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New

NONDESTRUCTIVE TESTING INFORMATION ANALYSIS CENTER

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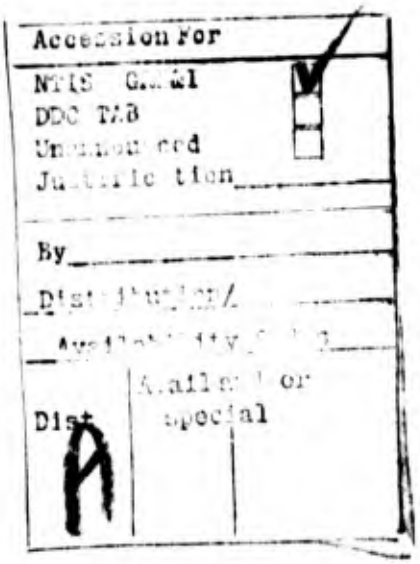

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ACKNOWLEDGEMENTS

As must be realized, this handbook is the product of the efforts of a number of people. Grateful appreciation is hereby expressed to each of them for their individual contributions.

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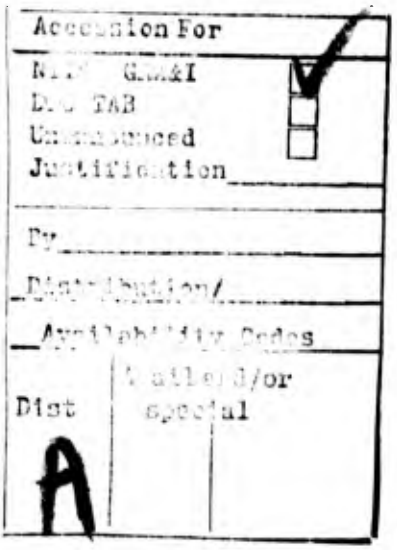
1. INTRODUCTION

This handbook has been prepared for the purpose of supplying a major source of references for the many aspects of nondestructive testing. In addition, it contains fundamental descriptions of testing techniques, applications of these techniques, and references to standard handbooks and textbooks containing sources of additional information. The final section of the handbook contains an index and a description of organizations active in NDT. Entries in this section were compiled from the responses to a questionnaire mailed out by the NTIAC staff.

An attempt has been made to list at least one source for all references. When available, the publisher is identified. Many of the references have an "AD" number such as AD XXXXXX or AD AXXXXXX. These references are available from the National Technical Information Service (NTIS), Springfield, Virginia. References having only an AD DXXXXXX are NTIAC source references and are not available. All references have an NT XXXXXX identification number. This is an NTIAC file number and is only for NTIAC internal use.

Material in the handbook, except as noted, has been generated from the NTIAC information files. It is believed that these files are the most comprehensive source of NDT references in the United States. It would be appreciated if any major omissions or errors were brought to the attention of the NTIAC staff.

It is intended that periodic additions will be made to the handbook in order to provide the most current information to the user. For this reason, a looseleaf format has been used to allow the insertion of new and revised pages. In order to receive these additions as they become available, please notify NTIAC of any address changes.



2. NDT OVERVIEW — 1978

2.1. A Brief Review of Some Recent Developments

2.1.1. Elastomer Products

The U. S. Army has objectively reviewed nondestructive testing technology as it may be applied to rubber and rubber products such as tires, tracked vehicle road wheels, rubber faced track pads used on tracked vehicles and elastomeric liners for rocket motor cases. Several years ago, a similar program concerning elastomeric fuel tanks was conducted.

Of primary interest in many studies of elastomers is bonding or unbonding to both base surfaces and elastomer-to-elastomer as in seams and tire plys. Optical holography is useful for detecting surface anomalies caused by unbonded areas, particularly in between tire plys. Ultrasonics have also been used to find void areas. Generally the elastomeric items must be loaded in order to increase the void area or volume thus increasing the detectability. Thermal techniques have been attempted but in general they are of low sensitivity. This is caused by the poor heat transfer coefficient of elastomers which in turn produces very small temperature differences between bonded and unbonded areas.

Radiography has little application in the detection of unbonds but may be quite useful for inspection of reinforcing cord, particularly steel wire.

Most testing of elastomers is destructive and many of the tests are conducted on the raw product or end product specimens while NDT is conducted mainly on the end product. The development of NDT of rubber products is presently hampered by a lack of correlation between defects or anomalies and the end item performance. Said another way, the inspector often does not know what to look for. Work is continuing on NDT of rubber products and statistical correlation of NDT results with item performance[1].

2.1.2. Holography

Holographic interferometry and speckle pattern displacement have been used to examine and measure flaws in fiber reinforced plastic tubes. The program used more or less conventional holographic techniques to produce fringe patterns in the unloaded and internally pressurized condition. However, the fringe pattern photographs were scanned with a computer controlled optical processing system. Computer software was developed which digitized the fringe patterns and calculated the flaw location, flaw size and surface strains[2].

2.1.3. Optics

The U.S. Army Picatinny Arsenal has completed a survey of the state-of-the-art of automated optical inspection. A number of individual subjects were surveyed including color, reticles, diffraction, scattering, scanners and information processing. While most of the optical inspections are performed by humans, many such inspections can be performed by automated equipment, particularly in high speed production line applications.

Defects having a color contrast with the background may be found using a photodetector in combination with the proper filters and illumination. Reticles can be used to enhance the image by matching the field of view of the photodetector to the target dimensions.

The diffraction pattern of a test object profile may be obtained by illuminating the test object with laser light. The technique is suitable for examination of small object characteristics such as holes, slits, wires and particles. Small dimensional variations will produce large diffraction pattern changes. Surface scattering of laser light is another technique to detect surface defects; however, the surface must be very uniform and generally have a roughness value of no more than .05 μm rms. Otherwise the surface scattering is so pronounced that the defect cannot be detected.

There are a number of optical scanners and image digitizing instruments available. These include mechanical scanning systems which move either the test object or use mirrors or prisms to move either the detector or illuminator, laser scanners, optical profilometers, TV cameras, flying spot scanners, and photodiode arrays. The output from the scanners may be electronically digitized for computer processing. The computers may either be used to produce enhanced images or to make "go", "no go" inspection decisions. Rapid advancements in computer technology, fast Fourier transforms, and algorithms promise further use of automated optical inspections[3].

An application of optical inspection has been made by a large automobile manufacturer using lasers. Three laser sensor heads examine nuts for cross threads, missing threads, thread pitch and burrs. A fourth head and two light emitting diodes check the surface for burrs and flaws. The examination rate is 9000 per hour; although the optical system is capable of much higher rates, the mechanical sorting system limits the throughput[4].

2.1.4. X-Rays

Small voids in the low density polyurethane foams used as a potting material inside the 1/8-inch steel shells of projectile fuzes were the cause of erratic fuze performance. Earlier studies had confirmed that conventional wet film X-radiography would not reliably detect the smaller voids of interest, i.e., down to 1/8-inch in diameter. Neutron radiography was investigated but required long exposures on fast grainy film which was unsatisfactory. A system was developed consisting of an X-ray source, an X-ray collimator, sodium iodide detectors, an amplifier control unit, and a chart recorder. The fuze was scanned by a motorized fixture which moved it through the collimated X-ray beam. The system sensitivity was limited by the X-ray source stability (0.75 percent) and detector sensitivity (0.02 percent) as compared to wet film sensitivity of about 2 percent. Detection of the 1/8-inch voids was realized, and the system appears capable of performing inspections on additional internal fuze components.[5]

It was desired to determine residual stresses in test objects using automated X-ray methods with rapid evaluation of results. The system which was developed consisted of a stress goniometer, a full wave X- ray generator, computer-oriented electronics and a telecomputer module which interfaces the system with a minicomputer. The stress determination is based upon the measurement of lattice strains detected through secondary radiation from the specimen surface and measurement of the Bragg angle. While the system was developed to measure residual stress in gun tubes, it can be used to measure stresses in many other metals[6].

2.1.5. Ultrasonics

A circular ultrasonic transducer array was constructed for making shear wave examinations of welded seams. The test specimen is immersed in an acoustic medium and the transducer array positioned above it. By sequentially pulsing the transducers, the flaw echo can be theoretically detected regardless of flaw orientation. In the experimental model which was built, certain flaw orientations were not detected because the transducer beam spread was too narrow. However, if the beam spread is broadened too much, there is a possibility of one transducer transmitting directly to another. Multiple indications also occurred in some scans because the transducers were not all focused on precisely the same point. The experimental model showed that the concept was viable. With improvements in array geometry and the addition of automated scanning under computer control as well as computer aided flaw evaluation, the system could be a powerful NDT tool[1].

Copper rotating bands are formed on steel rocket motor bodies by first laying a copper weld bead on the motor and then machining the bead to the final shape. Poor band bonding was found to be responsible for subnormal projectile performance. An ultrasonic C-scan system was developed to inspect the bond integrity. Both the test specimen and transducer were placed under water and the motor body placed on a motorized turntable such that the entire bond could be automatically scanned by the transducer. A laboratory calibration standard was developed and bond acceptability criteria was evolved. Test projectiles were inspected and then fired. Every projectile which had a satisfactory bond as shown by inspection had no indication of band bond failure as evidenced by satisfactory flights. A weld process improvement program was initiated which was evaluated through the use of the ultrasonic scanning system. As a result of welding process improvements, 1500 rounds were produced with only one having a marginally rejectable band and four having minor unbonded areas. Previously, 10 to 20 percent flight failures were experienced which attributed to band bond failures[4].

An automated system has been developed for detecting the position of a manually manipulated ultrasonic transducer. The system includes a search unit consisting of a transducer, a transducer shoe, and two acoustic transmitters; an acoustic receiver array; a control unit; an ultrasonic instrument; and a tape recorder. A data processing subsystem is also used consisting of a minicomputer, tape deck and other computer peripherals. As the search unit is manipulated in the vicinity of the weld, its position and all flaw echoes of interest are recorded on magnetic tape. The computer is then used to calculate, print, and plot inspection results. The primary advantage of the system is speed since no manual data recording or measurement of transducer location is necessary.[2]

2.1.6. References

1. NTIAC Newsletter, Dec, 1977
2. NTIAC Newsletter, Mar, 1977
3. NTIAC Newsletter, April, 1977
4. "Laser Inspection System," Automotive Engineering, Society of Automotive Engineers, Vol 86, No. 3, March, 1978
5. NTIAC Newsletter, Sep, 1977
6. NTIAC Newsletter, Jun, 1977

7. NTIAC Newsletter, Jan, 1978
8. NTIAC Newsletter, Feb, 1978
9. "Search Unit Tracking and Recording System," Southwest Research Institute, 1977

2.2. A Forecast of Future Developments

2.2.1. Automation

Without doubt, automation will continue its rapid advances of the past at an even faster pace. The reasons for this are two-fold. First, industry needs and wants automation because it is faster, cheaper, and more accurate than many manual techniques. Certainly there are exceptions. For one-time examinations or some type of unique examination, manual methods will always predominate. But if the examination is repetitive or production oriented, the prospect for automation is excellent.

The second reason for the forecast increase in automation are the new tools which are available. Minicomputers are becoming more and more powerful, and they are showing up everywhere. Data handling and complex waveform analysis are two common mini-computer applications in NDT. Bubble memories, fast Fourier transforms, and sophisticated software are but a few of the computer aids that greatly increase their usefulness. Automated pattern recognition and waveform analysis will continue to develop and be used for extensive accept-reject decision making. Techniques such as ultrasonic holographic imaging and secondary emission of X-ray spectra seem likely candidates for increased automation. Automated application and reading of liquid penetrant indications may also become more common.

2.2.2. New Techniques

The prediction of "scientific breakthroughs" is an impossible task which will not be attempted. But the technical journals report monthly on new techniques which are not so much "scientific breakthroughs" as they are extensions of and new application of known technology and principles. An example of such an application is the use of a high resolution scanning Auger microprobe in combination with a scanning electron microscope and secondary ion mass spectrometry for chemical surface analysis.[1]

It may certainly be expected that new applications of available technology will continue. While it is doubtful that any of the big seven (VT, MT, PT, RT, UT, LT and ET) will be replaced by a newcomer, many of the other NDT techniques such as acoustic emission are being applied more and more.

2.2.3. Certification

There is a growing trend toward formalized personnel training, qualification, and certification. This is true not only for NDT personnel but also for quality control inspectors and quality assurance auditors. Similarly, formal qualification of the procedure and equipment is also being required. This is already a fact of life in the nuclear power industry and is growing into other industries. The welding industry has long been accustomed to formal qualification of welders, weld procedures, and weld inspectors. Many industries also routinely qualify NDT inspectors to the requirements of SNT-TC-1A, particularly those working to the requirements of the ASME Boiler and Pressure Vessel Code. In addition, look for those industries which offer products affecting the public health and safety and use NDT as a quality control tool, to be required to qualify their NDT people and procedures. This will apply not only to the NDT techniques covered by SNT- TC-1A but also to any other NDT technique which might be developed. For example, the government has recently published formal quality assurance requirements for safety and pollution prevention equipment used in offshore oil and gas operations. This in turn will require qualification of NDT equipment and personnel used in the fabrication of such equipment.

2.2.4. References

1. Leys, J. and Ruscica, R.; "New Dimension in Problem Solving," *Industrial Research/ Development*, Vol 20, No. 3, Mar 1978, pp 114-119

2.3. Bibliography of Surveys and State-of-the-Art Reviews

This section contains an annotated bibliography of surveys and state-of-the-art reviews which have been published during the past five years. This bibliography may prove useful to those users who wish to quickly gather the latest literature on discrete NDT subject matter.

2.3.1. Surveys

NT-11975

Addison, Robert C., Jr.; "Recent Advances in Ultrasonic Imaging," Proc of ARPA/AFML Rev of Quant NDE, pp 273-301, Dec 1975.

An attempt has been made to survey the many varieties of ultrasonic imaging systems that are currently being developed and to categorize them according to the function they serve best. Furthermore, a uniform set of criteria has been used to evaluate the performance of these systems in terms of commercially available B and C scan systems.

NT-12271

Alburger, J.R.; "New Concepts, Materials, and Techniques in the Inspection Penetrant Process," Bulletin No. 751001, Adv. in Inspection Penetrant Technology, 10 pp, Tracer Tech, 1975.

The inspection penetrant method of nondestructive testing, originated circa 1930, has developed into several highly sophisticated yet reliable processes for the detection and evaluation of surface flaws and discontinuities in fracture-critical parts. The advances in penetrant technology which have led to this excellent state of the penetrant art have come about through studies made on the process materials themselves, on the physics and optics of visible-color and fluorescent dyes, and on instrumentation for measuring and testing penetrant performance features. This chapter provides a summary of a number of the more significant features of penetrant technology which have undergone improvements in recent years. A discussion is given concerning the possibility of combining various advances in penetrant technology to yield a close-to-perfect inspection penetrant system.

NT-12272

Alburger, J.R.; "Reliability and Reproducibility in the Inspection Penetrant Process," Bulletin No. 751004, Adv. in Inspection Penetrant Technology, 10 pp, Tracer Tech, 1975.

The technology of inspection penetrant materials and processes has been developed to the point where extremely small surface crack defects in fracture-critical parts may be detected by use of properly designed inspection penetrants, and through correctly utilized processes. Also, the flaw-detection sensitivity may be accurately controlled by appropriate adjustments in the physical-chemistry of the penetrant process materials and the technique of their usage. Several factors are significant with respect to flaw detection performance of a given penetrant process, and all of these must be given consideration in assessing the process as to its reliability and reproducibility of results. This chapter presents a summary of various performance- related penetrant parameters, and includes a discussion of methods for minimizing possible process deviations.

NT-14128

Anderson, Robert T.; "Eddy Current Testing," Prevention of Structural Failure, No. 5; Am Soc Metals, Materials/ Design Forum, pp 54-66, 1975.

This is a survey paper which presents the principles and applications of eddy current testing. Two figures are given in the paper to illustrate the necessary fundamentals upon which much of eddy current testing is based.

NT-9062

Arrington, M.; "Acoustic Emission," British J Non-Destr. Test, Vol 17, No. 1; pp 10-14, Jan 1975.

The growth of acoustic emission methods, from the first experiments to an industrial technique is outlined. The origins of emission, the instrumentation used and the methods of data processing and presentation are described. Typical testing techniques are described and methods of improving the signal-to-noise ratio for continuous monitoring are detailed. Finally the present and possible future industrial applications of acoustic emission are reviewed.

NT-7790

Atherton, N. J.; "An Investigation of the Radiation Doses Received by Industrial Radiographers," British J Non-Destr Test, Vol 15, No. 4; pp 112-114, Jul 1973.

A survey carried out by HM Factory Inspectorate of the radiation doses received by industrial radiographers showed that the radiation doses received by workers engaged in site radiography were significantly higher than those for workers employed in radiography in factory conditions.

NT-8787

Baker, Merlin R.; "A Magnetic Method of Detecting Shell Casing Defects," Rept No. USAMC-ITC-02-08-73-102, Army Materiel Command, Intern Training Center, Texarkana, TX, 54 pp, May 1974, (AD-786514).

The report presents the results of a technique used to detect defects in shell casings manufactured under the small caliber ammunition modernization program. The method of detecting defects is based on the fact that a magnetic flux field is produced about a conductor carrying a current. The technique for testing shell casings was evaluated in the laboratory of 5.56 caliber shell casings. The results of the laboratory tests proved that the magnetic field check is not sensitive to small defects. The lack of sensitivity is due to the fact that the magnetic field about a defect failed to follow the shape of the defect but rather tended to form a concentric symmetrical pattern.

NT-15100

Bainton, K. F.; "Characterizing Defects by Determining Magnetic Leakage Fields," NDT International, Vol 10, No. 5; pp 253-257, Oct 1977.

Harwell's computerised NDT literature store was used to identify papers discussing magnetic flux leakage detection of defects. The following survey deals with those papers which deal at least in part with the characterization of defects rather than purely defect detection. The papers covered used magnetic particle, magnetographic or magnetometric detection techniques, and various theoretical models were proposed. It would appear that there is a measure of agreement between theoretical models and experimental data if one chooses to work with specific flaw forms and materials, testing of material in automatic plant, being a practical consequence. It is important to know the magnetic history of some materials in order to work at a suitable magnetization level. For the general case it has been suggested that one may be able to characterize surface opening cracks, but not sub-surface flaws, by an equivalent depth width and angle. Experimentally, improvements in tapes, microprobes, methods of magnetization, lift off control and use of electronic tailoring have led to improved signal-to-noise, sensitivity and resolution.

NT-10868

Bennett, William F. and Greer, Amos S., "Access Engineering and Other Related Problems of Nuclear Power Plants," Materials Evaluation, Vol 33, No. 9; pp 227-231, Sep 1975.

Section XI of the ASME code, rules for inservice inspection of nuclear reactor coolant systems, stipulates the requirements governing inservice inspection (ISI). When constructing a nuclear power plant, the utility must consider plant design, component design and fabrication, and construction procedures in order to achieve designs providing sufficient access to allow compliance with the ISI requirements. The principal early responsibility of the utility is to establish the overall inservice inspection philosophy which dictates the requirements for access for inspection. This paper describes design considerations which must be addressed to provide sufficient access for of ISI operations in full compliance with ASME Section XI. Included in this discussion are advantages of ID and OD inspection; clearing requirements for vessels, nozzles, and piping; and weld design criteria as related to inservice inspection.

NT-14309

Berninger, W. H., Redington, R.W. and Chen, A.C.N.; "X-Ray Computerized Tomography — A Technology Overview," Paper Summaries, ASNT Spring Conference, 2 pp, 1977.

This paper provides an overview of CT technology and a description of the performance characteristics of existing instruments. The discussion is subdivided into several sections which include X-ray properties of biological and non-biological materials, data collection techniques, image formation mathematics, instrument specifications, and application examples.

NT-11479

Biard, Bob; "Status of Optoelectronics," Electro-Optical Systems Design, Vol 8, No. 1, pp 16-17, Jan 1976.

There are two major areas of activity in optoelectronics, one is the development of solar energy converters and the other is the development of solid state sources and detectors for optical communications systems. In particular, those applications involving fiber optics have caused considerable optoelectronic device development activity. As far as the commercially available devices are concerned, activity is relatively stable with the possible exception of increased efforts to develop better UV detectors.

NT-10860

Blitz, J.; "Non-Destructive Testing Education in the USA," Non-Destr. Test. Res & Practice, Vol 8, No. 4, pp 191-192, Aug 1975.

The author, active in NDT education in Great Britain, evaluates American education in the subject. He describes how the education co-ordinates with qualification and illustrates the discussion with his own experience.

NT-9291

Bobbin, John; "New Developments in Ultrasonic Testing," ASTM Standardization News, Vol 3, No. 3, pp 29-30, 48, 51, Mar 1975.

Ultrasonics is the most versatile nondestructive testing technique having been used in applications ranging from detection of large laminar flaws in heavy metal plate to small stringer defects in nuclear fuel tubes. More recently it has been used to determine physical and metallurgical properties of materials. Significant trends and developments are reported, and the problems of acceptable standards are considered.

NT-11679

Bolis, Enrico; "Non-Destructive Inspection Practices. Volume II," Rept No. AGARD-OGRAPH-201-VOL-2, Advisory Group for Aerospace Research and Development, Paris, 192 pp, Oct 1975, (AD-A018844).

Contents: The non-destructive measurement of residual stress; NDI of welding; NDI of bonded structures; NDI of composite materials; detection and measurement of corrosion by NDI; subject index; cross reference table showing which NDI methods may be used for investigating various types of defects; non- destructive inspection procedures USAF; non-destructive test manual Boeing Document D6 7170 Rev. 14, Mar 15/74 (Part 4, 55-10-07; Part 6, 55-00-00).

NT-9647

Breton, P. J.; "Customize Surface Analysis," Industrial Research, Vol 17, No. 5, pp 69-72, May 1975.

The general characteristics of electron beam analysis are addressed and given particular emphasis for incorporation at the center of complex systems used for complete material characterization. Systems are described which depend on simultaneous processing of the useful information from signals emitted from material under electron bombardment. Requirements are indicated and a system described for simultaneous detection of secondary electron imaging of surface topography, backscattered and absorbed electron imaging of atomic number compositional contrast, energy-dispersive solid state X-ray initial element identification and crystal spectrometer quantitative and trace element analysis. Also indicated is the fast growing auger spectroscopy again making use of a central core of modular electron optics.

NT-11770

Briggs, Charles W.; "Developments in Gamma Ray Radiography 1928-41," Materials Evaluation, Vol 34, No. 3, pp 14A-20A, 52A, Mar 1976.

This is a paper presented by Charles W. Briggs at the first and organizational meeting of the American Industrial Radium and X-Ray Society, Inc., at Massachusetts Institute of Technology, Cambridge, Mass , October 17, 1941. It is reprinted to bring to light the groundwork and establishment of gamma radiography in the United States. It is a thorough history of that development through 1941.

NT-14142

Bryant, L. E.; "Portable Flash X-Ray Systems: Applications and Techniques," 8th World Conference on NDT, Cannes, France, 8 pp, Sep 1976.

Three energies of portable flash X-ray equipment are described, and applications such as jetting and high explosive studies, bullet impact and casting of lead experiments are given as well as techniques and triggering and protection of equipment and film.

NT-8193

Bushnell, J. C.; "A Survey of Nondestructive Testing Techniques," Fracture and Flaws, Proc 13th Annual Symposium, pp 26-35, Mar 1973, (Jointly sponsored by N. Mex. Section, ASME, Univ of N. Mex. College of Engineering).

This paper discusses nondestructive testing from the standpoint of the various kinds of information which can be obtained. The primary emphasis is on the quantitative limits to the capabilities of nondestructive testing. An attempt is made to estimate possible near-future extensions of these limits.

NT-12335

Carpenter, James L., Jr. and Stuhrke, William F.; "Hydrogen Embrittlement to Structural Alloys - A Technology Survey," Rept. No. NASA-CR 134962, Martin Marietta Aerospace, Orlando, FL,146 pp, Jun 1976, (For sale by NTIS, Springfield, VA).

This technology survey report is comprised of reviewed and evaluated technical abstracts for about 90 significant documents relating to hydrogen embrittlement of structural metals and alloys. Particular note was taken of documents regarding hydrogen effects in rocket propulsion, aircraft propulsion and hydrogen energy systems, including storage and transfer systems. The abstracts in the report are selected from the pertinent literature published between April 1962 and December 1975 with most attention devoted to the last five years. The purpose of this report is to provide, in quick reference form, a dependable source for current information in the subject field.

NT-12336

Carpenter, James L., Jr. and Stuhrke, William F.; "NDE - An Effective Approach to Improved Reliability and Safety A Technology Survey," Rept No. NASA-CR-134963, Martin Marietta Aerospace, Orlando, FL, 178 pp, Jun 1976, (For sale by NTIS, Springfield, VA).

This technology survey report is comprised of technical abstracts for about 100 significant documents relating to the nondestructive testing of aircraft structures or related structural testing and the reliability of the more commonly used evaluation methods. Particular attention is directed toward six NDE techniques: acoustic emission; liquid penetrant; magnetic particle; ultrasonics; eddy current; and radiography. The introduction of the report includes an overview of the state-of-the-art represented in the documents that have been abstracted. The abstracts in the report are mostly for publications in the period April 1962 through December 1975. The purpose of the report is to provide, in quick reference form, a dependable source for current information on the subject field.

NT-11482

Casasent, Dave; "Status of Optical Data Processing," Electro-Optical Systems Design, Vol 8, No. 1, pp 28-29, Jan 1976.

Parallel processing at the speed of light, this was the early promise of optical data processing. Each year, more commercially available and hardened systems using optical sources appear: the point of sale checkout counter systems, currency sorters, credit card verifiers, fingerprint identification systems, etc. These represent major engineering advances. Three areas of optical computing technology are the subject of intense current research and promise to produce major advances in practical coherent optical processors. They are: development of real-time devices, increased flexibility of operations, and integration of hybrid systems.

NT-10668

Clarkson, V. W.; "The Requirement for the Non-Destructive Testing of Airframes," British J Non- Destr Test, Vol 17, No. 4, pp 118-121, Jul 1975.

The requirements for the NDT of aircraft structures is reviewed on a historical basis; possible future requirements are assessed.

NT-10545

Clifton, G.; "The Development of Non-Destructive Testing for Aircraft," Aircraft Engineering, Vol 47, No. 6, pp 14-27, Jun 1975.

Non-Destructive testing (NDT) makes use of the controlled application of physical phenomena to materials so that interpretation of signals derived from the materials indicates their fitness, or otherwise, to perform a design function. The purpose of NDT is to ensure that mainly load carrying components and structures are free from defects. Established nondestructive testing has become of primary importance in aircraft maintenance and manufacture both as a positive indication for safety and as a method of saving costs. This article written for aircraft engineers is a broad review of the development of NDT in their industry and a brief indication of the status of its various components today.

NT-13649

Clifton, James R.; "Nondestructive Tests to Determine Concrete Strength—A Status Report," Rept. No. NBSIR 75 729, National Bureau of Standards, Building Research Div, Washington, D C; 39 pp, Jul 1975, (For sale by NTIS, Springfield, VA).

Individual and combined nondestructive test methods have been critically reviewed as potential methods to determine safe formwork removal times. The techniques reviewed are the Windsor probe, the Schmidt rebound hammer, pull-out measurements, push-out cylinders, ultrasonic pulse velocity measurements, and the maturity and equivalent age concepts. The individual methods, themselves, do not give good estimates at the in situ strengths of concretes and, it is recommended that future research emphasize combined methods. A proposed research program which emphasizes combined nondestructive test methods has been developed.

NT-11286

Close, D. H.; "Holographic Optical Elements," Optical Engineering, Vol 14, No. 5, pp 408-419, Oct 1975.

This article is a survey of the characteristics, technology and applications of holographic optical elements (HOES). HOES function by diffraction of light from a grating structure with nonuniform groove spacing. HOES provide a system of thin film optics. They have unique system functions and configurations, a rapid variation of optical power and image characteristics with wavelength, and relatively large amounts of astigmatism and coma, and require special consideration of optical efficiency during system design. Comparison of the aberrations of F 3.3 elements shows that the on-axis HOE and the conventional lens have similar aberration levels. The off-axis HOE has four times as much astigmatism and twice as much coma. These grating aberrations, for conjugate points different from the construction points, are proportional to

the average surface grating spatial frequency of an off-axis HOE. HOE technology is less developed than conventional technology. The complexity of HOES, and the lack of a suitable aberration theory, require computer-based raytracing for system design and development. We give the basic raytracing equations and the special requirements for hologram recording apparatus and materials. HOES provide unique capabilities over narrow bandwidths, rather than replace conventional elements. HOES in laser optical systems and in visual displays, appear to be advantageous and technically and economically feasible.

NT-9720

"Controls 75 - Your Control Show in Print," Control Engineering, Vol 22, No. 6, pp 41-46, Jun 1975.

Guide to current sources of control equipment and services. Lists manufacturers and describes latest products. Producers are listed alphabetically.

NT-11100

Davis, D. F.; "Advanced Metallic Structures: Air Superiority Fighter Wing Design for Improved Cost, Weight and Integrity. Volume 1. Program Overview," Rept. No. AFFDL-TR-73-50-VOL-1, General Dynamics, Convair Aerospace Div, Fort Worth, TX; 426 pp, Jul 1973, (AD-781806).

This report describes the preliminary design and analysis for an advanced air superiority fighter stores loaded, wet wing structure. The wing box of the F-111F airplane designed by the Convair Aerospace Division of General Dynamics was used as the baseline vehicle. A unique design methodology was followed to arrive at three configurations which offer an optimum balance between structural efficiency and technological advancement. This methodology consists of compiling element concepts; integrating them into cross-section drawings; optimizing them in analytical assemblies; and finally preparing full wing box designs. Each step was followed with a detailed evaluation and ranking step which utilized a formal merit rating system. This system permitted the evaluation of numerous concepts and insured that each technical discipline participated in the design selection.

NT-8855

Debenedetti, Sergio and Oosterhuis, William T.; "Mossbauer Effect Application," Carnegie-Mellon Univ, Dept of Physics, Pittsburgh, PA, 14 pp, Feb 1975, (AD-A005422).

An accounting of the past 13 years of research on the Mossbauer effect is presented in the form of a list of publications and of doctoral theses.

NT-9226

Dukhanin, A.M., Brazhnikov, N.I. and Kasoev, V.G.; "Foreign Patents and Publications on Electromagnetic-Acoustic Test Methods and Instruments," Soviet J Non-Destr. Test., Vol 10, No. 2, pp 180-182, Apr 1974.

Foreign patents and publications are surveyed; lines of progress in the method are indicated.

NT-8998

Ebert, Lynn J.; "Effects of Residual Stresses Upon Design, Fabrication and Field Service," Rept. No. AFML-TR-74-238, Proc Interdisciplinary Workshop for Quantitative Flaw Definition; pp 406-449, Nov 1974.

A survey article. Covers definition of residual stresses (RS); intrinsic nature of RS; origin of RS; effects of RS on tensile properties, toughness, fatigue resistance, corrosion and machinability; RS in design considerations, relief of RS; RS annealing; mechanical relief of RS; effects of RS in field service. No discussion of nondestructive methods of measuring RS.

NT-14562

Ennos, A. E.; "Optical Fingerprinting with the Laser for Engineering Measurement," The Engineering Uses of Coherent Optics, Cambridge Univ Press; pp 225-248, 1976.

A survey is made of metrological techniques that have been developed using the laser speckle pattern as a means of fingerprinting or optically characterising a particular surface. Speckle interferometers have the high sensitivity of the conventional instrument, but can measure displacements and strain of a surface without preliminary preparation, and can detect surface vibration patterns. The simpler technique of laser photography relies upon imaging the speckle pattern, with subsequent analysis of its diffraction spectrum, to measure surface displacement and vibration to a lower order of accuracy. The advantages and limitations of these techniques are discussed and examples given of their engineering application. Methods for detecting surface changes and for assessing surface roughness quantitatively are described.

NT-14781

Ermolove, N. and Ryshov-Nikoov, V. I.; "Theory of Operation of Piezoelectric Probes in Ultrasonic Defectoscopes," Soviet J Non-Destr Test, Vol 12, No. 5; pp 465-473, Oct 1976, (Eng. Trans. published by Plenum Publishing Corp, N Y).

In this paper the modern theory of piezoelectric probes for ultrasonic defectoscopes is presented with the aid of a survey of studies made in the USSR and abroad. The fundamental concepts are defined and relations are derived that characterize the probe operation. The analysis follows the method of probe design, which has been developed at the School of the Ulyanov (Lenin) Leningrad Electrotechnical Institute.

NT-13183

"Federal Scientific and Technical Communication Activities: 1975 Progress Report," Rept. No. NSF 76-25, National Science Foundation, Office of Science Information Service, Washington, D C; 99 pp, Jun 1976, (For sale by NTIS, Springfield, VA).

This report presents highlights of 1975 activities of over 60 Federal scientific and technical information programs in 15 executive departments and independent agencies, the Smithsonian Science Information Exchange, the Government Printing Office and the Library of Congress. Each program prepared its own description. The Division of Science Information, National Science Foundation, compiled the resulting descriptions and prepared a list of acronyms and abbreviations, and an index. A prefatory chapter summarizes significant developments and trends in Federal information programs. Further details are available in the program descriptions themselves or from the responsible agency officials whose names are appended.

NT-8130

Feshchenko, Yu B. and Frolova, N.K.; "Development of Magnetographic Metal Inspection," Soviet J Non-Destr. Test., Vol 9, No. 4, pp 442-447, Aug 1973.

This is a review of the essential achievements in the nondestructive inspection of metals by the magnetographic method. A chronological account is given of the various developmental stages. Trends in the further perfection of techniques and tools are discussed.

NT-14129

Gardner, C.G. and Kusenberger, F.N.; "Quantitative Nondestructive Evaluation by the Magnetic Field Perturbation Method," Prevention of Structural Failure, No. 5, Am Soc Metals, Materials Design Forum, pp 67-85, 1975.

This paper reviews the magnetic field perturbation method of nondestructive evaluation, focusing on the magnetometric approach which lends itself both to quantitative interpretation and automation. The paper indicates the general state of development of the method and its potential with respect to use in quantitatively characterizing material defects. Some recent industrial applications are given and a survey of several aerospace applications.

NT-9169

Gavert, R.B., Moore, F.L. and Westbrook, J. H.; "Critical Surveys of Data Sources ... Mechanical Properties of Metals," Rept. No. NBS SP 396-1, 102 pp, Feb 1974.

This study was undertaken with the objective of providing a detailed critical survey of the existent compilations of mechanical property data for commercially available metals and alloys. This survey was intended to assess the scope, assets and deficiencies of about forty of the most prominent sources of such information. There were included: handbooks and technical compilations, information centers, foreign information sources, technical societies, and trade associations. The initial listing of sources to be examined was prepared by the authors with the advice and assistance of a subcommittee of the Metals Properties Council. The aim was to restrict the survey to sources which actually had compilations of mechanical property data in some form. Thus sources which offered only generalized guides to the literature, monographs, textbooks, or periodicals publishing original research or engineering articles were not to be included. Those sources from the original listing which were found upon detailed examination to fall into the latter categories are therefore treated in a separate appendix.

NT-8628

Gericke, Otto R.; "Overview of Nondestructive Inspection Techniques," Fracture Mechanics of Ceramics, Vol 1, Plenum Press, N Y, 44 pp, 1973.

Numerous nondestructive inspection techniques are available today for the detection of flaws in a variety of materials including ceramics. The purpose of this paper is to present an overview of current NDT principles and techniques including criteria for the proper selection of effective test methods. The process of selecting and developing suitable test procedures for a particular quality assurance purpose is governed by several factors. One is the nature of the flaws anticipated, another the characteristics of materials and structures involved, and a third the location and configuration of defects. In discussing the various options available to the designer or user of nondestructive test procedures, one must first attempt to clarify the scientific as well as the semantic problem which has arisen from the rapid proliferation of inspection techniques. The complexity of the subject can be reduced by establishing three major categories of test disciplines under which all currently known NDT methods can be classified. They are: motion-of-matter testing, electromagnetic testing, probing media testing. Using this grouping, individual NDT techniques are discussed with primary emphasis being placed on the general principles and on recent innovations and improvements of the technique.

NT-8392

Gilbert, Pierre and Keyser, J. Hode; "A Study of Currently Used Methods for Determining the Permeability of Bituminous Mixtures," J Test. & Eval., Vol 1, No. 6, pp 484-493, Nov 1973.

This paper presents a review of 15 permeameters along with a study on the advantages, disadvantages and limitations of the six most currently used methods. The precision of the latter and the relationships which exist between the methods were also investigated. The review shows the need for selecting the type of permeameter according to the purpose of measurements taking into account their inherent limitations. It also shows the need for establishing a standard permeability unit. Tests were made on laboratory molded specimens on slab surfaces, and on cores extracted from slabs. Test results indicate that precision must be expressed in terms of percentage of the mean. For mixes containing more than 6 percent voids, there is a good correlation between: (a) permeability and voids; (b) field and laboratory tests; (c) air permeameters and water permeameters; (d) permeability and rate of flow. Greater values were obtained with permeameters using air and when tests were made on pavement surfaces.

NT-10392

Glenewinkel, Rolf and Gottfeld, F.H.; "Nondestructive Testing During the Construction of Pipelines," Proc 7th International Conference on NDT, Vol. II, Warsaw, Poland, Polish Soc. Mech. Eng, 4 pp, Jun 1973.

This paper presents a short survey of NDT methods applied to pipeline inspection.

NT-14282

Graff, K.; "Macrosonics in Industry: Ultrasonic Soldering," Ultrasonics, Vol 15, No. 2, IPC Science and Tech. Press Ltd, Guildford, Surrey, England, pp 75-81, Mar 1977.

This is a survey article describing ultrasonic use in soldering all-aluminum heat exchangers. The author describes the basic mechanisms, ultrasonic solder pots, and soldering irons. He also discusses the use of ultrasonics in the mass soldering of printed circuit boards and in reflow soldering as applied to microcircuits. Previously tinned connections of a microcircuit chip are brought into contact with the substrate connections of an external circuit. The substrate is heated to reflow the solder while ultrasonic vibrations are introduced by transversely vibrating a probe which presses against the chip. The vibrations act to disperse the oxides from the joining surfaces so that the process has a strong resemblance to ultrasonic metal welding.

NT-8894

Green, R. E., Jr.; "Ultrasonic Attenuation Detection of Fatigue Damage," Ultrasonics International 1973 Conference Proceedings; pp 187-193, Mar 1973.

Comparative evaluation shows that the ultrasonic attenuation technique is superior to all other known ultrasonic techniques for early detection of fatigue damage. Results are reported of recent experiments which used change in ultrasonic attenuation measurements as a continuous monitor of fatigue damage during cyclic testing of polycrystalline metallic specimens. All experiments performed on different metals at various vibrational amplitudes yielded similar results in that ultrasonic attenuation served as a very sensitive indicator of fatigue damage and in every case indicated that fracture was eminent before conventional ultrasonic testing could detect an additional echo caused by energy reflected from a crack.

NT-13302

Greguss, Pal; "Acoustical Holography," Physics Today, Vol 27, No. 10, pp 42-49, Oct 1974.

This is an elementary survey paper of the field of acoustic holography with a general discussion of sound wave holography, acoustic imaging, detector arrays, focused images, multiplexing and speckle patterns.

NT-14764

"A Guide for Interpretation of Nondestructive Tests of Ordinary-, Medium-, and High-Strength Low-Alloy Steel Butt-Joint Weldments in Ship Hull Structures," Rept. No. SSC-264, National Academy of Sciences, Washington, D C; 48 pp, Apr 1977.

A survey was made of various codes and standards applicable to the interpretation of nondestructive tests of welds in ordinary-, medium-, and high-strength low-alloy steels. This guide has been developed for application to steel welds in ship hull structures of the general cargo, tanker and passenger class as differentiated from Naval ships. The guide exhibits nondestructive test results of several classes of defects with suitable test to delineate the maximum size and/or distribution that would be recommended as acceptable for ship hulls.

NT-15085

"Guide for Interpretation of Nondestructive Tests of Ordinary-, Medium-, and High-Strength, Low- Alloy Steel Butt-Joint Weldments in Ship Hull Structures," Rept. No. SSC-245, Ship Structure Committee, Washington, D C; 61 pp, Apr 1977, (AD-A041376).

A survey was made of various codes and standards applicable to the interpretation of nondestructive tests of welds in ordinary-, medium-, and high-strength low-alloy steels. This guide has been developed for application to steel welds in ship hull structures of the general cargo, tanker and passenger class as differentiated from Naval ships. The guide exhibits nondestructive test results of several classes of defects with suitable test to delineate the maximum size and/or distribution that would be recommended as acceptable for ship hulls.

NT-13831

Hagemaier, D. J.; "Bonded Joints and Non-Destructive Testing; Bonded Honeycomb Structures - 2," Non-Destr. Test. Res. and Practice; pp 38-48, Feb 1972.

