German)**
F. Rohner
Metall, v. 15, March 1961, p. 216-219

Review of technique development including improvement of image interpretation in X-ray-through-radiation of light metals by xeroradiography, and by electronic and semiconductor image amplifiers, use of Tm-170 and Eu-155 isotopes as radiation sources and application of radiography to strip and sheet thickness measurements.

3961 **INVESTIGATION OF USEFULNESS OF A 5 MEV LINEAR ELECTRON ACCELERATOR FOR THROUGH-RADIATION OF STEEL (German)**
Hermann Moller, Helmut Weeber
Archiv fur das Eisenhuttenwesen, v. 32, February 1961, p. 107-112

Comparative through-radiation of steel wires with a linear 5 MeV electron accelerator, a 15 MeV betatron, and 5 Curie Co-60 radiation to evaluate usefulness of electron accelerator in X-ray steel testing. Influence of amplifier Pb foils.

3963 **DIMENSIONAL STUDIES OF STIMULATED EXPERIMENTAL GAS-COOLED REACTOR FUEL ELEMENTS AT ELEVATED TEMPERATURES**
W.R. Martin
American Nuclear Society, Transactions, v. 4, June 1961, p. 149-150

X-ray and isotope radiography study of expansion, plastic strain and fracture of $UO_2$ encapsulated in Type -304 stainless steel while subjected to cyclic heating to 4000 F. 5 ref.

3964 **NONDESTRUCTIVE METHOD TO DETECT PIPES AND CAVITIES IN HOT STEEL BLOOMS DURING THE ROLLING-PROCESS BY MEANS OF BETRATRON, X-RAY IMAGE INTENSIFIER AND TELEVISION-SETUP**
W. Lueckerath, K. Flink, R. Flossmann
Philips--Serving Science & Industry, v. 8, January 1961, p. 7-12

A betatron X-ray testing assembly is used in a rolling mill to study macroscopic solidification structures and defects by shooting hard X-rays into the steel. The resulting penetration pattern is transmitted by X-ray image intensifier tube and television unit to a screen for observation.

3973 **AN INFRARED NONDESTRUCTIVE TESTING SYSTEM FOR ROCKET MOTORS**
F.E. Alzofon
Lockheed Missiles and Space Company, Sunnyvale, California
Materials Evaluation, November 1965

The Lockheed Missiles and Space Company has designed, fabricated, and delivered to the U.S. Navy, an infrared nondestructive testing system to be applied to inspection of Polaris A-3 motors. The system is intended to be used for usability analysis of the infrared nondestructive testing technique in production line inspection. Research conducted along with the design and fabrication program, indicates the feasibility and value of infrared testing relative to other NDT techniques. A description of the system is presented, along with some of the results of the experimental program.

3974 **CALCULATION OF THE NUMBER OF BETA EMITTERS REQUIRED FOR RADIOGRAPHY AND RADIOMETRIC INVESTIGATIONS**
L.M. Yefimov
Metallurgy and Metallography, p. 348-61
NSA 19355 (Np-tr-448)

A theoretical calculation of the electron yield from a sample was made, and on this basis the problem of the necessary concentration of beta tracers for radiometric analysis and radiography was solved. The required exposure time in radiography was calculated. (C.J.G.)

3978 **APPLICATION FOR TRITIUM TO WELDING AND RADIOGRAPHY WITH TRITIUM**
B.I. Bruk, G.I. Nikolaev
Metallurgy and Metallography, p. 535-544
NSA 19366 (NP-tr-448)

The application of tritium to show the effect of free moisture, contained in the coating of electrodes, on the saturation of the seam metal and adjacent primary metal with hydrogen during arc welding. The free moisture of the electrode coating plays an active part in saturating the seam metal with hydrogen during welding. The application of tritium in studying the distribution of hydrogen in titanium and zirconium radiographically. (CJG)

3979 **NONDESTRUCTIVE TESTING OF STAINLESS-CARBON STEEL WELDS. CORE I, SEED 2.**
Section 2, Test Results T-641300. Duquesne Light Co., Shippingport, Pa.
First issue January 10, 1961, 14 p. NSA 12593 (DLCS-2410202)