This is the second of two parts of a paper giving a comprehensive survey of NDT methods for revaluating adhesive bonded honeycomb structures. In Part 1 the utilization of sandwich structures on modern aircraft and important design factors such as impact, fatigue, and environment were discussed. Materials used in the fabrication of honeycomb structures were presented to show the complex nature of these assemblies. Nondestructive test methods presently used to evaluate honeycomb structures were also described. Those methods, described in Part 1 included verifilm, meseran, leak test, holographic interferometry, ultrasonic, tap test, eddyson IC, and sonic resonance. Thermal or infrared, and X-ray radiography are discussed in the second part of the paper. Part 2 also discusses and describes reference standards and acceptance standards as related to honeycomb structures. The applications and limitations of each NDT method are summarized along with the merits of bond testing methods for honeycomb assemblies.

NT-8412

Hardrath, H. F.; "Structural Integrity in Aircraft," J. Test. & Eval., Vol 1, No. 1; pp 3-12, Jan 1973.

The paper reviews briefly the current design philosophies for achieving long, efficient, and reliable service in aircraft structures. The strengths and weaknesses of these design philosophies and their demonstrated records of success are discussed. The state of the art has not been developed to the point where designing can be done without major test inspection and maintenance programs. A broad program of research is proposed through which a viable computerized design scheme will be provided during the next decade. The program will organize and correlate existing knowledge on fatigue and fracture behavior, identify gaps in this knowledge, and guide specific research to upgrade design capabilities. An early application of the scheme leads to an objective choice of materials to provide maximum reliability between inspections. An analytical tool has been developed that assesses the resistance of a structural configuration to fatigue and static crack propagation.

NT-11925

Hauser, Stuart M.; "A Brief Review of Markets and Trends in Nondestructive Testing (NDT) Equipment," Stanford Research Institute, Menlo Park, CA, 5 pp, Feb 1976.

A brief review of the US NDT industry in mid-1975 to assess current markets and trends. The results of that research are reported and are based upon interviews in more than 50 organizations which constitute major suppliers of NDT equipment and services, or conduct research into NDT techniques.

NT-9377

Hibben, S., et al; "Sovrad — A Digest of Recent Soviet R and D Articles. Volume, Number 1, 1975," Informatics, Inc, Rockville, MD, 16 pp, Jan 1975, (AD-A003915).

This is a collection of brief abstracts on miscellaneous topics from the current Soviet technical literature. Topics discussed are: electron beam target effects, oceanography, aperture synthesis, holographic imaging, nuclear pumped laser, and X-ray lasers.

NT-13499

Holloway, J. A. and Shelton, W. L.; "A Survey of Image Processing Methods for Radiography," Materials On The Move, 6th National SAMPE Technical Conference, Vol 6, SAMPE National Business Office, Azusa, CA; pp 110-117, 1974.

An investigation of radiographic image processing methods using analog, digital and photographic approaches was conducted. Several systems were evaluated to determine the state-of-the-art for enhancement of industrial radiographs. Control radiographs were used to determine system capabilities such as resolution and sensitivity, dynamic range, degree of enhancement, speed, scan area, reproducibility, and cost.

NT-12188

Holloway, J. A., Shelton, W. L. and Mitchell, J.; "Image Processing of Industrial Radiographs," Rept. No. AFML-TR-75-46, Air Force Materials Lab, Wright-Patterson AFB, OH; 40 pp, Mar 1975, (AD-A020956).

The report documents the data accumulated as a result of a survey of various approaches to radiographic image processing conducted by the Air Force Materials Laboratory. A detailed discussion of each method is presented together with the results of an evaluation of several typical systems using a set of control radiographs. Systems evaluated include electronic or electromechanical, using both analog and digital techniques as well as photographic approaches to image processing.

NT-12304

Hugues, J. C. and Chemin, P.; "Nondestructive Testing by the Liquid Penetrant Method, Part I," Qualite, Vol 15, No. 78, pp 43-47, Apr 1976.

General principles of the liquid penetrant method are reviewed. A mathematical expression for the critical thickness of penetrant film required for flaw detectability is obtained from Beers law. Representative recipes for visible dye and fluorescent dye penetrants are given. Actions of developers are discussed in terms of Turins law of capillarity. Classification of commercially available products is given. Block procedural diagrams for pre-emulsion; solvent washable, water emulsifiable; and oil emulsifiable penetrant systems are given.

NT-11480

Hunter, W. R.; "Status of the Extreme UV Technology," Electro-Optical Systems Design, Vol 8, No. 1; pp 18-19, Jan 1976.

One of the most active areas in UV has been in UV imaging. The goal has been to develop improved imaging systems so that areas of radiation, such as the sun, could be monitored in near real time and phenomena that last only a second or so could be monitored and investigated. Therefore, much of the effect has been in the development of photoelectric detectors that are capable of imaging in the vacuum ultraviolet. Progress is being made in this direction with the development of an EUV one-dimensional counting array. Those enamored of acronyms might christen it euvodca and perhaps gain stimulation of a sort to pursue this article if not the subject. Also of interest is a semi-transparent mesh photocathode development that offers little to the acronomists but a lot to those trying to improve electrographic cameras. Two final items of particular concern involve the use of photodiodes with pulsed radiation sources and holographic diffraction used in sychrotron radiation. These four areas are good indications of the developmental trends in the UV and will be discussed further.

NT-7240

Johnson, Cameron D. and Mayer, Gerald M.; "Applications of Holographic Interferometry in Underwater Acoustics Research," Rept. No. NUSC-TR-4353, Naval Underwater Systems Center, Newport, R I; 19 pp, Jun 1972, (AD-746134).

Holographic interferometry has gained wide acceptance as a nondestructive testing and vibration analysis technique since its introduction in 1965. The report outlines the history of holographic interferometry, describes the holography process, and describes several applications representative of the present state of the art of holographic interferometry that are particularly relevant to underwater acoustics work. Potential future applications are presented for consideration.

NT-14712

Klappert, Walter R.; "Nondestructive Testing of Rubber Products Used by the Army," Rept. No. AMMRC-MS-77-1, Army Materials and Mechanics Research Center, Watertown, MA; 11 pp, Jan 1977, (AD-A039319).

This paper is a survey of the field of rubber and rubber testing leading to a discussion of the nondestructive testing of rubber products used by the Army. It includes a primer on rubber itself, a review of physical tests, and concludes with a survey of rubber-related nondestructive testing research.

NT-8707

Klyuev, V. V., et al; "Seventh International Conference on Nondestructive Testing," Soviet J Non- Destr. Test., Vol 10, No. 1, pp 119-123, Feb 1974.

A brief narrative review of the Seventh International Conference on Nondestructive Testing, held at Warsaw, Poland, June 1-8, 1973.

NT-7751

Korpel, A.; "Acoustic Microscopy," Proc U.S. - Japanese Science Cooperation Seminar, 3D, Plenum Press, N Y; pp 345-363, 1973.

An historical background of acoustic microscopy methods is presented. Present methods are described with emphasis on the scanning laser acoustic microscope for the visualization of acoustic surface waves. A simplified diagram and explanation of this device is given. It is concluded that acoustic microscopy resolution must be increased by an order of magnitude to reach the resolving power of the optical microscope.

NT-8992

Lackman, Leslie M.; "Advanced Composites Status Review," Rept. No. AFML-TR-74-238, Proc Interdisciplinary Workshop for Quantitative Flaw Definition; pp 272-307, Nov 1974.

A brief but thorough overview of present day composites technology in aerospace applications. The primitive state of NDT for composites is noted.

NT-11001

Lane, Clyde H.; "Considerations in Microcircuit Visual Inspection," Rept. No. RADC-TR-75-150, Rome Air Development Center, Griffiss AFB, N Y; 40 pp, Jun 1975, (AD-A012197).

Microcircuit visual inspection is examined primarily from a human factor standpoint. This is essentially a summary of many papers having a direct or indirect bearing on the subject. A brief description is given of the equipment used, relative to the parameters of greatest concern. Effects of complexity, defect rate, magnification, visual angle of the defect, contrast and vigilance on inspection accuracy are discussed. Finally, inspection effectiveness is discussed and a model developed by researchers at Sandia Laboratories is given.

NT-9412

Lange, Yu. V.; "Nondestructive Acoustic Methods of Testing Joints in Laminated Structures," Soviet J Non-Destr Test, Vol 10, No. 3, pp 301-307, Jun 1974.

The basic acoustic methods of nondestructive inspection of metallic and nonmetallic bonded structures, laminated-plastic parts, and other laminated structures are considered. Most attention is paid to the impedance, velocimetric, and free-oscillation methods based on dry point contact between the data unit and the part under inspection. Their greatest advantage is that they do not require contact lubrication, which facilitates inspection of parts made of hygroscopic materials. From among the methods requiring contact lubrication, the reverberation method and the method of estimating the strength of cemented joints by correlating this strength to the characteristic impedance of the adhesive are considered.

NT-8447

Lavery, Adelbert I.; "NDT as Applied to Vehicle Safety," Proc 1973 Symposium on NDT of Tires, Boston, MA; pp 15-17, Apr 1973. NTIAC-75-1 Available from NTIS, Springfield, VA 22161.

Several questions affecting the application of nondestructive testing to transportation systems are discussed. The discussion examines in detail the following questions: 1. Why is nondestructive testing of interest? 2. When should nondestructive testing methods be applied? 3. Where in the transportation system can nondestructive testing be applied? 4. What are the steps in applying nondestructive testing? Emphasis is given to the identification of factors that influence the cost of inspection. Finally, a comprehensive program to evaluate nondestructive tire testing methods, sponsored by the National Highway Traffic Safety Administration and performed by the Transportation Systems Center, is briefly discussed.

NT-11481

Levin, H.; "Status of E-O Imaging Systems," Electro-Optical Systems Design, Vol 8, No. 1, pp 20-21, Jan 1976.

Self-scanning solid-state imagers continue to stir a ruckus in the imaging community as they mount an attack on the only remaining vacuum tube contained in a modern television camera. These imagers on a chip are up against a tough adversary where resolution, sensitivity, and initial cost are deciding factors. The solid state devices do fill the need for facsimile, aerial reconnaissance, bar-code readers and point-of-sale sensors, and there are clear indications that the solid state imager is steadily moving from its novelty/performance evaluation phase into the commercial application phase of its development. Here, hard nose judgments, based on benefits-to-cost consideration, are deciding factors in the tube versus the chip alternatives. Focal plane imaging processing techniques provide the system engineer with completely new options that require re-thinking the conventional hardware architecture and provide opportunities not previously available with tube devices.

NT-10690

Lean, E. G., Heidrich, P. F. and White, J. M.; "Thin Film Acousto-Optic Devices — Review and Assessment," IEEE (SU) Ultrasonics Symposium Proc, Milwaukee, WI, pp 81-84, Nov 1974.

Many thin film acousto-optic interaction experiments for Bragg modulators and deflectors, for mode converters, and for fast switches have been demonstrated. Due to the high power density, long interaction and controllable dispersion associated with guided wave structures, the thin film acousto-optic devices have proved to have advantages over their bulk wave counterparts. In this talk, the basic principle and device parameters of thin film acousto-optic devices will be reviewed and assessed in terms of (1) theoretical calculations involving the complication of guided wave structures, (2) the possible device configurations which affect the efficiency and speed, (3) the material problems, (4) the transducer problems and, (5) the possible applications. The comparisons with bulk acousto-optic devices and thin film electro-optic and magneto-optic devices will be included. Current experimental results of thin film A-O devices will be presented.

NT-8116

Leiner, F. M. and Shcheglov, O. M.; "Nondestructive Methods in the Defectoscopy of Parts of Cranes," Soviet J. Non-Destr Test, Vol 8, No. 5; pp 627-628, Oct 1972.

This article describes the use of general nondestructive test methods on parts of cranes in metallurgical industries.

NT-8469

Li, Shu-Tien and McGonnagle, W. J.; "Some Potentials and Frontiers of Nondestructive Testing and Evaluation--Part 1," International J Non-Destr Test, Vol 4, No. 3; pp 215-229, Dec 1972.

This report presents a survey of present and future applications of nondestructive testing and evaluation techniques. Methods discussed are acoustic or stress wave emission, ultrasonic-spectroscopic analysis, ultrasound imaging, ultrasonic critical-angle reflectivity, and ultrasonic holography.

NT-11654

Liebowitz, Harold; "Fracture Mechanics of Aircraft Structures," Rept. No. AGARD-AG-176, Advisory Group for Aerospace Research and Development, Paris; 624 pp, Jan 1974, (AD-777641)

Contents: history of loading of aircraft and examples of aircraft failure; the use of fracture mechanics principles in the design and analysis of damage tolerant aircraft structures; basic concepts of fracture mechanics; fail-safe design procedures; experimental techniques for determining fracture toughness values; flaw detection methods.

NT-11483

Lockie, Doug; "Status of Fiber Optics," Electro-Optical Systems Design, Vol 8, No. 1, pp 30-31, Jan 1976.

Fiber optics technology has matured considerably during the last few years. Losses in optical fibers have decreased from 1000 DB per KM to less than 10. The price of fibers has also dropped drastically. Individual fibers and cable bundles have been ruggedized; single fibers are now under consideration for data transmission. Current production techniques yield optical fibers of high quality with reduced impurities, low losses, and closer diameter tolerances for both core and cladding.

NT-11099

Lord, Robert J.; "Evaluation of the Reliability and Sensitivity of NDT Methods for Titanium Alloys," Rept. No. AFML-TR-73-107-VOL-2, McDonnell Aircraft Co, St Louis, MO; 375 pp, Jun 1974, (AD-A001604).

The report describes the work conducted on a program designed to improve nondestructive testing techniques and then to evaluate the capability and reproducibility of the improved nondestructive testing techniques for the evaluation of discontinuities occurring in titanium. Reported are penetrant dwell times, penetrant bleed-out times, developer types, emulsification times, and water washing parameters required to effectively penetrant inspect parts which may contain a variety of crack sizes and porosity. Both post-emulsifiable and water washable fluorescent penetrants were investigated. The effect of kilovoltage on radiographic contrast sensitivity is discussed. Ultrasonic inspection of contour surfaces is reported and methods for improving near-surface resolution are documented. Methods for ultrasonic inspection of thin machined parts are reported.

NT-13623

Lott, D. R., et al; "NDT Evaluation of Solar Cell Weld Joints with Details of Selected Post-Bond and Pre-Bond Systems," Proc Eleventh IEEE Photovoltaic Conf, pp 134-144, 1975.

The current state of the art in nondestructive testing was surveyed to investigate the use of test methods for determining parallel gap solar cell joint weld quality. Seven post-bond NDT systems, two in-process and one pre-bond system were selected from the survey for test evaluation. An augmented visual post-bond system and a resistive pre-bond system were selected from these ten NDT methods as most completely meeting acceptance requirements.

NT-9915

"Low-Light and Thermal Imaging Developments,"Electro-Optical Systems Design, Vol 7, No. 7, pp 36-37, Jul 1975.

London—more progress has been made in low-light television and thermal imaging systems in the past ten years than in the whole of the previous, Prof. R. A. Smith told delegates at a recent I.E.E. Conference on low light level and thermal imaging. However, Prof. Smith also said, we are a long way from a perfect system, and emphasized the need for a more thorough understanding of psychophysics. Other factors of current interest include noise, digital processing and thermal imaging.

NT-13246

MacDonald, Bruce A.; "Proceedings, Workshop on Welding Research Opportunities," Rept. No. ONR-ACR-213, Office of Naval Research, Arlington, VA, 145 pp, Jan 1974, (AD-A028395).

Contents: Survey of welding — marine welding, aeronautical welding, Navy research and development laboratory programs, Navy research and development programs, welding process development, welding abroad: fracture of welds in high-strength steels and tour of welding facilities in Russia. Scientific and technological limitations in welding — Part I, physics of arc transfer, and weld cracking dynamics, scientific and technological limitations in welding — Part II, environmental effects on welds, nondestructive evaluation and failure analysis, new welding process; and opportunities for welding research — short presentations, and general discussion — the welding research council, research on additives to filler metals, the integrity of welded structures, weld flux research, the use of computers in weld design.

NT-10702

Maines, J. D.; "Surface-Acoustic-Wave Devices: Past Successes and Future Prospects," IEEE (SU) Ultrasonics Symposium Proc, Milwaukee, WI; pp 136-146, Nov 1974.

During the past five years most of the major electronics-systems firms in the USA, and a large number in Europe, have devoted research and development effort to surface acoustic waves. Devices have now been developed which meet demanding specifications, and for some equipments are having a significant impact on both the performance and system design philosophy. This paper illustrates the range of components that have now been developed and briefly discusses their basic operation and performance. Application of these devices is mainly to radar and communications systems. These areas will be specifically discussed with the main emphasis on radar where application is more advanced. Current research is aimed at extending the range of surface wave devices or developing new signal processing techniques. An attempt will be made to assess the significance of these developments particularly in relation to advances in other technologies.

NT-7821

"Materials for Radiation Detection," Rept. No. NMAB-287, National Materials Advisory Board (NAS-NAE), Washington, D C, 359 pp, Jan 1974, (AD-778012).

The report surveys the available information (complete through 1971) on detectors for the electromagnetic radiation spectrum in the wavelength range 10 to the minus 10th power to 1 cm. The detectors are divided according to wavelength range into four groups: (1) sensors for X-rays and gamma-rays; (2) sensors for ultraviolet, visible and near-infrared radiation; (3) detectors for infrared radiation from 2 to 200 micrometers; (4) detectors for far-infrared and millimeter wave radiation. Conclusions and recommendations are made for (a) fundamental studies, (b) research on specific materials with definite applications, and (c) the establishment of two groups for continuing review and further study of specific problems.

NT-9152

McClung, Robert W.; "Into the Looking Glass: An Introspective Testing," Materials Evaluation, Vol 33, No. 2, pp 16A-19A, 43A-45A, Feb 1975.

This survey article considers the philosophy and management aspects of NDT from a critical point of view and provides an analysis of the current NDT tools. It is suggested that the practitioners of NDT evaluate every aspect of NDT to increase its viability in total technology.

NT-11032

McClung, R. W.; "Nondestructive Testing Methods," Annual Review of Materials Science, Vol 4; pp 1-20, 1974.

Recent advances in the standard methods, as well as key developments in newer methods are reviewed very briefly but cogently. Especially useful for historical perspective.

NT-8445

McMaster, Robert C.; "Potentials of Automated Nondestructive Examination," Automated Inspection and Product Control, Chicago, IL, pp 319-332, Oct 1974.

This survey article on automated NDE examines the needs for automated inspection, justification for automation, test functions which can be automated and applications. Early development of automated NDE is traced and many applications are reviewed. Present developments and trends are analyzed.

NT-13134

Neuschaefer, Robert W. and Beal, James B.; "Assessment of and Standardization for Quantitative Nondestructive Testing," Rept. No. NASA-TM X-64706, National Aeronautics and Space Administration, Huntsville, AL, 78 pp, Sep 1972, (For sale by NTIS, Springfield, VA).

This document assesses present capabilities and limitations of nondestructive testing (NDT) as applied to aerospace structures during design, development, production, and operational phases. It will help determine what useful structural quantitative and qualitative data may be provided from raw materials to vehicle refurbishment. This assessment considers metal alloy systems and bonded composites presently applied in active NASA programs or strong contenders for future use. Quantitative and qualitative data has been summarized from recent literature and in-house information, and presented herein along with a description of those structures or standards where the information was obtained. Examples, in tabular form, of NDT technique capabilities and limitations have been provided. NDT techniques discussed and assessed were radiography, ultrasonics, penetrants, thermal, acoustic, and electromagnetic. Quantitative data is sparse; therefore, obtaining statistically reliable flaw detection data must be strongly emphasized. The new requirements for reusable space vehicles have resulted in highly efficient design concepts operating in severe environments. This increases the need for quantitative NDT evaluation of selected structural components, the end item structure, and during refurbishment operations.

NT-12525

Noakowski, Von P.; "Examinations and Control of Profile Properties of Concrete Steels," Materialprufung, Vol 18, No. 7, pp 230-235, Jul 1976.

One of the most important developments of the last decade in the field of compound building materials, steel concrete, is the strength of superior reinforcing steel and concrete. Paralleling these developments, the quality of the combination was forced to be improved. The profile properties of reinforcing steel are primary determinants of such quality. The shape, dimensions, and effectiveness of the profiling are especially important. This paper is a survey of the present state-of-the-art. The exposition is based on experience gained in promoting research and acceptance tests, in contributing to DIN 488 and CEB requirements as well as accomplishment of theoretical research.

NT-10888

"Nondestructive Inspection Specialist Career Ladder AFSCS 53630, 53650, 53670, and 53690," Rept. No. AFPT-90-536-150, Air Force Occupational Measurement Center, Lackland AFB, TX, 71 pp, May 1975, (AD-A011569).

The report describes the results of the occupational survey of the nondestructive inspection career ladder, AFS 536X0, by the Occupational Survey Branch, USAF Occupational Measurement Center, from November 1973 to January 1975.

NT-8231

"Nondestructive Testing: A Survey," Rept. No. NASA-SP-5113, Southwest Research Institute, San Antonio, TX, 282 pp, 1973, (Available from U.S. GPO, Washington, D C).

A general survey of nondestructive evaluation with emphasis on contributions by the National Aeronautics and Space Administration and its contractors. Chapters include introduction, liquid penetrants, ultrasonics, radiography, eddy current testing, thermal and infrared testing, microwave techniques, magnetic testing, leak testing, strain sensing, and development methods. Extensive bibliography for each chapter.

NT-10463

"Nondestructive Testing — Diversification at Harwell," European Scientific Notes, Vol 29, No. 8, Office of Naval Research, London; pp 352-354, Aug 1975.

NT-9041

Ono, Kanji; "Acoustic Emission and Microscopic Deformation and Fracture Processes," Rept. No. UCLA-ENG-7465, School of Engineering and Applied Science, University of California at Los Angeles; 68 pp, Aug 1974, (AD-787086).

This paper reviews diverse observations of acoustic emission from materials and attempts to interpret them on the basis of current knowledge of plastic deformation and fracture. Observed acoustic emission characteristics have been classified into five categories, which arise from heterogeneous and homogeneous yielding, dynamic strain aging, twinning and other heterogeneous deformation and strain induced transformation of acoustic emission during plastic deformation are examined in relation to these metallurgical aspects as well as the mechanical vibration viewpoint. For example, tensile deformation of magnesium is mainly via twinning, which generates shear mode acoustic emission. On the other hand, the yielding of a HSLA steel samples excites longitudinal resonances along the length of the sample. It is shown that the micro-yielding concept with suitable modifications best explains these acoustic emission behavior observed. This paper also reviews important aspects of measurement techniques and theoretical considerations of acoustic emission behavior.

NT-14610

Parish, R. W.; "Radiography and Industrial Innovation," British J Non-Destr. Test., Vol 19, No. 3, pp 138, 143-148, May 1977.

The author presents a brief survey and historical review of the field, drawing particularly upon work done by himself and colleagues in the Nondestructive Center at Harwell, England.

NT-13838

Pollock, A. A. and Smith, B.; "Stress-Wave-Emission Monitoring of a Military Bridge," Non-Destr. Test., Res. and Practice, pp 348-353, Dec 1972.

Stress-wave-emission (acoustic emission) monitoring was carried out during the static proof loading trials of a prototype, transportable tank bridge. Analysis of emission counts was performed on-line during loading periods, hold periods and repeat tests, and post test analysis yielded further information on amplitude distributions and source locations. The results were correlated with other engineering measurements and direct observations of local plasticity. Laboratory tests and an acoustic survey were conducted in support of the bridge tests.

NT-8075

Popov, E. I., et al; "Analog-Computer Simulation of the Hysteresis Loop of a Magnetically Soft Material," Soviet J. Non-Destr. Test., Vol 8, No. 4, pp 457-464, Aug 1973.

A survey is presented of papers in which the hysteresis loops of ferromagnetic materials have been simulated. A classification of methods is given, with their advantages and disadvantages, and new methods are presented for simulating the dynamic hysteresis loops of soft magnetic materials.

NT-9294

Poulsen, P. E.; "The Photo-Elastic Effect in Three-Dimensional States of Stress," Rept. No. R 48, 52 pp, 1974.

In photo-elastic investigations of inhomogeneous, three-dimensional stress fields, an optical signal is obtained which depends on the stress field along the light-wave's path through the model. The report gives a description of the assumptions and principles for existing methods of describing a light-wave's passage of an optically heterogeneous and anisotropic body. The terms heterogeneous and anisotropic refer only to the optical properties of the body. From a mechanical point of view we assume that the body is homogeneous and isotropic, so that Hookes law is valid throughout with constant modulus of elasticity and Poissons ratio.

NT-13192

Roger, Albert P.; "Automatic and Manual Eddy Current Techniques for Military Aircraft," presented at Fall ASNT Conference, Houston, TX; 38 pp, 1976.

Improvements in NDT equipment have increased the versatility of eddy currents for applications relating to military aircraft. More frequent inspections are being conducted for crack detection, metal separation, hardness determinations, non-metallic coating thickness measurements, corrosion detection, and heat damage. Manual and automatic techniques are being utilized in combination with information displays which use fast-speed recorders or storage (memory) type cathode ray tubes (CRT). Newer equipment also incorporates digital displays and phase-amplitude CRT displays. Problem solving is becoming easier and more reliable with these newer eddy current techniques.

NT-8175

Runck, Roger J.; "Nondestructive Testing of Beryllium," Rept. No. MCIC-74-22, Battelle Memorial Inst, Defense Ceramics Information Center, Columbus, OH, 72 pp, Jul 1974.

The various properties of beryllium are assessed relative to nondestructive testing methods, e.g., high modulus of elasticity accounts for tight surface cracks thus limiting visual inspection methods; the high velocity of sound in beryllium makes ultrasonic tests more difficult. Radiography is indicated as the current preferred NDT technique, and quantitative information on all forms of radiography is provided. Newer techniques of acoustic emission and holography are examined. Generally, most tests are assigned a supplementary status to radiography and liquid penetrant tests. All test methods are described, evaluated in terms of advantages and disadvantages, and most are supported by case histories of inspection of beryllium. Significantly the urgent need for nondestructively characterizing and evaluating the surface condition of fabricated beryllium is noted.

NT-10379

Schon, R. and Lewerentz, U ; "Fiber-Optics and Their Application in Modern Technology," Proc 7th International Conference on NDT, Warsaw, Poland, Polish Soc. Mech. Eng., Vol II, No. E-04, 4 pp, Jun 1973.

Industrial fiberscopes are flexible, fiber-optical endoscopes originally specifically developed at the air industries' suggestion. With these instruments, test engineers may examine the inside of hollow spaces hitherto inaccessible. For their manufacture, optical glass fibers of the finest structure and highest degree of resolution are being used. By the reflection of highly intensive cold light, a picture of brilliant definition is transmitted. The instruments are equipped with either forward or side viewers. Their quality depends mainly on the regularity of the fiber bundling. Photographic documentation is possible. They find application in the aircraft, car, chemical, heavy-industry, nuclear and electric power plants.

NT-9340

Sharpe, R. S., Ed; "Research Techniques in Nondestructive Testing," Academic Press, London and N Y, 454 pp, 1973.

Includes following chapters: Proton Radiography, by A.M. Kohler and H. Berger; Information Theory Applied to Industrial Radiography, by R. Halmshaw; Computer and Optical Processing of Pictures, by C. J. Taylor and B. R. Pullan; Electroluminescent Storage and Display Panels for Radiography, by P. W. Ranby; Magnetic Flux Analysis Techniques, by N. Davis; Eddy Current Test for Tubing Flaws in Support Regions, by H. Libby; Optical Holographic Interferometry, by J. E. Sollid; Non-Coherent Optical Techniques for Surface Survey, by J. P. Duncan; Vibration Monitoring, by E. Downham; Means of Visualizing Ultrasound, by D. M. Marsh; The Reduction and Display of Ultrasonic Data, by D. S. Dean and D. Young; Ultrasonic Image Synthesis, by L. Kay; Electromagnetic Generation of Ultrasound, by E. R. Dobbs. Each chapter is a short survey with selected references.

NT-11470

Shaw, G. R. O.; "Wot! No Cracks?", British J Non-Destr Test., Vol 18, No. 1, pp 15-21, Jan 1976.

This paper is based on the December 1974 Sandt Annual Lecture. It gives a personal point of view on nondestructive testing in terms of recent technical advances, scope for further development, training and certification, effectiveness and future outlook.

NT-9914

Singer, B.; "Pyroelectric Vidicons — The IR Imaging Dark Horse," Electro-Optical System Design, Vol 7, No. 7, pp 30-34, Jul 1975.

Pyroelectric vidicons are on the verge of offering serious competition to the cryogenically cooled IR quantum detectors for many applications. Making this competition possible is the development of improved pytoelectric materials, electron guns and target fabrication techniques.

NT-9644

Silk, M.G., Williams, N.R. and Bainton, K.F.; "The Potential Role of NDT Techniques in the Monitoring of Fixed Offshore Structures," British J Non-Destr Test, Vol 17, No. 3, pp 83-87, May 1975.

For the NDT of drilling and production platforms it is suggested that monitoring systems may have to replace divers and possible methods are considered. Methods discussed are witness devices, television viewing, sonar, ultrasonic Lamb waves, low frequency ultrasonics for concrete, acoustic emission, and vibration analysis. Some of these techniques could readily be installed on existing structures; others would be more limited and would have to be designed into new platforms.

NT-8967

Smith, T. A. and Warwick, R. G.; "A Survey of Defects in Pressure Vessels Built to High Standards of Construction and Its Relevance to Nuclear Primary Circuits," International Journal of Pressure Vessels and Piping, Vol 2, No. 4; pp 283-322, Oct 1974.

This paper surveys reported failure data on pressurized plants built to high standards of construction. The period covered is from the latter half of 1967 until the end of 1972. The information under review is limited to that gathered by the Associated Offices Technical Committee and UKAEA Safety and Reliability Directorate. All reported events are analyzed, categorized and tabulated, and a survey of British and American nuclear circuits has been made for comparison with conventional plants of relevant construction and service. Failure probabilities for the various categories of plant considered in this paper are: (I) conventional plant — all types (a) during construction potential 2.1 × 10 to the minus 3 (b) during service — potential 1.1 × 10 to the minus 3 — catastrophic 1.5 × 10 to the minus four. (II) conventional plant relevant to nuclear circuits — potential 6.0 × 10 to the minus 4 — catastrophic 4.7 × 10 to the minus 5. (III) nuclear circuits (a) during current survey period - potential 3.4 × 10 to the minus 2 — catastrophic 1.15 × 10 to the minus 2. (b) considering all reactor types and including the figures from a previous survey -- potential 1.46 × 10 to the minus 2 — catastrophic 2.5 × 10 to the minus 3.

NT-8227

Spanner, Jack C.; "Acoustic Emission Techniques and Applications," Intex Publishing Co, Evanston, IL; 274 pp, 1974.

A comprehensive practically-oriented critical review of the literature of acoustic emission through about 1972. Chapters include introduction, terminology, system analysis, materials research applications, theoretical studies, weld monitoring applications, structural integrity applications, geological applications, equipment, and conclusions. A bibliography is included as an appendix.

NT-9592

"State-of-the-Art Reviews Report Bibliography Feb 47—May 74," Rept. No. DDC-TAS-74-41, Defense Documentation Center, Alexandria, VA, 281 pp, Feb 1975, (AD-A005375).

This bibliography contains 229 references pertinent to the evaluation and results of surveys, studies, and literature searches in the state-of-the-art reviews of selected subjects. The indexes included are corporate author-monitoring agency and subject.

NT-9301

Stuhrke, William F. and Carpenter, James L., Jr.; "Fracture Toughness Testing Data — A Technology Survey," Rept. No. NASA-CR-134752, Martin Marietta Aerospace, Orlando, Fl ; 190 pp, Jan 1975, (For sale by NTIS, Springfield, VA).

This technology survey report is comprised of reviewed and evaluated technical abstracts for about 90 significant documents relating to fracture toughness testing for various structural materials including information on plane strain and the developing areas of mixed mode and plane stress test conditions. The introduction to the report includes an overview of the state-of-the-art represented in the documents that have been abstracted. The abstracts in the report are mostly for publications in the period April 1962 through April 1974. The purpose of this report is to provide, in quick reference form, a dependable source for current information in the subject field. It is a companion volume to NASA Cr-134753, fracture toughness testing data — a bibliography.

NT-9310

Stuhrke, William F. and Carpenter, James L., Jr.; "Life Prediction of Materials Exposed to Monotonic and Cyclic Loading-Technology Survey," Rept. No. NASA-CR-134750, Martin Marietta Aerospace, Orlando, Fl ; 227 pp, Jan 1975, (For sale by NTIS, Springfield, VA).

This technology survey report is comprised of reviewed and evaluated technical abstracts for about 100 significant documents relating primarily to life prediction for structural materials exposed to monotonic and cyclic loading, particularly in elevated temperature environments. The introduction to the report includes an overview of the state-of-the-art represented in the documents that have been abstracted. The abstracts in the report are mostly for publications in the period April 1962 through April 1974. The purpose of this report is to provide, in quick reference form, a dependable source for current information on the subject field. It is a companion volume to NASA Cr-134751, Life Prediction of Materials Exposed to Monotonic and Cyclic Loading — A Bibliography.

NT-12153

Swamy, S. G. N.; "The Progress of Non-Destructive Testing in India," Non-Destr. Test. Res. and Pract., Vol 9, No. 2, pp 63-65, Apr 1976.

The author surveys NDT in India from the Indian Empire before 1948 to the modern India of the atomic age. He briefly explains the recent emphasis on NDT in National and International programmes in the country. He covers the breadth of instrument manufacture, standardization and trade.

NT-8793

Taylor, J. L.,Ed; "Basic Metallurgy for Non-Destructive Testing," The Non-Destr. Test. Society of G. B.; 67 pp, 1974.

A compilation of eleven articles originally published in British Journal of Non-Destructive Testing, and constituting a brief introductory treatment of practical metallurgy. Chapters include solidification and crystallinity; atoms, bonds and crystal structure; equilibrium diagrams; the iron-carbon diagram and the hardening of steel; fusion welding of steel; defects in fusion welds; the formation of flaws in steel castings; deformation, strengthening mechanisms and annealing; defects in steel forgings mechanical testing; and oxidation and corrosion of metals and alloys.

NT-9615

"Technical File No. 16 - Nondestructive Testing," Engineering, Vol 215, No. 4, pp 1-8, Apr 1975.

A brief general survey of nondestructive testing, with emphasis on communication between designer and testor.

NT-9288

Thomson, Robb M.; "A Review of Nondestructive Evaluation Opportunities," ASTM Standardization News, Vol 3, No. 3, pp 8-11, Mar 1975.

There is a widely based and fast growing requirement for a general expansion of the use of NDE, and for more powerful NDE tools in new, as well in old, applications. These requirements are examined in detail and the direction NDE research and development must take to meet the requirements is pointed out. Particular attention is drawn to in-service inspection, quantification of materials acceptability, automation, NDE in design, and standards.

NT-8367

Triandafilidis, G.E.; "Soil-Stress Gage Design and Evaluation," J Test. and Eval, Vol 2, No. 3, pp 146-158, May 1974.

A state-of-the-art review of the various basic types of soil-stress gages available today (1973) is presented. The basic parameters that influence soil-stress measurements as well as the design and evaluation criteria of soil stress gage instrumentation for laboratory and field applications are discussed. Soil-stress gage performance is evaluated in terms of geometry, stiffness, pressure-sensitive, and gross gage areas, unit weight, natural frequency, calibration, waterproofing, temperature sensitivity, signal-to-noise ratio, and placement characteristics.

NT-13607

Tyrer, H.; "Post-War Development in Non-Destructive Testing," Aeronaut. J, Vol 79; pp 480-488, Nov 1975.

This is a brief survey of the common NDT methods as used for production, development, and in-service testing.

NT-8307

Van Der Kleij, N. and Leefland, H. P.; "Neutron Radiography, Its Principles and Applications," abridged paper, Materialprufung, Vol 16, No. 9, pp 287-288, Sep 1974.

The principle of neutron radiography is essentially similar to that of X-Radiography in that a beam of particles is attenuated on passing through matter, and the attenuated beam forms an image of the object under inspection on some suitable recording material. Neutrons are used in a similar manner as C-rays, although in some circumstances they give a poorer radiograph. Their advantage is that the differences in absorption between portions of a specimen may be much greater for neutrons than for X-rays, and since it can be unaffected by interfering gamma radiation, the neutron radiograph can be superior in contrast.

NT-8229

Vary, Alex, "Nondestructive Evaluation Technique Guide," Rept. No. NASA-SP-3079, National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH, 105 pp, 1973. (Available from NTIS, Springfield, VA).

A total of 70 individual nondestructive evaluation (NDE) techniques are described, each in a standardized single-page format for quick reference. Information is presented in a manner that permits ease of comparison of the merits and limitations of each technique with respect to various NDE problems. An NDE technique classification system is presented. It is based on the system that was adopted by the National Materials Advisory Board (NMAB). The classification system presented herein follows the NMAB system closely with the exception of additional categories that have been added to cover more advanced techniques presently in use. The rationale of the technique description format used herein is explained. The format provides for a concise description of each technique, the physical principles involved, objectives of interrogation, example applications, limitations of each technique, a schematic illustration, and key reference material. Cross-index tabulations are also provided so that particular NDE problems can be referred to appropriate techniques.

NT-9498

Victor, A. E. and Munzlinger, F. D.; "Pattern Recognition — A Science of Many Disciplines," Rept. No. ONRL-C-11-74, Office of Naval Research, London, 19 pp, Dec 1974, (AD-A006446).

Highlights of the Second International Joint Conference on Pattern Recognition are discussed. Emphasis is given to the problems being experienced in the field and how the experts view the direction that future progress in pattern recognition will take. A listing of the papers given at the conference is included in the appendix.

NT-13266

Vogel, Paul E.J.; "Proceedings of the Second Symposium on Nondestructive Testing of Tires," Rept. No. NTIAC 75-1, Army Materials and Mechanics Research Center, Watertown, MA, Oct 1974, (Available from NTIS, Springfield, VA).

Sixteen formal papers and four workshop reports are presented on the NDT of tires. Concentration is on holography, X-ray radiography, and infrared and ultrasonics methods.

NT-8959

Vogel, Paul E. J.; "The State of the Art of Nondestructive Testing of Tires," Rept. No. AMMRC-PTR-73-9, Army Materials and Mechanics Research Center, Watertown, MA, 37 pp, Oct 1973, (AD-774188).

The work was performed to provide a source of information on all known methods of nondestructive testing of tires. The report reflects the results of a tire testing survey which has been conducted over the past year. It represents an extensive literature search, visits to Army, Navy, Air Force, Department of Transportation installations, and to the National Bureau of Standards; to three major high performance tire rebuilders; ten tire test equipment manufacturers; three major test tracks; and 22 manufacturers of new tires.

NT-8290

Vogel, Paul E. J., Ed; "Proceedings of the 1973 Symposium on Nondestructive Testing of Tires," 140 pp, 1973, (Available from NTIS, Springfield, VA).

Sixteen formal papers and four workshop reports are presented on the NDT of tires. Concentration is on holography, X-ray radiography, infrared and ultrasonics methods. .

NT-9653

Vrabel, Joseph and Brown, Earle B.; "The Practice of Interferometry," Optical Engineering, Vol 14, No. 2, pp 124-129, Apr 1975.

A brief review of the several types of interferometer is given. Four specific forms of instrument which are routinely used for interferometric testing at Perkin-Elmer are illustrated and described. A number of examples of interferograms obtained with each form of instrument are presented. The relationship of recent advanced developments to the actual practice of interferometry is indicated.

NT-13531

Wachtman, John B., Jr; "Highlights of Progress in the Science of Fracture of Ceramics and Glass," J Am Ceramic Soc, Vol 57, No. 12, pp 509-519, Dec 1974.

Rapid, catastrophic propagation of cracks is described in terms of stress concentration and energy balance conditions from a fracture-mechanics viewpoint. Slow crack propagation by stress corrosion or other mechanisms is also presented in fracture-mechanics terms. Data on slow crack propagation and accompanying acoustic emission in a variety of ceramics and glasses are reviewed. A survey is presented of the application of these results to the quantitative treatment of strength, dependence of strength on loading rate, time to failure, proof testing, acoustic emission monitoring, thermal shock, impact damage, and erosive machining. Some limitations in the application of fracture mechanics to ceramics are discussed.

NT-9209

Wagstaff, T. A.; "Non-Destructive Testing in Electronic Component Manufacture — Submerged Repeater Capacitors," British J Non-Destr. Test., Vol 16, No. 3, pp 76-79, May 1974.

This paper describes the quality control procedures for repeaters and amplifiers manufactured for use in submarine cables. Because the cost of replacing a faulty repeater in service would be 1/4—1/2 thousand pounds, exceptionally high reliability is essential and a wide range of NDT techniques is used and described.

NT-11484

Watson, Robert; "Status of Radiometry and Photometry," Electro-Optical Systems Design, Vol 8, No. 1, pp 34-35, Jan 1976.

In discussing the state of affairs in radiometry and photometry, I have divided it into five categories: 1) physical standards, 2) documentary standard, 3) regulatory agencies, 4) instrumentation, 5) potpourri.

NT-13524

Yatsyk, S. I.; "Ultrasonic Test Methods in Metallography (Survey)," Ind. Lab, Vol 40, No. 7, pp 972-979, Jan 1975.

The present survey attempts to systematize all papers dealing with ultrasound applied to solid and liquid metals, while also giving a general conception of the scientific and applied problems solved by means of ultrasonic methods at high temperatures. Particular attention is given to specific problems related to the use of high temperatures. No details are given of the use of special monitoring and measuring equipment.

NT-9440

Ziebarth, Hans K., Chang, Jee-Da, and Kukel, Joseph; "Mechanical Component Failure Prognosis Study," Rept. No. USAAMRDL-TR-73-26, Airesearch Mfg Co, Torrance, CA, (AD-771033).

The report presents the results of a study of failure prognosis of mechanical components of propulsive transmissions and gearboxes of Army aircraft. The step from on-line determination of component current mechanical condition by inferential, or diagnostic, methods to condition prognosis appears feasible if diagnostic techniques of the signature-composite interpretive type are used and diagnostic information is blended with inputs from the areas of component design theory, tribology, system abnormal physiology, and life predictive theory. For current component status determination, use of dynamic and lubricant-carried particle content signatures was found to be of greatest value. Use of the composite exceedance method in the dynamic data interpretation area and use of statistical methods recently developed in fluid-borne particle metrology in the lubricant particle content area would be indicated for attaining prognostic objectives.

NT-15546

Zieler, Erich; "Possibilities and Limits of Industrial Radiography and Radioscopy," Acta Electronica, Vol 20, No. 1, pp 11-24, 1977.

This paper gives a survey of the basic physical facts pertinent to the application of X-rays in industrial radiography and radioscopy. Data on spectral and spatial intensity distribution of X-rays emitted under various conditions are given. Interaction of radiation and matter as determined by absorption and scattering processes is discussed for different materials of practical interest. The process of X-ray imaging is described. The factors bearing on image quality and detail detectability are explained. Qualitative account and quantitative data on the influence of focal spot size, radiation quality, internal unsharpness of the recording medium, as films or image intensifier-television-chain, are given. After a synopsis of the final performance of the X-ray imaging procedure, comprising the influence of all factors mentioned above, some remarks on magnification radiography and direct television fluoroscopy are added.

NT-8473

Zisfein, Melvin B. and Tarpley, William B.; "Critical Thoughts on Structural Mechanics and NDE," International J Non-Destr Test., Vol 4, No. 2, pp 95-117, Sep 1974.

Paper addresses broad questions of NDE technologically both philosophically and practically from viewpoints of advanced research and current shop practice. The views of the hard scientist are considered with those of the systems engineers. The current state-of-the-art is assessed on a general basis and suggestions are made for both research and applications.

2.3.2. State-of-the-Art Reviews

NT-11975

Addison, Robert C., Jr; "Recent Advances in Ultrasonic Imaging," Proc of ARPA/AFML Rev of Quant NDE, pp 293-301, Dec 1975.

An attempt has been made to survey the many varieties of ultrasonic imaging systems that are currently being developed and to categorize them according to the function they serve best. Furthermore, a uniform set of criteria has been used to evaluate the performance of these systems in terms of commercially available B and C scan systems.

NT-13515

Barton, J. P.; "Neutron Radiography Newsletter," ASNT, Columbus, OH, 33 pp, 1976.

This newsletter begins with a review of neutron radiographic activities in England, the Continent, USA, South Africa, Indonesia and Japan. Many applications involve testing of nuclear reactor components, although most facilities are available for other industrial requirements. In the U.K. most activity is in neutron radiographic research rather than applications. There follows a review of meetings at which papers dealing with neutron radiography were presented. The next section presents news of people and places. The newsletter concludes with a state-of-the-art review of neutron radiography. There is a bibliography of 29 recent publications, as well as 57 references.

NT-13827

Berger, Harold; "The Present State of Neutron Radiography and its Potential," Materials Evaluation, pp 55-65, Mar 1972.

The present state of the art of thermal-neutron radiography as it relates to industrial application is reviewed. Techniques for performing this type of nondestructive test are well developed and available.Commercial neutron radiographic service can be obtained in several countries. In-house thermal-neutron radiographic facilities in non-nuclear organizations are now going into service. Progress with those facilities will be closely followed as harbingers of the potential growth of thermal-neutron radiography. Some predictions concerning the future of this technique are given.

NT-13606

Board, D. B.; "Incipient Failure Detection in CH-47 Helicopter Transmissions," Paper 75-WA/DE-16, ASME Winter Annual Meeting, ASME, N Y; 10 pp, 1975.

During U. S. Army funded research of state-of-the-art diagnostic and prognostic techniques for potential application to the CH-47C Chinook medium lift helicopter, a new technique for high frequency vibro-acoustic emission analysis was evaluated on three CH-47 drive system transmissions in a regenerative test stand. Test results indicate that this new technique for high frequency vibro-acoustic analysis shows excellent potential for early stage in-situ detection and identification of faults in complex, high-speed, rotating machinery. Of the five faults indicated and verified by teardown inspection during this test, only one was known at the outset of the test and all five were detectable through analysis of test data without any need for baseline information. This capability for in-situ fault detection and isolation without the need for baseline data and with decisions based on engineering rationale rather than rationalized pattern recognition, indicates an important superiority over the more classical forms of low frequency vibration analysis that have been employed to date for helicopter transmission diagnosis and prognosis.

NT-13546

Booth, Newell, Ed; "Acoustical Holography — Volume 6," Proc 6th International Symposium on Acoustical Holography, Plenum Press, N Y; 771 pp, 1975.

This volume contains the proceedings of the Sixth International Symposium on Acoustical Holography and Imaging, held in San Diego, California, February 4-7, 1975. The title of this symposium differs from that of the first four by the addition of the word imaging, reflecting an increase in emphasis on nonholographic methods of acoustical visualization. For convenience, no change has been made in the title of this published series. The 38 papers presented here define the state-of-the-art in the rapidly developing field of acoustical holography and imaging. Many of them describe applications in such fields as medical diagnostics, microscopy, nondestructive testing, underwater viewing, and seismology.

NT-8928

Broek, David; "Cracks at Structural Holes," Rept. No. MCIC-75-25, Battelle Columbus Labs, Metals and Ceramics Information Center, Columbus, OH; 44 pp, Mar 1975, (For sale by NTIS, Springfield, VA).

A review of the state of the art of dealing with cracks at holes in engineering structures. The usefulness of existing analysis methods and their limitations in practice are assessed.

NT-13649

Clifton, James R.; "Nondestructive Tests to Determine Concrete Strength — A Status Report," Rept. No. NBSIR 75 729, National Bureau of Standards, Building Research Division, Washington, D C; 39 pp, Jul 1975, (For sale by NTIS, Springfield, VA).

Individual and combined nondestructive test methods have been critically reviewed as potential methods to determine safe formwork removal times. The techniques reviewed are the Windsor probe, the Schmidt rebound hammer, pull-out measurements, push-out cylinders, ultrasonic pulse velocity measurements, and the maturity and equivalent age concepts. The individual methods, themselves, do not give good estimates at the in-situ strengths of concretes and it is recommended that future research emphasize combined methods. A proposed research program which emphasizes combined nondestructive test methods has been developed.

NT-12069

"Electromagnetic-Acoustic Transducers, A Survey of the State of the Art," Rept. No. NTIAC 76-1, NTIAC, Southwest Research Institute, San Antonio, TX; 43 pp, Jan 1976.

This report is a brief review of those aspects of electromagnetic-acoustic generation and detection of interest in nondestructive evaluation (NDE). Since this is a developing technology, there are no standard transducer designs and practices. The principles of ultrasonic wave generation as related to electromagnetic-acoustic transducer (EMAT) design are emphasized. EMATS are of interest in NDE because they offer a completely noncontacting technique for generating and detecting ultrasonic waves. The report discusses theory, experimental studies, design, and applications of EMATS.

NT-14212

El-Sum, H.M.A.; "Analytical Study of Acousto Optical Holography Interfacing Methods for Acoustical and Optical Holography," Rept. No. NASA-CR-2775, El-Sum Consultants, Atherton, CA; 96 pp, Dec 1976, (For sale by NTIS, Springfield, VA).

This report covers a study of the International Status of the Art of Acousto-Optical imaging techniques adaptable to nondestructive testing and, more important, to interfacing methods for acoustical and optical holography in nondestructive testing research. Evaluation of 20 different techniques encompassed investigation of varieties of detectors and detection schemes, all of which are described and summarized. Related investigation is reported in an appendix. The report presents important remarks on image quality, factors to be considered in designing a particular system, and conclusions and recommendations for extension of this work. Three bibliographies are included. Compatible systems to be used with the MSFC hybrid system (op-

tical, acoustical, and correlation) are a Bragg diffraction (direct optical-acoustical interaction) scheme and the electronically focused and scanned piezoelectric array. Both systems have sensitivity approaching 10 to the minus 9 to 10 to the minus 11 w cm squared and resolution approaching the acoustical wavelength in the tested material, are capable of real-time display, and can be designed for use in either a pure optical or an acousto-optical mode of operation. At the same time, a portable acoustic probe, akin to the probe used in medical diagnosis, can be designed for testing large objects on site.

NT-13845

"Emission Measurement Techniques for Particulate Matter from Power Plants, Cement Manufacture and the Iron and Steel Industry," Organization for Economic Co-Operation and Development, Winfrith, England, Published by Ministere De La Protection De La Nature Et De Lenvironment, Paris; 39 pp, 1975.

In reviewing the state of the art in respect of automated instruments for measuring emissions of particulate matter from selected sources, it has been assumed that instruments would be used for measuring emission after application of high efficiency abatement equipment. Three purposes for which these types of instruments are required have been recognized, namely: (I) monitoring the operation of particulate abatement equipment; (II) establishing that emissions meet required limits set by authorities; (III) ensuring the maintenance of ambient air quality standards where these have been set and that the public have no reason to complain from the resulting emissions.

NT-13548

Erikson, K. R., et al; "Through-Transmission Acoustical Holography for Medical Imaging — A Status Report," Proc 6th International Symposium on Acoustical Holography, Plenum Press, N Y, pp 15-55, 1975.

The findings reported here represent the current status of an evaluation of through-transmission holographic acoustical imaging in a clinical setting. The major objective of this effort is the investigation of the diagnostic usefulness of holographic images of soft tissue structures and organs in the human body, particularly the abdomen. This work involves a series of experiments including the imaging of organs in vitro, animals, patients, pregnant women, and a series of test objects.The 1 MHz holographic system used in this evaluation is described, together with images of several test objects. Selected clinical results, including in vivo images of several near term fetuses, are presented and discussed. Finally, we comment on through- transmission acoustical holography as a modality for soft tissue diagnosis.

NT-11080

Forrer, G. R. and Sattler, F. J.; "State-of-the-Art Review of Nondestructive Testing as Applied to Nuclear Pressure Vessels and Components," Materials Evaluation, Vol 33, No. 10, pp 20A-23A, 25A- 27A, Oct 1975.

The state of nondestructive testing technology as applied to nuclear pressure vessels and components is the result of many factors. For nondestructive testing, or examination (NDE), as referenced in the ASME codes, the extensive use of several methods is necessary to provide the assurance of quality. These methods of themselves do not add quality nor improve the individual product. Through their selective use, however, detrimental fabrication or service-induced imperfections are revealed which might result from manufacturing or operating conditions that exceed reasonable limits.

NT-8911

Greguss, P.; "Real-Time Acoustical-to-Optical Convertors — State of the Art," Inter 1973 Conf Proc, pp 265-269, Mar 1973.

Real time acoustical-to-optical conversion techniques are reviewed. It is shown that most new real-time displays are based on acousto-optic effects suggested several decades ago for the visualization of acoustical field intensity distributors, but are only now realizable through improved technology. The advantages and disadvantages of the systems are discussed together with the use of liquid crystals, one of the most promising developments in acoustical-to-optical convertors. At the conference, the paper was supported by a short film.

NT-7313

Grubinskas, Robert C.; "State of the Art Survey on Holography and Microwaves in Nondestructive Testing," Rept. No. AMMRC-MS-72-9, Army Materials and Mechanics Research Center, Watertown, MA, 109 pp, Sep 1972, (AD-755116).

The object of this monograph is to trace the evolution of relatively new nondestructive testing techniques arising from the vigorously active fieldsof holography and microwaves. Highlighted areas include the description of existing techniques to the evaluation of materials, structures, and end items for quality assurance purposes. An extensive reference and bibliographical section has also been included to increase the usefulness of this document and to provide a launching point for further study.

NT-12474

Guild, F. J., et al; "The Application of Acoustic Emission to Fibre-Reinforced Composite Materials," Composites, Vol 7, No. 3, pp 173-179, Jul 1976.

Applied to metallic materials, acoustic emission is rapidly gaining status as a practical non-destructive test tool. This has resulted from exhaustive research efforts to detect and identify such features as phase transformation, plastic deformation and crack growth. This review examines the state of the art with regard to composite materials where fracture processes are generally more complex and interpretation is correspondingly more difficult

NT-13462

Gulley, Lee R., Jr; "An Investigation of the Effectiveness of Magnetic Particle Testing," Rept. No. AFML-MX-TM-73-5, Air Force Materials Lab, Wright-Patterson AFB, OH; 42 pp, Oct 1973, (AD-914888).

As part of the current emphasis to improve knowledge of the actual effectiveness of state-of-the-art nondestructive test methods, an evaluation program was designed and conducted involving magnetic particle testing. Participants were asked to test a set of flawed, geometrically complex parts and to answer questions regarding their use of magnetic particle methods. The data obtained from the participants was then analyzed to determine what could be learned about present day practice. Results indicated the existence of at least one outstanding test group with the balance falling into a much less effective category. The use of variable part geometry and surface finish as expected, lowered somewhat the detectability of the flaws within the test parts. Despite the relatively large size of the flaws in the parts, many were missed, indicating a need to further emphasize improved magnetic particle inspection training and certification of personnel. The results show that flaw size is not as important a variable as is technique and such variables as bath concentration and field strength.

NT-14133

Hagemaier, Donald; "State-of-the-Art Inspection of Aircraft Structures," Prevention of Structural Failure, No. 5, Am Soc Metals, Materials/Design Forum, 2D, 1974; pp 161-187, 1975.

This paper presents NDE test procedures used to achieve quality and reliability assurance and prevention of structural failure in aircraft structures. In synopsis form a nondestructive inspection plan covering the complete product cycle from design to service is presented. The plan covers specifications, research and development, fabrication, NDI manual, and field service manuals. The author also presents newly developed damage tolerance criteria concerning initial damage versus minimum detectable defect size. Considerations for on-condition maintenance of critical structures are discussed.

NT-10867

Hagemaier, Donald; "State of the Art Inspection of Aircraft Structures by Nondestructive Testing," Materials Evaluation, Vol 33, No. 9, pp 217-224, 225-226, 231, Sep 1975.

This paper presents nondestructive test procedures used to achieve quality and reliability assurance and prevention of structural failure in aircraft structures. A nondestructive testing plan covering the complete product cycle from design to service is presented in synopsis form. This plan covers specifications, research

and development, fabrication, NDI manual and field service manuals. In-process control and product quality assurance requirements, for p esent generation aircraft materials and processes, are described. Newly developed damage tolerance criteria concerning initial damage vs. minimum detectable defect size are presented and evaluated. The philosophy for obtaining data for an inservice NDI manual is presented. Considerations for on-condition maintenance of critical structure are discussed.

NT-13529

Hagemaier, Don; "Ultrasonic Applications in the Aero space Industry," SAE Paper 740811, 30 pp, 1974.

This paper discussed state-of-the-art ultrasonic testing as used to inspect and evaluate parts and materials for aerospace systems. The paper is divided into four sections: purpose of testing; basic requirements for application, such as equipment, reference standards, and acceptance criteria; standard applications, such as wrought metal products, tubing and pipe welded assemblies, thickness and corrosion, fiber-reinforced composites, adhesive-bonded assemblies, brazed and diffusion-bonded assemblies, aircraft maintenance inspection, attenuation, and grain-boundary reflections; and research and development applications, such as the liquid-level detector, titanium hydride detector, measurement of applied stress, ultrasonic extensiometer, ultrasonic modulus versus mechanical properties for fiber composites, ultrasonic spectroscopy, acoustic holography, and critical angle reflectivity.

NT-10662

Hanson, A. G.; "A Survey of Display Systems and Their Video Reception Capabilities," Rept. No. OTR-74-46, Department of Commerce, Washington, D C; 64 pp, Nov 1974, (For sale by US GPO, Washington, D C).

An overview of the current developmental status of devices which demonstrate applicability to display of video information, with emphasis upon compatibility with broadband digital transmission. Primary concern is with emerging types of devices which indicate promise of overcoming inherent limitations of the conventional analog cathode ray tube. Of particular interest are several technological approaches to creation of a flat panel display. Display types include beam-addressed and matrix-addressed, either light-emitting or non-light-emitting (light valves). Specific approaches include gas-discharge panels, flat-panel crts, electroluminescent panels, and liquid crystal panels.

NT-13499

Holloway, J. A. and Shelton, W. L.; "A Survey of Image Processing Methods for Radiography," 6th National SAMPE Tech Conf, Vol 6, SAMPE National Business Office, Azusa, CA; pp 110-117, 1974.

An investigation of radiographic image processing methods using analog, digital and photographic approaches was conducted. Several systems were evaluated to determine the state-of-the-art for enhancement of industrial radiographs. Control radiographs were used to determine system capabilities such as resolution and sensitivity, dynamic range, degree of enhancement, speed, scan area, reproducibility, and cost.

NT-13632

Hudson, C. Michale and Seward, Sue K.; "A Literature Review and Inventory of the Effects of Environment on the Fatigue Behavior of Metals,"published in Eng Fract Mech, Vol 8, No. 2, Pergamon Press Ltd, Oxford, England; pp 315-329, 1976.

An experimental investigation into the measurement of fracture toughness on small precracked bend specimens after general yield is described. Six parameters are compared on the basis of their accuracy and utility in predicting K (Sub IC). The parameters are: (I) the on-load crack tip opening displacement, cod, (II) the lateral (notch root, crack tip) contraction, NRC, (III) the angle of bend, (IV) the equivalent energy. The materials used were, for the most part, A533B and 4340 steels.

NT-13330

Kearney, F. and Fornango, J.; "Investigation of Automated Evaluation of Field Weld Radiographs," Rept. No. CERL-TR-M-185, Construction Engineering Research Lab (Army), Champaign, IL; 19 pp, Jul 1976, (AD-A028605).

Since evaluation of field welds using radiographs requires that an inspector compare the radiograph with a standard, subjectivity is introduced. An automated image-analyzing system is proposed to remove this subjectivity. Radiographs containing sharp, well defined defects on a uniform background can be analyzed in cathode-ray scanners and special-purpose computers in real time. However, the visual contrast in field weld radiographs is rather poor, and many extraneous features are usually present. A scan of 80 standard radiographs using an image analyzer detected only 296 weld defects while human operators identified 988. Techniques for enhancement and filtering of extraneous features are essential to the automated analysis of field weld radiographs. It is recommended that further work on development of an automatic radiographic analyzer be deferred until major advancements occur in the state of the art of image analysis.

NT-13892

Kessler, Edward G.; "State-of-the-Art Survey for Automatic Optical Detection of Surface Defects on Ordnance Material," Rept. No. PA-TR-4880, Picatinny Arsenal, Dover N J; 33 pp, Sep 1976, (AD-A031001).

This state-of-the-art survey is aimed towards optical procedures that might prove useful in detecting defects (such as cracks, blemishes, pits, and missing or out-of-tolerance components) typically found in ordnance items. Included in this report are sections on color, diffraction, reticles, scatter, optical spatial filters, mechanical and electronic optical scanning systems, and analog-digital electronic information analysis. It is found in general that the ability to resolve a defect has an inverse relationship to the complexity of the background. If the background is sufficiently subdued, a simple photodetector circuit will serve. It is concluded that the design engineer must carefully evaluate the specific problem in order to obtain the simplest, most cost effective defect detection system that meets quality control criteria.

NT-13590

Kitchens, T. A.; "An Overview of Acoustic Emission from Great Britain," ESN-29, European Scientific Notes, Office of Naval Research, London; pp 509-511, Dec 1975.

An overview of acoustic emission from Great Britain held at the Geological Society of London on Acoustic Emission, on 29 October 1975, six presentations of the state-of-the-art of AE from different points of view were given, including the characteristics of AE and the techniques used in the present practical analysis.

NT-9378

Kumar, A.; "Application of Acoustic Emission to Weld Monitoring," Rept. No. CERL-IR-M-117, Army Construction Engineering Research Lab, Champaign, IL; 17 pp, Dec 1974, (AD-A003992).

The report discusses the feasibility of applying acoustic emission to real-time monitoring of gas metal arc welding. A state-of-the-art survey indicated that investigators had some success with detecting cracks, porosity, and slag inclusion during the welding of steels by monitoring acoustic emission. The presence of cracks was most easily detected in gas tungsten arc welding of stainless steels. Slag inclusions associated with roped bead in submerged arc welding can also be detected by acoustic emission. In the present work, cracks were introduced in a restrained weldment by hydrogen additions to the shielding gas. Selective filtering was used to increase the signal-to-noise ratio. Results show that the acoustic emission rate from cracks is much higher than that from the welding arc noise. A real-time weld monitor for detection of cracks in steel is therefore technically feasible. However, when porosity was introduced, the acoustic emission rate was about the same order as that from the welding arc noise. Thus, porosity could not be detected by the acoustic emission in a real-time weld monitoring situation.

NT-13623

Lott, D. R., et al; "NDT Evaluation of Solar Cell Weld Joints with Details of Selected Post-Bond and Pre-Bond Systems," Proc Eleventh IEEE Photovoltaic Conf, pp 134-144, 1975.

The current state of the art in nondestructive testing was surveyed to investigate the use of test methods for determining parallel gap solar cell joint weld quality. Seven post-bond NDT systems, two in-process and one pre-bond system were selected from the survey for test evaluation. An augmented visual post-bond system and a resistive pre-bond system were selected from these ten NDT methods as most completely meeting acceptance requirements.

NT-15233

Meyer-Ebrecht, D. and Spiesberger, W.; "Novel Techniques for Medical X-Ray Diagnostics—An Impetus to Nondestructive Testing," Materialprufung, Vol 19, No. 10, pp 409-415, Oct 1977.

In recent years medical X-ray diagnostics has much profited by a rapid development of component technologies as well as image generation and processing methods: technologic progress on image pickup devices has improved image quality, and electronic image processing by means of video techniques or digital computers made feasible new investigation and evaluation methods. Various processes for three-dimensional imaging have been developed, of which computer tomography (scanning an object layer with a narrow collimated X-ray beam and reconstructing the layer image digitally) was somewhat a revolution for X-ray diagnostics. Numerous novel image processing methods were investigated to fulfill the needs for quantitative radiograph analysis as well as for automation of the evaluation of screening investigations. This contribution shall review state-of-the-art and trends, and it shall indicate analogue applications in industrial X-ray testing.

NT-14302

Mucciardi, Anthony N., Shankar, Ramesh, and Chang, Jian K.; "Quantitative NDE Procedures for Measurement of Fatigue Cracks and Defects in Adhesive Bond Lines and Stainless Steel Weldments," Paper Summaries, ASNT Spring Conference, 3 pp, Mar 1977.

Adaptive Learning Networks (ALNS) have been successfully applied to measure subsurface fatigue cracks in aircraft wing fastener holes from the characteristics of their ultrasonic NDE signatures. In this project the ALNS ability to measure subsurface cracks smaller than 30 mils, which were previously unidentifiable, was demonstrated. This project and current adaptronics NDE work are milestones in the union of state-of-the-art nonlinear adaptive signal processing technology and NDE techniques. The signal processing steps performed on NDE waveforms are described. The applicability of ALNS to characterize and measure defects from parameters of the processed waveforms recorded from fastener holes, adhesively bonded joints and stainless steel weldments are presented.

NT-14134

Noronha, Pascal J. and McKannan, E. C.; "A Review of the State-of-the-Art of the Non-Destructive Testing of Flight Pressure Vessels," Prevention of Structural Failure, No. 5, Am Soc Metals, Materials/Design Forum, 2D, 1974, pp 188-203, 1975.

This paper reports on the state-of-the-art of NDE of space vehicle pressure vessels. The vessels differ from conventional ground base pressure vessels in the low safety factors used in order to permit maximum weight production. Techniques currently being used are described along with the advantages, limitations and limits of detectability at high levels of confidence. Techniques to be used in the future to improve the limits of minimum flaw size detection include delta scan and acoustic emission techniques.

NT-13786

Papazoglou, Vassilios and Masubuchi, Koichi; "Integration of M.I.T. Studies on Prediction and Control of Distortion in Welded Aluminum Structures," Technical Rept. No. 1, Massachusetts Inst of Tech, Department of Ocean Engineering, Cambridge, MA; 170 pp, Sep 1976, (AD-A033490).

This report covers the development of analytical means for predicting and controlling weld distortion of welded aluminum structures. The report presents basic background information and covers the present state-of-the-art by integrating results obtained recently at M.I.T. distortion in welded structures is caused by three fundamental dimensional changes, namely transverse shrinkage, longitudinal shrinkage and angular change. During the fabrication of actual structures, such as ships, airplanes and buildings which have various types of joints, these dimensional changes are combined. Therefore, shrinkage distortion that occurs in structures can be extremely complex.

NT-12068

"Proceedings of a Workshop on Nondestructive Evaluation of Residual Stress," Rept. No. NTIAC 76-2, NTIAC, Southwest Research Institute, San Antonio, TX; 389 pp, Aug 1975.

This workshop was held in San Antonio, Texas on August 12 and 13, 1975, and was sponsored by the Air Force Materials Laboratory (AFML). D. M. Forney, Jr. of AFML was workshop chairman. Workshop goals: identify present and future requirements for NDE measurements of residual stress, documenting the present state of the art; identify viable new approaches to improve NDE technology; foster communication among participants to consolidate available knowledge. Formal presentations included: an overview of NDE of residual stress; macro and micro aspects of residual stress; welding stresses; carburized gears and materials; tank automotive components; X-ray diffraction of machined surfaces; fatigue loading relief of compressive layers; computer aided analysis of heavy weldments; stress corrosion cracking of reactor piping; current stresses in polymer composites; angle ply composites; ceramic turbine components; X-ray measurement of residual stress including correction factors, automation; ultrasonic methods including dispersion, birefringence, harmonics, velocity, electromagnetic methods including material properties, Barkhausen effect, ultrasound generation, composites; nuclear hyperfine structure, Mossbauer effect, nuclear magnetic and quadrupole resonance; acoustic nuclear resonance; lithium nuclear microprobe technique.

NT-12061

Richmond, W. Frank, Jr; "Research Study of Reliability Prediction of Mechanical and Structural Systems. Volume I. R and M Prediction in Engineering Development," Rept. No. AMSAA-SP-19 Vol 1, Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, MD; 29 pp, Mar 1975, (AD-A011238).

Valid predictions of R and M (reliability and maintainability) should be based on design processes as the true determinants. Failure to do this and to develop the necessary data has resulted from lack of understanding and liaison between analysts and designers. The first corrective step should be development of a data base, initially from design testing, then from better instrumentation of R and M testing, using design, instrumentation, and data systems skills. Design-oriented failure-mode analysis and maintainability analysis are necessary for data classification. Proper use of the data for prediction depends upon an improved understanding and liaison between analysts and designers.

NT-14034

Rumbold, J. G.; "Ultrasonic Dimensional Tube Testing Techniques," Materials Evaluation, Vol 35, No. 2, pp 45-49, Feb 1977.

A state-of-the-art approach to measuring tubular dimensional parameters with pulse-echo ultrasonics is presented. This new system provides a measurement of thickness, outside diameter, inside diameter, eccentricity and ovality. In addition, the running average or the average per tube of any of these parameters can be obtained. The principle of measurement of this immersion technique is explained in detail along with a thorough explanation of the variables that can affect accuracy and stability. A review of the first generation equipment is given to highlight the complexity of the problems, both electronic and ultrasonic, that had to be overcome. The solution is a marriage of digital computation with analog computation. The result is a system that can provide a combined accuracy, stability and repeatability of within 0.002 in. (0.005 mm).

NT-14298

Rundquist, D. E. and Orphan, V. J.; "Assessment of Thick Section Radiographic Methods," Paper Summaries, ASNT Spring Conference, 2 pp, Mar 1977.

Science Applications, Inc., (SAI) is currently conducting for the Electric Power Research Institute (EPRI) an assessment of thick-section X-ray radiography, a nondestructive testing (NDT) technique with wide spread use in the nuclear power industry. The current SAI program has provided an integrated approach to assessing the state-of-the-art of thick-section radiographic methods and to identifying means of optimizing present techniques. Major accomplishments of the present program include development of a sophisticated mathematical model of a high-energy radiography system and the use of this model to investigate the effect on several performance criteria (unsharpness, sensitivity, latitude and exposure time) of varying system parameters (such as source energy, source energy distribution, focal spot size, source angular distribution, source-object-imaging system geometry, object thickness, intensifying screen-film changes, etc.). A number of promising approaches for optimizing the methods used to perform high-energy radiography on thick steel sections have been identified. The developed calculational model can, for example, be used to systematically investigate the parameters associated with metallic intensification screens.

NT-14244

Silvus, H. S., Jr; "Advanced Ultrasonic Testing Systems—A State-of-the-Art Survey," 74 pp, Sep 1976, (For sale by NTIAC, Southwest Research Institute, San Antonio, TX).

The purpose of this document is to present a concise survey of the state of the art in advanced ultrasonic testing systems, techniques, and system components. Information presented is intended to give a practical overview of the types of ultrasonic nondestructive inspection apparatus presently in use and of relatively new techniques which are being applied to improve the capabilities of such systems. The technical level of the discussion is such that this document will be useful to the reader who has only an introductory knowledge of ultrasonic nondestructive evaluation, but who wants to know what can be done and what is being done in this field. The sophisticated reader can use this document to review with minimum expenditure of time and effort approximately 120 relatively recent papers in the field of ultrasonic nondestructive evaluation of materials.

NT-14078

Southworth, Howard L., Steele, Norman W., and Torelli, Peter P.; "Practical Sensitivity Limits of Production Nondestructive Testing Methods in Aluminum and Steel," Rept. No. AFML-TR-74-241, Boeing Commercial Airplane Co, Seattle, WA; 187 pp, Jan 1975, (AD-A017373).

The report describes the work accomplished under an 18-month program conducted by evaluate the sensitivity capabilities of current state-of-the-art nondestructive inspection methods. The methods include magnetic particle, penetrant, eddy-current, ultrasonic, and radiographic. These capabilities were demonstrated in response to varied surface flaws and were statistically defined in terms of probability and confidence of detection. This was accomplished with differing specimen configurations in two representative aircraft structural alloys and for both laboratory and production inspections.

NT-12065

Stark, Robert M. and Yi Yang, Cheng; "Research Study of Reliability Prediction of Mechanical and Structural Systems," Rept. No. AMSAA-SP-19-VOL-2, Delaware University, Newark, DE; 44 pp, May 1972, (AD-A011239).

This study was intended to assess the state-of-the-art of predicting the reliability of items that fail due to mechanical stresses, and to identify those areas in which development effort should be intensified. In order to achieve an orientation toward application rather than analytical theories, a sample approach has been chosen by AMSAA, the details of the sample being selected by consultation between AMSAA and the University of Delaware. The study revealed a dearth of design-oriented data on mechanical failures and a virtual absence of analytical methods and expertise to use such data. Development of a data base is recommended, initially from design testing. This experience and its result will provide a basis of analytical expertise to use the data for reliability prediction.

NT-9592

"State-of-the-Art Reviews, Report Bibliography Feb 47-May 74," Rept. No. DDC-TAS-74-41, Defense Documentation Center, Alexandria, VA; 281 pp, Feb 1975, (AD-A005375).

This bibliography contains 229 references pertinent to the evaluation and results of surveys, studies, and literature searches in the state-of-the-art reviews of selected subjects. The indexes included are corporate author-monitoring agency and subject.

NT-15200

"Static Brake Inspection Investigation, Vol. II," Rept. No. DOT HS-802 071, Avco Systems Div, Wilmington, MA; 347 pp, Oct 1976, (For sale by NTIS, Springfield, VA).

Final technical report of a program to investigate methods and to devise a system for motor vehicle brake inspection which precludes the necessity for wheel removal. PMVI requirements and criteria are reviewed, state-of-the-art equipment and methods are surveyed. Industry dialogu is established in support of feasibility of new concepts, which include vehicle modifications and new test methods. All proposed new methods are defined, conceptually developed, and analyzed for current feasibility and future potential. Experimental work is included to supplement the literature search and analytical work where necessary to support conclusions. Inspection methods investigated include radiography, ultrasonics, acoustic emissions, acoustic signature, fiber optics, gas chromatography, etc. Alternatives are summarized, traded off and a final specification for PMVI brake inspection is recommended. The recommended specification includes proof test, visual wear indicators, access ports and simple inspection tools. It is concluded that all of the program objectives can be satisfied by methods which are cost effective, easily implemented in the field and acceptable to industry.

NT-14918

Sushinsky, G. F., et al; "Improved Ultrasonic Standard Reference Blocks," Rept. No. AFML-TR-77-40, National Bureau of Standards, Washington, D C; 134 pp, Apr 1977, (AD-A042787).

A program to improve the quality, reproducibility and reliability of nondestructive testing through the development of an improved ASTM-type ultrasonic reference standards system is described. Reference blocks of aluminum, steel, and titanium alloys are considered. Equipment representing the state-of-the-art in laboratory and field ultrasonic equipment was obtained and evaluated. RF and spectral data on twenty-two sets of ultrasonic reference blocks were taken as part of a task to quantify the variability in response from nominally identical blocks. Techniques for residual stress, preferred orientation, and microstructural measurements were refined and applied to reference blocks rejected by manufacturers during fabrication in order to evaluate the effect of metallurgical condition on block response. The effects of certain dimensional variables on block response were studied and new fabrication techniques considered. A study of the effects of measurement system variables on block response was carried out. A calibration service for ASTM E127-type reference blocks has been established and the development of a loaner service for calibration blocks is underway.

NT-11293

Trolinger, J. D.; "Flow Visualization Holography," Optical Engineering, Vol 14, No. 5, pp 470-481, Oct 1975.

The combination of the techniques of holography with those of flow visualization has resulted in one of the most widespread uses of holography. The most significant recent contributions in the field comprise solution of practical engineering problems, refinement in analytical and interpretive methods, and an increasing list of current and potential applications. The purpose of this paper is to summarize the methods and state-of-the-art of holographic flow visualization. Holographic interferometry, like conventional interferometry, provides a measurement of optical path length between points of space. This can be applied to determine gas density or to observe density gradients and their movement throughout a volume. Moreover, a holographic image of a space is not just limited to interferometric analysis. Such images are amenable to a broad class of optical analysis, including three-dimensional photography and optical filtering methods such as Schlieren photography.

NT-7759

Wagai, Toshio; "Present State of the Clinical Application of Ultrasonotomography," Ultrasonic Imaging and Holography, Plenum Press, pp 553-566, 1974, (Proc U.S.-Japanese Science Cooperation Seminar).

The ultrasonic tissue visualization technique by means of the reflection method (ultrasonotomography, echography) has been utilized effectively for clinical diagnoses through the entire world. It has various kinds of advantages, and is also highly valued among many techniques in the application of diagnostic ultrasound. According to this trend, ultrasonotomography has been accepted as a new routine, diagnostic tool, particularly in the fields of internal medicine, neurology, obstetrics and others. At the same time, this method has been discussed in its practical evaluation and limitation in comparison with other usual tissue visualization techniques such as X-ray, scintigraphy and thermography. In this paper, the outline of the present state of diagnostic application of ultrasonotomography which has been carried out at the research center, as well as future prognosis, will be described from a clinical point of view.

NT-13667

Waung, Y. C., Beskos, D. E. and Sachse, W.; "Ultrasonic Velocity Measurement of Elastic Constants of AL-CUAL2 Eutectic Composite," Journal of Materials Science, Vol 10, No. 1, pp 109-112, Jan 1975.

Ultrasonic velocity measurements were performed to determine the dynamic elastic stiffness constants of the AL-CUAL2 unidirectionally solidified eutectic, which consists of unidirectional CUAL2 platelets in an AL matrix. The phase velocity of ultrasonic waves in the eutectic was measured by the echo-overlap technique. The material was assumed to be transversely isotropic and its elastic constants, in units of 10 to the 10th power dyn cm to the minus 2, are found to be: C33 = C11 = C22 = 122.8, C44 = C55 = 29.7, C12 = C13 = 59.5, where the subscript 3 indicates the fibre direction. These results indicate that the AL-CUAL2 eutectic is almost elastically isotropic or more precisely, has cubic symmetry. The elastic moduli are used to evaluate the engineering constants of this material. The value of Young's modulus is found to be in close agreement with that measured by others in quasi-static tests.

NT-13727

Yee, Bill G. W. and Couchman, James C.; "Application of Ultrasound to NDE of Materials," IEEE Transactions on Sonics and Ultrasonics, SU-23, pp 299-305, Sep 1976.

A review of state of the art applications of ultrasonics to the nondestructive inspection of materials for defects is given along with some of the limitations associated with the present state of the art. These limitations include 1) the inability to determine defect dimensions quantitatively, 2) the lack of suitable reference standards, 3) the general lack of equipment for the inspection of parts with complex geometries, 4) the nonreproducibility of transducer characteristics, and 5) the lack of a sound theoretical foundation for ultrasound-discontinuity interaction. Some of the current research and development work in the use of digital computers for scanning parts with complex geometries and in signal processing to increase inspection reliability and defect detection is also described.

3. TECHNIQUE GUIDES

3.1. Technique Selection Chart

The technique selection chart on page 3-3 furnishes quick guidance regarding the use of NDT methods versus the material property of interest. Obviously, any guide of this type is subject to interpretation and should not be used as an absolute dictum regarding the proper application of NDT methods.

Paragraph B of this section of the yearbook, "Synopsis of NDT Methods," provides a description of each NDT method on the Technique Selection Chart.

3.2. Index to Synopsis of NDT Methods

3.3. Synopsis of NDT Methods

3.3.1. Introduction

This section is based upon a paper, "Overview of Nondestructive Inspection Techniques," by Otto R. Gericke of the Army Materials and Mechanics Research Center in Watertown, Massachusetts. The paper was published in the proceedings of the "Symposium on Fracture Mechanics of Ceramics," sponsored by Pennsylvania State University in 1973. The publisher of the proceedings was the Plenum Publishing Company, Limited, of New York. The editor gratefully acknowledges the permission of the author and publisher to use this material.

The original text has been edited, slightly rearranged, and updated in places. References have been added to most of the inspection techniques. These references were taken from the NTIAC information files and were selected primarily to give the reader information concerning some of the latest applications and developments of the technique.

This listing is inclusive of the major NDT methods but by no means does it present all approaches that have been used to nondestructively examine test specimens. The application of the NDT techniques is likewise under continuous expansion and the examples in the text only serve to illustrate a few of the uses of the specific technique.

3.3.2. Methods Involving Motion of Matter

3.3.2.1. Static Loading

3.3.2.1.1. Gravitation (Weighing)

The density of samples of materials and of relatively small items can be determined by weighing them first in air and then immersed in water. If precision balances are used for this purpose, the density measurement can serve as a nondestructive test. It can be used, for instance, to segregate different types of materials and to examine items for gross defects such as porosity and inclusions.

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LEGEND

A - HIGH UTILITY
B - MODERATE UTILITY
C - LOW UTILITY
BLANK - NOT APPLICABLE

BLACK - FERROMAGNETIC METALS
RED - NONFERROMATIC METALS
GREEN - NONMETALS

(Cell entries below are given as black/red/green.)