All the welds that were radiographed appear to be satisfactory for continued use in the plant except in the 1A reactor coolant loop drain weld. The radiography of this weld indicates the presence of a 3/8 inch transverse defect. The majority of the welds showed indications of porosity. (JRD)

3981 **POSSIBLE AND IMPOSSIBLE IN RADIOGRAPHY**
J.H. Stam
Nuclear Science Abstracts, 1961, p. 2067
NSA 15988. Haarlem, Netherlands, N.V. Detechnische Uitgeveri

Radiographic analysis of fusion butt welds in steel plate containing intensional defects at various plate thicknesses using Ir-192 and Co-60 gamma sources to 31 MeV.

3989 **METALLURGICAL APPLICATIONS OF THE X-RAY SCANNING MICROANALYZER IN AN INDUSTRIAL LABORATORY (French)**
D.A. Melford
Revue Universelle des Mines, de la Metallurgie, de la Mecanique, v. 17,
April 1961, p. 247-252

Analysis of complex nonmetallic inclusions or surface segregation of residual elements in mild steel and growth material on a tungsten electrode.

3990 **THE BRITISH STEEL CASTINGS RESEARCH ASSOC. EIGHTH ANNUAL REPORT**
1961. 37 p. 5 East Bank Road., Sheffield 2, England

A review of research during the year on steelmaking, deoxidation, desulphurization, moiding, and coremaking, heat treating, cleaning, and testing of castings.

3991 **CORRELATION OF TENSILE PROPERTIES OF STEEL CASTINGS AND MATERIAL IMPERFECTIONS AS DETERMINED BY RADIOGRAPHY**
L. Mattek, R. Woodward
General Dynamics Corp. (Wright Air Development Div.) U.S. Office of Tech. Ser., February 1961, 307 p.

Correlation for type-410 stainless in thicknesses of 0.1, 0.2, 0.3 and 0.6 inch at room temperature. Research establishes a statistical adequacy for a 0.95 confidence level to support engineering designs and structural stress analyses for castings of 0.1, 0.2 and 0.3 inch thickness.

3993 **RADIOGRAPHIC INVESTIGATION OF AUSTENITIC STEELS (Russian)**
V.I. Grigorkin, G.V. Korotushenko
Izvestiya VUZ--Chernaya Metallurgiya, February 1961, p. 96-99

Investigation of crystal lattice periods, alteration in the fine grain structure and grain hardenability as dependent on fast plastic deformation of commercial forged hoop iron and rich Mn austenitic steels. 13 ref.

3994 **SOME PROBLEMS CONCERNING THE FUSION WELDING OF WROUGHT ALUMINUM ALLOYS**
(French) H. Gerbeaux
Soudage et Techniques Connexes, v. 15, May-June 1961, p. 219-237

Review of the production properties and use of Al and Al alloys, with attention to weldability of Al-Mn alloys. Study of the oxy-acetylene and gas-shielded welding of Al and Al-Mg alloys, with particular emphasis on prevention of swells, blowholes, and crack phenomena. Radiographic inspection of welds and methods of chemical analysis, especially the determination of Mg.

3995 **FABRICATION OF HIGH PURITY (99.8%) ALUMINUM TANKS**
R.K. Battersby
Australian Institute of Metals, Journal, v. 6, August 1961, p. 186-194

Requirements for vessels used as containers for concentrated hydrogen peroxide. Development of welding techniques for cylindrical 500 and 1000 gallon tanks. Pickling and cleaning techniques, inert gas shielded arc welding and radiographic inspection. 5 ref.

## DESCRIPTOR INDEX

All descriptors listed in alphabetical order pertain to the information contained in the report or item that is identified by the AMMRC number following descriptor. This journal is concerned with radiographic testing literature and every item in the journal contains some aspect of radiographic testing. A complete breakdown of each subject item by descriptors was deemed necessary in order to make the journal useful.

Reviewers need only to look up the item numbers which apply to the particular descriptors of interest and turn to the abstract applicable to those referenced numbers.

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