	OBJECTIVE	Methods Involving Motion of Matter: Static Loading: Gravitation (Weighing)	Static Loading: Hydrostatic Testing	Static Loading: Microstrain Measurement	Surface Distortion: Optical Holography, Moiré	Surface Distortion: Photoelastic Coatings	Surface Distortion: Brittle Coatings	Audio Frequency: Natural Resonance	Audio Frequency: Acoustic Emission, Stress Wave	Ultrasonics: Imaging/Holography: Probe Scanning	Imaging/Holography: Liquid Levitation	Imaging/Holography: Electronic Scanning	Imaging/Holography: Acousto-Optical Imaging	Chemical Detectors: Small Particle Suspensions	Chemical Detectors: Liquid Crystals	Chemical Detectors: Thermochromic Substances	Echo Ranging: Distance, Elastic Properties	Ultrasonic Spectroscopy: Resonance	Ultrasonic Spectroscopy: Attenuation	Ultrasonic Spectroscopy: Defect-Echo Analysis	Electromagnetic Tests: Electrostatics: Thermoelectric Potential	Electrostatics: Electrochemical	Electrostatics: Triboelectric	Electrostatics: Corona	Electric Current: Electrical Resistance	Magnetic: Barkhausen Effect	Magnetic: Eddy Current	Magnetic Perturbation: Static Magnetic Field	Magnetic Perturbation: Electric Current	Radio Frequency: Dielectric Test	Magneto Absorption: Electron Paramagnetic Resonance	Magneto Absorption: Nuclear Magnetic Resonance	Microwaves: Transmission	Microwaves: Reflection, Mode Change	Microwaves: Microwave Holography	Microwave Spectroscopy: Absorption Spectra	Microwave Spectroscopy: Nuclear Quadrapole Resonance	Infrared: Heat Flow, Temperature	Infrared: Infrared Spectroscopy	Optical Testing: Visual Inspection	Optical Testing: Optical Spectroscopy, Colorimetry	X-Radiography
DISCONTINUITIES AND SEPARATIONS	SURFACE FLAWS				A/A/A	C/C/C	C/C/C			A/A/B	A/A/B	A/A/A	A/A/A	B/B/C	B/B/C	B/B/C	A/A/B		C/C/	A/A/B					B/B/			A//	/B/				//C	A/A/B	//C			C//B		A//A		B/B/B
	SURFACE-CONNECTED FLAWS		A/A/A	C/C/C	A/A/A	A/A/C	A/A/C	B/B/C	B/B/B	A/A/B	A/A/A	A/A/A	A/A/A	B/B/C	B/B/C	B/B/C	A/A/B		C/C/	A/A/B					B/B/			A//	/B/	//B			//C	A//B	//C			C//B		A//A		A/A/A
	INTERNAL FLAWS			C/C/C	B/B/B	C/C/C	C/C/C	C/B/C	B/B/B	A/A/B	A/A/A	A/A/A	A/A/A	B/B/C	B/B/C	B/B/C	A/A/B		C/C/	A/A/B				//C				A//		//B			//B	//B	//C			C//B				A/A/A
STRUCTURE OR MALSTRUCTURE	MICROSTRUCTURE																		A/A/B	B/B/C											A/A/A	A/A/A			//B	A//C	A/A/A					B/B/B
	MATRIX STRUCTURE																		A/A/B						C/B/	C	/B/				A/A/A	A/A/A			//C		A/A/A					B/B/B
	SMALL STRUCTURAL FLAWS																		B/B/C									C		//C	A/A/A	A/A/A			//B							A/A/A
	GROSS STRUCTURAL FLAWS			C/C/	C/C/C		C/C/C												B/B/C									C		//C	B/B/B	B/B/B			//B							A/A/A
DIMENSIONS AND METROLOGY	DISPLACEMENT AND/OR POSITION	C/C/C		B/B/B				A/A/A																														/C/				A/A/A
	DIMENSIONAL VARIATIONS	B/B/B			C/C/C			B/B/C																			/A/							B/B/C						C/C/C		C/C/C
	THICKNESS OR DENSITY	B/B/B						C/C/C		B/B/C		B/B/C	B/B/C	B/B/C	B/B/C	B/B/C	A/A/B	A/A/A	A/A/A	A/A/B							/A/			//A				B/B/C						C/C/C		B/B/B
PHYSICAL PROPERTIES	ELECTRICAL PROPERTIES																					C/C/			A/A/		/B/			//A					//C							
	MAGNETIC PROPERTIES																									C	/A/	C			B/B/											
	THERMAL PROPERTIES														B/B/B																							C//C				
	MECHANICAL PROPERTIES		B/B/B	B/B/B		C/C/C	C/C/C	B/B/B		C/C/		C/C/	C/C/	C/C/	C/C/	C/C/	C/C/	B/B/B	B/B/B	C/C/	B/B/	B/B/	C//C			B				//B					//C							
	SURFACE PROPERTIES				C/C/C																																			B/B/B		
CHEMICAL COMPOSITION	ELEMENTAL ANALYSIS																				C/C/	C/C/	C//C			B						A/A/A				A//B	C//C		B//A		B/B/C	
	IMPURITY CONCENTRATION																		C/C/			C/C/			B/B/			C		//A		A/A/A				A//B	C//C		B/B/A		A//B	
	METALLURGICAL CONTENT																C/C/		C/C/		B/B/	B/B/	C		C	B						A/A/							B/B/			C/C/
	PHYSICOCHEMICAL STATE							//C									C/C/C																				C//B		A/B/B			
STRESS, FATIGUE, WEAR, ETC.	STRESS, STRAIN, AND HEAT TREATMENT		C/C/C	A/A/A		A/A/A	A/A/A			C/C/		C/C/	C/C/				C/C/	C/C/	B/B/	C/C/					C	A																
	FATIGUE DAMAGE AND CRACK PROPAGATION			B/B/B	A/A/B	A/A/A	A/A/A	B/B/B	A/A/A	B/B/	B/B/	B/B/	B/B/	B/B/	B/B/	B/B/	B/B/		C/C/	B/B/				//B	B/B/	B		A	/B/				//C	A/A/B	//C					A//A		C/C/
	WEAR, SPALLING, AND EROSION				A/A/B			C/C/	C/C/C		C/C/	C/C/	C/C/	C/C/	C/C/	C/C/C	C/C/	B/B/		B/B/								B		//B				B/B/C	//C					A/A/A		B/B/C
	CORROSION AND CHEMICAL DAMAGE				B/B/C			C/C/		B/B/	B/B/	B/B/	B/B/	C	C	C	B/B/			B/B/				//B	B/B/	C	/B/	B					//B		//C					A//A	C//C	B/B/C
	RADIATION DAMAGE																		//C						C	C				//B	A/A/B	A/A/A					B/B/B					

TECHNIQUE SELECTION CHART

3.3.2.1.2. Hydrostatic Testing

In hydrostatic proof testing, pressurized water or other liquids which are much less hazardous than gases under pressure are utilized to examine pressure vessels, pipes, or vacuum systems for leaks. Observed is either the liquid escaping from the test object or the decrease in hydraulic pressure resulting from a leak. The sensitivity of the test can be improved if water additives are used that decrease the surface tension or if liquids with intrinsically low surface tension are substituted for water. Adding a dye, a fluorescent substance, or a radioactive material to the liquid and scanning the specimen surface with a suitable light source or a radiation detector will improve the detection of the leakage.

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3.3.2.1.3. Microstrain Measurement

Materials can be tested in the pre-yield microstrain region without impairing their future practical usefulness. A microstrain measurement is simply a magnification of the stress-strain behavior to detect very small plastic strains considerably below the engineering yield stress. Initial experimental results indicate that embrittlement and grain size of arc-cast molybdenum can be determined by this method.

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3.3.2.1.4. Surface Distortion

3.3.2.1.4.1. Optical Holography, Moire

In conventional photography, the illuminating light is diffusely reflected by the photographed scene and then recorded for a particular set of imaging conditions that are usually determined by a lens system. In contrast, holography uses coherent, highly monochromatic illumination and produces a photographic record that depends on the phase as well as the amplitude of the light reflected from the illuminated scene. Under normal viewing conditions, in ambient light, a hologram appears as a meaningless combination of interference patterns. To obtain a comprehensible image, a special reconstruction process employing a coherent light source, such as a laser, has to be used to illuminate the hologram. Since a hologram registers the phase of light, which depends on the exact distance from a reflecting surface element to the photographic medium, the three-dimensional properties of the interrogated scene are obtained. For example, an object with a flat surface of moderate roughness, which on an ordinary photograph has a completely uniform appearance, will produce a hologram that represents the surface relief pattern. The ability of holography to register the distance dimension is, of course, subject to the usual limitations on resolution imposed by the finite wavelength of the light employed. Hence, a hologram of a large, flat, highly polished surface may be uncharacteristic.

If the unevenness of the surface of a specimen can be registered by a holographic process, a distortion of the specimen surface changes its hologram. Hence, a superposition and reconstruction of holograms obtained before and after a mechanical distortion of the surface of an item produces an image with interference fringes that characterize this distortion. Cracks and other flaws, even if located below the surface, that give rise to surface distortion anomalies can sometimes be identified by observing the fringe patterns they produce. Also, bonding defects in composite materials, such as honeycomb panels, can often be located by this technique.

The Moire technique works similarly to holography except that rather than utilizing the natural surface relief of the specimen, a special pattern in the form of a fine grid is employed which is permanently fixed to the surface of the test specimen. The specimen deformation can then be noted by observing the Moire fringes that are produced when a reference grid on a transparent overlay is placed on the test specimen.

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3.3.2.1.4.2. *Photoelastic Coating*

This test reveals the location of stresses at the surface of a test specimen. The specimen is provided with a reflective surface (for instance by polishing it if it is a metal) and covered with a thin firmly attached layer of a special plastic material which under stress exhibits birefringence. After applying a load to the specimen, the coated surface is observed using polarized light and a reflection polariscope to detect the birefringence in the coating. The birefringence indicates the distribution of stresses.

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3.3.2.1.4.3. *Brittle Coatings*

Brittle coatings may be applied to the surface of a test item to evaluate strain patterns. The coatings are either resin based or ceramic based, the latter having the most frequent use in high temperature applications. After the coating material is sprayed on the item, time must be allowed for the coating to dry and become brittle. The coatings will creep with time, and if the item is subjected to strain over an extended period, strain indications will be ambiguous if correction for creep is not made. If the item is strained and then returned to rest, the cracks in the brittle coating may be very tight and difficult to detect. In such cases, crack detection, i.e. strain sensing, may be enhanced by using dye penetrants or electrified particles.

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3.3.2.2. Audio Frequency

3.3.2.2.1. Natural Resonance

A solid test specimen usually exhibits a number of acoustical resonances. The resonant frequencies depend on the specimen geometry and the elastic properties of the specimen material. The manner in which the specimen is clamped or supported also greatly influences the frequencies of its natural resonances. The point on the specimen to which the external excitation forces are coupled and the mode of excitation (i.e., compressional, shear or bending forces) are other factors influencing the resonant conditions.

Observed are not only natural resonant frequencies of the specimen, but also their time decay which represents the damping characteristics of the material or structure. Natural resonances are not limited to the audible range but may reach well up into the ultrasonic domain.

Originally, this method was based entirely on the ability of the human ear to distinguish changes in tone quality (timbre) induced by changes in specimen characteristics. Today attempts are made to substitute electronic equipment for human hearing. This involves the oscillographic display and spectrum analysis of the specimen oscillations induced by the excitation impulse. The most complete electronic analysis is offered by instruments which permit an examination of the attack and decay of the various frequency components contained in the natural vibrations of a specimen.

The natural resonance method is used to determine changes in specimen configuration or elastic properties, gross flaws such as cracks, and distributed defects such as porosity can sometimes be detected. In addition, structural defects such as bond delaminations or component movement may produce characteristic signals.

If the structure to be evaluated has moving parts such as a gear train, the normal operation of the device will generate acoustic signals which when analyzed may indicate deficiencies.

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3.3.2.2.2. Acoustic Emission, Stress Wave

Audio-frequency and ultrasonic signals are produced if a material is mechanically stressed. The amplitude

and frequency spectrum of these acoustic emissions is sometimes a function of fatigue damage, cracks, and other defects in the specimen. The analysis of acoustic emission signals can therefore serve for a detection of such defects.

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3.3.2.3. Ultrasonics

3.3.2.3.1. Imaging, Holography

3.3.2.3.1.1. Probe Scanning

Ultrasonic transmission images can be obtained with a pair of scanning, mechanically linked transducer probes that are mounted in-line facing each other. The specimen which is placed between these transducers has to be immersed in a liquid. The transducers are operated in the through-transmission mode, one acting as a transmitter and the other as a receiver. The amplitude of the signal picked up by the receiver depends on the ultrasonic attenuations in the test specimen. If the received signal is amplified and fed to the intensity grid of an oscilloscope whose X and Y deflection voltages are derived from the transducer scanning mechanism, an image representing the spatial variations in specimen transmissivity is obtained. In another display method a facsimile recorder is substituted for the oscilloscope. By electronically superimposing the received signal with a reference signal of the same frequency, an alternating voltage is generated which represents both amplitude and phase changes introduced by the test specimen. If a small lamp mounted on the transducer scanning mechanism is energized by this voltage and photographed during the scanning process, an optical rendition of the ultrasonic hologram of the test specimen is obtained. As in optical holography, the hologram thus obtained can be reconstructed with a laser beam to yield an image of the specimen.

The ultrasonic imaging techniques described above can be modified to operate in the pulse-echo mode by using a single transducer for transmission and reception. For this mode of operation, a time gating device is used that separates the received signal from the transmitted pulse and from undesirable echoes reflected from interfaces formed by specimen boundaries. To construct a hologram, the ultrasonic pulses interrogating the test specimen must be of sufficient duration to permit electronic mixing with a reference signal.

If the geometry of the test specimen is favorable, pulse echo imaging provides improved sensitivity for the detection of small defects. The pulse echo method cannot be used if the specimen is too thin for separating the defect echoes from the interface echoes by means of electronic time gating.

The main advantage of imaging over hand testing is that it yields easily interpretable information on the cross-sectional size of a defect provided that at least one dimension of the defect is larger than the ultrasonic beam diameter.

3.3.2.3.1.2. Liquid Levitation

Ultrasonic energy of the compressional mode impinging upon a free liquid surface imparts an impulse to the molecules of that surface. This impulse lifts the molecules up against the gravitational forces. As a result, an ultrasonic energy field striking upon a free liquid surface produces a relief pattern corresponding to the spatial variations in the ultrasonic energy level introduced by the transmission characteristics of a test specimen placed in the path of the ultrasonic beam. In order to obtain a visible image, the relief pattern has to be transformed into a spatial light intensity modulation which is accomplished by a Schlieren-optical process. The image contains the outlines of defects such as laminations, inclusions, holes and cracks which are hidden in the ultrasonically interrogated specimen.

By superimposing a homogeneous reference beam of identical frequency on the ultrasonic beam passed through the test specimen, a relief pattern is obtained that represents an acoustical hologram of the test specimen. A laser reconstruction of the relief hologram will yield an optical image that is similar to the one provided by the Schlieren-optical method. Since in both instances ultrasonic images are presented in real time, a test specimen may be viewed in motion which facilitates the detection of defects. In addition to displaying laminar discontinuities, holes, and inclusions, ultrasonic imaging will sometimes even reveal tight cracks that are oriented parallel to the ultrasonic beam provided they are deep enough to produce edge reflections.

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3.3.2.3.1.3. Electronic Scanning

In addition to scanning a test specimen with a moving transducer probe, ultrasonic images can also be obtained by using electronic scanning. For this purpose a thin piezoelectric wafer with a relatively large cross section is used. One side of the wafer is metallized and grounded and faced toward the ultrasonic field to be imaged. The other nonconducting side develops electrical charges corresponding to the impinging ultrasonic energy field. The charges can be detected either by a small, moving electrode or an electron beam scanning over the transducer. The use of electron beam scanning requires that the piezoelectric wafer be mounted as the face plate of an evacuated tube. To withstand the pressure differential the wafer must be provided with a curvature or be laminated to a thicker, ultrasonically transparent face plate.

Electronic imaging methods provide very high test sensitivity but currently suffer from the disadvantage that images are not obtained in real time. This problem could be solved if a mosaic-like solid-state amplification and display panel mounted on the rear surface of the piezoelectric wafer could be developed to dispense with the need for a scanning electrode or electron beam.

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3.3.2.3.1.4. Acousto-Optical Imaging

This method uses plane, longitudinal waves of uitrasonic frequencies. After having passed through the test specimen the waves are directed into a transparent liquid where periodic density fluctuations are formed resembling a diffraction grating. With a coherent light beam intersecting the ultrasonically produced density grating at a Bragg angle, a diffracted image is obtained which represents the ultrasonically interrogated cross section of the test specimen. Usually the ultrasonic transmitter and the test specimen are immersed in the same liquid used for the acousto-optical imaging process. But direct coupling of transducer and specimen and the use of a separate tank for the conversion process is also feasible.

The method can be used in both the transmission and the pulse echo mode. Pulse echo operation requires that the ultrasonic signal and the light beam be pulsed in synchronism with each other.

Images are similar to those produced by the scanning probe procedure but are obtained in real time and thus permit the observation of a moving specimen which greatly facilitates the detection of defects.

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3.3.2.3.1.5. Chemical Detectors

A variety of chemical processes can be used to render ultrasonic energy visible. The following substances have been explored as detectors of ultrasonic fields:

3.3.2.3.1.5.1. Small Particle Suspensions

If a standing ultrasonic wave is set up in a suspension of small particles, the particles tend to accumulate at the displacement nodes of the wave. Particles with ellipsoidal bodies tend to be aligned with their larger axes parallel to the wave front. These effects counteract the random particle distribution due to thermal motion and lead to an image of the ultrasonic field if the suspension is viewed in either transmitted or reflected light. A permanent record of the ultrasonic field pattern can be secured if the particles are suspended in liquid gelatin which is caused to solidify while ultrasonically irradiated.

3.3.2.3.1.5.2. Liquid Crystals

Cholesteric liquid crystals viewed in ambient light change their color if their temperature varies over a certain, predetermined range. This effect can be used to visualize ultrasonic energy fields since ultrasound striking upon a substance ultimately is converted to heat. In another version of this method stress sensitive rather than tempterature sensitive liquid crystals are used which detect the ultrasound field through the stresses it induces.

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3.3.2.3.1.5.3. Thermochromic Substances

There are a number of chemical compounds which, in a manner quite similar to liquid crystals but by a different process, change their color when heated above a certain temperature. Silver mercury tetraiodide is one such compound that has been established as a detector for ultrasound but requires relatively high power levels to produce good indications.

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3.3.2.3.2. Echo Ranging - Distance, Elastic Properties

Pulsed ultrasonic energy can be used to determine the distance from a specimen surface to a discontinuity reflecting ultrasound, or to measure the velocity of ultrasound propagation. An interface within a specimen or a specimen boundary at which an abrupt change in acoustic impedance (which is the product of the density and the ultrasonic velocity) takes place constitutes a discontinuity reflecting ultrasound. If the ultrasonic velocity in the specimen is known, the distance of a discontinuity from the test surface can be derived from the time that elapses between the transmission of the ultrasonic pulse and the return of its echo. Conversely, if the

distance of an interface or boundary can be determined by other means (for instance by mechanical gaging) the pulse travel time will determine the velocity of ultrasound in the particular material. By determining the ratio of the velocities observed for the longitudinal (compressional) and the transverse ultrasonic propagation modes, the elastic properties of a material can be derived. If this ratio is V_R, Poisson's ratio σ, for example, is given by

$$\sigma = (2 - V_R^2)/2(V_R^2 + 1)$$

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3.3.2.3.3. Ultrasonic Spectroscopy

3.3.2.3.3.1. Resonance

An ultrasonically excited test specimen with parallel surfaces exhibits thickness resonances whose fundamental frequency f is governed by $f = c/2d$ where c represents the ultrasonic velocity (usually the velocity of

longitudinal ultrasonic waves), and d the specimen thickness. Harmonic resonances occur at 2f, 3f, etc.

The resonance technique can be used to measure either the ultrasonic velocity in the test specimen or to determine the thickness. Since the fundamental resonance frequency is inversely proportional to the thickness, testing of very thin material can pose a problem. The practical frequency limit for piezoelectric transducers is about 50 MHz which permits the detection of resonances in steel or some ceramic materials down to a thickness of about 0.002 inches.

The equipment used in these measurements employs a highly damped piezoelectric transducer which operates over a wide range of frequencies. Either swept frequency or pulsed signals can be used to excite the various specimen resonances which can then be displayed by a spectrum analyzer. If two consecutive harmonics fall into the frequency range of the transducer the test yields unambiguous data, otherwise the order of the observed resonance has to be deduced by estimating the specimen thickness or velocity, whichever is to be determined.

With an ultrasonic spectroscope employing pulsed signals, thickness resonances can often be obtained even in the case of rough surfaces produced by corrosion. Hence, this method can be used to determine thinning of materials due to corrosion.

If spectral lines caused by resonances are obtained sequentially (which is the process used by all swept frequency spectrum analyzers) the line count over a fixed time interval is directly proportional to the specimen thickness.

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3.3.2.3.3.2. Attenuation

The frequency dependence of the attenuation of ultrasound in a material can be used to determine a variety of structural conditions. The microstructure of solids, for example, can be examined by obtaining their ultrasonic attenuation spectrum over a certain range of frequencies.

Factors influencing the ultrasonic attenuation are grain size, grain boundary conditions, porosity, and inclusions. Preferred grain orientation can produce an anisotropic behavior of the attenuation coefficient.

Equipment used for these measurements consists either of a manually tuned ultrasonic test instrument or, more conveniently, an ultrasonic spectroscope. Instead of the through transmission technique, the pulse echo method is normally preferred because it requires the calibration of only one transducer. Analyzed is the signal reflected from the opposite specimen surface. The advantage of the ultrasonic spectroscope is that it requires an analysis of only the first back echo to obtain the relative amplitudes of the various frequency components. In contact testing, only the first back echo is free from transducer loading effects.

In the case of laminated materials containing a glue line or a layer of solder or brazing material, the attenuation of ultrasonic signals is due to reflections from interfaces. It is a function of the frequency, the thickness of the intermediate layer, and the acoustic impedances of the materials involved.

A test frequency suitable for examining the bond integrity of this type of composite can be determined experimentally with an ultrasonic spectroscope. It can also be theoretically calculated from the equations developed by Rayleigh.

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3.3.2.3.3.3. Defect-Echo Analysis

For defects that are smaller than the ultrasonic beam cross section the defect-echo amplitude obtained by a pulse-echo test is a function of the total configuration of the defect. A relatively large defect with an unfavorable orientation or geometry will sometimes reflect less energy back to the transducer than a small defect that is flat and positioned at right angles to the beam. Consequently, it is very difficult to deduce the size and severity of a defect solely on the basis of its echo amplitude. Additional information can be derived from a pulse-echo inspection; however, if a test signal with a broad frequency spectrum, provided by short pulse duration, is used and the defect-echo subjected to spectral analysis. By comparing the relative amplitudes of the various frequency components contained in the defect-echo spectrum, certain geometrical characteristics of the defect can be ascertained. A defect oriented at an angle with respect to the test surface for instance, exhibits a spectrum whose low frequency amplitudes exceed the high frequency amplitudes because in the echo return, the better collimated high frequencies are deflected to one side and miss the transducer. To cite other examples: defects with sharp edges or multiple defects often produce a periodic spectral structure because they give rise to interference phenomena, a spherical defect presents a different spectrum than a defect with a flat surface such as a crack, and a very small defect reflects high ultrasonic frequencies more readily than low frequencies.

The evaluation of a defect-echo spectrum can be carried further by obtaining a second order spectrum which represents the frequencies of periodicities in the original spectrum.

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3.3.3. Electromagnetic Tests

3.3.3.1. Electrostatics

3.3.3.1.1. Thermoelectric Potential

In thermoelectric potential testing, two probes of a known material are brought into intimate contact with the test specimen. One junction is heated to a predetermined temperature while the other is maintained at room temperature (or at 0°C). The thermoelectric voltage set up between the two junctions which can be measured electronically is a function of material type and can be used as a criterion for sorting purposes.

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3.3.3.1.2. Electromechanical Potential

When an electrically conducting probe is brought in contact with a metal through a liquid electrolyte, an electrical potential is developed between the probe and the metal. For a given probe material, the magnitude and polarity of this voltage depends on the electrode potential of the metal specimen. The method can therefore be used to sort or identify metals.

3.3.3.1.3. Triboelectric Potential

If a known dielectric material is brought in contact with another nonconducting specimen and is then separated from it, a triboelectric potential is set up between the two specimens. A triboelectric series has been established that indicates the order of materials arranged so that the substance with the higher number becomes positively charged after having touched a substance of a lower number. In this series, for example, calcium carbonate has a very high number and hard rubber a very low number. Hence, calcium carbonate particles blown out of a hard rubber nozzle become charged and can be used for electrified particle testing.

Materials can be identified or sorted by establishing their relative position in the triboelectric series.

3.3.3.1.4. Corona

A void or delamination located in electric insulation material is filled with air or gas. Hence, a strong electric field applied to the material will produce an ionization and result in a corona-like discharge and current flow through the defect. The current flow due to corona effects can be observed by monitoring the electric current flowing out of the high voltage source. Another method of detection which also assists in determing the location of the defect uses a radio frequency receiver with a scanning, probe-like antenna to pick up the high frequency oscillations generated by the corona discharge.

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3.3.3.2. Electric Current, Electrical Resistance

Tests involving the measurement of direct current flowing through a specimen of known dimensions can be used to determine its specific resistance (resistivity). While the conductivity of a material, which is the inverse of its resistivity, can also be obtained by eddy current testing, the use of direct current avoids the skin effect and enables a complete penetration of the test specimen. The resistivity of a material can be correlated to a variety of properties such as grain boundary conditions, cold working, residual stresses, impurity content and porosity.

In the case of metallic specimens, direct current or low frequency alternating current can be used to ascertain the depth of surface cracks which are oriented normal to the test surface. The method utilizes two field probes which are brought in contact with the surface of the specimen in such a manner that they span the crack. A constant current is sent through these probes. One or two additional probes can be used to determine the voltage drop across the opening of the crack. Since the current through the field probes is held constant, the magnitude of the voltage drop measured across the crack is proportional to the electrical resistance of the specimen. The resistance, in turn, is influenced by the depth of the crack because the deeper the crack the narrower the current-carrying cross section of the specimen.

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3.3.3.3 Magnetic

3.3.3.3.1. Barkhausen Effect

When a ferromagnetic material is subjected to a relatively slowly increasing magnetic field, its magnetization will change in small steps rather than continuously. The quantized behavior is the result of a certain degree of randomness in the realignment of the magnetic domains of the material with the applied magnetic field. These so called "barkhausen jumps" can be detected by an induction coil encircling the specimen and after amplification, be reproduced by a speaker. Hence, the phenomenon is also called "Barkhausen noise." By plotting the Barkhausen noise signal amplitude versus the strength of the magnetic field, characteristic curves can be obtained, which vary in accordance with the thermal and mechanical history of the specimen. Cold working and heat treatment of a material affect its Barkhausen noise signal. The method has also been used for determining residual stress in steel.

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3.3.3.3.2. Eddy Current

Eddy currents are set up in an electrically conducting test object if it is subjected to a varying magnetic field generated, for instance, by a coil carrying an alternating electric current. The magnetic reaction of these eddy currents on the field coil or on a second, auxiliary probe coil, is analyzed for amplitude and phase information to obtain the electrical conductivity and the magnetic permeability of the specimen. The data can, in turn, often be correlated to the microstructure and the heat treating or cold working history of the tested material.

The method is used with large encircling coils to determine overall specimen characteristics or with small probe coils to detect local variations of specimen properties. In the latter form, the procedure lends itself to an examination for surface or subsurface defects such as cracks, pores, and other inhomogeneities. The im-

plementation of a probe coil inspection procedure and the results of such a test are often similar to those obtained by a magnetic leakage field inspection. The main difference is that in eddy current testing, the depth of penetration into the specimen can be controlled by selecting the frequency of the alternating field current. If a spectrum of frequencies is involved, as is the case with a pulsed field current, the frequency dependence of eddy current amplitudes and phases can sometimes provide further data on certain specimen characteristics such as case hardening.

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3.3.3.3.3. Magnetic Perturbation

3.3.3.3.3.1. Static Magnetic Field

Ferromagnetic materials can be inspected for surface and subsurface defects by a magnetic procedure. In this method, the test specimen is magnetized by sending an electric current through it or by placing it between the pole shoes of a magnet. Defects are detected by scanning the specimen with a magnetic probe which senses the magnetic perturbations caused by surface discontinuities. Subsurface defects can also be found if they give rise to sufficient magnetic field inhomogeneities at the specimen surface. As probes, either Hall detectors

or induction coils are used which are hand held or attached to a mechanical scanning mechanism. In contract to Hall probes, induction coils require rapid motion relative to the magnetic leakage field to generate adequate output voltages. In the case of crack detection, both the magnetizing field and the probe scanning direction must have components normal to the crack orientation. Hence, to consider all possible crack geometries, two orthogonal magnetization and scanning processes are required. If the tested material exhibits adequate magnetic retentivity, the test can be divided into two steps, magnetization and subsequent probe scanning.

3.3.3.3.3.2. Electric Current

An electric current established in a conductive specimen by either an induction coil or electrodes will cause the formation of a magnetic field at the surface. Discontinuities and inclusions close to the surface of the specimen will disturb the electric current flow which, in turn, will produce perturbation of the associated magnetic field. This technique is used on non-magnetic, electrically conductive metals. The detection of the magnetic field perturbation is accomplished with inductive coils used with electronic enhancement of the signal-to-noise ratio since the field perturbations are quitesmall compared with the field perturbations produced by magnetic inspection for flaws in ferromagnetic materials.

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3.3.3.4. Radio Frequency

3.3.3.4.1. Dielectric Test

In addition to corona testing, electrical insulating materials can be inspected for bulk properties by measuring their dielectric characteristics. Determined is the complex dielectric constant whose reactive component represents the material electrical polarizability and whose resistive component corresponds to the dielectric loss caused by the frictional resistance the material offers to induced polarization currents. It may be necessary to make measurements over a wide range of frequencies from audio to microwave regions to find a suitable frequency for detecting a particular material property.

The method can be used for determining properties such as density, porosity, contamination, and water content. In addition, the technique can be used for monitoring the thickness and integrity of insulating foils and plates by passing them through an air gap capacitor and monitoring its capacitance.

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3.3.3.4.2. Magnetoabsorption

When a ferromagnetic material is placed in a radio frequency coil and is magnetized, the radio frequency loss in the coil is found to be a function of the strength of the magnetic bias field. The relationship between the loss factor and the magnetic field strength is called a magnetoabsorption curve and is directly related to the relative reversible permeability of the specimen. Experiments conducted with iron and nickel wire indicate that annealing and cold working will influence the shape of the magnetoabsorption curve. Fatigue, stress magnitude, and stress direction also influence the magnetoabsorption curve of the tested material.

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3.3.3.4.2.1. Electron Paramagnetic Resonance

Paramagnetic materials are composed of atoms having at least one unpaired electron. Electron paramagnetic resonances involve the precession of such unpaired electrons in a uniform magnetic field. Depending on the applied magnetic field and the type of atoms or ions contained in the test specimen, the precessional spectra of electrons can contain resonance frequencies of up to 10 GHz. In cases where the internal molecular structure results in shifting and splitting of spectral lines the method can be used to study molecular and crystalline structure.

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3.3.3.4.2.2. Nuclear Magnetic Resonance

When a substance containing nuclei with a net magnetic moment is placed in a strong, constant magnetic field, transitions between magnetic energy states can be induced by a superimposed radiofrequency field. Resonances representing the nuclear energy state transitions can then be determined by noting the accompanying radio frequency power absorption. Nuclear magnetic resonances cover a wide range of frequencies (up to 100 MHz). They depend on the magnetic field strength and the type of elements or isotopes contained in the test specimen. In addition, nuclear magnetic spectra are influenced by the lattice structure of the test specimen. The method is used for chemical analysis including the determination of trace elements and impurities. In addition, defects such as dislocations and boundary discontinuities can be detected. Since the method is sensitive to the distribution of atoms, it has potential for the detection of embrittlement due to migration of impurities to grain boundaries.

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3.3.3.5. Microwaves

3.3.3.5.1. Transmission

A microwave beam passing through an electrically nonconductive material undergoes changes in amplitude and phase. These changes are influenced by discontinuities such as voids and delamination in the material. One method of determining the phase and amplitude changes is to reflect the wave from a metal plate in order to obtain standing waves. The locations of the nodes and the amplitude of antinodes of the standing wave will then reveal changes in phase and amplitude. With this type of experimental arrangement, the test specimen is placed between the microwave antenna and the reflector plate. The attentuation of microwaves due to scattering from numerous small discontinuities such as pores can be measured by placing the specimen between the antennas of a transmitter and a receiver and observing the decrease in received signal.

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3.3.3.5.2. Reflection, Mode Change

The determination of changes in the phase and amplitude of microwaves reflected from the surface or from internal discontinuities of a specimen can provide an assessment of the integrity of an item. By using two transmitter and receiver systems, and comparing the microwave signals reflected from two opposite surfaces of a specimen its thickness can be monitored without mechanical contact.

Cracks located at a metallic surface can be detected by reflecting microwaves from the specimen surface. In this test, the transmitter and the receiver are decoupled by using a propagation mode for the transmission that is orthogonal to the mode detected by the receiver. A suitably oriented crack will couple microwave power between these orthogonal modes and produce a reflected signal. If a radiating transmission line (a so called stripline antenna) is used in place of an antenna horn, large areas of the test specimen can be electronically scanned for cracks having a geometrical component normal to the transmission line.

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3.3.3.5.3. Microwave Holography

Liquid crystal panels can provide real time images of microwave field strength distributions over a prescribed area. Employing millimeter waves and using an interferometric set up, a microwave hologram can be obtained. The reconstruction of this hologram through an optical process involving a laser light source, yields an image representing the spatial variations in dielectric properties exhibited by the item interrogated by the microwave signal.

Since the liquid crystal detector is a heat sensitive device, relatively high microwave intensities are required. Hence, the method is probably suitable only for through transmission testing and therefore limited to the inspection of nonmetallic materials. However, the inspection of composite materials, consisting of metallic fibers or whiskers in a nonmetallic matrix, may be feasible.

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3.3.3.5.4. Microwave Spectroscopy

3.3.3.5.4.1. Absorption Spectra

Microwave molecular absorption spectra arise mostly from the rotational energy states of molecules. A spectral line signifies a transition between two stationary rotational energy states involving electromagnetic radiation. Frequencies range from 1 GHz to 300 GHz. The method can only be used to identify molecules as a whole rather than individual elements. The molecules to be identified must exhibit a magnetic or electric dipole moment and have a vapor pressure and concentration that in relation to their absorption coefficient is sufficient for their detection.

3.3.3.5.4.2. Nuclear Quadrapole Resonance

Transitions in quadrupole orientation energies of the atomic nuclei of a solid can be observed directly through their microwave absorption spectrum. In gases they can be observed as perturbations of the rotational spectrum obtained in the microwave range.

The method is used to characterize molecules which do not exhibit a polarity that would render them detectable by microwave molecular absorption techniques.

3.3.3.6. Infrared

3.3.3.6.1. Heat Flow, Temperature

Surface temperature measurements conducted with infrared radiation detectors can be used to determine the heat flow into or out of a test specimen, without contacting the surface. Discontinuities such as voids and delaminations which impede the flow of heat can be detected. Conversely, the effectiveness and uniformity of materials used for thermal insulation can be examined by the heat transmission techniques. To correctly measure the surface temperature of an item. With an infrared detector, the surface of the item must have a constant emissivity. Hence, a uniform application of a coating with known infrared emissivity is often a prerequisite of the test.

Infrared cameras which provide thermograms of the specimen surface can be employed to determine the size and location of defects. Thermograms can also be obtained with cholesteric liquid crystals. These substances selectively reflect certain wavelengths of light which depend on the temperature of the crystals. A liquid crystal thermogram therefore is multicolored with each color representing a particular temperature range. Other thermochromic compounds such as paints and phosphors as well as meltable substances have been used to form thermograms.

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3.3.3.6.2. Infrared Spectroscopy

Infrared radiation covers the electromagnetic spectrum situated between the microwave and the visible range. Infrared absorption spectroscopy is used in chemical analysis, particularly for organic compounds.

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3.3.3.7. Optical Testing

3.3.3.7.1. Visual Inspection

This is the oldest NDT method. It can be enhanced by the use of optical magnification of the inspected specimen surface and by the use of closed circuit television systems for remote monitoring. If access to the surface to be inspected is difficult due to the specimen geometry, an optical or closed circuit television borescope can be used. The optical borescope can be improved by utilizing fiber optics to look through small openings, around corners or view small diameter bores.

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3.3.3.7.2. Optical Spectroscopy, Corlorimetry

Characteristic spectral lines arise from transitions between energy states of molecules and atoms and can be used to characterize a material with regard to its chemical composition. In comparison to X-ray spectroscopy, optical spectra are very complex and require special analysis methods or equipment. Automated and computerized spectrometers are available for fast quantitative chemical analysis. Both emission and absorption spectroscopy are used

Colorimetry is a qualitative form of spectroscopy used to empirically determine the concentration of solutions and to grade products.

3.3.3.8. X-Rays

3.3.3.8.1. X-Radiography

X-rays can be transmitted through thick sections of most materials. Their unusual penetrating power is based on two facts. First, X-rays do not encounter reflective scattering at structural interfaces because at their high radiation energies the index of refraction is constant (about 1) for all materials. Secondly, the transmission of X-rays is not affected by conduction band electrons which are responsible for the high absorption and

reflectivity of metals at lower radiation energy levels as for instance the visible range.

Radiographs are essentially shadowgraphs with the image contrast depending on the degree of variation in thickness, density, and/or atomic number of the penetrated material. The image definition is inversely proportional to the diameter of the radiation source and specimen to detector distance and is improved as the radiation source to specimen distance increases.

As detectors, photographic film, fluorescent screens, and television camera tubes with faceplates that are specially sensitized to X-rays are used. Also, a solid state image conversion panel has been developed for X-rays. For attainment of optimum image quality, photographic film is still considered to be the best detector.

Radiography will detect a large variety of defects as long as they constitute a sufficiently large spatial variation in penetrated mass or atomic number. The energy of available radiation sources ranges from a few kiloelectron volts to many megaelectron volts. It has to be chosen in accordance with the material and the size of the specimen. Higher atomic numbers, thicker sections, and higher density require larger radiation energies. Since the attenuation of X-rays in a material follows an exponential decay law, an increase in detector exposure time or radiation intensity produces an increase in penetrating power even if the radiation energy remains equal.

The contrast of film radiographs can be enhanced by the use of special scanning photometers or by an electronic amplification of the variations in film density. Computerized and photographic image enhancement techniques also have been used to improve film radiography.

Enlarged images can be obtained by employing a fine grain film and subsequently using a photographic enlargement process or by producing an enlarged geometric projection of the test specimen.

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3.3.3.8.2. X-Radiometry

If only a small area of a specimen is to be inspected, high sensitivities can be attained by the use of electronic radiation detectors (radiometers) in conjunction with electronic counters or sealers. This technique is employed in applications such as thickness monitoring of material being produced on an assembly line, height of fill of material inside a container such as a can, and monitoring of component presence or absence on an assembly.

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3.3.3.8.3. X-Ray Diffraction

The diffraction of X-rays by a crystalline or other type of ordered structure can yield information on a variety of material properties. The method is used with through transmission as well as back scattering procedures. Filters or curved diffraction grids provided by bent single crystal wafers are used to produce the required monochromatic radiation. Diffraction patterns are obtained on photographic film or are registered by means of scanning radiation detection devices coupled with chart recorders. To examine single crystals or textured structures of specimen the scanning process must cover a solid angle. Precise goniometer mechanisms are required for these measurements to obtain exact values of diffraction angles.

Material properties that can be determined by this method include: crystal lattice constants, textures, grain sizes, metallurgical phases, dislocation densities, and stresses. Residual stresses can best be determined by the back scatter technique.

Penetration of the test specimen by the X-rays depends on the energy of the radiation. Since the electron voltages of the characteristic X radiation (e.g.,) most often used in diffraction work are only of the order of 10,000 electron volts the penetration of metals is limited to a shallow surface layer.

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3.3.3.8.4. X-Ray Spectroscopy

X-Ray spectra of the elements are considerably less complex than optical spectra and offer a superior method for determining chemical composition, alloying constituents, traces, impurities and coatings. The instrumentation used for X-ray spectroscopy is similar to X-ray diffraction equipment. It consists of a radiation detector, a goniometer, and a chart recorder. An analyzer crystal with a known lattice constant is placed in the center of the goniometer to obtain angle indications which correspond to the various characteristic X-ray wavelengths emitted by the elements in the specimen. To excite these characteristic X-ray wavelengths the specimen can be irradiated with an X-ray source generating a continuous spectrum (Bremsstrahlung) of adequate energies or if the specimen can be placed in a vacuum by electron bombardment.

Since air strongly absorbs the characteristic X-radiation of elements whose atomic number is below 13 (Aluminum) the goniometer must be placed in an evacuated chamber to detect such elements.

If used with a scanning electron beam the method provides a point-by-point chemical microanalysis of a surface.

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3.3.3.8.5. Back Scattering

Back scattered X-rays and gamma-rays can be employed for gaging thin materials. There are two scattering mechanisms producing coherent and incoherent (the Compton effect) scattering. Compton scattering involves the interaction of X-rays with the orbital electrons of an atom. Since the electron when liberated from its orbit is accelerated, it takes up energy which results in scattered radiation having a lower energy level than the incident radiation. The energy loss increases with the scattering angle. In the second scattering process, coherent scattering, the scattered energy is identical to the incident radiation. A third mechanism is involved when material is excited by X-rays, that being fluorescent radiation. The material will fluoresce when the incident radiation liberates another X-ray whose energy is characteristic of the element.

As long as the self-absorption of scattered radiation by the specimen is insignificant, the intensity of the back scattered radiation is proportional to the thickness of the test specimen. The method can be used to monitor the thickness of sheet material and foils. Coatings such as tin plating on steel may be analyzed with the fluoresced X-rays. Most commercial instruments are capable of analyzing both scattered and fluoresced X-rays.

The normally stringent requirements for the stability of the X-ray source and the radiation detection equipment can be relaxed if a differential method is used employing two detectors. In the case of gaging zinc coatings on steel, for example, one detector senses the characteristic radiation of zinc and the other that of steel. The coating thickness is then determined from the difference in the two radiation levels.

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3.3.3.9. Gamma-Rays

3.3.3.9.1.Gamma Radiography

Gamma radiography, like X-radiography, is used to make shadowgraphs of the penetrated materials. Several differences and similarities exit between the two techniques. X-radiation is produced by bombardment of a target with electrons. The target material emits a continuum of electromagnetic quanta ranging from the lowest energy photon which will penetrate the window in the X-ray tube up to some maximum energy value determined by the energy of the impinging electrons. Gamma-rays are produced by the transition from one nuclear level to another or by the disintegration of an elementary particle. In either case, the result is an emission of photons, the majority of which have a relatively narrow frequency range. On the other hand, an X-ray and a gamma ray having the same energy level are fundamentally identical and react with matter in the same way. One of the advantages of gamma radiography is that it can be accomplished with radioisotopes and does not require a high voltage power supply necessary for the generation of X-rays. Because of the broad spectrum of the X-ray energy spectrum as opposed to the single peak of gamma radiation, X-ray radiographs generally have more contrast thereby providing somewhat greater definition.

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NT-014158

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3.3.3.9.2. Gamma Radiometry

Gamma radiometry is similar in application to X-radiometry. It is used for inspection or examination of small areas of the specimen and results in either digital or analog signals related to the through transmission characteristics of the specimen. Radiographic images are not produced.

Selected References

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3.3.3.9.3. Gamma Ray Diffraction

Gamma ray diffraction, like X-ray diffraction, measures the diffraction angles of the crystalline structure of the test specimen. The advantage of gamma rays is that they are mono-energetic and therefore produce spectra of higher resolution than X-ray spectra.

3.3.3.9.4. Mossbauer Spectroscopy

The energy of a gamma ray source used to irradiate a test specimen can be changed by Doppler-shifting. A precise Doppler shift can be obtained if the source is moved relative to the specimen with the help of a Mossbauer motor. Such fine tuning of gamma ray energies makes it possible to explore the absorption spectrum for gamma rays exhibited by a test specimen. The so called Mossbauer Spectrum is dependent upon nuclear energy transitions and characterizes the types of atoms contained in the specimen and also their lattice arrangement.

Elements containing isotopes that exhibit nuclear resonances suitable for Mossbauer spectroscopy are: iron, nickel, zinc, tin, tellurium, iodine, tungsten, iridium, platinum, and gold. Most widely studied has been iron, whose 57 isotope has a natural abundance of 2% and exhibits a 14.4 KeV transition energy. Since this is a relatively low energy, only thin specimens can be examined in a transmission test determining the absorption of gamma rays in the specimen. Thick specimens require a front-surface method involving measurements of either the relatively low level re-emission of absorbed 14.4 KeV gamma rays or the more intense 6.4 KeV characteristic X-radiation of iron resulting from the resonant absorption of incident 14.4 KeV gamma rays. The penetration depth is only a few thousandths of an inch.

In the case of iron, a Mossbauer spectrum will reveal the interaction of nuclear gamma-ray resonances with the lattice structure and the magnetic properties of a material. The method can therefore be used to determine phases in steel, the nature of surface corrosion and possibly residual stresses existing at the surface of a specimen.

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3.3.4. Methods Employing a Probing Medium

3.3.4.1. Liquid Penetrant

3.3.4.1.1. Visible Dye

There are a number of penetrant "systems" consisting of various combinations of penetrants, dyes, emulsifiers, developers, and penetrant removers. Each system has certain advantages and have specific applications for which they are best suited. Visible dye penetrants are generally less sensitive than fluorescent penetrants and are often used to detect cracks in materials leaving rough surfaces and porosity such as castings. The method consists of cleaning the specimen surface, drying, applying the penetrant, removal of excess penetrant, and application of a developer. The time of penetrant dwell before the excess is removed and the time of developer dwell affect the test sensitivity and are normally determined by specimen temperature, air temperature, expected defect depth, and expected defect width.

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NT-014875

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Fricker, Richard T.; "Training and Qualification of Liquid Penetrant Inspectors," Paper Summaries, ASNT Spring Conf., 1977.

3.3.4.1.2. Fluorescent Dye

Visible dye penetrant tests can be made more sensitive by substituting a fluorescent penetrant to render the defect indications more visible. Use of a fluorescent penetrant requires subsequent examination in a darkened area with an ultraviolet light. The method has been used to detect cracks in the anodized coating on aluminum. The primary requirement of any penetrant test is that the defect be open to the surface although it need not be a through wall defect.

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3.3.4.2. Gaseous Penetrant

3.3.4.2.1. Krypton 85

The radioisotope Krypton 85 can be employed as a tracer gas in leakage tests, or it can be used as a gaseous penetrant. In the latter case, the test specimen is placed in a container filled with Krypton 85 under pressure. This results in cracks, pores and other discontinuities which are open to the surface being invaded by the radioactive gas. The gas is absorbed at the internal surfaces produced by these defects. Hence, a subsequent radiometer scanning or auto-radiographic process will reveal their location and configuration. In addition to detecting cracks the technique can be used to study wear, erosion and chemical attack.

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3.3.4.2.2. Leak Testing

To reveal leaks, gaseous probing media can be used. Various types of processes can be used for detecting gas leakage through a defect.

Selected References

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NT-015372

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3.3.4.2.2.1. Bubble Method

In this method the test specimen is immersed in a liquid or coated with a soap solution. The leak is detected by observing the bubbles formed by the escaping gas. If the specimen is immersed, the test can be made more sensitive by using a liquid with a low surface tension and by reducing the ambient pressure.

Selected References

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"Standard Method of Testing for Leaks Using Bubble Emission Techniques," Rept. No. ASTM E515, 1977 Annual Book of ASTM Standards, Pt. 11, pp 587-589, 1977.

3.3.4.2.2.2. Mass Spectrometry

High sensitivity permitting the detection of very small leaks is provided by mass spectrometry. One approach is to connect a vacuum pump together with a mass spectrometer internally to the test object. The leak is found by passing a source of tracer gas over the outer surface of the specimen. In another version of the test, the tracer gas is pumped into the specimen and air samples for mass spectrometry analysis are taken from the outer surface of the specimen. A common tracer gas, providing very high sensitivity, is helium.

Selected References

NT-015321

"Standard Method for Calibration of Helium Leak Detectors by Use of Secondary Standards," Rept. No. ASTM F78, 1976 Annual Book of ASTM Standards, Pt. 43, pp 363-366, 1976.

NT-015315

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3.3.4.2.2.3. Positive-Ion Probe

Halogen vapors can be used as probing media for leak detection. They are detected with a special probe electrode emitting positive ions. In the presence of halogen vapor, the electrode is poisoned which results in a reduction of the electric current associated with the ion emission process that can be electronically indicated.

Selected References

NT-015358

"Standard Recommended Practice for Testing for Leaks Using the Halogen Leak Detector (Alkali-Ion Diode)," Rept. No. ASTM E427, 1977 Annual Book of ASTM Standards, Pt. 11, pp 508-516, 1977.

3.3.4.3. Macroscopic Particles

3.3.4.3.1. Electrified Particles

The electrified particle method can be used to inspect electrically nonconducting coatings on metals for defects. The method employs small particles of specially selected white, grey, or black calcium carbonate which are blown through a spray gun having a hard rubber nozzle. Triboelectric action renders the particles emerging from the nozzle of the spray gun positively charged. The charged particles are attracted to cracks and holes in the coating because due to electrostatic influence, charges are built up in the metal at the sites of defects.

If the entire test specimen is electrically nonconductive, the surface of the specimen must first be treated with water containing a wetting agent. By penetrating into surface discontinuities, the water renders these spaces electrically conductive and capable of developing negative charges in response to the electrostatic influence generated by the electrified particles. The method is also effective for detecting subsurface defects if the defects can be filled with water penetrant from the opposite surface which may otherwise be inaccessible.

3.3.4.3.2. Magnetic Particles

Ferromagnetic materials can be inspected for surface and subsurface defects by magnetizing the specimen with either a permanent magnet or electromagnet. Small ferromagnetic particles, when applied to the specimen surface, will accumulate at the surface of the magnetic leakage field. They have the advantage of producing a visible outline of the discontinuity on the surface of the test specimen. The visibility of these traces can be improved by coating the magnetic particles with a fluorescent substance and examining the specimen in ultraviolet light. To facilitate the movement of magnetic particles to the sources of leakage fields, a suspension of particles in a liquid such as light oil can be used instead of blowing the dry magnetic particle powder onto the test specimen.

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3.3.4.3.3. Filtered Particles

The attempt to inspect materials having porous surfaces by means of liquid penetrants may result in poor contrast due to a haze of background indications. This problem can be alleviated by using a suspension of colored or fluorescent particles in a colorless liquid. When such a suspension is sprayed on the test specimen, the liquid will seep into cracks and similar surface defects leaving the particles behind at the surface. The defects therefore manifest themselves through an accumulation of filtered out particles. The most significant use of this method is in the inspection of unfired clayware.

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Hughes, E.T. and Powers, D.R.; "Inspecting with Filtered and Electrified Particles," AD 194196.

NT-000192

Betz, C.E.; "Two New Testing Methods for Ceramic Products," AD 191160, 1948.

3.3.4.4. Atomic Particles

3.3.4.4.1. Ion, Alpha, Proton Radiation

The use of ion, alpha, and proton beams for radiographic purposes is still in a laboratory stage. The radiation can be used to detect defects or to gage material thickness.

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NT-012528

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NT-011782

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NT-010740

Hartemann, P. and Morizot, M.; "Variation of Surface — Acoustic-Wave Velocity Produced by Ion Implantation," IEEE (SU) Ultrasonics Symposium Proc., pp 307-310, Nov 1974.

NT-009582

Schulman, James H.; "X-Ray Imaging by Ionography,"Rept. No. ESN-29-4, European Scientific Notes, pp 190-193, Apr 1975.

NT-008783

Hunt, Robert C.; "Specific Ion Measurement for Process Control," Instrum. & Control Syst., Vol 47, No. 12, pp 50-51, Dec 1974.

3.3.4.4.2. Radio-Isotope Tracer

Artificially produced radioactive isotopes of elements added to their stable isotope, or isotopes, will render them traceable by means of radiation detection. Either photographic film or electronic radiation detectors can be used to determine the location and concentration of the tracer. The method is applicable to the study of wear caused by abrasion, corrosion, or oxidation. In metallurgy, tracer methods enable the determination of the distribution of alloying constituents and the study of diffusion processes. This technique produces excellent wear data on internal combustion engines which have been fitted with irradiated piston rings. The wear data is developed by monitoring the radioactivity of the engine lubricating oil.

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Semel, Stanley, et al; "A Radioactive Tracer Method for the Inspection of the Delay Element in M200 Series Hand Grenade Fuzes," AD 695635, Sep 1969.

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3.3.4.5. Sub-Atomic Particles

3.3.4.5.1. Electrons, Beta Radiation

3.3.4.5.1.1. Electron Microscopy

The method of electron microscopy is limited to specimens that are small enough in size to fit into an evacuated chamber. Two techniques have evolved in recent years which seem adaptable to solving NDT problems.

Electron mirror microscopy involves the reflection of an electron beam by the specimen which is biased slightly negative with respect to the cathode. The information in the reflected beam is presented visually on a phosphorescent screen. Electrical and magnetic as well as structural patterns of the specimen surface can be observed. The effects of stresses and strains on the specimen surface can be detected.

A scanning, highly-focused electron beam may be employed to interrogate the surface of a test specimen. Back emitted electrons provide an image of the specimen surface on a phosphorescent screen. The method can also be used for a point-by-point X-ray spectroscopy of the specimen surface. In conjunction with an Auger analyzer the energies of secondary electrons liberated from the specimen surface can be determined which enables the analysis of light elements and the study of monolayers on surfaces.

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NT-013491

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NT-013261

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3.3.4.5.1.2. Electron Diffraction

According to the DeBroglie hypothesis and quantum mechanics, an electron with a momentum P is associated with a wavelength λ by $\lambda = h/p$ where h is Planck's constant. Beams of electrons with wavelengths having the same order of magnitude as atoms or molecules are easily produced and can be used to study crystal structures in a manner similar to X-ray diffraction experiments. Electrons, however, provide less penetration than X-rays.

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NT-008970

Phillips, G.A., et al; "Modern Techniques Reveal Ceramic Surfaces," Industrial Research, pp 46-50, Dec 1974

NT-008854

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NT-012561

Wendelken, John Franklin; "High Resolution Low Energy Electron Diffraction from the Aluminum (100) Surface," AD A025348, Oct 1974.

3.3.4.5.1.3. Beta Particle Thickness Gaging

The absorption or back scattering of beta particles can be utilized to gage thin materials on the production line. A radioisotope is used as the radiation source and an ionization chamber serves as a detector. High stability of the gaging process can be attained with a differential method in which comparisons are made to a second, identical source and detector interacting with a reference specimen.

Maximum thicknesses that can be gaged by this method range from 0.02-inches in steel, brass, and copper to 0.2-inches in materials such as paper and rubber.

Selected References

NT-015268

"Standard Method for Measurement of Coating Thickness by the Beta Backscatter Principle," Rept. No. ASTM B567, 1975 Annual Book of ASTM Standards, Pt. 9, pp 385-391, 1976.

NT-013712

Abel, A.B.; "Nondestructive Methods for the Acceptance of Plating Thickness on Printed Circuit Boards," Rept. No. BDX-613-1044, 1973, (For sale by NTIS, Springfield, VA).

NT-010904

Latter, D.T.; "Measuring Coating Thickness by the Beta-Backscatter Technique," British J. Non-Destr. Test., Vol 17, No. 5, pp 145-147, 149-152, Sep 1975.

NT-010126

Brown, F.W., III; "Measurement of Paint Film Thickness by Beta-Ray Backscattering," Rept. No. NCEL-TN-847, AD 684431, Oct 1966.

NT-009100

Gardner, R.P. and Dunn III, J.W.; "Simultaneous Use of Beta-Particle Transmission and Backscatter Gauges for Determining Hydrogen, Carbon, and Oxygen Percentages in Liquids," Analytical Chem., Vol 37, No. 4, pp 528-530, Apr 1965.

NT-009106

Danguy, Louis and Grard, Fernand; "Thickness Measurement of Thin Layers by the Backscattering of Beta Rays," Institut Interuniversitaire Des Sciences Nucleaires, Centre De La Faculte Polytechnique De Mons.

NT-009102

Zumwalt, L.R.; "The Best Performance from Beta Gages," Nucleonics, Vol 12, No. 1, pp 55-58, Jan 1954.

3.3.4.5.1.4. Exo-Electrons

Exo-electrons are emitted from metal surfaces as the result of mechanical action disturbing the surface

structure. To measure exo-electron currents, an electric voltage is applied between the test specimen and an electrode located close to the surface element being examined. To release exo-electrons the specimen usually must be heated. Irradiation of the specimen surface with ultraviolet light increases the exo-electron current by a considerable factor but also produces a background current due to photoelectric electron emission. In some instances it is even possible to observe exo-electron currents without a reduction in ambient air pressure.

The method has been used to detect fatigue damage, surface crack initiation, annealing, and grinding effects.

Selected References

NT-015109

Rabinowicz, Ernest; "Exoelectrons," Scientific American, Vol 236, No. 1, pp 74-82, Jan 1977.

NT-014790

Alimov, V.I.; "Exoemission Defectoscopy of the Initial Stages of Fatigue Fracture," Sov. J. Non-Destr. Test., Vol 12, No. 5, Oct 1976, pp 504-507, Jul 1977, (English translation published by Plenum Publishing Corp, N Y).

NT-014717

Baxter, W.J.; "Laser Scanner for Exoelectron Display and Measurement of Fatigue Damage," J. Test. and Eval., Vol 5, No. 4, pp 243-250, Jul 1977.

NT-014224

Buck, O., et al; "Deformation Enhanced Photoemission from Aluminum," Applied Physics, Vol 12, No. 4, pp 301-310, Apr 1977.

NT-013822

Thompson, D.O., et al; "Fatigue-Induced Photoelectron Enhancement (Exo-Electron) From Aluminum," J. Applied Physics, Vol 47, No. 9, pp 3846-3857, Sep 1976.

NT-011998

Buck, Otto; "Energy Dependence of Fatigue-Enhanced Photoemission," Proc. of ARPA/AFML Rev. of Quant. NDE, pp 681-694, Dec 1975.

NT-009905

Baxter, William J. and Rouze, Stanley R.; "Photostimulated Exoelectron Emission from Slip Lines: A New Microscopy of Metal Deformation," J. Applied Physics, Vol 44, No. 10, pp 4400-4404, Oct 1973.

NT-011468

March, P.A. and Rabinowicz, E.; "Exoelectron Emission for the study of surface Fatigue Wear," Contract No. DAHC04-74-0028 sponsored by U.S. Army Research Office, Durham, N.C.

NT-009628

Martin, George, et al; "The Early Detection of Fatigue Damage," Rept. No. NA-69-173, Feb 1969, (Bibliography).

NT-009002

Himmel, L.; "Exo-Electron Emission From Metals," Rept. No. AFML-TR-74-238, Proc. Interdisciplinary Workshop for Quantitative Flaw Definition, pp 503-506, Nov 1974.

3.3.4.5.2. Neutrons

3.3.4.5.2.1. Neutron Radiography

The attenuation coefficient of a material for neutron beams can be quite different from that for X-radiation. This is because in neutron radiography the neutron cross sections of the atomic nuclei contained in a material determine the attenuation while in the case of X-rays the energy levels of orbiting electrons of the atoms are the determining factor. Many light elements, notably boron, hydrogen and lithium exhibit much higher attenuation for neutrons than for X-rays. Conversely, lead and uranium, are examples of materials that are difficult to X-ray but easily penetrated by neutrons. As a result, neutron radiography can provide results not obtainable by X-radiography. A case in point is the radiographic visualization of explosive material contained in a steel projectile body using neutron radiation.

The neutron absorption of a material can be changed by additives. For instance, doping Fe with only 0.01 atomic percent of Gd[157] will increase its effective thermal neutron cross section by a factor of three.

Selected References

NT-014982

Halmshaw, R.; "Image Quality in Neutron Radiography," British J. Non-Destr. Test., Vol 19, No. 5, pp 230-233, Sep 1977.

NT-014870

Haskins, Jerry; "Standards for Neutron Radiography," Rept. No. ASTM STP 624, Nondestructive Testing Standards - A Review, pp 108-114, 1977.

NT-014335

Cassidy, J.P.; "Use of a Van DeGraaff Accelerator for Neutron Radiography," Paper Summaries, ASNT Spring Conf, Mar 1977.

NT-014299

Garrett, Donald A., et al; "Innovations in Neutron Radiography," Paper Summaries, ASNT Spring Conf, Mar 1977.

NT-014250

Richardson, A.E.; "Improved Images in 14.5 MEV Neutron Radiography," Materials Evaluation, Vol 35, No. 4, pp 52-58, Apr 1977.

NT-014242

Petersen, D.H. and Dance, W.E.; "Detection of Adhesive Bond-Line Flaws by Neutron Radiography," Advances in Joining Technology, pp 583-591, 1976.

NT-014090

Tyufyacov, N.D., et al; "Neutron Radiography Features of Laminated Objects," 8th World Conf. on NDT, Cannes, France, 5 pp, Sep 1976.

NT-014089

Gorbunov, V.I. and Pekarsky, G. Sh.; "Neutron Radiometric Testing of Laminated Products with Metal Screens of Variable Thickness," 8th World Conf. on NDT, Cannes, France, 4 pp, Sep 1976.

NT-014086

Berger, H. and Bracher, D.A.; "Real-Time Thermal Neutron Radiographic Detection Systems," 8th World Conf. on NDT, Cannes, France, 7 pp, Sep 1976.

NT-014085

Garrett, D.A. and Bracher, D.A.; "Electronic Imaging Applied to Neutron Radiography," 8th World Conf. on NDT, Cannes, France, 6 pp, Sep 1976.

NT-013827

Berger, Harold; "The Present State of Neutron Radiography and Its Potential," Materials Evaluation, pp 55-65, Mar 1972.

3.3.4.5.2.2. Neutron Diffraction

The diffraction of a neutron beam follows similar principles as electron beam diffraction. Neutrons, however, will penetrate materials much more readily than electrons. Furthermore, since neutrons possess intrinsic magnetic moments, their interaction with a material is subject not only to the distribution of the atomic nuclei but also to the distribution of the magnetization resulting from electron spin. Hence, the magnetic structure of ferromagnetic materials can be explored by this method.

The equipment used for neutron diffraction experiments is similar to X-ray diffraction equipment and produces similar data displays.

Selected Reference

NT-013664

Miller, J.W. and Hewitson, V.S.; "Applied Small-Angle Neutron Diffraction," European Scientific Notes, pp 366-367, Aug 1976.

3.3.4.5.2.3. Neutron Activation Analysis

Neutrons are uncharged corpuscles and are therefore able to penetrate the electron cloud surrounding the nucleus of an atom. Thus, they can be used to interact with the atomic nuclei of materials and induce artificial radioactivity. Once a material has been activated, it can be studied with the help of radiation detection equipment to determine the elements and their relative abundance in the test specimen. The procedure makes it possible to detect the improper mixing or alloying of substances or to check for filling deficiencies, thickness variations, and other conditions associated with a reduction of the normal content of one or several elements.

Selected References

NT-015201

Regge, P. De, et al; "Comparison of Neutron Activation Analysis with Other Instrumental Methods for Elemental Analysis of Airborne Particulate Matter," Proc. of International Symposium on the Development of Nuclear-Based Techniques for the Measurement, Detection and Control of Environmental Pollutants, Vienna, Austria, Mar 1976. (For sale by Technical Information Service, American Institute of Aeronautics and Astronautics, Inc, N Y).

NT-014722

Howdyshell, P.A.; "A Comparative Evaluation of the Neutron/Gamma and Kelly-Vail Techniques for Determining Water and Cement Content of Fresh Concrete," Rept. No. CERL-SR-M-216, AD A040061, May 1977.

NT-013812

Wainerdi, R.E.; "A Study of the Feasibility of Fast Neutron Activation Analysis as a Nondestructive Testing Method for Alpha Phase Titanium Alloy," Rept. No. N69 10664, Jun 1968, (For sale by NTIS, Springfield, VA).

NT-013184

Bernstein, Karl; "Activation Analysis," Industrial Research, Vol 18, No. 9, pp 87-91, Sep 1976.

NT-012331

Eiss, N.S., Jr., et al; "An Application of Neutron Activation Analysis to the Measurement of the Wear of Polymers," Wear, Vol 38, No. 1, pp 125-139, Jun 1976.

NT-011548

Rodriguez, F.A., et al; "Nondestructive Neutron Activation Analysis for Trace Impurities," Proc. 7th Symposium on NDE, pp 373-378, 1969.

NT-009645

Law, Joseph J.; "Instrumental Neutron Activation Analysis for Iodine in Seaweeds," Texas J. of Science, Vol 26, No. 1, pp 93-98, Feb 1975.

NT-009492

Van Grieken, F. and Hoste, J.; "Annotated Bibliography on 14 MEV Neutron Activation Analysis," Bureau Eurisotop — Information and Documentation Section, Eurisotop Information Booklet 65, 287 pp, 1972.

3.3.4.5.3. Positron Annihilation

Positrons entering a material are first slowed down, i.e., are thermalized by collisions with electrons, and finally are paired with electrons which leads to their annihilation with a concomitant emission of gamma rays. Since the decay of the positron population follows an exponential law, a mean lifetime can be defined (about 0.2 nanoseconds) and measured by detecting the gamma radiation associated with the pair formation. Dislocations and vacancies produced by deforming a specimen give rise to an increase in positron lifetime. Thus, the fatigue damage of a specimen, for example, can be determined by this method.

In another approach, the angular distribution of gamma ray photons emitted from pair formations has been examined and was found to be affected by the composition of the specimen and the amount of strain present. Because positrons do not penetrate deeply into a material, the positron annihilation method is limited to examining surface layers not exceeding a few thousandths of an inch.

Selected References

NT-015101

Tao, S.J.; "A Study on the Use of Positron Annihilation as a Non-Destructive Evaluation Tool for Micro-Structure Defects in Aluminum, Titanium and Their Alloys and Nickel Base Superalloys," work performed for Office of Naval Research, Arlington, VA, Mar 1977.

NT-015097

Coleman, C.F.; "Positron Annihilation — A Potential New NDT Technique, Part 2," NDT International, Vol 10, No. 5, pp 235-239, Oct 1977, (IPC Science and Technology Press Ltd, Guildford, Surrey, England.

NT-015096

Coleman, C.F.; "Positron Annihilation — A Potential New NDT Technique, Part 1," NDT International, Vol 10, No. 5, pp 227234, Oct 1977, (IPC Science and Technology Press Ptd, Guildford, Surrey, England).

NT-014553

Sosin, Abraham; "Positron Annihilation: From QED to NDE — A Primer and a Report on the International Conference on Positron Annihilation (4th) Held on 23-26 Aug 1976 at Helsingor, Denmark," Rept. No. ONRL-C-38-76, AD A037907, Feb 1977.

NT-013718

Thrane, N. and Petersen, K.; "The Relationship Between Void Size and Positron Lifetime in Neutron Irradiated Molybdenum," Applied Physics, Vol 12, No. 2, pp 187-189, Feb 1977.

NT-013716

Kojima, T., et al; "Studies of Martensitic Transformation in Cu-Al Alloys by Positron Annihilation," Applied Physics, Vol 12, No. 2, pp 179-181, Feb 1977.

NT-013495

Byrne. J.G.; "Positron Lifetime Measurements as a Non-Destructive Technique to Monitor Fatigue Damage," Rept. No. UTEC-75-130, Sep 1975, (For sale by NTIS, Springfield, VA).

NT-012010

Tao, S.J.; "Positron Annihilation Meanlife and Defects Created by Heat or Deformation in Aluminum, Titanium and Their Alloys and Nickel Base Superalloys," Feb 1976, Contract No. N00019-75-C-0236, (New England Institute, Ridgefield, CT).

NT-011999

Byrne, J.G.; "The Current Status of Nondestructive Testing with Positron Annihilation," Proc. of ARPA/AFML Rev. of Quant. NDE, pp 695-718, Dec 1975.

NT-010224

Myllyla, R. and Karras, M.; "Positron Annihilation Probing for the Hydratation Rate of Cement Paste," Applied Physics, Vol 7, No. 4, pp 303-306, Aug 1975.

NT-010818

Tao, S.J., et al; "A Study of Heat and Other Treatment on Aluminum and Some Aluminum Alloys by Positron Annihilation," Proc. ASNT 10th Symposium on NDT, pp 152-160, Apr 1975.

4. BIBLIOGRAPHY OF HANDBOOKS, TEXTBOOKS, AND BIBLIOGRAPHIES

This section contains an annotated bibliography of handbooks published in the last 10 years, all textbooks, and bibliographies published since 1972. It was developed from the NTIAC data files and therefore is inclusive of all NDT material reviewed by the NTIAC staff.

4.1. Handbooks

NT-9490

Altan, Taylan et al; "Forging Equipment, Materials, and Practices," Rept. No. MCIC-HB-03, Battelle Columbus Labs, Metals and Ceramics Information Center, Columbus, Ohio; 501 pp, Oct 1973.

The handbook provides design engineers with up-to-date information about the many aspects of forging including descriptions of important developments made more recently by industry and/or government. The handbook describes suitable measures for in-process quality control and quality assurance, summarizes relationships between forging practices and important mechanical properties and compares various forging devices to aid in equipment selection. Attention is also given to describing practices for relatively new materials and emerging forging practices.

NT-12320

"Applications Handbook of Precision Phase Measurement," Dranetz Eng. Labs, Inc.; South Plainfield, N.J., 24 pp, 1975.

This handbook is an attempt to distill long experience into a conveniently compact, readable, and yet authoritative reference. Some of its pages are addressed to the engineer who has had little experience with phase measurement, or to the advanced engineering student. Other parts of the text are intended for systems designers and development engineers. The book covers theory of operation of phase meters, fundamental measurement theory, applications, and description of modern phase instrumentation.

NT-8205

Chandler, Harry E., Ed; "Metal Progress Data Book," American Society of Metals, Vol 106, No. 1, 255 pp, Jun 1974.

The focus of this issue is on the three practical aspects of metalworking: metal and materials selection; process engineering, including testing and inspection; and fabrication technology. The data have been updated with emphasis on applications, processing, and fabrication. Data are presented in three sections: materials selection-parts, shapes, components, ferrous and nonferrous metals and alloys, super alloys, special-duty metals, nonmetallics, plastics; process engineering-heat treating, testing and inspection, cleaning, finishing, coating; fabrication technology-welding, joining, forming, machining.

NT-9177

"Direct-Current Magnetic Measurement for Soft Magnetic Materials," Rept. No. STP 371 S1, American Soc. for Testing & Materials, Philadelphia, PA; 68 pp, 1970.

A handbook on ASTM test methods for characterizing soft ferromagnetic materials. Covers basic principles, the ring test for induction and hysteresis, the Epstein frame procedure, permeameters, comparative methods, hysteresigraphs, magnetometers, design and construction of test apparatus, and hysteresis loop testing.

NT-14521 M

"Engineering Design Handbook. Development Guide for Reliability. Part Four. Reliability Measurement," Rept. No. AMCP-706-198, Army Materiel Command, Alexandria, VA; 296 pp, Jan 1976, (AD-A027371).

Reliability measurement techniques provide a common discipline that can be used to make system reliability projections throughout the life cycle of a system. The data on component and equipment failures obtained during the reliability measurement program can be used to compute component failure distributions and equipment reliability characteristics. Reliability measurement techniques are used during the research and development phase to measure the reliability of components and equipments and to evaluate the relationships between applied stresses and environments and reliability. Later in a system life cycle, reliability measurement and testing procedures can be used to demonstrate that contractually required reliability levels have been met.

NT-12296 M

Funk, C.J., Bryant, S.B. and Heckman, P.J. Jr.; "Handbook of Underwater Imaging System Design," Rept. No. NUC-TP-303, Naval Undersea Center, San Diego, CA; 310 pp, Jul 1972, (AD-904472).

The resources necessary to reliably predict optical viewing system performance in various water conditions have been summarized in handbook format. Multiple scattering effects are included. The handbook introduces the basic optical properties of seawater, conventional underwater television systems, and extended-range techniques. A nomogram is provided as a simple graphical tool for the design of conventional underwater television systems. A more general method, consisting of sets of formulas and data tables, is developed for predicting the performance of a variety of viewing systems as functions of hardware components (sources and receivers), practical viewing geometries, and water conditions. The formulas are summarized in a simple table, and sample calculations are presented. Finally, the analytical model is verified by comparison with experimental data.

NT-9169

Gavert, R.B., Moore, R.L. and Westbrook, J.H.; "Critical Surveys of Data Sources: 1. Mechanical Properties of Metals," Rept. No. NBS SP 396-1; 102 pp, Feb 1974.

This study was undertaken with the objective of providing a detailed critical survey of the existent compilations of mechanical property data for commercially available metals and alloys. This survey was intended to assess the scope, assets and deficiencies of about forty of the most prominent sources of such information. There were included: handbooks and technical compilations, information centers, foreign information sources, technical societies, and trade associations. The initial listing of sources to be examined was prepared by the authors with the advice and assistance of a subcommittee of the Metals Properties Council. The aim was to restrict the survey to sources which actually had compilations of mechanical property data in some form. Thus sources which offered only generalized guides to the literature, monographs, textbooks, or periodicals publishing original research or engineering articles were not to be included. Those sources from the original listing which were found upon detailed examination to fall into the latter categories are therefore treated in a separate appendix.

NT-8230

"A Guide to the Radiographic Evaluation of Discontinuities in Aluminum Castings," General Dynamics, Convair Aerospace Division; 139 pp, 1973.

This book illustrates a variety of discontinuities in aluminum castings and categorizes them relative to ASTM Standard E 155, a collection of reference radiographs published by the American Society for Testing and Materials. The purpose of the illustrations is to demonstrate and instruct, not for formal standards. Also contains general information on interpretation of radiographs.

NT-11461

Haver, A. George; "A Users Guide on Pulse Laser Holography for Wind Tunnel Testing," Rept. No. ARL-TR 75-0213, Aerospace Research Labs, Wright-Patterson AFB, Ohio, 208 pp, Jun 1975.

Holographic techniques used to obtain shadowgraph, Schlieren and interferometric data of wind tunnel investigations are described. Optical definitions and basic principles, holographic fundamentals and specific measuring techniques, system design factors and alignment procedures, equipment care, and data reduction methods plus numerous examples of typical wind tunnel results are presented.

NT-11281

Juran, J.M., Gryna, Frank M.and Bingham, R.S., Jr., Eds; "Quality Control Handbook," McGraw-Hill, N Y; 1752 pp, 1974.

A comprehensive handbook on industrial quality control. Section 12 is on inspection test. Section 13 is on measurement, and includes a very brief guide to NDT methods and applications.

NT-7719

Khalileev, P.A.;" Terminology in the Field of Defectoscopy," Sov. J. Non-Dest. Test.; Vol 9, No. 2, pp 201-211, Apr 1973.

A discussion of the problems of terminology in nondestructive testing and quality control. Includes a draft of recommended definitions for a USSR state standard for defectoscopy, terms, and definitions. Includes recommended definitions for maximum sensitivity, guaranteed sensitivity, and monitoring reliability.

NT-11322

Kruzas, Antony T., Ed; "Encyclopedia of Information Systems and Services," Anthony T. Kruzas Associates, Ann Arbor, MI; 1271 pp, 1974.

Describes and analyzes approximately 1750 information services, including publishers, computer software and time-sharing companies, micrographic firms, libraries, information centers, government agencies, clearing houses, research centers, professional associations, and consultants. Indexed.

NT-11213

Libby, Hugo L.; "Introduction to Electromagnetic Nondestructive Test Methods," Wiley-Interscience, NY; 365 pp, 1971.

Eddy current testing is the main subject of this book. Fundamentals are emphasized. Boundary value problems basic to the theory of the tests are usually treated by an intuitive approach. Eddy current test principles are explained by use of approximations to give insight to the behavior of the abstract field events. Three chapters are devoted to the fundamentals of the technique and its applications while the remaining seven chapters provide in-depth treatment of the subject.

NT-8904

Marr, J. William; "Leakage Testing Handbook," Rept. No. NASA-CR-952, General Electric Co, Schenectady, N Y; 392 pp, Apr 1968, (For sale by NTIS, Springfield, VA)

A comprehensive handbook on leak testing including fundamentals, flaw characteristics, methodology for testing, standards, specifications, procedure for leak testing, possible nondestructive testing methods and bibliography. Methods of testing discussed are: mass spectrometer, heat anode halogen, pressure change procedure, flow measurement procedure, bubble testing, radioisotope halide, sonic, light absorption, high voltage vacuum gage, combustible gas, condensation nuclei and buoyancy change. References and bibliography are current through 1967.

NT-14964 M

McCarty, J.E. et al; "Adhesive Bonded Aerospace Structures Standardized Repair Handbook," Rept. No. AFML-TR-76-201, Boeing Commercial Airplane Co, Seattle, WA; 62 pp, Dec 1976, (AD-A042389).

This report covers the fourth phase of a five-phase program to develop a standardized handbook for the repair of bonded aircraft structure. Tasks include the standardization of small repairs that are now covered by the various aircraft technical orders as well as general instruction for large repair work, including component rebuilding. Work completed in Phase IV included the repair and flight simulation test of an F-111 outboard spoiler. This work will serve as a base for procedures to be designated in the handbook.

NT-9335

Muller, E.A.W.; "Handbuch Der Zerstorungsfreien Materialprufung," in German, R. Oldenbourg Verlag Munchen; 1973.

A general handbook of nondestructive testing somewhat comparable to the American work edited by McMaster. The book is in loose leaf form, and portions of it have been issued irregularly since 1958, the most recent being issued in 1973. Major sections are denoted by letters of the alphabet; subs introduction; B. Physical foundations; C. technical instruments and equipment; D. arrangement of test stations, organization and cost of testing; E. manifestation of test indications, accuracy and sensitivity of the test methods; F. application of nondestructive test methods in foundry works; G. press parts and forge pieces; H. drawn and rolled materials; K. concrete, ceramic, refractory materials; Q. thickness control; R. texture investigation by radiological means; T. strain measurement; U. spectrum analysis; Y. art, antiquity, and prehistoric studies. Other sections are (apparently) in preparation.

NT-8231

"Nondestructive Testing, a Survey," Rept. No. NASA-SP-5113, Southwest Research Inst, San Antonio, TX; 282 pp, 1973, (Available from U S GPO).

A general survey of nondestructive evaluation with emphasis on contributions by the National Aeronautics and Space Administration and its contractors. Chapters include introduction, liquid penetrants, ultrasonics, radiography, eddy current testing, thermal and infrared testing, microwave techniques, magnetic testing, leak testing, strain sensing, and development methods. Extensive bibliography for each chapter.

NT-7567 M

Padilla, F., Harrigan, W.C., Jr. and Amateau, M.F.; "Handbook of Test Methods for Evaluation and Qualification of Aluminum-Graphite Composite Materials," Rept. No. SAMSO-TR-75-54, Aerospace Corp, El Segundo, CA; 72 pp, Feb 1975, (AD-A007057).

Aluminum-graphite composites are produced through molten infiltration of aluminum into continuous tows of graphite fibers. The process produces a continuous rod of composite that is subsequently fabricated into larger structures. The testing and evaluation of this system requires the use of unique testing techniques. The report explains in detail the testing techniques developed for this composite system.

NT-9455 M

Potter, J.M. and Noble, R.A.; "A Users Manual for the Sequence Accountable Fatigue Analysis Computer Program," Rept. No. AFFDL-TR-74-23, Air Force Flight Dynamics Lab, Wright-Patterson AFB, OH; 68 pp, May 1974, (AD-781379).

The report presents a detailed description of a computer program to calculate cumulative damage of notched structural members subjected to arbitrary spectra. The sequence accountable fatigue analysis computer program develops its sequence sensitivity by tracking residual stresses local to a notch throughout the spectrum of loads. Residual stress relaxation analysis is included to increase the generality of the results. An example spectrum and resulting cumulative damage analysis are illustrated.

NT-6927 M

"Quality Assurance. Guidance to Nondestructive Testing Techniques," Rept. No. AMCP-702-10, Army Materiel Command, Washington, D C; 179 pp, Apr 1970, (AD-728162).

Reference material is provided on the following topics: visual inspection; liquid penetrant inspection; magnetic particle inspection; X- and gamma-ray film radiography; fluoroscopic and electronic X-ray and gamma ray imaging systems; sonic and ultrasonic NDT;eddy current NDT; conductivity NDT; microwave NDT; infrared NDT; liquid crystal NDT; kryptonation NDT; corona discharge NDT; leak testing; effectiveness of NDT; comparative NDT.

NT-9835

"Residual Stress Measurement by X-ray Diffraction," SAE Rept. J784A, Society of Automotive Engrs., Inc, N Y; 119 pp, Aug 1971.

A comprehensive guide to the practical application of X-ray diffraction to the measurement of residual stress. Background theory is summarized. Commercial apparatus and procedures for use are described. Calibration, various corrections, and standard specimens are discussed.

NT-13523

Sharpe, R.S., Cole, H.A. and Heselwood, W.C.; "Quality Technology Handbook," Harwell Nondestructive Testing Centre, England; 515 pp, 1975.

NT-8289

Sharpe, R.S., Langton, H.J. and Dowden, W.A., Eds; "Quality Technology 73," Harwell Nondestructive Testing Centre, England; 408 pp, 1973.

Useful data and information are presented on U.K. government establishments, research associations and societies, markets for NDT equipment, NDT equipment suppliers, survey of X-ray sets and ultrasonic thickness gauges and general literature relating to NDT. Especially important is the technical section compiling fact and practice on NDT methods, fracture mechanics, welding effects and defects in casting.

NT-9488 M

"Static Testing of Reinforced Plastics: A Reference Manual (Introduction and Chapter VI)," Rept. No. FTD-MT-24-1351-74, Foreign Technology Div, Wright-Patterson AFB, OH; edited Machine Trans. of Mono. Metody Staticheskikh Ispytanii Armirovannykh Plastikov. Spravochnoe Posobie, N.P., 28 pp, Jun 1974, (AD-783579).

NT-8229

Vary, Alex; "Nondestructive Evaluation Technique Guide," Rept. No. NASA-SP-3079, National Aeronautics and Space Administration,Lewis Research Center, Cleveland, OH; 105 pp, 1973, (Available from NTIS, Springfield, VA).

A total of 70 individual nondestructive evaluation (NDE) techniques are described, each in a standardized single-page format for quick reference. Information is presented in a manner that permits ease of comparison of the merits and limitations of each technique withrespect to various NDE problems. An NDE technique classification system is presented. It is based on the system that was adopted by the National Materials Advisory Board (NMAB). The classification system presented herein follows the NMAB system closely with the exception of additional categories that have been added to cover more advanced techniques presently in use. The rationale of the technique description format used herein is explained. The format provides for a concise description of each technique, the physical principles involved, objectives of interrogation, example applications, limitations of each technique, a schematic illustration, and key reference material. Cross-index tabulations are also provided so that particular NDE problems can be referred to appropriate techniques.

NT-10891

Wahll, Marshall J. and Frontani, Roy F.; "Handbook of Soviet Alloy Compositions," Rept. No. MCIC-HB-05, Battelle Columbus Labs, Metals and Ceramics Information Center, Columbus, OH; 320 pp, Feb 1975.

Tables of chemical composition of many metals and alloys used in the USSR. Also summarizes Soviet practice in alloy designation.

NT-11842

Youshaw, Robert A. and Criscuolo, Edward L.; "A Guide for the Nondestructive Testing of Non-Butt Welds in Commercial Ships. Part 1," Rept. No. NOLTR-74-138-PT-1, Naval Ordnance Lab, White Oak, MD; 62 pp, Dec 1974, (AD-A014547).

Procedures are presented for performing visual inspection, magnetic particle testing, radiography, ultrasonics, and penetrant testing on steel welds in the thickness range of 1/2 inch to 2-1/2 inches. The basic weld joints considered are the corner joint, the tee, X, and the lap joint. A discussion is presented for each of the inspection methods whereby weld quality may be controlled in a meaningful way when there is a need to do so.

NT-11841

Youshaw, Robert A. and Criscuolo, Edward L.; "A Guide for the Nondestructive Testing of Non-Butt Welds in Commercial Ships. Part 2," Rept. No. NOLTR-74-138-PT-2, Naval Ordnance Lab, White Oak, MD; 42 pp, Dec 1974, (AD-A014548).

Procedures are presented for performing visual inspection, magnetic particle testing, radiography, ultrasonics, and penetrant testing on steel welds in the thickness range of 1/2 inch to 2-1/2 inches. The basic weld joints considered are the corner joint, the tee, X, and the lap joint. A discussion is presented for each of the inspection methods whereby weld quality may be controlled in a meaningful way when there is a need to do so.

4.2. Textbooks

NT-14858

Berger, Harold; "Nondestructive Testing Standards — A Review," Rept. No. STP 624, ASTM, Philadelphia, PA; 354 pp, 1977, (Symposium sponsored by NBS, ASTM Com. E-7 on NDT and ASNT).

One of the driving forces for this symposium was the realization that there are a large number of standards for nondestructive testing, that they originate in several organizations, and that the standards have evolved over a period of years. There also were indications from a number of users of nondestructive testing that the present system of standards does not satisfy all requirements. There was some lack of reproducibility and there were omissions in some areas, for example, ultrasonic transducer calibration procedures or methods of assessing radiographic resolution. For all these reasons and because increasing demands were being made on nondestructive testing, for example, to provide more quantitative results so fracture mechanics criteria could be used in design, this seemed like a good time to step back and examine nondestructive testing standards. The symposium was organized to perform that examination by looking at nondestructive testing standards in a broad way. Where are standards satisfactory or lacking? What suggestions can be made for improvement? The symposium addressed these questions in 38 papers presented over three days in six sessions. Most of these papers are contained in this publication.

NT-9077

Betz, C.E.; "Principles of Magnetic Particle Testing," Magnaflux Corp, Chicago, IL; 525 pp, Feb 1967.

Standard text on magnetic particle testing. Covers history and fundamentals of method and its applications.

NT-14677

Birks, L.S.;"X-Ray Spectrochemical Analysis," Interscience Publishers, Inc, N Y; 148 pp, 1959.

The main headings of this book are: (1) simplified fundamentals, (2) excitation of the X-ray spectra, (3) dispersion and geometry, (4) detection and measurement, (5) techniques for quantitative analysis, (6) applications and specimen techniques, (7) the electron probe microanalyzer. Also included are 3 appendices, author and subject indexes.

NT-14679

Bloembergen, N.; "Nuclear Magnetic Relaxation," W.A. Benjamin, Inc, N Y; 187 pp, 1961.

Chapter 1 contains the following major headings: (1) nuclear spin and moments, (2) mathematical introduction of the spin, (3) the atomic beam deviation method, (4) the resonance principle, (5) the molecular beam magnetic resonance method, (6) nuclear paramagnetism, (7) resonance absorption and dispersion in nuclear paramagnetism. The other chapters are entitled: (1) theory of the nuclear magnetic resonance, (2) the experimental method, (3) theory and experimental results, and (4) relaxation by quadrupole coupling.

NT-14685

Carlin, Benson; "Ultrasonics," McGraw-Hill Book Co, Inc, N Y; 317 pp, 1960.

This book contains the following chapters. (1) ultrasonic waves, (2) crystals for ultrasonic use, (3) crystal holders for ultrasonic use, (4) magnetostriction, (5) miscellaneous transducers for generating ultrasonics, (6) measurement, (7) ultrasonic power equipment, (8) nondestructive testing of materials: continuous-wave and resonance, (9) nondestructive testing of materials: pulsed, (10) effects, (11) applications.

NT-14689

Clark, George L.; "Applied X-Rays," McGraw-Hill Book Co, Inc, N Y; 852 pp, 1955.

The contents of this book are: Part I, general physics and applications of X-radiation; chapter 1, before and after the discovery by Rontgen, chapter 2, X-ray tubes; chapter 3, high-voltage equipment; chapter 4, the measurement of intensity (dosage); chapter 5, the measurement of quality (wavelength): X-ray optics; chapter 6, X-ray spectra and atomic structure; chapter 7, chemical analysis from X-ray spectra; chapter 8, the absorption and scattering of X-rays; chapter 9, radiography (Roentgenography); chapter 10, microradiography; chapter 11, the chemical effects of X-rays; chapter 12, the biological effects of X-radiation; Part II, the X-ray analysis of the ultimate structure of materials; chapter 13, crystallography and X-ray diffraction, chapter 14, the experimental X-ray methods of crystal analysis; chapter 15, the interpretation of diffraction patterns in terms of ultimate structure; chapter 16, the results of crystal analysis: elements and inorganic compounds; chapter 17, crystal chemistry; chapter 18, the silicates; chapter 19, alloys; chapter 10, organic compounds; chapter 21, the structure of glasses, liquids, and other colloidal and amorphous materials; chapter 22, the texture of metals; chapter 23, polymers — synthetic and natural materials with giant molecules; and an appendix, space-group symbols.

NT-14678

Clauser, H.R.; "Practical Radiography for Industry," Reinhold Publishing Corp, 307 pp, 1952.

The main section headings are: (1) nature, characteristics and properties of X-rays, (2) the generation of X-rays and X-ray equipment, (3) procedures and radiograph interpretation, (4) exposure factors and technique, (5) sensitivity and radiograph quality, (6) films and film processing, screens and filters, (7) gamma-ray radiography, (8) radiography of welds, (9) radiography of castings, (10) fluoroscopy, (11) high-voltage radiography, (12) other techniques and applications of radiography, and (13) protection and safety.

NT-14682

Ensminger, Dale; "Ultrasonics, the Low- and High-Intensity Applications," Marcel Dekker, Inc, N Y; 586 pp, 1973.

The main headings are: (1) ultrasonics — a broad field, (2) elastic wave propagation and associated phenomena, (3) fundamental equations employed in ultrasonic design and applications, (4) design of ultrasonic horns for processing applications, (5) basic design of ultrasonic transducers, (6) determining properties of materials, (7) nondestructive testing — basic methods and general considerations, (8) use of ultrasonics in the nondestructive testing of metals, (9) use of ultrasonics in the inspection of nonmetals, (10) imaging, process control, and miscellaneous low-intensity applications, (11) applications of high-intensity ultrasonics — basic mechanisms and effects, (12) applications of high-intensity ultrasonics, (13) applications of ultrasonics based on chemical effects, (14) medical applications of ultrasonic energy.

NT-14680

Goldman, Richard; "Ultrasonic Technology," Reinhold Publishing Co, London; 315 pp, 1962.

This book contains the following chapters: (1) introduction, (2) nature of sound, (3) ultrasonic transducers, (4) power applications, (5) testing and examination, (6) measurement of time and distance, an author index and subject index.

NT-14676

Hanstock, R.F.; "The Non-Destructive Testing of Metals," The Institute of Metals, London; 170 pp,1951.

Following are the chapter titles: (1) introduction, (2) measurement of thickness, (3) the evaluation of surface finish, (4) detection of cracks at or near the surface, (5) radiography, (6) detection of flaws by ultrasonic methods, (7) dynamic tests, (8) damping capacity: definitions and methods of measurement, (9) damping capacity: dependence on metallurgical condition, (10) damping capacity: theoretical aspects, (11) X-ray diffraction: introduction, (12) X-ray diffraction: applications, (13) electrical and magnetic methods of estimating composition and condition, (14) some methods of analysis. An appendix entitled, summary of some non-destructive methods of examination is included as well as author and subject indexes.

NT-9304

Helstrom, Carl W.; "Statistical Theory of Signal Detection," Pergamon Press, N Y; 364 pp, 1960.

A textbook of theory. Covers signals and filters, noise, hypothesis testing, detection of a known signal, detection of signals of random phase, detection by multiple observations, the theory of estimation, the estimation of signal parameters, detection of signals of unknown arrival time, signal resolution, and stochastic signals.

NT-11279

Keyser, Carl A. et al; "Manufacturing Processes and Materials for Engineers," Lawrence E. Doyle, ed; Prentice-Hall, Inc, Englewood Cliffs, N J; 875 pp, 1969.

A general text and reference book on manufacturing processes, with primary emphasis on metals. Testing of engineering materials, production of metals and alloys, foundry processes, casting, powder metallurgy, metal-working, shearing and forming, welding, cutting, turning, finishing, etc. Discusses measurement and inspection, automation, economics, etc.

NT-14687

Lytel, Allan; "Industrial X-Ray Handbook," Howard W. Sams & Co, Inc, Indianapolis, IN; 286 pp, 1962.

The contents of this book are: Chapter 1, introduction; Chapter 2, generating radiation; Chapter 3, detecting radiation; Chapter 4, basic principles and applications; Chapter 5, electronic equipment and techniques; Chapter 6, medical equipment; Chapter 7, industrial and commercial uses; Chapter 8, laboratory uses of radiation; Chapter 9, health physics; Appendix 1, gamma-ray equipment; Appendix 2, gamma exposure time computation; Appendix 3, exposure factors; glossary of terms, and bibliography.

NT-8225

McGonnagle, Warren J.; "Nondestructive Testing," 2nd ed, Gordon and Breach, Science Publishers, N Y; 455 pp, 1971.

Textbook. Chapter titles are introduction, visual testing, pressure and leak testing, liquid penetrant inspection, thermal methods, X-ray radiography, gamma radiography, ultrasonics, dynamic testing, magnetic methods, electrical methods of nondestructive testing, eddy current methods, other useful testing techniques, thickness measurements. References for each chapter.

NT-14895

"1975 Annual Book of ASTM Standards-Part II — Metallography; Nondestructive Tests," ASTM, Philadelphia, PA; 628 pp, 1975.

This book contains numerous standards, tentatives, and related material pertaining to metallography and nondestructive tests. Specific NDT items covered include: bubble emission, coating thickness by magnetic field and electromagnetic methods, eddy current testing, electromagnetic testing, leak testing, liquid penetrant inspection, magnetic particle inspection, magnetic testing, penetrant inspection, radiographic testing, ultrasonic testing. Also included are definitions of terms relating to various forms of nondestructive testing.

NT-967

McMaster, Robert C.; "Nondestructive Testing Handbook, Vol. II," The Ronald Press Co, N Y; 962 pp, 1959.

This is the second of 2 volumes containing sections 28 through 54. Sections 1 through 27 appear in Volume 1. Titles of the sections in Vol. II are as follows: electrified-particle tests, electrified-particle test indications, magnetic-particle test principles, magnetic-field test principles, magnetic-field test equipment, electric current test principles, eddy current test principles, eddy current cylinder tests, eddy current tube tests, eddy current sphere and sheet tests, eddy current test equipment, eddy current test automation, eddy current test indications, ultrasonic fields, ultrasonic immersion tests, ultrasonic immersion test indications, ultrasonic contact tests, double-transducer ultrasonic tests, ultrasonic resonance tests, natural frequency vibration tests, brittle-coating tests, photoelastic-coating tests, resistance strain-gage tests.

NT-14686

"Radiography in Modern Industry," Eastman Kodak Company, Rochester, N Y; 122 pp, 1947.

The contents of this book are: (1) radiography's function in industry, (2) the radiographic process, (3) X-ray generating apparatus, (4) geometric principles, (5) factors governing exposure, (6) radiographic screens, (7) scattered radiation, (8) arithmetic of exposure, (9) sensitivity and detail visibility, (10) special techniques, (11) Kodak industrial X-ray films, (13) the processing room, 3 appendices and a bibliography.

NT-14684

St. John, Ancel and Isenburger, Herbert R.: "Industrial Radiology: X-Rays and Gamma Rays," John Wiley & Sons, Inc, N Y; 303 pp, 1943.

Following is a list of chapters contained in this book. (1) the infancy of radiology, (2) the history of industrial radiology, (3) nature and properties of X-rays, (4) influence of matter on X-rays, (5) influence of X-rays on matter, (6) production, detection, and recording of X-rays, (7) X-ray generators, (8) an installation for industrial radiography, (9) making a radiography, (10) photographic procedure, (11) interpreting radiographs, (12) industrial fluoroscopy, (13) radiography of large castings and forgings, (14) radiography of welded vessels and structures, (15) radiography of small objects, (16) some interesting examples, (17) radiography with gamma rays, (18) radiographic specifications and inspectors, (19) operating and cost data, (20) looking ahead. Also included are 4 appendices.

NT-9655

Schreiber, Edward, Anderson, Orson L. and Soga, Naohiro; "Elastic Constants and Their Measurement," McGraw-Hill Book Company; 196 pp, 1973.

Defines elastic moduli, including anisotropic constants. Discusses elasticity in single crystals, and the Voigt and Reuss averaging schemes for polycrystalline solids. Experimental methods of elastic wave velocimetry are described, with discussion of accuracy and precision. Methods include direct transit time measurement; pulse-echo methods; interferometry; phase comparison; and pulse superposition. Transducers and coupling materials for both normal and high-pressure, high-temperature conditions are discussed. Dynamic resonance methods of measuring elastic moduli, include torsional vibration; flexural vibration; and longitudinal vibra-

tion. Tables of shape factors for specimens of different shape are given. Resonant-sphere methods of sound velocimetry are described. Indirect methods of estimating elastic constants from thermodynamic data are discussed. The final chapter is devoted to pressure and temperature derivatives of elastic constants and thermodynamic functions.

NT-9340

Sharpe, R.D., Ed; "Research Techniques in Nondestructive Testing," Academic Press, London and N Y; 454 pp, 1973.

Includes following chapters: proton radiography, by A.M. Kohler and H. Berger; information theory applied to industrial radiography, by R. Halmshaw; computer and optical processing of pictures, by C.J. Taylor and B.R. Pullan; electroluminescent storage and display panels for radiography, by P.W. Ranby; magnetic flux analysis techniques, by N. Davis; eddy current test for tubing flaws in support regions, by H. Libby; optical holographic interferometry, by J.E. Sollid; non-coherent optical techniques for surface survey, by J.P. Duncan; vibration monitoring, by F. Downham; means of visualizing ultrasound, by D.M. Marsh; the reduction and display of ultrasonic data, by D.S. Dean and D. Young; ultrasonic image synthesis, by L. Kay; electromagnetic generation of ultrasound, by E.R. Dobbs. Each chapter is a short survey with selected references.

NT-14681

"Welding Inspection," American Welding Society, Inc, N Y; 243 pp, 1968.

The main headings contained in this book are as follows: (1) application and scope, (2) requirements of an inspector, (3) duties of an inspector, (4) definitions of welding terms and processes, (5) symbols, (6) welding procedure specifications, (7) qualification of welding procedures, (8) qualification of welders and welding operators, (9) heat control and heat-treating operations, (10) weldment defects, (11) destructive testing of welds, (12) nondestructive testing, (13) selection of samples for welding tests. Under Section 12, nondestructive testing, the following are discussed: (1) visual inspection, (2) magnetic particle inspection, (3) liquid penetrant inspection, (4) radiographic inspection, (5) ultrasonic inspection, (6) eddy current (electromagnetic) testing, (7) proof tests, and (8) leak tests.

NT-14688

Wiltshire, W.J., Ed; "A Further Handbook of Industrial Radiology," Edward Arnold (Publishers) Ltd, Great Britain; 338 pp, 1957.

The contents of this book are: Chapter 1, high voltage X-ray generators, p 1; Chapter 2, natural and artificial sources for gamma-radiography, p 20; Chapter 3, scattered radiation, p 43; Chapter 4, radiographic quality and sensitivity, p 64; Chapter 5, films and their processing, p 96; Chapter 6, the reproduction of radiographs, p 121; Chapter 7, fluoroscopy, p 136; Chapter 8, electrical methods for detection and measurement, p 169; Chapter 9, weld radiography, p 190; Chapter 10, castings and their radiography, p 208; Chapter 11, microradiography, p 226; Chapter 12, industrial xeroradiography, p 279; and Chapter 15, an introduction to applied X-ray diffraction methods, p 299.

4.3. Bibliographies

NT-11871

Barton, J.P.; "Neutron Radiography — An Overview," Rept. No. STP 586, ASTM, Practical Applications of Neutron Radiography and Gaging; pp 5-19, 1976.

Neutron radiography is a nondestructive testing technique similar to X-radiography that can have important advantages in many specific situations. Large thicknesses of some dense metals can be penetrated; high sensitivity can be obtained for small details containing hydrogen and certain other light elements; materials of similar density can be contrasted: and high radioactive objects can be neutron radiographed without interference from the gamma radiation. During the decade 1965 to 1975, industrial application of neutron radiography has grown rapidly due to (1) availability of suitable neutron sources, (2) advancements of the techniques, and (3) widening appreciation of the capabilities. Over 100 centers are now performing neutron

radiography. Most use neutron beams of predominantly thermal energy from a nuclear reactor source, but there are examples of different techniques, some using different neutron energies, and some using accelerator or isotopic neutron sources

NT-13938 M

"Bibliography of Reports on Neutron Radiography,"Rept. No. LEC-2451, Lockheed Electronics Co, Plainfield, N J; 6 pp, Dec 1975, (AD-B014699).

The recent application of neutron radiography on the lance program suggests that this technique could be a valuable inspection tool in other applications. The usefulness of neutron radiography is due to the fact that neutrons are attenuated to an extreme degree by hydrogen and boron while X-rays are attenuated more by dense metals. Thus neutron radiographs will show adhesives, explosives, elastomers, and plastics (which contain hydrogen), hydrogen embrittlement of welds, and integrity of boron fiber composites and boron control rods for reactors. The attached bibliography lists some of the more useful papers on this subject for guidance in application.

NT-11281

Bresniker, Robert L.; "Nondestructive Testing, Report on Task XI, NDT, of System Effectiveness and Safety Technical Committee," Proc. 1975 Annual Reliability and Maintainability Symposium; American Institute of Aeronautics and Astronautics; 6 pp, Jan 1975.

A brief discussion of NDT, with selected literature citations. Cites most pertinent mil-inspection and mil-standards. Also lists many contractor NDT specifications developed by or for NASA and the DoD.

NT-13756

Briers, J.D.; "The Interpretation of Holographic Interferograms," Optical and Quantum Electronics, Vol 8, No. 6, Chapman and Hall, London; pp 469-501, Nov 1976.

Holographic interferometry is a very powerful technique for the measurement of small deformations and displacements of opaque solid objects. Unfortunately, the quantitative interpretation of the fringe patterns is somewhat involved, and the large number of papers published on this subject in the past 10 years has caused considerable confusion. This review paper is an attempt to rationalize the field by classifying the many different interpretation schemes into four main techniques, and by offering guidelines for the choice of technique for different applications.

NT-12538

Carpenter, James L., Jr; "Bibliography of Information on Mechanics of Structural Failure (Hydrogen Embrittlement, Protective Coatings, Composite Materials, NDE)," Rept. No. NASA-CR-134964, Martin Marietta Aerospace, Orlando, FL; 172 pp, Jun 1976, (For sale by NTIS, Springfield, VA 22151).

This bibliography is comprised of approximately 1600 reference citations related to four problem areas in the mechanics of failure in aerospace structures. The bibliography represents a search of the literature published in the period 1962-1976, the effort being largely limited to documents published in the United States. Listing are subdivided into the four problem areas: hydrogen embrittlement; protective coatings; composite materials; and nondestructive evaluation. An author index is included. The bibliography is a companion volume to NASA CR-134962, Hydrogen Embrittlement of Structural Alloys — A Technology Survey, and NASA CR-134963, NDE — An Effective Approach to Improved Reliability and Safety — A Technology Survey.

NT-9302

Carpenter, James L., Jr, Moya, Nestor and Stuhrke, William F.; "Fracture Toughness Testing Data — A Bibliography," Rept. No. NASA-CR-134753, Martin Marietta Aerospace, Orlando, FL; 73 pp, Jan 1975, (For sale by NTIS, Springfield, VA).

This bibliography is comprised of approximately 800 reference citations related to the mechanics of failure in aerospace structures. Most of the references are for documents that include fracture toughness testing data and its application or documents on the availability and usefulness of fracture mechanics analysis methodology. The bibliography represents a search of the literature published in the period April 1962 through April 1974 and is largely limited to documents published in the United States. It is a companion volume to NASA Cr-134752, Fracture Toughness Testing Data — A Technology Survey.

NT-9311

Carpenter, James L., Jr, Moya, Nestor and Stuhrke, William F.; "Life Prediction of Materials Exposed to Monotonic and Cyclic Loading — A Bibliography," Rept. No. NASA-CR-134751, Martin Marietta Aerospace, Orlando, FL; 78 pp, Jan 1975, (For sale by NTIS, Springfield, VA).

This bibliography is comprised of approximately 1200 reference citations related to the mechanics of failure in aerospace structures. Most of the references are for information on life prediction for materials exposed to monotonic and cyclic loading in elevated temperature environments such as that in the hot end of a gas turbine engine. Additional citations listed are for documents on the thermal and mechanical effects on solar cells in the cryogenic vacuum environment; radiation effects on high temperature mechanical properties; and high cycle fatigue technology as applicable to gas turbine engine bearings. The bibliography represents a search of the literature published in the period April 1962 through April 1974 and is largely limited to documents published in the United States. It is a companion volume to NASA CR-134750, Life Prediction of Materials Exposed to Monotonic and Cyclic Loading — A Technology Survey.

NT-12013

Derboghosian, Satrak; "A Report Guide to Radiographic Testing Literature, Volume IV," Rept. No. AMMRC-MS-72-4, Army Materials and Mechanics Research Center, Watertown, MA; 80 pp, Jun 1972, (AD-749258).

The report guide covers a portion of the abstracts on radiographic testing included in the holdings of the nondestructive testing information analysis center.

NT-8661

Derboghosian, Satrak; "A Report Guide to Radiographic Testing Literature, Volume V," Rept. No. AMMRC-MS-73-5, Army Materials and Mechanics Research Center, Watertown, MA; 77 pp, Dec 1973.

The report guide covers a portion of the abstracts on radiographic testing included in the holdings of the nondestructive testing information analysis center.

NT-13218 M

Derboghosian, Satrak and Kazarian, Ara; "A Report Guide to Radiographic Testing Literature, Volume VI," Rept. No. AMMRC-MS-75-3, Army Materials and Mechanics Research Center, Watertown, MA; 91 pp, Apr 1975, (AD-A023900).

This report guide covers a portion of the abstracts on radiographic testing included in the holdings of the nondestructive testing information analysis center.

NT-13219 M

Derboghosian, Satrak and Kazarian, Ara; "A Report Guide to Radiographic Testing Literature, Volume VII," Rept. No. AMMRC-MS-75-4, Army Materials and Mechanics Research Center, Watertown, MA; 85 pp, May 1975, (AD-A023901).

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. This guide is Volume 7 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.

NT-11635

Drouillard, T. F.; "Acoustic Emission — A Bibliography for 1970-1972," Rept. No. SP571, ASTM, 1916 Race Street, Philadelphia, PA 19103; pp 241-271, Jan 1974.

The bibliography includes nearly all references in the literature on acoustic emission published during the three-year period, 1970 through 1972. Included in the 412 references are several for each of the associated technologies including: signature analysis, boiling detection, cavitation, leak detection, seismology, and rock mechanics. Information has also been obtained from eight abstracting and indexing services searched in compiling the bibliography. The bibliography has been arranged alphabetically by author and is cross referenced with a list of approximately 400 authors. Also included is a subject index. Technical articles listed were published in some 90 different journals and in 8 different languages.

NT-11289

Ebersole, John F.; "Optical Image Subtraction," Optical Engineering, Vol 14, No. 5, pp 436-447, Oct 1975.

There are several methods for optically subtracting one image from another in order to detect differences between scenes or between photographs of scenes. There are many applications for such a technology, including earth resource studies, meteorology, automatic surveillance and/or inspection, pattern recognition, urban growth studies, and bandwidth compression. This paper presents an overview of several techniques for obtaining optical image subtraction, including holographic, interferometric, coding, and positive-negative superposition methods. As part of this review, a table is presented summarizing and comparing the characteristics of more than twenty-five approaches. An extensive bibliography is also given.

NT-15212 M

El-Sum, H.M.A.; "Analytical Study of Acousto Optical Holography Interfacing Methods for Acoustical and Optical Holography," Rept. No. NASA-CR-2775, El-Sum Consultants, Atherton, CA; 96 pp, Dec 1976, (For sale by NTIS, Springfield, VA).

This report covers a study of the international status of the art of acousto-optical imaging techniques adaptable to nondestructive testing and, more important, to interfacing methods for acoustical and optical holography in nondestructive testing research. Evaluation of 20 different techniques encompassed investigation of varieties of detectors and detection schemes, all of which are described and summarized. Related investigation is reported in an appendix. The report presents important remarks on image quality, factors to be considered in designing a particular system, and conclusions and recommendations for extension of this work. Three bibliographies are included. Compatible systems to be used with the MSFC hybrid system (optical, acoustical, and correlation) are a Bragg diffraction (direct optical-acoustical interaction) scheme and the electronically focused and scanned piezoelectric array. Both systems have sensitivity approaching 10 to the minus 9 to 10 to the minus 11 w m squared and resolution approaching the acoustical wavelength in the tested material, are capable of real-time display, and can be designed for use in either a pure optical or an acousto-optical mode of operation. At the same time, a portable acoustic probe, akin to the probe used in medical diagnosis, can be designed for testing large objects on site.

NT-7297 M

"Fatigue and Fracture of Aircraft Structures and Materials, Report Bibliography Dec 56-Feb 72," Rept. No. DDC-TAS-72-51, Defense Documentation Center, Alexandria, VA; 292 pp, Sep 1972.

The bibliography is a selection of unclassified references on fatigue and fracture of aircraft structures and materials. References are sequenced numerically within each of the following categories: general and miscellaneous reports, instrumentation, sonic fatigue, materials, airplane panels, wings, fuselages, landing gear and mechanical fasteners. Corporate author-monitoring agency, subject, title, report number and AD number indexes are included.

NT-8130

Feshchenko, Yu. B. and Frolova, N.K.; "Development of Magnetographic Metal Inspection," Sov. J. Non-Destr. Test., Vol 9, No. 4; pp 442-447, Aug 1973.

This is a review of the essential achievements in the nondestructive inspection of metals by the magnetographic method. A chronological account is given of the various developmental stages. Trends in the further perfection of techniques and tools are discussed.

NT-10663

Fleck, J.N.; "Bibliography on Fibers and Composite Materials — 1969-1972," Rept. No. MCIC-72-09, Battelle Columbus Labs, Metals and Ceramics Information Center, Columbus, OH; 103 pp, Jul 1972, (AD-746214, For sale by NTIS, Springfield, VA).

The bibliography contains over 3000 references, including translated items from Japan, West Germany, U.S.S.R., and other countries as well as references of original English language publications of the United States and United Kingdom. The references are categorized by specific fiber and matrix materials. In addition, many references are grouped in the general categories of compatibility studies, theory and design, testing and evaluation, application, and fabrication. A group of references to general review articles is included. The references represent the holdings of the former Defense Ceramic Information Center (DCIC) plus those of the Fibers and Composites Center (FCIC) at Battelle's Columbus Laboratories and MCIC.

NT-9169

Gavert, R.B., Moore, R.L. and Westbrook, J.H.; "Critical Surveys of Data Sources: 1. Mechanical Properties of Metals," Rept. No. NBS SP 396-1, 102 pp, Feb 1974.

This study was undertaken with the objective of providing a detailed critical survey of the existent compilations of mechanical property data for commercially available metals and alloys. This survey was intended to assess the scope, assets and deficiencies of about forty of the most prominent sources of such information. There were included: handbooks and technical compilations, information centers, foreign information sources, technical societies, and trade associations. The initial listing of sources to be examined was prepared by the authors with the advice and assistance of a subcommittee of the metals properties council. The aim was to restrict the survey to sources which actually had compilations of mechanical property data in some form. Thus sources which offered only generalized guides to the literature, monographs, textbooks, or periodicals publishing original research or engineering articles were not to be included. Those sources from the original listing which were found upon detailed examination to fall into the latter categories are therefore treated in a separate appendix.

NT-9006

Green, Robert E., Jr and Pond, Robert B., Sr; "An Ultrasonic Technique for Detection of the Onset of Fatigue Damage," Rept. No. AFOSR-TR-73-0901, Johns Hopkins Univ, Baltimore, MD; 70 pp, May 1973.

The purpose of the research is to develop an ultrasonic techniques for the detection of the onset of fatigue damage. Particular emphasis is placed on the use of ultrasonic attenuation measurements as a continuous monitor of fatigue damage during cyclic testing of metal specimens. Efforts to date have indicated that the history of attenuation during fatigue of the specimen provide an index as to the onset of failure. Ultrasonic attenuation measurements made simultaneously with fatigue tests on aluminum bars give an early warning or eminent fracture. Such a warning occurs much earlier than detection of energy reflected from a crack by conventional ultrasonic techniques. This is true for specimens which were initially defect free and for those which initially had structural defects. A systematic comparison is being made between ultrasonic attenuation and other ultrasonic techniques, principally surface wave techniques and acoustic emission techniques.

NT-11461

Haver, A. George; "A Users Guide on Pulse Laser Holography for Wind Tunnel Testing," Rept. No. ARL-TR 75-0213, Aerospace Research Labs, Wright-Patterson AFB, OH; 208 pp, Jun 1975.

Holographic techniques used to obtain shadowgraph, Schlieren and interferometric data of wind tunnel investigations are described. Optical definitions and basic principles, holographic fundamentals and specific measuring techniques, system design factors and alignment procedures, equipment care, and data reduction methods plus numerous examples of typical wind tunnel results are presented.

NT-9591 M

Hibben, Stuart G.; "Bibliography of Soviet Laser Developments, No. 17, July-September 1974," Informatics Inc, Rockville, MD; 110 pp, Jan 1975, (AD-A005566).

This is the Soviet laser bibliography for the third quarter of 1974 and is No. 17 in the series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; laser-induced chemical reactions; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics.

NT-11686 M

Hibben, Stuart G. and Minkus, Carl; "Bibliography of Soviet Laser Developments Number 20. April-June 1975," Informatics Inc, Rockville, MD; 114 pp, Nov 1975, (AD-A018639)

This is the Soviet laser bibliography for the second quarter of 1975 and is No. 20 in the series on Soviet laser developments. The coverage includes basic research on solid state, liquid, gas, and chemical lasers; components; nonlinear optics; spectroscopy of laser materials; ultrashort pulse generation; crystal growing; theoretical aspects of advanced lasers; and general laser theory. Laser applications are listed under biological effects; communications; computer technology; holography; laser-induced chemical reactions; instrumentation and measurements; beam-target interaction; and plasma generation and diagnostics.

NT-13778 M

Hutchinson, Ronald L. and Ulery, Harry H., Jr; "Criteria for Airport Pavements," Rept. No. FAA-RD-74-35, Army Engineer Waterways Experiment Station, Vicksburg, MS; 135 pp, Sep 1976, (AD-A032491).

An investigation was conducted which resulted in suggested changes to existing Federal Aviation Administration Design, Construction, and Evaluation Criteria for civil airport pavements. Through individual studies, design and construction procedures were developed for prestressed concrete, fibrous concrete and continuously reinforced concrete pavements; porous friction surface courses; and pavements incorporating stabilized layers, insulating layers, and membrane-encapsulated layers. Proposals were made for statistical quality control of paving materials. A nondestructive pavement evaluation procedure based on steady state vibratory loadings and measurements of the resulting elastic deflections was developed. An economic analysis was performed to relate pavement upgrading cost to a penalty cost associated with adding gears and wheels to aircraft in order to provide flotation for present-day pavement design criteria. Studies of aircraft dynamic load effects and wheel-path distribution were made. This report summarizes these studies. Individual technical reports are available for all of the above-mentioned studies.

NT-8354

"Infrared Detectors, Report Bibliography Dec 60—Dec 73," Rept. No. DDC-TAS-74-25, Defense Documentation Center, Alexandria, VA; 325 pp, Jun 1974.

The bibliography contains unclassified and unlimited citations on infrared detectors. These citations are studies and analyses pertaining to detection techniques, equipment, refrigeration systems, instrumentation, sensitivity, reliability, design, measurement, and performance engineering. Computer generated indexes of corporate author monitoring agency, subject, title, and personal author are provided.

NT-11819

Keskyla, A.Y.; "Techniques for Increasing the Bandwidth of the Acoustic Section in Flaw Detection Equipment," Sov. J. Non-Destr. Test., Vol 11, No. 3; pp 303-313, Jun 1975.

Techniques for increasing the acoustic bandwidth of ultrasonic flaw-detection equipment are surveyed. Block diagrams are given for the implementation of various methods of shortening transient effects in the acoustic section, along with the results of practical applications of those methods. Approaches analyzed include: electrical damping of the piezoelectric vibrator; correction of the piezoelectric vibrator frequency response by LCR circuits; correction of response by variable thickness piezoelectric plates; use of vibrators with low resonance frequencies; use of special piezoceramic compositions; special processing of piezoceramics; use of driving pulses whose spectrum compensates that of the vibrator; electronic compensation of input reactance of the vibrator; and compensation of free vibrations of the transmitting vibrator.

NT-14708 M

Klappert, Walter R. and Merhib, Charles P.; "A Report Guide to Ultrasonic Testing Literature — Volume VII," Rept. No. AMMRC-MS-76-5, Army Materials and Mechanics Research Center, Watertown, MA; 123 pp, Nov 1976, (AD-A040059).

This report guide covers a portion of the abstracts on ultrasonic testing included in the holdings of the nondestructive testing information analysis center.

NT-11284

Kurtz, Robert L. and Owen, Robert B.; "Holographic Recording Materials — A Review," Optical Engineering, Vol 14, No. 5; pp. 393-401, Oct 1975.

Early holograms were recorded on photographic plates, and today such plates are still the most common holographic recording medium. However, the nature of the holographic process, plus the development of high-power coherent light sources, invited the use of materials other than photographic emulsions. As a result, holograms have been recorded in dichromatic sensitized gelatin, photoresist, electro-optical crystals, photochromic films and glasses, thermoplastics, photo-polymers, amorphous semiconductors, and dye, MNBI, vesicular, and diazo films, as well as the more standard silver halide emulsions. In this review, the holographic recording materials currently available are examined along with a few of their applications. Some experimental media are also studied. No effort to rank the materials is made, as the purpose of this review is simply to familiarize the reader with the various options he has in selecting a holographic recording material for his particular application. This approach is felt to be appropriate since most media currently available will form excellent holograms.

NT-12009

Liu, Y.Y.; "Liquid Crystals," Rept. No. TB 75-13, LC Science Tracer Bullet; 7 pp, Nov 1975

A short but basic bibliography on liquid crystals and their applications.

NT-9503

Marron, Beatrice, Fong, Elizabeth and Fife, Dennis; "A Mechanized Information Services Catalog," Rept. No. NBS TN-814, National Bureau of Standards, Washington, D C; 56 pp, Feb 1974, (For sale by Supt. of Documents, GPO, Washington, D C 20402).

NBS is mechanizing a catalog of currently available information sources and services. Information from recent surveys of machine-readable, commercially-available bibliographic data bases, and the various current awareness, batch retrospective, and interactive retrospective services which can access them, has been correlated and converted into a machine-readable data base. A prototype searching capability has been established on an operational interactive retrieval system. Reasons for establishing the catalog and the choice of the initial information are detailed and the prototype implementation is described. Sample queries are included, as well as a to-date listing of the catalog. Plans for future development are discussed.

NT-11592 M

Mercier, Noelle; "Controle Non Destructif De Materiaux Par Ultrasons (Nondestructive Control of Materials by Ultrasonic Tests)," Office National Detudes Et De Recherches Aerospatiales, Chatillon-Sous-Bagneux, France; 103 pp, 1974, (AD-B007818).

A bibliographic study of nondestructive control methods of solids by ultrasonic tests, and of the ultrasonic emission of a transducer of finite dimension, is first presented. The principle of two of these methods is verified experimentally; they should permit the measurement of various physical parameters of solids, and the detection of local inhomogeneities. The first method calls upon the analysis of the ultrasonic signal (amplitude and phase), after it has crossed a constant thickness of a metallic specimen. This analysis reveals variations of attenuation and of ultrasonic propagation velocity within the specimen. A good spatial resolution is obtained by using L-MM-DIA. probes. The second method contributes, by using a test rig equipped with broad frequency band electrostatic transducers, to the knowledge of the attenuation law of the specimens as a function of frequency (present range: 5 to 15 MHz); from this, a classification of these specimens as regards their granulometry is deduced.

NT-13406

Merhib, Charles P. and Taylor, Leon; "A Report Guide to Thermal Testing Literature, Volume II," Rept. No. AMMRC-MS-72-3, Army Materials and Mechanics Research Center, Watertown, MA; 73 pp, Apr 1972, (AD-740654).

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

NT-7819

Miller, James G. and Fedders, Peter A.; "Spin-Phonon Interactions in Magnetic Materials," Rept. No. AFOSR-TR-74-0305, Washington Univ, St Louis, MO, Dept of Physics; 10 pp, Jan 1974.

In this final scientific report the theoretical and experimental research carried out under AFOSR sponsorship is discussed. Included are discussions of acoustic paramagnetic resonance in dense magnetic insulators (RBMNF3), higher order acoustic paramagnetic resonance in dilute magnetic systems (MGO:FE(2¼), ultrasonic coupling to nuclear spins in an antiferromagnet (RBMNF3), a novel theory of ultrasonic spin echoes, and acoustic magnetic resonance in metals. In addition to the experimental work performed on material systems, two contributions to experimental ultrasonic techniques are also included: an improved transducer correction for velocity measurement and a transmission oscillator ultrasonic spectrometer.

NT-9179

Moore, J.F., et al; "Nondestructive Detection of Structural Damage Uniquely Associated with Fatigue," Rept. No. AFML-TR-74-131, Rockwell International Corp, Los Angeles, CA; 216 pp, Jul 1974.

The program was directed at the development of reliable nondestructive testing and inspection methods to locate and assess fatigue damage in Air Force aircraft structures. The primary nondestructive test approach is the application of exoelectron emission to the detection of fatigue damage. Initially, a series of controlled fatigue tests were conducted in an ultrahigh vacuum chamber to fully characterize the surface state of the specimen prior to, during, and after fatigue measurement. Next, a series of fatigue tests were conducted in air on specimens of different shapes with and without discontinuities under various loading and environmental conditions, in order to develop a practical technique for applying exoelectron emission and surface potential difference measurements to assess fatigue damage as well as to predict final failure sites. A prototype system design for the automatic scanning and exoelectron emission testing of aircraft-type structures was developed.

NT-11579 M

Murphy, Margaret M. and Lenoe, Edward M.; "Design Analysis, Testing, and Reliability of Joints — An Annotated Bibliography," Rept. No. AMMRC-MS-75-7, Army Materials and Mechanics Research Center, Watertown, MA; 165 pp, Sep 1975.

An annotated bibliography of the work reported in the literature (1969-June 1975) on joining technology is presented. The bibliography covers experimental as well as theoretical aspects of the engineering methodology and considers a wide variety of types of joints, fracture mechanics aspects, nondestructive test procedures, reliability, and materials science considerations in joining structural materials.

NT-7576 M

"Non-Destructive Testing: Methods, Techniques and Their Applications, Report Bibliography May 64-Apr 73," Rept. No. DDC-TAS-73-67, Defense Documentation Center, Alexandria, VA; 291 pp, Nov 1973.

The bibliography is a compilation of unclassified-unlimited references on nondestructive testing: methods, techniques and their applications. Some methods and techniques discussed are electromagnetic, eddy current, holography, magnetic, photoplasticity, optical correlation and light scattering. This report also presents information on flaw detection, fatigue damage, thickness measurements, techniques for inspection, crack detection, and evaluation and characterization of materials. Corporate author-monitoring agency, subject, title, and personal author indexes are included.

NT-7575 M

"Non-Destructive Testing: Radiography, Report Bibliography Mar 64-Jun 73," Rept. No. DDC-TAS-73-66, Defense Documentation Center, Alexandria, VA; 131 pp, Nov 1973.

This bibliography is a compilation of unclassified-unlimited citations on nondestructive testing: radiography. It contains 86 entries pertaining to radiographic techniques for use in inspection and evaluation of electronic parts, metal fatigue, and filament wound materials. Entries are sequenced by AD number. Computer-generated indexes of corporate author monitoring agency, subject, title, and personal author are provided.

NT-8231

"Nondestructive Testing: A Survey," Rept. No. NASA-SP-5113, Southwest Research Inst, San Antonio, TX; 282 pp, 1973, (Available from U.S. GPO, Washington, D C).

A general survey of nondestructive evaluation with emphasis on contributions by the National Aeronautics and Space Administration and its contractors. Chapters include introduction, liquid penetrants, ultrasonics, radiography, eddy current testing, thermal and infrared testing, microwave techniques, magnetic testing, leak testing, strain sensing, and development methods. Extensive bibliography for each chapter.

NT-7562 M

"Non-Destructive Testing: Ultrasonics, Report Bibliography Jan 64-May 73," Rept. No. DDC-TAS-73-65, Defense Documentation Center, Alexandria, VA; 191 pp, Nov 1973, (AD-769200).

The bibliography is a compilation of unclassified-unlimited citations on nondestructive testing: ultrasonics. References pertain to ultrasonic techniques for inspection of welds, thickness measurements, flaw detection evaluation and characterization of materials, fatigue damage and crack detection. Corporate author-monitoring agency, subject, title, and personal author indexes are included.

NT-9041 M

Ono, Kanji; "Acoustic Emission and Microscopic Deformation and Fracture Processes," Rept. No. UCLA-ENG-7465, Univ of California at Los Angeles; 68 pp, Aug 1974.

This paper reviews diverse observations of acoustic emission from materials and attempts to interpret them on the basis of current knowledge of plastic deformation and fracture. Observed acoustic emission

characteristics have been classified into five categories, which arises from heterogeneous and homogeneous yielding, dynamic strain aging, twinning and other heterogeneous deformation and strain induced transformation of acoustic emission during plastic deformation are examined in relation to these metallurgical aspects as well as the mechanical vibration viewpoint. For example, tensile deformation of magnesium is mainly via twinning, which generates shear mode acoustic emission. On the other hand, the yielding of a HSLA steel sample excites longitudinal resonances along the length of the sample. It is shown that the micro-yielding concept with suitable modifications best explains these acoustic emission behavior observed. This paper also reviews important aspects of measurement techniques and theoretical considerations of acoustic emission behavior.

NT-11298

Pohlman, R.; "Documentation in Ultrasonics," Vol 7, 491 pp, 1975, (SwRI Library No. Z7144W2P65).

A bibliography of publications in ultrasonics, mostly during 1974. Arranged topically. Citations include author(s), title, and source, but not abstracts. Author index. A section on materials testing (organized subtopically) contains 787 citations.

NT-11201

"Radiologic and Radionuclide Imaging," The Alliance for Engineering in Medicine and Biology, 5454 Wisconsin Avenue, Chevy Chase, MD 20015; 106 pp, Jun 1975.

Radiologic and radionuclide imaging technology was assessed to determine areas of application of relevant new technology and to define possible research and development needed both to enhance performance capabilities of current equipment and to generate improved technology and instrumentation. A list of priority ordered R&D objectives for achieving these goals over the next 5-year period is included, together with a comprehensive rationale supporting the conclusions. An extensive bibliography of over 900 items was developed to provide a data base of the state of the art, as represented in the literature (1950-1974), as well as a listing of the work in progress.

NT-11856

Rossmassler, Stephen A.; "Critical Evaluation of Data in the Physical Sciences — A Status Report on the National Standard Reference Data System," Rep. No. NBS-TN-881, National Bureau of Standards, Washington, D C; 53 pp, Sep 1975, (For sale by the Supt. of Doc., U.S. GPO).

This is a report on the status of the national standard reference data system as of April 1975. Current activities and functions of the office of standard reference data are summarized. A complete list of data evaluation projects supported by the office of standard reference data during fiscal year 1975 is included; this list also includes projects which received financial support during the previous fiscal year, and which are still actively involved in some aspect of data compilation and evaluation. The list of projects includes continuing data centers in the United States whose activities fall within the scope of the system, but which are not formally affiliated with it. A list of publications resulting from the standard reference data program is provided.

NT-10802

Sherwood, Gertrude B. and White, Howard J., Jr; "A Bibliography of the Russian Reference Data Holdings of the Library of the Office of Standard Reference Data," Rept. No. NBS TN 848, National Bureau of Standards, Washington, D C; 20 pp, Sep 1974, (Available from U.S. GPO).

This text presents a listing of the Russian reference data holdings of the library of the Office of Standard Reference Data of the National Bureau of Standards as of March 1974. In addition to the bibliographic listing, information on the status of translations into English is given where available.

NT-8227

Spanner, Jack C.; "Acoustic Emission Techniques and Applications," Intex Publishing Co, Evanston, IL; 274 pp, 1974.

A comprehensive practically oriented critical review of the literature of acoustic emission through about 1972. Chapters include introduction, terminology, system analysis, materials research applications, theoretical studies, weld monitoring applications, structural integrity applications, geological applications, equipment, and conclusions. A bibliography is included as an appendix.

NT-11623

Spanner, J.C., Ed; "Monitoring Structural Integrity by Acoustic Emission," Rept. No. SP 571, ASTM, 1916 Race St, Philadelphia, PA 19103; 289 pp, Jan 1974.

This ASTM special technical publication is a compilation of the presentations at the symposium on monitoring structural integrity by acoustic emission, Ft. Lauderdale, FL, 17-18 Jan 1974. The sponsor was Committee E-7, Nondestructive Testing, with J.C. Spanner as symposium chairman. Topics presented were a general discussion of acoustic emission, determination of frequency content of acoustic bursts, acoustic emission during phase transformations in cooling steel, inspection of gas pipelines, geologic structure stability evaluation, welded ammunition belt link acceptance testing, industrial acoustic emission nondestructive testing, acoustic emission analysis technology, establishing structural integrity, nuclear plan integrity assurance, flaw growth in metallic and composite structures, bibliography.

NT-9592 M

"State-of-the-Art Reviews, Report Bibliography Feb 47-May 74," Rept. No. DDC-TAS-74-41, Defense Documentation Center, Alexandria, VA; 281 pp, Feb 1975, (AD-A005375).

This bibliography contains 229 references pertinent to the evaluation and results of surveys, studies, and literature searches in the state-of-the-art reviews of selected subjects. The indexes included are corporate author-monitoring agency and subject.

NT-9301

Stuhrke, William F. and Carpenter, James L., Jr; "Fracture Toughness Testing Data — A Technology Survey," Rept. No. NASA-CR-134752, Martin Marietta Aerospace, Orlando, FL; 190 pp, Jan 1975, (For sale by NTIS, Springfield, VA).

This technology survey report is comprised of reviewed and evaluated technical abstracts for about 90 significant documents relating to fracture toughness testing for various structural materials including information on plane strain and the developing areas of mixed mode and plane stress test conditions. The introduction to the report includes an overview of the state-of-the-art represented in the documents that have been abstracted. The abstracts in the report are mostly for publications in the period April 1962 through April 1974. The purpose of this report is to provide, in quick reference form, a dependable source for current information in the subject field. It is a companion volume to NASA CR-134753, Fracture Toughness Testing Data — A Bibliography.

NT-11462

Taylor, R.H.; "Electron Spin Resonance of Magnetic Ions in Metals — An Experimental Review," Advances in Physics, Vol 24, No. 6; pp 681-791, Nov 1975.

The contribution that the technique of electron spin resonance has made to our understanding of the behavior of localized magnetic moments in metals is reviewed. The main areas of application of the technique are discussed at a simple theoretical level and its limitations are pointed out. A comprehensive review of the experimental results obtained from electron spin resonance is presented and, in appendices to the article, a comprehensive list of experimental results is given indexed to author, impurity and host and to areas of application. In a final section of the review an attempt is made to suggest those areas in which electron spin resonance still has an important part fo play in adding to our understanding of magnetism in metals.

NT-8229

Vary, Alex; "Nondestructive Evaluation Technique Guide," Rept. No. NASA-SP-3079, National Aeronautics and Space Administration, Lewis Research Center, Cleveland, OH; 105 pp, 1973, (Available from NTIS, Springfield, VA).

A total of 70 individual nondestructive evaluation (NDE) techniques are described, each in a standardized single-page format for quick reference. Information is presented in a manner that permits ease of comparison of the merits and limitations of each technique with respect to various NDE problems. An NDE technique classification system is presented. It is based on the system that was adopted by the National Materials Advisory Board (NMAB). The classification system presented herein follows the NMAB system closely with the exception of additional categories that have been added to cover more advanced techniques presently in use. The rationale of the technique description format used herein is explained. The format provides for a concise description of each technique, the physical principles involved, objectives of interrogation, example applications, limitations of each technique, a schematic illustration, and key reference material. Cross-index tabulations are also provided so that particular NDE problems can be referred to appropriate techniques.

NT-9692

Williams, P.G.; "Automated Non-Destructive Testing," Rept. No. CE-BIB-227, Central Electricity Generating Board, London, England; 11 pp, Aug 1972.

A selective bibliography 1963-Feb 1972. Covers all NDT methods; only 34 references. Most of the automation is in fact semi-automation.

5. STANDARDS, SPECIFICATIONS AND RECOMMENDED PRACTICES

5.1. Introduction

This section of the Handbook contains a bibliography of standards, specifications and recommended practices. Some of the entries in the bibliography are annotated while others are not. Each entry contains the name of the publishing organization which is the normal source of the document. A subject index is included to aid the user in the search for documents relating to particular subjects.

5.2. Index

5.3. Bibliography of Standards, Specifications and Recommended Practices

NT-7661

"Visual Inspection Guide for Rubber Molded Items," MIL-STD-407, 128 pp, Feb 1957

This document covers the defects for conventional rubber molded items, that is, articles which are made by curing rubber compounds in a forming mold. Cast plastisol items, O rings, pneumatic tires and tubes, molded rubber fuel tanks, ebonite items and items containing cellular rubber are specifically excluded. The primary objective of this document is to present word descriptions and photographs of possible defects in rubber molded items that may be presented for inspection.

NT-7666

"Visual Inspection Guide for Rubber Extruded Goods," MIL-STD-298, 41 pp, Jan 1957

This document covers the defects for conventional rubber extruded goods, that is, items which are made by forcing unvulcanized rubber compound through a forming die and which are subsequently cured without being confined in a mold. Cast plastisol items, coated electrical wire and items containing cellular rubber are specifically excluded. The primary objective of this document is to present word descriptions and photographs of possible defects in rubber extruded goods that may be presented for inspection.

NT-7669

"Visual Inspection Guide for Hard Rubber (Ebonite) Items," MIL-STD-297, 40 pp, Jan 1957

This document covers the defects for hard rubber (ebonote) items; that is, articles which are made by curing high sulfur rubber compounds. Items containing cellular rubber are specifically excluded from this document. The primary objective of this document is to present word descriptions and photographs of possible defects in hard rubber (ebonite) items that may be presented for inspection.

NT-7671

"Visual Inspection Guide for Cellular Rubber Items," MIL-STD-293, 63 pp, Oct 1956

This document covers only visual defects for sponge rubber items. These include chemically blown or expanded rubber items having either open and interconnecting cells or closed and noninterconnecting cells. Also included are cellular products made from chemically or mechanically foamed lattices or liquid elastomers. The primary objective of this document is to present word descriptions and photographs of possible defects in cellular rubber items that may be presented for inspection.

NT-7672

"Rubber Products, Terms for Visible Defects of," MIL-STD-177A, 20 pp, Aug 1969

This standard covers a glossary of terms describing visible defects in rubber products. It includes words currently in general usage with a unique meaning in the rubber industry. Where the term rubber is used it includes the synthetic elastomers as well as natural rubber. The primary objective of this document is to present definitions of visual defects in rubber products. It is not the purpose of this standard to classify defects as being major or minor.

NT-7677

"Quality Assurance Terms and Definitions," MIL-STD-109B, 11 pp, Apr 1969

This document provides a standardized interpretation of quality assurance terms and definitions to be applied throughout the determination of product quality. This standard, therefore, is a collation and listing of terminology in use by the military and industry. It is not all inclusive but does include commonly used terms pertaining to the quality program as defined in or explained by authoritative documents. Accordingly, to lend credence to the definitions of the terms, these authoritative documents are designated at the end of the definition as the source of the definition.

NT-7683

"Military Standard Visual Inspection Guide for Rubber Sheet Material," MIL-STD-289A, 38 pp, Dec 1968

This document covers only visual defects for conventional rubber sheet material, from which gaskets, and similar items are cut. This standard is not applicable to cellular rubber, coated fabrics, cast plastisol, or latex films. The primary objective of this document is to present word descriptions and photographs of possible defects in rubber sheet material that may be presented for inspection. This standard includes photographs of only the most common surface defects that might occur during fabrications.

NT-7684

"Military Standard Inspection, Radiographic," MIL-STD-453, 15 pp, Oct 1962

This standard covers radiographic inspection of material for the presence of cracks, porosity, blowholes, inclusions, and similar defects.

NT-8180

"Military Standard — Nondestructive Testing Personnel Qualifications and Certification," MIL-STD-410D, 19 pp, Jul 1974

MIL-STD-410D specifies the qualification and certification requirements for nondestructive testing personnel performing, eddy current, liquid penetrant, magnetic particle, radiographic, and ultrasonic test methods.

NT-8181

"Inspection Program Requirements, Nondestructive Testing: For Aircraft and Missile Materials and Parts," MIL-I-6870C, 15 pp, Mar 1973

This specification (MIL-I-6870C) covers requirements for establishing the nondestructive testing (NDT) program for the procurement of all supplies or services when referenced in the item specification, contract, or order. This specification applies to all materials and parts for aircraft and missiles and their propulsion systems when nondestructive testing is required for acceptance.

NT-8182

"Inspection Process, Magnetic Particle," MIL-I-6868D, 17 pp, Dec 1971

This specification (MIL-I-6868D) covers general requirements and tests for performing magnetic particle inspection.

NT-8183

"Inspection, Penetrant Method of," MIL-I-6866B (ASG), 13 pp, Jan 1969

MIL-I-6866B (ASG) and Amendment-2 describes the military specifications for fluorescent and visible dye penetrant inspection.

NT-9270

"Military Standard Qualification and Certification of Inspection Personnel (Ultrasonics)," MIL-STD-1263 (MR), 8 pp, Apr 1973

This standard covers the minimum requirements and criteria for qualification and certification of government and nongovernment personnel engaged in or responsible for ultrasonic testing inspection for Department of the Army. Inspection personnel qualified and certified in accordance with this standard shall be identified as Class 1 (Operator Level), Class 2 (Inspector Level), or Class 3 (Supervisor Level).

NT-9272

"Military Standard Nondestructive Testing Requirements for Metals," MIL-STD-271E (Ships), 58 pp, Oct 1973

This standard covers the requirements for conducting nondestructive tests used in determining the presence of surface and internal discontinuities in meals. It also contains the minimum requirements necessary to qualify nondestructive test and inspection personnel, procedures, and nondestructive test equipment. This standard does not contain acceptance criteria for nondestructive tests. This standard covers the following types of test methods: (A) Radiography, (B) Magnetic Particle, (C) Liquid Penetrant, (D) Ultrasonic.

NT-9368

"API Bulletin on Nondestructive Testing Terminology," API BUL 5T1; 15 pp, Apr 1971, American Petroleum Institute, Washington, D C

The purpose of this bulletin is to provide definitions of imperfections and defects which occur in steel pipe. Definitions are grouped according to those occurring in (1) locations other than the weld, (2) double submerged arc welds, (3) electric flash-welds, and (4) electric resistance welds. Definitions are listed in English, French, German, Italian, Japanese, and Spanish.

NT-9447

"Calibration System Requirements," MIL-C-45662A, 4 pp, Feb 1962

This specification provides for the establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment used to assure that supplies and services presented to the government for acceptance are in conformance with prescribed technical requirements.

NT-9448

"Inspection System Requirements," MIL-I-45208A, 4 pp, Dec 1963

This specification establishes requirements for contractors inspection systems. These requirements pertain to the inspections and tests necessary to substantiate product conformance to drawings, specifications and contract requirements and to all inspections and tests required by the contract. These requirements are in addition to those inspections and tests set forth in applicable specifications and other contractual documents.

NT-9449

"Inspection Materials, Penetrant," MIL-I-25135C (ASG) with Amendment 3, 30 pp, Jun 1964

This specification covers materials used in the penetrant inspection of metal and nonporous ceramic and plastic parts to determine material defects open to the surface. Materials covered by this specification are suitable for use in conjunction with visible dye penetrant inspection methods and fluorescent dye penetrant inspection methods.

NT-9450

"Quality Program Requirements," MIL-Q-9858A, 9 pp, Dec 1963

This specification requires the establishment of a quality program by the contractor to assure compliance with the requirements of the contract. This specification will apply to complex supplies, components, equipments and systems for which the requirements of MIL-I-45208 are inadequate to provide needed quality assurance. Therefore, it is essential to control work operations and manufacturing processes as well as inspections and tests.

NT-9523

"Airplane Damage Tolerance Requirements," MIL-A-83444 (USAF), 17 pp, Jul 1974

This specification contains the damage tolerance design requirements applicable to airplane safety of flight structure. The objective is to protect the safety of flight structure from potentially deleterious effects of material, manufacturing and processing defects through proper material selection and control, control of stress levels, use of fracture resistant design concepts, manufacturing and process controls and the use of careful inspection procedures.

NT-9579

"Handbook for Standardization of Nondestructive Testing Methods," MIL-HDBK-333 (USAF), Vols. I and II, 387 pp, Apr 1974

This document provides a guide for the standardization of nondestructive testing methods to meet aerospace requirements. Every effort has been made to reflect the latest information available in the present state of the art. This handbook contains a discussion of the variables affecting the quality of NDT, the effect of these variables on quality, and how these variables can be standardized, calibrated, and controlled. The six NDT methods most commonly used for inspecting aircraft materials and structures discussed are: (1) magnetic particle, (2) penetrant, (3) radiography, (4) ultrasonics, (5) eddy current, and (6) thermal.

NT-9739

"Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the United States Navy," MIL-STD-278D (Ships), 61 pp, Jan 1970

This standard establishes the requirements for fabrication, welding, and inspection; and casting, inspection and repair for machinery, piping and pressure vessels in ships of the United States Navy. Topics in the welding section include: quality assurance inspection and qualification provisions, materials considerations, welding parameters and controls, workmanship requirements, postheat requirements; design requirements for welded joints, and inspection requirements. Topics in the casting section include: nondestructive tests, NDT acceptance criteria, extent of NDT, NDT responsibilities, repair procedures, and repair inspection requirements.

NT-11366

"Radiographic inspection; Soundness Requirements for Aluminum and Magnesium Castings (For Small Arm Parts)," MIL-STD-139A, 14 pp, Jan 1965

The purpose of this standard is to provide established radiographic inspection standards and inspection procedures for aluminum and magnesium castings for small arms parts. This revision introduces the use of industrial radiographic standards, ASTM E 155-60T, for discontinuities commonly occurring in thin wall aluminum and magnesium castings up to 2 inches in thickness and retains the industrial standards previously specified, ASTM E 98-53T, for use only on castings over 2 inches in thickness. Prepared by the U.S. Army Weapons Command in conjunction with the Department of Defense Standardization Program, it is one of a series of standards which will encompass all FSC 1005 weapons, accessories, and related equipment.

NT-11367

"Metals; Test Methods," Fed. Test Method Std. No. 151B, 41 pp, Nov 1967

Test methods are covered for: mechanical properties, composition, metallographic properties, leak testing, coatings, corrosion, inclusion content. This test method standard covers common requirements that may be omitted from the detail specifications for metals and metal products. This standard forms a part of such detailed specifications when referred to therein. Standard test methods used for measuring the properties of metals and metal products are described herein. Administrative procedures and requirements, and acceptance-inspection standards, may be found in procurement documents and specifications and are not a part of this document.

NT-11368

"Welding and Brazing Procedure and Performance Qualification," MIL-STD-248C, 74 pp, Oct 1973

This standard contains the requirements for the quali fication of welding and brazing procedures, welders, brazers and brazing and welding operators that must be met prior to any production fabrication. It includes manual, semi-automatic and machine welding and brazing of ferrous, nonferrous, and dissimilar metals. The qualification tests required by this standard are devised to demonstrate the adequacy of the welding or brazing procedures and to demonstrate the ability of welders, brazers, welding operators and brazing operators to produce sound welds or brazes.

NT-11369

"Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the U. S. Navy," MIL-STD-278D (Ships), 69 pp, Jan 1970

Part I covers welding for joining or overlaying and allied processes including inspection employed in the fabrication, alteration or repair of machinery, piping and pressure vessels for ships of the U. S. Navy. Part II contains the minimum requirements for inspection castings, and repairing defects to the extent necessary to meet the applicable acceptance standard.

NT-11370

"Inspection Procedure for Determining the Magnetic Permeability of Wrought Austenitic Steels," MIL-STD-288, 5 pp, Nov 1957

This standard covers the inspection procedure which shall be used for determining the magnetic permeability of wrought austenitic steel applicable to purchases where essentially nonmagnetic material is specified. This standard shall not be used for material intended for periscope tubes or accessories.

NT-11371

"Inspection, Radiographic," MIL-STD-453, 6 pp, Sep 1963

This standard covers general requirements for radiographic inspection of material. It includes materials and equipment, personnel, procedure, and inspection and records.

NT-11372

"Reference Radiographs for Steel Welds," MIL-STD-779, Nov 1965

MIL-STD-779 consists of: Volume I — 0.030 in., 0.080 in. and 0.187 in. standards applicable to thicknesses below 0.250 in. Volume II — 0.375 in., 0.750 in. and 2.0 in. standards applicable to thicknesses between 0.250 in. and 3.0 in. Volume III — 5.0 in. standards applicable to thicknesses over 3.0 in. and up to and including 8.0 in. This document contains selected radiographs illustrating various types and degrees of discontinuities occurring in steel welds. It is intended to provide inspectors and contractors engaged in the evaluation of steel welds with: A. A Guide enabling recognition, through radiographic examination, of discontinuities in steel welds and their differentiation both as to type and degree. B. Example radiographic illustrations of discontinuities and a nomenclature for reference in acceptance standards, specifications and drawings. The range of severity for the graded type discontinuities was selected so as to extend from that just discernible to that evident of poor workmanship and commonly rejectable in commercial practice. The ungraded illustrations are included for educational purposes.

NT-11373

"Nondestructive Testing, Welding, Quality Control, Material Control and Identification and Hi-Shock Test Requirements for Piping System Components for Naval Shipboard Use," MIL-STD-798 (Ships), 14 pp, Nov 1968

This standard covers the requirements for nondestructive testing, welding, quality control and identification and hi-shock for piping system components. It does not apply to primary side components of nuclear ships. Test methods include radiography, dye penetrants, and magnetic particle.

NT-11374

"Indicators," MIL-STD-1211, 10 pp, Jun 1969

This standard is a presentation of nomenclature, symbols, chemical and physical properties and requirements, military use, directions for use, packaging data, labeling, storage information, and shelf life of all military standard indicators. This standard does not necessarily include all classifications of the items represented by the title or those which are commercially available. It does contain items preferred for use in the selection of indicators for application by the Department of Defense. This standard covers the following items: fluorescent indicator mixture, hydrocarbon analysis; gasoline indicating paste; leak test compound, oxygen systems; magnetic inspection powder; sea marker, fluorescein (for lifeboat use); sea marker, fluorescein (for lifejacket use), water indicating paste.

NT-11375

"Radiographic and Visual Soundness Requirements for Cobalt-Chromium Alloy Liners (For Small Arms Barrels)," MIL-STD-1257A, 16 pp, Jan 1967

This standard establishes radiographic and visual standards and standard inspection procedures for use in acceptance inspection for soundness of cobalt-chromium alloy liner castings and finish-machined liners for small arms barrels.

NT-11376

"Radiographic Testing Requirements for Cast Explosives," MIL-STD-746A, 5 pp, Jan 1963

This standard covers the requirements for radiographic inspection used in determining the presence of discontinuities in cast explosives.

NT-11377

"Equipment, Leak Detection, Helium, for Chemical Munitions," MIL-STD-1441 (MU), 5 pp, Jun 1968

This standard covers various types and classes of helium leak detection equipment for use in testing the inert components of chemical munitions for leaks, and also the final closure containing the chemical fill.

NT-11378

"Castings, Classification and Inspection of," MIL-C-6021G, 16 pp, Sep 1967

This specification prescribes the requirements for the classification and inspection of ferrous and nonferrous metal castings. This specification supplements detail casting specifications when specified.

NT-11379

"Inspection, Penetrant Method of," MIL-I-5866 (ASG), 10 pp, Jan 1969

This specification covers inspection by the penetrant method of the surfaces of aircraft, missile, and critical ground handling equipment, component parts, and the basic materials for fabricating these parts.

NT-11380

"Magnetic Inspection Units," MIL-M-6867C, 35 pp, Jan 1969

This specification covers stationary, mobile, and portable equipment suitable for use in the magnetic-particle inspection of items and parts made of magnetic materials.

NT-11381

"Inspection, Ultrasonic, Wrought Metals, Process For," MIL-I-8950B, 10 pp, Jul 1970

This specification governs the process for ultrasonic inspection of materials and parts for discontinuities which may impair their quality. This specification applies to the inspection of wrought metals, including forgings and forging stock; rolled billet; bar or plate; extruded bar, tube and shapes; and parts made therefrom, when specified by the engineering drawing, contract or purchase order. Application to welds, castings, or sandwich structures, or to sizes outside the acceptance standard size limitations specified in the material specifications is not intended.

NT-11382

"Radiographic Inspection; Soundness Requirements for Arc and Gas Welds in Steel," MIL-R-11468 (ORD), 20 pp, Sep 1951

This specification covers methods for defining soundness and freedom from defects of arc and gas welds in steel as determined by radiographic inspection.

NT-11383

"Radiographic Inspection; Soundness Requirements for Steel Castings," MIL-R-11469 (ORD), 36 pp, May 1953

This specification covers methods for defining soundness and freedom from defects in steel castings as determined by radiographic inspection.

NT-11384

"Radiographic Inspection: Qualifications of Equipment, Operators and Procedures," MIL-R-11470A (MR), 14 pp, Jul 1971

This specification covers methods for the qualification of equipment, operators and procedures for industrial radiographic inspection.

NT-11385

"Magnetic-Particle Inspection; Process, for Ferromagnetic Materials," MIL-M-11472 (ORD), 5 pp, Nov 1952

This specification covers wet and dry methods of magnetic-particle inspection for use in determining surface imperfections in ferromagnetic materials.

NT-11386

"Magnetic-Particle Inspection; Soundness Requirements for Weldments," MIL-M-11473 (ORD), 14 pp, Sep 1951

This specification covers methods for defining soundness and freedom from defects of weldments by magnetic-particle inspection, in which direct current is passed through ferromagnetic material for assistance in the interpretation of magnetic-particle patterns on weldments.

NT-11387

"Screen, X-Ray Protective," MIL-S-15253B, 9 pp, May 1959

This specification covers sectional and mobile X-ray protective screens for protecting operators from primary and secondary radiation when operating X-ray and photofluorographic equipment.

NT-11388

"Copper-Nickel Alloy, Rod, Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate) and Forgings," MIL-C-15726E (Ships), 14 pp, Aug 1970

This specification covers copper-nickel-alloy which is satisfactory for use in applications involving sea water exposure. Test methods covered include visual examination, chemical analysis, tension tests, bending tests, and ultrasonic tests.

NT-11389

"Drier, X-Ray Film, and Drier and Bin X-Ray Film, 110 Volt, 60 Cycle, (Hertz)," MIL-D-15862C, 16 pp, Jul 1969

This specification covers X-ray filmdriers of the horizontal and vertical types, suitable for use in drying radiographic films.

NT-11390

"Steel Plate, High Tensile (HT), Hull and Structural," MIL-S-16113C (Ships), 24 pp, Mar 1966

This specification covers sheared or gas cut steel plate primarily for use in the hulls of combatant ships, submarines, and other critical structures, and is intended for fabrication by welding.

NT-11391

"Steel Plate, Alloy, Structural, High Yield Strength (HY-80 and HY-100)," MIL-S-16216H (Ships), 24 pp, Mar 1972

This specification covers HY-80 and HY-100, sheared or gas cut, alloy steel plate, intended primarily for use in the hulls of combatant ships and for other critical structural applications where a notch tough high strength material is required. The requirements for HY-80 plate apply up to 8 inches thick, and for HY-100 plate, apply to 5 inches thick.

NT-11392

"Tanks, Master, X-Ray and Photodosimetric Film Processing, Mechanically Cooled, Self-Contained Naval Shipboard," MIL-T-19367A (Ships), 13 pp, Mar 1962

This specification covers mechanically cooled, self-contained, developing tanks with a master tank containing 3 insert tanks used for developing X-ray and photodosimetric films.

NT-11393

"X-Ray Apparatus, Radiographic, Industrial, Spot, Portable, 140 KVP," MIL-X-19685A, o pp, Jun 1959

This specification covers a portable 140 K.V.P. X-ray unit, consisting primarily of a tube head and control unit, used in place of trepanning metals.

NT-11394

"X-Ray Apparatus, Ratiographic, Industrial, Portable, 120 to 150 KVP Rating," MIL-X-19847A, 9 pp, Dec 1959

This specification covers X-ray units consisting primarily of a portable self-rectified tube head and a control unit.

NT-11395

"Steel Structural Shapes, Weldable Medium Carbon and High Tensile; Hull and Structural," MIL-S-2016B, 8 pp, Apr 1973

This specification covers carbon steel and high tensile steel structural shapes for use in shipbuilding and other structural work where the steel is intended for fabrication by welding.

NT-11396

"Steel Castings, Alloy, High Yield Strength (HY-80 and HY-100)," MIL-S-23008B (Ships), 9 pp, Jul 1965
This specification covers HY-80 and HY-100 alloy steel castings for use in applications where good weldability and notch toughness are required.

NT-11397

"Steel Forgings, Carbon and Alloy, for Shafts, Couplings, and Stocks (Rudders and Diving Planes)," MIL-S-23284 (Ships), 26 pp, May 1967
This specification covers carbon and alloy steel forgings for torsional shafts, including propulsion shafts for ships, sleeves, couplings, rudder stocks, diving plane stocks, and related parts.

NT-11398

"Magnetic Particle Inspection Unit, Lightweight,"MIL-M-23527 (Ships), 11 pp, Dec 1962
This specification covers lightweight portable magnetic particle inspection units capable of providing alternating current (A.C.) and half wave direct current (H.W.D.C.) output. The unit is primarily for inspection ferritic steels for the presence of surface and subsurface discontinuities by prod and coil methods of magnetization.

NT-11399

"Densitometer FM-35A," MIL-D-26372 (USAF), 20 pp, Jun 1958
This specification covers one type of densitometer designated FM-35A.

NT-11400

"Leak Detector (For 55-Gallon Drums)," MIL-L-28510 (YD), 9 pp, Oct 1967
This specification covers the requirements for a submergible-type leak detector for detecting leaks in 55-gallon tight head drums in a drum reconditioning plant

NT-11401

"Illuminator, X-Ray Film, Collapsible," MIL-I-36013B, 10 10 pp, Jul 1972
This specification covers a lightweight, collapsible, X-ray film illuminator for use in the field for viewing films up to and including 14 inches by 17 inches.

NT-11402

"Tank, Master, X-Ray Film Processing," MIL-T-36028A, 15 pp, Apr 1967
This specification covers an air cooled X-ray film processing tank complete with two removable 5 gallon tank inserts, of strong construction, and suitable for field use.

NT-11403

"Darkroom, X-Ray, Portable, Tent Type, Lightweight, Field," MIL-D-36105 (DMSC), 23 pp, Mar 1962

NT-11404

"Radiographic Paper and Developer Assemblies, 9-3/8 by 10-1/2 Inches, 10S," MIL-R-36154 (BUMED), 7 pp, May 1963
This specification covers radiographic paper and developer assemblies (packets), suitable for use in producing X-ray positives by a dry processing method without the use of darkroom facilities.

NT-11405

"Processing Unit, X-Ray Film," MIL-P-36206A, 13 pp, Sep 1974
This specification covers two types of X-ray film processing units with a rear panel, suitable for use in normal darkroom development of standard X-ray films.

NT-11406

"Tank, Insert, X-Ray Film Processing," MIL-T-36213A, 8 pp, Jun 1966
This specification covers two types of corrosion-resisting steel insert tanks. One type shall be mounted on legs and shall be suitable for use with two and three compartment X-ray film processing units. The other type shall be lightweight and suitable for field use with a single compartment X-ray film processing master tank.

NT-11407

"Cabinet, Cassette Transfer, Wall Mounted," MIL-C-36373 (DM), 6 pp, Feb 1965
This specification covers one type of lead lined, two compartment, lightproof, manual cassette transfer cabinet, designed for mounting into the wall. The unit is used for passing loaded exposed and unexposed medical X-ray film cassettes into and out of the darkroom in military medical X-ray facilities.

NT-11408

"Processing Machine, Radiographic Paper and Developer Assembly," MIL-P-36541, 11 pp, Sep 1967
This specification covers a lightweight field type spring-driven, processing machine for use with radiographic paper and developer assemblies in ten seconds to one minute developing.

NT-11409

"Fluorescent Penetrant Inspection Units," MIL-F-38762 (USAF), 15 pp, Jun 1968
This specification covers three types of fluorescent penetrant inspection units. Fluorescent penetrant inspection units covered by this specification shall be of the following types, as specified: Types MA-1, MA-2, MA-3; Internal Tank size 33 inches wide, 16 inches long, 14 inches deep; 29 inches wide 43 inches long, 26 inches deep; 44 inches wide, 67 inches long, 26 inches deep, respectively.

NT-11410

"Manual, Technical: Nondestructive Inspection," MIL-M-38780A (USAF), 33 pp, Apr 1973
This specification contains instructions for the preparation of technical manuals required for the application of nondestructive inspection (NDI) methods on aircraft (-36 Manual), missiles and space weapons (-26 Manuals), and engines (-9 Manual). Instructions for the preparation of NDI methods to be included in maintenance manuals for components and equipment not requiring a separate manual (-36, -26, -9) are also provided. The manuals and procedures covered by this specification are intended to provide instructions and guidance to NDI technicians in the organizational, intermediate, and depot levels of maintenance for the use of NDI methods on systems, subsystems, support systems and their components.

NT-11411

"Welding, Gas Metal-Arc and Gas Tungsten-Arc, Aluminum Alloys, Readily Weldable for Structures, Excluding Armor," MIL-W-45205A (MR), 9 pp Jun 1969
This specification covers the welding of aluminum alloys for structural applications other than armor by the gas metal-arc or tungsten-arc welding process.

NT-11412

"Radioactive Test Sample, Strontium 90-Yttrium 90, Beta, M6," MIL-R-51060 (CM1C), 7 pp, Jun 1961
This specification covers one type of radioactive source (M6) for use in radiac calibrating instruments.

NT-11413

"Ultrasonic Inspection, Immersion, of wrought Metal General Specification for," MIL-U-81055 (WEP), 7 pp, May 1964

This specification covers the procedure and acceptance levels for the ultrasonic inspection of ferrous and nonferrous, wrought alloy parts and materials. These parts and materials include forgings, extrusions, bars, plates, and tubes.

NT-11414

"Radiographic Inspection, Quality Levels For," MIL-R-81080 (WEP), 7 pp, May 1964

This specification covers the allowable acceptance limits of defects in fusion weld joints as indicated by radiographic inspection.

NT-11415

"X-Ray Apparatus, Radiographic, Industrial Lightweight, Portable, 140 KVP - Rating," MIL-X-81383 (AS), 15 pp, Jun 1966

This specification covers a portable 140 kilovolt (KVP), minimum 4 MA X-ray unit, consisting primarily of a tubehead, control unit, and interconnecting cables for detecting defects in aircraft structures and or/components.

NT-12123

"Visual Inspection Standards for Small Arms Ammunition Through Caliber .50," MIL-STD-636, 76 pp, Jun 1958

This standard provides procedures for determining and evaluating defects in small arms ammunition up to and including caliber .50, and the standard shall be used as a supplement to pertinent specifications.

NT-12124

"Reliability Program for Systems and Equipment Development and Production," MIL-STD 785A, 11 pp, Mar 1960

This standard establishes uniform criteria for a reliability program, and provides guidelines for the preparation and implementation of a reliability program plan.

NT-12125

"Reliability Assurance Program for Electronic Parts Specifications," MIL-STD-790C, 12 pp, Apr 1968

This standard is for direct reference in electronic parts established reliability (ER) specifications and establishes the criteria for a reliability assurance program which are to be met by manufacturers qualifying electronic parts to the specifications. This standard is applicable when: (a) referenced in ER specifications where attainment of specified failure rate levels and assurance of homogeneity of parts require control of production facilities, materials, and processes, (b) the qualifying activity evaluates, accepts, and monitors the reliability assurance program as a requisite for qualification approval.

NT-12126

"Visual Inspection Guide for Pneumatic Tires (Nonaircraft)," MIL-STD-1224, 134 pp, Sep 1960

This document covers only visual defects of conventional, pneumatic, nonaircraft, rubber tires. Its primary objective is to present photographs with narrative descriptions of some of the more commonly observed defects in pneumatic tires, either new or used, which may be presented for inspection. In addition, it provides a training aid for inspectors. It is not intended to replace a particular inspection aid which may be provided to inspectors for verifying product conformance to a particular specification.

NT-14691

"Solution, Fluorescent Penetrant, Water Base," SAE AMS 3158, 3 pp, 1964, (Soc. of Automotive Engineers, Warrendale, PA)

This specification consists of an acknowledgement, application, composition, technical requirements — a) physical properties, b) color, c) toxicity, d) water solubility, e) fluorescence, f) test apparatus, g) viewer, h) cobalt glass filters, i) ultraviolet lamp, j) masking paper. The test procedure is given along with a definition of impact sensitivity. It also discusses reports identification, approval, and rejections.

NT-14692

"Aircraft Quality Steel Cleanliness, Martensitic Corrosion Resistant Steels — Magnetic Particle Inspection Procedure," SAE AMS 2303, 6 pp, 1967, (Soc. of Automotive Engineers, Warrendale, PA)

This specification contains an acknowledgement, application, procedure — a) sampling, b) heat qualifications, c) product qualifications, d) specimen preparation, e machining allowances, f) heat treatment, g) finish machining, h) inspection, i) evaluation of steel cleanliness, j) frequency, k) severity. It also discusses disposition of the material, reports, and identification.

NT-14693

"Fluoroscopic X-Ray Inspection," SAE AMS 2650, 5 pp, 1945, (Soc. of Automotive Engineers, Warrendale, PA)

This specification contains an acknowledgement, purpose, application, limitation, procedure, marking, reports, precautionary measures, and various notes.

NT-14694

"Radiographic Inspection," SAE AMS 2635B, 4 pp, 1967, (Soc. of Automotive Engineers, Warrendale, PA)

This specification includes an acknowledgement, application, equipment — general, film, penetrameters; procedure, identification, records, reports, and approvals.

NT-14695

"Oil, Fluorescent Penetrant, Solvent Soluble," SAE AMS 3155B, 3 pp, 1970, (Soc. of Automotive Engineers, Warrendale, PA)

This specification includes acknowledgement, application, composition, and technical requirements — a) physical properties, b) toxicity, c) solvent solubility, d) fluorescent brightness, e) test apparatus, f) preparation of specimens, g) test procedure, h) fluorescent stability, i) corrosion testing, j) test specimens, k) procedure, l) storage stability. Precautions, reports, identification, and approval.

NT-14696

"Oil, Fluorescent Penetrant, Water Soluble," SAE AMS 3156B, 3 pp, 1970, (Soc. of Automotive Engineers, Warrendale, PA)

This specification includes acknowledgement, application, composition, technical requirements — a) physical properties, b) toxicity, c) water solubility, d) fluorescent brightness, e) test apparatus, f) preparation of specimens, g) test procedure, h) fluorescent stability, i) corrosion tests, j) test specimens, k) procedure, l) water tolerance, m) storage stability. It also discusses precautions, report preparation, identification, approval, and rejections.

NT-14697

"Oil, Fluorescent Penetrant, High Fluorescence, Solvent Soluble," SAE AMS 3157A, 3 pp, 1970, (Soc. of Automotive Engineers, Warrendale, PA)

This specification contains acknowledgements, application, composition, technical requirements — a) physical properties, b) toxicity, c) solvent solubility, d) fluorescent brightness, e) test apparatus, f) preparation of specimens, g) test procedure, h) fluorescent stability, i) corrosion test, j) test specimens, k) procedure, l) storage stability. It also discusses precautions, reports, identification, approval, and rejections.

NT-14698

"Leak Test Solution, Liquid Oxygen Compatible," SAE AMS 3159C, 3 pp, 1967, (Soc. of Automotive Engineers, Warrendale, PA)

This specification contains an acknowledgement, application, technical requirements — general: composition, leak detecting properties, appearance, odor, toxicity, flammability, mold growth, properties, turbidity, evaporation residue, foaming ability. It also discusses spreading and wetting ability, PH value, impact sensitivity, corrosiveness. The specification discusses reports, packaging, identification, approval, and rejections.

NT-14699

"Premium Aircraft — Quality Steel Cleanliness - Magnetic Particle Inspection Procedure," SAE AMS 2300B, 6 pp, 1973, (Soc. of Automotive Engineers, Warrendale, PA)

This specification covers sampling and testing procedures to determine conformance of premium aircraft-quality ferromagnetic steels to cleanliness requirements of material specifications in which this specification is referenced. Applicable primarily to blooms, billets, extrusions, tube rounds, stock for forgings and rings, bars, and heavy wall tubing used in the fabrication of highly stressed parts and assemblies where very rigid magnetic particle standards are used in the final inspection of such parts. The specification includes applicable documents, technical requirements, quality assurance provisions, and preparation for delivery.

NT-14700

"Top Visual Quality (TVQ) O-Ring Packings and Gaskets Surface Inspection Guide and Acceptance Standard," SAE AS 708, 4 pp, 1965, (Soc. of Automotive Engineers, Warrendale, PA)

The scope of this standard is to establish the inspection requirements and acceptance standards for optimum surface finish O-ring packings and gaskets. The standard lists applicable documents, general requirements, detail requirements, inspection, and packaging.

NT-14701

"Universal Leak Detector," SAE ARP 726, 6 pp, 1963, (Soc. of Automotive Engineers, Warrendale, PA)

The purpose of this document is to provide a recommended practice for the design of a universal leak detector which will pressurize a closed system with a mixture of inert and tracer gas and provide a probe and detector to indicate location and rate of system leakage with a high degree of accuracy. This recommended practice covers a self-contained detection system which is capable of pressurizing a closed system up to 70 psig with halogen (tracer) gas and up to 3500 psig with nitrogen. The document provides general requirements, specific requirements, and discusses precautions.

NT-14702

"Acceptance Criteria — Magnetic Particle, Fluorescent Penetrant, and Contrast Dye Penetrant Inspection," 8 pp 1972, (Soc. of Automotive Engineers, Warrendale, PA)

This standard includes an acknowledgement, application, requirements, definitions, and rejection.

NT-14703

"Nondestructive Testing Symbols," AWS A2.2-69, 11 pp, Jul 1973, (American Welding Society, Inc, N Y)
The contents of this guide are: basic symbols — basic testing symbols, and elements of the testing symbol. General provisions — significance of the arrow, vocation of testing symbol, direction of radiation, combination of nondestructive testing symbols and welding symbols, and use of references. The final section contains methods of specifying extent of nondestructive test — specifying length and section to be tested, specifying the number of tests, specifying tests made all around the joint, and specifying tests of areas of parts. The standard establishes the symbols for use on drawings to specify nondestructive test for determining the soundness of materials. The symbols included in the standard represent nondestructive inspection definitions and details for the use of the various nondestructive inspection methods are found in welding inspection.

NT-14286

"Tables of Brinell Hardness Values (HB) for Use in Tests Made on Flat Surfaces," ISO Recommendation R410, 29 pp, Dec 1964, (International Organization for Standardization, Paris)

NT-14827

"Verification of Vickers Hardness Testing by Machines," ISO Recommendation R146, 6 pp, Mar 1968, (International Organization for Standardization, Paris)

NT-14828

"Tables of Vickers Hardness Values (HV) for Metallic Materials," ISO Recommendation R409, 34 pp, Dec 1964, (International Organization for Standardization, Paris)

NT-14829

"Flexible Cellular Materials - Hardness Testing by Indentation Techniques," ISO 2439, 4 pp, Oct 1972, (International Organization for Standardization, Paris)

NT-14830

"Light Metals and Their Alloys — Brinell Hardness Test," ISO Recommendation R191, 5 pp, Oct 1971, (International Organization for Standardization, Paris)

NT-14831

"Rockwell Superficial Hardness Test (N and T Scales) for Steel," ISO Recommendation R1024, 12 pp, Mar 1969, (International Organization for Standardization, Paris)

NT-14832

"Light Metals and Their Alloys Vickers Hardness Test (Test Loads from 1 to 100 KGF)," ISO Recommendation R192, 5 pp, Oct 1971, (International Organization for Standardization, Paris)

NT-14833

"Rockwell Hardness Test (B and C Scales) for Steel," ISO Recommendation R80, 10 pp, Feb 1968, (International Organization for Standardization, Paris)

NT-14834

"Brinell Hardness Test for Steel," ISO Recommendation R79, 5 pp, Mar 1968, (International Organization for Standardization, Paris)

NT-14835

"Brinell Hardness Test for Copper and Copper Alloys," ISO Recommendation R403, 5 pp, Nov 1964, (International Organization for Standardization, Paris)

NT-14836

"Vickers Hardness Test for Copper and Copper Alloys (Test Loads from 2.5 to 50 KGF)," ISO Recommendation R399, 6 pp, Nov 1964, (International Organization for Standardization, Paris)

NT-14837

"Calibration of Standardized Blocks to be Used for Rockwell B and C Scale Hardness Testing Machines," ISO Recommendation R674, 7 pp, Feb 1968, (International Organization for Standardization, Paris)

NT-14838

"Recommended Practice for Radiographic Inspection of Circumferential Fusion Welded Butt Joints in Steel Pipes Up to 50 mm (2 in.) Wall Thickness," ISO Recommendation R947, 17 pp, Jan 1969, (International Organization for Standardization, Paris)

NT-14839

"Determination of Indentation Hardness of Plastics by Means of a Durometer (Shore Hardness)," ISO Recommendation R868, 6 pp, Nov 1968, (International Organization for Standardization, Paris)

NT-14840

"Verification of Brinell Hardness Testing Machines," ISO Recommendation R156, 7 pp, Nov 1967, (International Organization for Standardization, Paris)

NT-14841

"Calibration of Standardized Blocks to be Used for Vickers Hardness Testing Machines," ISO Recommendation R640, 7 pp, Nov 1967, (International Organization for Standardization, Paris)

NT-14842

"Verification of Rockwell Superficial N and T Scale Hardness Testing Machines," ISO Recommendation R1079, 10 pp, May 1969, (International Organization for Standardization, Paris)

NT-14843

"Verification of Rockwell B and C Scale," ISO Recommendation R716, 8 pp, May 1968, (International Organization for Standardization, Paris)

NT-14844

"Calibration of Standardized Blocks to be Used for Rockwell Superficial N and T Scale Hardness Testing Machines," ISO Recommendation R1355, 7 pp, Aug 1970, (International Organization for Standardization, Paris)

NT-14845

"Recommended Practice for Radiographic Inspection of Circumferential Fusion Welded Butt Joints in Steel Pipes up to 50 mm (2 in.) Wall Thickness," ISO Recommendation R947, 17 pp, Jan 1969, (International Organization for Standardization, Paris)

NT-14846

"Radiographic Image Quality Indicators Principles and Identification," (International Organization for Standardization, Paris)

NT-14847

"Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints for Steel Plates up to 50 mm (2 in.) Thick," ISO Recommendation R1106, 7 pp, Sep 1969, (International Organization for Standardization, Paris)

NT-14848

"Welds in Steel-Reference Block for the Calibration of Equipment for Ultrasonic Examination," ISO 2400, 3 pp, Jun 1972, (International Organization for Standardization, Paris)

NT-14849

"Recommended Practice for the X-Ray Inspection of Fusion Welded Butt Joints for Aluminum and Its Alloys and Magnesium and Its Alloys 5 to 50 mm Thick," ISO 2437, 8 pp, Oct 1972, (International Organization for Standardization, Paris)

NT-14850

"Recommended Practice for Radiographic Inspection of Fusion Welded Butt Joints for Steel Plates 50 to 200 mm Thick," ISO 2405, 7 pp, Sep 1972, (International Organization for Standardization, Paris)

NT-14851

"Radiography of Welds and Viewing Conditions for Films Utilization of Recommended Patterns of Image Quality Indicators (I.Q.I.)," ISO 2504, 7 pp, Feb 1973, (International Organization for Standardization, Paris)

NT-14852

"Non-Conductive Coatings on Non-Magnetic Basis Metals Measurement of Coating Thickness — Eddy Current Method," ISO 2360, 5 pp, Jun 1972, (International Organization for Standardization, Paris)

NT-14853

"Vulcanized Rubbers of High Hardness (85 to 100 IRHD) Determination of Hardness," ISO 1400, 6 pp, May 1975, (International Organization for Standardization, Paris).

NT-14854

"Electrodeposited Nickel Coatings on Magnetic and Nonmagnetic Substrates — Measurement of Coating Thickness — Magnetic Method," ISO 2361, 5 pp, Aug 1972, (International Organization for Standardization, Paris)

NT-14855

"Non-Magnetic Metallic and Vitreous or Porcelain Enamel Coatings on Magnetic Basis Metals — Measurement of Coating Thickness Magnetic Method," ISO 2178, 5 pp, Jun 1972, (International Organization for Standardization, Paris)

NT-14856

"Vulcanized Rubbers — Determination of Hardness (Hardness Between 30 and 86 IRHD)," ISO 48, 7 pp, Apr 1975, (International Organization for Standardization, Paris)

NT-14857

"Vulcanized Rubbers of Low Hardness (10 to 35 IRHD) Determination of Hardness," ISO 1818, 7 pp, May 1975, (International Organization for Standardization, Paris)

NT-14907

"Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components (Dry Power Magnetic Particle Inspection Method)," MSS/SP-53, 6 pp, Jan 1957, (Manufacturers Standardization Soc. of the Valve and Fittings Industry, Arlington, VA)

NT-14908

"Quality Standard for Steel Castings — Radiographic Inspection Method for Valves, Flanges, Fittings and Other Piping Components," MSS/SP-54, 4 pp, Feb 1959, (Manufacturers Standardization Soc. of the Valve and Fittings Industry, Arlington, VA)

NT-14909

"Quality Standard for Steel Castings for Valves, Flanges and Fittings and Other Piping Components (Visual Method)," MSS/SP-55, 17 pp, Apr 1961, (Manufacturers Standardization Society of the Valve and Fittings Industry, Arlington, VA)

NT-14910

"Personnel Qualification and Certification in Nondestructive Testing," Recommended Practice No. SNT-TC-1A, 1975 Edition; 36 pp, Jun 1975, (American Society for Nondestructive Testing, Columbus, OH)

NT-14911

"Ultrasonic Examination of Tubular Products," PFI/ES-18, 4 pp, Jan 1975, (Pipe Fabrication Institute, Pittsburgh, PA)

NT-14912

"Access Holes and Plugs for Radiographic Inspection of Pipe Welds," PFI/ES-16, 5 pp, Oct 1974, (Pipe Fabrication Institute, Pittsburgh, PA)

NT-14913

"Method for Vacuum Leak Calibration," AVS/2.2-1968, J Vacuum Science and Technology, Vol 5, No. 6, 4 pp, Nov 1968.

NT-14924

"Vickers Hardness Test for Steel," ISO Recommendation R81, 5 pp, Nov 1967, (International Organization for Standardization, Paris)

NT-14926

"Nondestructive Flaw — Detection Methods," FME 17-1, 4 pp, Oct 1967, (Factory Mutual System, Norwood, MA)

NT-14927

"Association of American Railroads," AAR M-126A, 4 pp, 1966, (Association of American Railroads, Washington, D C)

NT-14930

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"Standard Method for Measurement of Coating Thickness by the Beta Backscatter Principle," ASTM B567, 7 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

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NT-15277

"Standard Specification for Straight-Beam Ultrasonic Examination of Steel Plates for Pressure Vessels," ASTM A435, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Recommended Practice for Measuring Coating Thickness by Magnetic-Field or Eddy-Current (Electromagnetic) Test Methods," ASTM E376, 4 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15279

"Standard Test Method for Electrical Conductivity by Use of Eddy Currents," ASTM B342, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Test Method for Indentation Hardness of Metallic Materials by Portable Hardness Testers," ASTM E110, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15281

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"Standard Recommended Guide for Preparation of a Leak Testing Specimen," ASTM E479, 6 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15283

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"Standard Methods of Testing for Leaks Using the Mass Spectrometer Leak Detector of Residual Gas Analyzer in the Tracer Prove Mode," ASTM E498, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Test Methods for Leaks Using the Mass Spectrometer Leak Detector in the Inside-Out Testing Mode," ASTM E493, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Test Method for Vickers Hardness of Metallic Materials," ASTM E92, 11 pp, 1977, (Am Soc of Test. and Mater, Philadelphia, PA)

NT-15287

"Standard Method for Wet Magnetic Particle Inspection," ASTM E138, 10 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15288

"Standard Method for Dry Powder Magnetic Particle Inspection," ASTM E109, 19 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15289

"Standard Reference Photographs for Magnetic Particle Indications on Ferrous Castings," ASTM E125, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Recommended Practice for Ultrasonic Testing by the Resonance Method," ASTM E113, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15291

"Standard Recommended Practice for Immersed Ultrasonic Testing by the Reflection Method Using Pulsed Longitudinal Waves," ASTM E214, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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NT-15293

"Standard Recommended Practice for Fabricating and Checking Aluminum Alloy Ultrasonic Standard Reference Blocks," ASTM E127, 14 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15294

"Standard Recommended Practice for Ultrasonic Inspection of Metal Pipe and Tubing," ASTM E213, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15295

"Standard Method for Ultrasonic Inspection of Longitudinal and Spiral Welds of Welded Pipe and Tubing," ASTM E273, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15296

"Standard Definition of Terms Relating to Liquid Penetrant Inspection," ASTM E270, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15297

"Standard Recommended Practice for Liquid Penetrant Inspection Method," ASTM E165, 14 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15298

"Standard Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness," ASTM E446, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15299

"Standard Reference Radiographs for Inspection of Aluminum and Magnesium Castings," ASTM E155, 4 pp, 1977, (Am Soc. Test. and Mater, Philadelphia, PA)

NT-15300

"Standard Reference Radiographs for High-Strength Copper-Base and Nickel-Copper Alloy Castings," ASTM E272, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15301

"Standard Reference Radiographs for Heavy-Walled (2 to 4-1/2 in. (51 to 114-mm) Steel Castings," ASTM E186, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15302

"Standard Reference Radiographs for Heavy-Walled (4-1/2 to 12-in. (114 to 305-mm) Steel Castings," ASTM E280, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15303

"Standard Reference Radiographs for Appearances of Radiographic Images as Certain Parameters are Changed," ASTM E242, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15304

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NT-15305

"Standard Test Methods for Indentation Hardness of Metallic Materials by Portable Hardness Testers," ASTM E110, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15306

"Standard Recommended Practice for Standardizing Equipment for Electromagnetic Testing of Seamless Aluminum-Alloy Tube," ASTM E215, 7 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15307

"Standard Recommended Practice for Electromagnetic (Eddy-Current) Testing of Seamless Copper and Copper-Alloy Tubes," ASTM E243, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15308

"Standard Recommended Practice for Eddy-Current Testing of Steel Tubular Products with Magnetic Saturation," ASTM E309, 2 pp,1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15309

"Standard Reference Photographs for Liquid Penetrant Inspection," ASTM E433, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15310

"Standard Method for Determining Image Quality in Thermal Neutron Radiographic Testing," ASTM E545, 9 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15311

"Standard Test Method for Microhardness of Materials," ASTM E384, 21 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15312

"Standard Recommended Practice for Acoustic Emission Monitoring of Structures During Controlled Stimulation," ASTM E569, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15313

"Standard Test Method for Electrical and Mechanical Properties of Magnetic Materials," ASTM A344, 12 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15314

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NT-15315

"Tentative Recommended Practices for Determining Hermeticity of Electron Devices with a Helium Mass Spectrometer Leak Detector," ASTM F134, 8 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15316

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NT-15317

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NT-15318

"Standard Recommended Practice for Determining Hermeticity of Electron Devices by Dye Penetration," ASTM F97, 4 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15319

"Standard Method for Nondestructive Measurement of Film Thickness of Pipeline Coatings on Steel," ASTM G12, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15320

"Standard Method for Measuring Neutron Flux by Radioactivation Techniques," ASTM E261, 11 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15321

"Standard Method for Calibration of Helium Leak Detectors by Use of Secondary Standards," ASTM F78, 4 pp, 1976, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15322

"Standard Method of Ultrasonic Testing and Inspection of Turbine and Generator Steel Rotor Forgings," ASTM A418, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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NT-15324

"Standard Method of Rapid Indentation Hardness Testing of Metallic Materials," ASTM E103, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15325

"Standard Method for Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications," ASTM B594, 9 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15326

"Standard Method and Specification for Ultrasonic Inspection of Aluminum-Alloy Plate for Pressure Vessels," ASTM B548, 6 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Test Method for Brinell Hardness of Metallic Materials," ASTM E10, 11 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15329

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NT-15332

"Standard Recommended Practice for Scleroscope Hardness Testing of Metallic Materials," ASTM E448, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Test Method for Rockwell Hardness of Fine-Grained Graphite Materials," ASTM C748, 2 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15334

"Standard Test Method for Knoop Indentation Hardness of Glass," ASTM C740, 6 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15335

"Standard Specification for Longitudinal-Beam Ultrasonic Inspection of Carbon and Low-Alloy Steel Castings," ASTM A609, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15336

"Standard Method for X-Ray Emission Spectrometric Analysis of Low-Alloy Steels and Cast Irons," ASTM E322, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15337

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"Standard Recommended Practice for Ultrasonic Inspection of Turbine-Generator Steel Retaining Rings," ASTM A531, 6 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Specification for Ultrasonic Examination of Large Forged Crankshafts," ASTM A503, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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NT-15345

"Standard Method for Measuring Thermal Neutron Flux by Radioactivation Techniques," ASTM E262, 8 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15346

"Standard Definitions of Terms Relating to Leak Testing," ASTM E425, 10 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

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"Standard Method of Testing for Leaks Using Bubble Emission Techniques," ASTM E515, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15348

"Standard Recommended Practice for Ultrasonic Contact Examination of Weldments," ASTM E164, 38 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15348

"Standard Definitions of Terms Relating to Ultrasonic Testing," ASTM E500, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15349

"Standard Recommended Practice for Measuring Ultrasonic Velocity in Materials," ASTM E494, 14 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15350

"Standard Definitions of Terms Relating to Magnetic Particle Inspection," ASTM E269, 3 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15351

"Standard Recommended Practice for Evaluating Performance Characteristics of Pulse-Echo Ultrasonic Testing Systems," ASTM E317, 12 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15352

"Standard Recommended Practice for Fabrication and Control of Steel Reference Blocks Used in Ultrasonic Inspection," ASTM E428, 7 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15353

"Standard Recommended Guide to Interpretation of Radiographs of Semiconductors and Related Devices," ASTM E431, 9 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15354

"Standard Reference Radiographs of Investment Steel Castings for Aerospace Applications," ASTM E192, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15355

"Standard Reference Radiographs for Tin Bronze Castings," ASTM E310, 4 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15356

"Standard Reference Radiographs for Steel Fusion Welds," ASTM E390, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15357

"Standard Recommended Practice for Radiographic Testing," ASTM E94, 16 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15358

"Standard Recommended Practice for Testing for Leaks Using the Halogen Leak Detector (Alkali-Ion Diode)," ASTM E427, 9 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15359

"Standard Recommended Practice for Electromagnetic (Eddy-Current) Testing of Seamless and Welded Tubular Products, Austenitic Stainless Steel and Similar Alloys," ASTM E426, 5 pp, 1977, (Am Soc Test. and Mater, Philadelphia, PA)

NT-15417

"Non-Destructive Testing — Method for Indirect Assessment of Black Light Sources," ISO 3059, 6 pp, 1974, (American National Standards Institute, Inc, N Y)

NT-15418

"Non-Destructive Testing — Metallographic Replica Techniques of Surface Examination," ISO 3057, 2 pp, 1974, (American National Standards Institute, Inc, N Y)

NT-15419

"Non-Destructive Testing — Aids to Visual Inspection-Selection of Low-Power Magnifiers," ISO 3058, 4 pp, 1974, (American National Standards Institute, Inc, N Y)

NT-15420

"Method for the Sensitometry of Industrial X-Ray Films for Energies up to 3 Million Electron Volts," ANSI PH2.8, 12 pp, 1975, (American National Standards Institute, Inc, N Y)

NT-15469

"Verification and Calibration of Rockwell B Hardness Standardized Blocks," ISO Recommendation R11, 16 pp, 1974, (Technology Reports Centre, Dept of Industry, Orpington, Kent, UK)

NT-15470

"Verification and Calibration of Rockwell C Hardness Standardized Blocks," ISO Recommendation R12, 16 pp, 1974, (Technology Reports Centre, Dept of Industry, Orpington, Kent, UK)

NT-15471

"Verification and Calibration of Vickers Hardness Standardized Blocks," ISO Recommendation R10, 16 pp, 1974, (Technology Reports Centre, Dept of Industry, Orpington, Kent, UK)

NT-15472

"Verification and Calibration of Brinell Hardness Standardized Blocks," ISO Recommendation R9, 16 pp, 1972, (Technology Reports Centre, Dept of Industry, Orpington, Kent, UK)

NT-15485

"Standard for Welding Pipelines and Related Facilities," API STD 1104, 53 pp, Jan 1977, (American Petroleum Institute, Washington, D C)

The purpose of this standard is to present methods for the production of high quality welds through the use of qualified welders using approved welding procedures, materials and equipment. It is also its purpose to present methods for the production of high quality radiographs to ensure the proper analysis of the welding quality through the use of qualified technicians, approved methods and equipment. This standard is intended to apply to gas welding and arc welding of piping used in the compression, pumping and transmission of crude petroleum, petroleum products and fuel gases, and to distribution systems where applicable.

NT-15595

"Military Standardization Handbook — Ultrasonic Testing," MIL-HDBK-726, 228 pp, Jun 1974

The purpose of this volume on ultrasonic testing is to provide DoD personnel with the basic principles underlying ultrasonic testing techniques. The subject matter covered includes a brief history of the development of ultrasonic testing technology, the theory and principles of ultrasonic testing and test systems, calibration and quality assurance standards, and typical applications of testing techniques. A glossary of ultrasonic testing terms and an appendix of symbolic definitions are provided for the benefit of the reader.

NT-15659

"Method of Test for Dielectric Constant (Permittivity) and Dissipation Factor of Epoxy Components Using the Null Method Three Terminal Measurement," ERF 26-69, 5 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15660

"Method of Test for Determination of Amino Nitrogen Content of Amines or Polyamides," ERF 25-68, 3 pp, 1968, (Soc of the Plastics Industry, Inc, N Y)

NT-15661

"Method of Test for Sag Flow of Highly Viscous Materials," ERF 24-68, 4 pp, 1968, (Soc of the Plastics Industry, Inc, N Y)

NT-15662

"Method of Test for Resistance to Impact by Falling Ball," ERF 23-69, 3 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15663

"Method of Test for Determination of the Thermal Conductivity of Cured Epoxy Resin Systems," ERF 22-69, 4 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15664

"Method of Test for Bearing Strength of Epoxy Compounds," ERF 21-66, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15665

"Method of Test for Shear Strength of Epoxy Compounds," ERD 20-66, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15666

"Method of Test for Resistance of Plastics to Chemical Reagents," ERF 19-69, 1 p, 1969, Soc of the Plastics Industry, Inc, N Y)

NT-15667

"Method of Test for Edgewise Compressive Properties of Laminating Systems," ERF 18-69, 2 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15668

"Method of Test for Deflection Temperature of Cured Epoxy Resins Under Load," ERF 17-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15669

"Method of Test for Coverage of Laminating Systems," ERF 16-69, 2 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15670

"Method of Test for Epoxy Content of Epoxy Resins," ERF 27-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15671

"Method of Test for Tensile Shear Strength of Adhesives," ERF 15-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15672

"Method of Test for Dimensional Stability of Epoxy Casting Compounds," ERF 14-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15673

"Method of Test for Pot Life of Epoxy Compounds," ERF 13-70, 3 pp, 1970, (Soc of the Plastics Industry, Inc, N Y)

NT-15674

"Method of Test for Linear Shrinkage of Epoxy Casting Resins During Cure," ERF 12-69, 3 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15675

"Method of Test for Coefficients of Linear Thermal Expansion of Epoxy Casting Systems," ERF 11-69, 2 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15676

"Method of Test for Peel Strength of Epoxy Adhesive," ERF 10-63, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15677

"Method of Test forHardness of Cured Epoxy Materials," ERF 9-68, 3 pp, 1968, (Soc of the Plastics Industry, Inc, N Y)

NT-15678

"Method of Test for Compressive Properties of Epoxy Casting or Molding Compounds," ERF 8-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15679

"Method of Test for Flammability of Hardened Epoxy Compounds Over 0.050 in. in Thickness," ERF 7-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15680

"Method of Test for Tensile Properties of Epoxy Compounds," ERF 6-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15681

"Method of Test for Flexural Properties of Epoxy Compounds," ERF 5-69, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15682

"Method of Test for Long-Time Creep of Epoxy Compounds," ERF 4-62, 1 p, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15683

"Method of Test for Specific Gravity of Epoxy Compounds and Components," ERF 3-69, 2 pp, 1969, (Soc of the Plastics Industry, Inc, N Y)

NT-15684

"Method of Test for Gel Time and Peak Exothermic Temperature of Epoxy Compounds," ERF 2-70, 1 p, 1970, (Soc of the Plastics Industry, Inc, N Y)

NT-15685

"Method of Test for Viscosity of Epoxy Compounds and Related Components," ERF 1-68, 2 pp, 1968, (Soc of the Plastics Industry, Inc, N Y)

6. DIRECTORY OF ORGANIZATIONS

This section of the Handbook is a listing of those U.S. organizations replying to a questionnaire mailed by NTIAC. While many organizations involved in NDT are not represented, those which are listed furnish a good cross-section of those organizations supplying NDT equipment, supplies, and services.

The Subject Index is arranged in alphabetical order under several major subject headings and lists the key words with the associated NTIAC accession number (NT XXXXXX) of each organization found in Section C. The Tradename Index is a listing of tradenames versus NTIAC accession number in Section C. Section C supplies the name, address, and a breif description of each organization and the products and services which are offered.

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6.1.1. Test Articles

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NT-15721, NT-15723, NT-15766, NT-15779, NT-15787, NT-15911, NT-15981, NT-15985

Pressure Vessels
NT-15724, NT-15727, NT-15733, NT-15739, NT-15763, NT-15770, NT-15789, NT-15790, NT-15791, NT-15793, NT-15798, NT-15808, NT-15821, NT-15831, NT-15837, NT-15839, NT-15866, NT-15893, NT-15900, NT-15903, NT-15911, NT-15917, NT-15941, NT-15951, NT-15954, NT-15976, NT-15980, NT-15981

Rods
NT-15722, NT-15734, NT-15763, NT-15805, NT-15821, NT-15911, NT-15948

Tubes
NT-15718, NT-15719, NT-15722, NT-15727, NT-15763, NT-15766, NT-15770, NT-15779, NT-15790, NT-15791, NT-15821, NT-15853, NT-15887, NT-15911, NT-1591, NT-15941, NT-15945, NT-15947, NT-15955, NT-15981, NT-15985

Weldments
NT-15719, NT-15723, NT-15727, NT-15733, NT-15734, NT-15737, NT-15758, NT-15763, NT-15791, NT-15793, NT-15806, NT-15808, NT-15832, NT-15980, NT-15981, NT-15985

6.1.2. Test Methods Involving Electromagnetics

Electric Current, electrical resistance
NT-15734, NT-15743, NT-15744, NT-15747, NT-15757, NT-15760, NT-15787, NT-15796, NT-15820, NT-15838, NT-15849, NT-15851, NT-15861, NT-15869, NT-15879, NT-15894, NT-15915, NT-15917, NT-15921, NT-15931, NT-15938, NT-15948, NT-15951, NT-15954, NT-15955, NT-15956, NT-15969

Electrostatics
NT-15756, NT-15785, NT-15868

Corona
NT-15726, NT-15757, NT-15796

Gamma rays
NT-15732, NT-15736, NT-15747, NT-15748, NT-15756, NT-15808, NT-15873, NT-15930, NT-15943

Backscatter Gaging
NT-15718, NT-15793, NT-15828, NT-15836, NT-15853, NT-15888, NT-15931, NT-15947, NT-15985

Gamma radiography
NT-15724, NT-15737, NT-15739, NT-15761, NT-15770, NT-15781, NT-15783, NT-15788, NT-15792, NT-15793, NT-15804, NT-15806, NT-15807, NT-15814, NT-15819, NT-15820, NT-15823, NT-15828, NT-15833, NT-15837, NT-15838, NT-15844, NT-15862, NT-15866, NT-15884, NT-15885, NT-15888, NT-15889, NT-15893, NT-15895, NT-15900, NT-15901, NT-15904, NT-15909, NT-15913, NT-15916, NT-15918, NT-15922, NT-15936, NT-15937, NT-15938, NT-15968, NT-15980, NT-15983

Gamma radiometry
NT-15828, NT-15836, NT-15934, NT-15947, NT-15985

Gamma ray diffraction
NT-15769,NT-15833, NT-15853

Mossbauer spectroscopy
NT-15769, NT-15853, NT-15875, NT-15912

Infrared
NT-15737, NT-15746, NT-15747, NT-15756, NT-15835, NT-15930

Heatflow, temperature
NT-15738, NT-15744, NT-15748, NT-15758, NT-15809, NT-15812, NT-15815, NT-15817, NT-15822, NT-15839, NT-15841, NT-15843, NT-15865, NT-15931, NT-15950, NT-15951, NT-15970, NT-15978

Infrared spectroscopy
NT-15723, NT-15772, NT-15799, NT-15828, NT-15870, NT-15906

Magnetics
NT-15756, NT-15757, NT-15766, NT-15771, NT-15835, NT-15860, NT-15935, NT-15977

Barkhausen effect
NT-15935

Eddy current
NT-15718, NT-15719, NT-15722, NT-15723, NT-15724, NT-15730, NT-15737, NT-15743, NT-15744, NT-15748, NT-15750, NT-15755, NT-15783, NT-15797, NT-15801, NT-15806, NT-15812, NT-15813, NT-15816, NT-15819, NT-15820, NT-15823, NT-15851, NT-15855, NT-15862, NT-15871, NT-15874, NT-15881, NT-15884, NT-15885, NT-15887, NT-15914, NT-15915, NT-15920, NT-15934, NT-15935, NT-15936, NT-15938, NT-15943, NT-15948, NT-15949, NT-15955, NT-15960, NT-15963, NT-15964, NT-15969

Magnetic Perturbation
NT-15718, NT-15743, NT-15797

Electric current
NT-15793

Static Magnetic Field
NT-15726, NT-15730, NT-15734, NT-15856, NT-15866, NT-15931, NT-15958

Microwaves
NT-15756, NT-15835

Microwave holography
NT-15930

Microwave spectroscopy
NT-15930

Transmission
NT-15747, NT-15773

Optical testing
NT-15747, NT-15756, NT-15774, NT-15835, NT-15840, NT-15854, NT-15930

Optical spectroscopy, colorimetry
NT-15760, NT-15806, NT-15858, NT-15866, NT-15938, NT-15948, NT-15986

Visual inspection
NT-15724, NT-15727, NT-15731, NT-15738, NT-15739, NT-15749, NT-15750, NT-15760, NT-15761, NT-15768, NT-15776, NT-15787, NT-15793, NT-15801, NT-15804, NT-15806, NT-15807, NT-15810, NT-15816, NT-15819, NT-15820, NT-15823, NT-15824, NT-15826, NT-15832, NT-15834, NT-15838, NT-15863, NT-15870, NT-15880, NT-15881, NT-15885, NT-15887, NT-15896, NT-15909, NT-15915, NT-15934, NT-15935, NT-15937, NT-15938, NT-15948, NT-15951, NT-15952, NT-15961, NT-15962, NT-15966, NT-15980, NT-15985, NT-15986

Radiofrequency
NT-15756, NT-15835

Dielectric test
NT-15747, NT-15861, NT-15870, NT-15931

Nuclear magnetic resonance
NT-15870

X-Rays
NT-15732, NT-15747, NT-15748, NT-15752, NT-15756, NT-15808, NT-15862, NT-15905, NT-15930

Backscatter gaging
NT-15769, NT-15793, NT-15828, NT-15836, NT-15853, NT-15922, NT-15985

X-radiography
NT-15721, NT-15722, NT-15723, NT-15724, NT-15730, NT-15737, NT-15738, NT-15739, NT-15740, NT-15745, NT-15761, NT-15766, NT-15777, NT-15781, NT-15783, NT-15788, NT-15791, NT-15792, NT-15793, NT-15804, NT-15806, NT-15807, NT-15812, NT-15814, NT-15819, NT-15820, NT-15823, NT-15826, NT-15830, NT-15831, NT-15832, NT-15838, NT-15844, NT-15866, NT-15869, NT-15876, NT-15881, NT-15884, NT-15885, NT-15887, NT-15890, NT-15893, NT-15895, NT-15897, NT-15900, NT-15901, NT-15904, NT-15909, NT-15913, NT-15914, NT-15915, NT-15916, NT-15918, NT-15920, NT-15922, NT-15925, NT-15934, NT-15935, NT-15936, NT-15937, NT-15938, NT-15941, NT-15943, NT-15946, NT-15948, NT-15957, NT-15964, NT-15967, NT-15968, NT-15969, NT-15980, NT-15981, NT-15982, NT-15983, NT-15984

X-radiometry
NT-15836, NT-15838, NT-15890, NT-15925, NT-15985

X-ray diffraction
NT-15723, NT-15769, NT-15806, NT-15828, NT-15853, NT-15866, NT-15870, NT-15874, NT-15886, NT-15918, NT-15925, NT-15938

X-ray spectroscopy
NT-15769, NT-15775, NT-15806, NT-15825, NT-15828, NT-15838, NT-15853, NT-15870, NT-15875, NT-15886, NT-15911, NT-15938, NT-15986

6.1.3. Test Methods Involving Motion of Matter

Audio frequency
NT-15736, NT-15747, NT-15754, NT-15796, NT-15816, NT-15835, NT-15921, NT-15951

Acoustic emission, stress wave
NT-15720, NT-15730, NT-15736, NT-15743, NT-15748, NT-15778, NT-15786, NT-15789, NT-15801, NT-15804, NT-15812, NT-15874, NT-15915, NT-15928, NT-15935, NT-15959

Natural resonance
NT-15723, NT-15741, NT-15749, NT-15753, NT-15754, NT-15806, NT-15818, NT-15877, NT-15931, NT-15961, NT-15980

Static loading
NT-15753, NT-15756, NT-15825, NT-15835, NT-15935

Gravitation (Weighing)
NT-15723, NT-15749, NT-15760, NT-15762, NT-15806, NT-15856, NT-15921, NT-15931, NT-15938, NT-15975, NT-15976

Hydrostatic testing
NT-15723, NT-15747, NT-15751, NT-15762, NT-15763, NT-15782, NT-15787, NT-15798, NT-15806, NT-15822, NT-15823, NT-15826, NT-15866, NT-15881, NT-15887, NT-15893, NT-15899, NT-15903, NT-15907, NT-15921, NT-15938, NT-15942, NT-15951, NT-15954, NT-15970, NT-15976, NT-15980

Microstrain measurement
NT-15723, NT-15747, NT-15762, NT-15806, NT-15849, NT-15863, NT-15887, NT-15893, NT-15907, NT-15921, NT-15931, NT-15938, NT-15951, NT-15954, NT-15965, NT-15980

Surface distortion
NT-15930, NT-15951, NT-15974

Brittle coatings
NT-15723, NT-15762, NT-15805, NT-15938

Optical holography
NT-16721, NT-15735, NT-15737, NT-15747, NT-15748, NT-15810, NT-15845, NT-15935

Ultrasonics
NT-15725, NT-15737, NT-15739, NT-15747, NT-15756, NT-15794, NT-15833, NT-15835, NT-15857, NT-15860, NT-15861, NT-15874, NT-15879, NT-15902, NT-15930

Echo ranging, distance-elastic properties
NT-15730, NT-15740, NT-15745, NT-15748, NT-15750, NT-15753, NT-15766, NT-15781, NT-15783, NT-15801, NT-15806, NT-15816, NT-15823, NT-15827, NT-15837, NT-15843, NT-15851, NT-15852, NT-15871, NT-15884, NT-15885, NT-15887, NT-15900, NT-15904, NT-15915, NT-15933, NT-15935, NT-15943, NT-15951, NT-15954, NT-15964, NT-15969, NT-15983, NT-15984

Imaging/holography
NT-15750, NT-15766, NT-15793, NT-15852, NT-15897, NT-15930

Acousto-optical imaging
NT-15743, NT-15748, NT-15930

Chemical detectors
NT-15930, NT-15938

Liquid crystals
NT-15838, NT-15930

Small particle suspensions
NT-15805, NT-15838, NT-15930

Thermochronic substances
NT-15930

Electronic scanning
NT-15779, NT-15793, NT-15806, NT-15816, NT-15851, NT-15930, NT-15933

Liquid levitation
NT-15743, NT-15887, NT-15980

Probe scanning
NT-15723, NT-15724, NT-15743, NT-15748, NT-15761, NT-15776, NT-15779, NT-15793, NT-15804, NT-15806, NT-15807, NT-15816, NT-15825, NT-15838, NT-15851, NT-15852, NT-15862, NT-15866, NT-15887, NT-15915, NT-15933, NT-15938, NT-15968

Ultrasonic spectroscopy
NT-15748, NT-15801, NT-15806, NT-15816, NT-15820, NT-15851, NT-15869, NT-15930, NT-15933, NT-15934

Attenuation
NT-15838

Defect-echo analysis
NT-15718, NT-15722, NT-15743, NT-15766, NT-15783, NT-15814, NT-15819, NT-15826, NT-15832, NT-15860, NT-15862, NT-15876, NT-15884, NT-15885, NT-15893, NT-15914, NT-15915, NT-15938, NT-15941, NT-15943, NT-15945, NT-15949

Resonance
NT-15805, NT-15819, NT-15838, NT-15931

6.1.4. Test Methods Involving a Probing Medium

Gaseous Penetrant
NT-15736, NT-15756, NT-15853

Krypton 85
NT-15747, NT-15777

Leak testing
NT-15720, NT-15730, NT-15787, NT-15806, NT-15820, NT-15826, NT-15882, NT-15884, NT-15885, NT-15887, NT-15904, NT-15926, NT-15935, NT-15938, NT-15943, NT-15976

Bubble method
NT-15726, NT-15747, NT-15753, NT-15761, NT-15763, NT-15770, NT-15777, NT-15781, NT-15804, NT-15819, NT-15821, NT-15866, NT-15900, NT-15915, NT-15979, NT-15980

Mass spectrometry
NT-15738, NT-15777, NT-15804, NT-15821, NT-15831, NT-15866, NT-15881, NT-15891, NT-15900, NT-15915, NT-15923, NT-15971

Positive ion probe
NT-15724, NT-15747

Liquid penetrant
NT-15722, NT-15723, NT-15726, NT-15730, NT-15733, NT-15737, NT-15739, NT-15747, NT-15756, NT-15763, NT-15776, NT-15781, NT-15783, NT-15793, NT-15801, NT-15804, NT-15806, NT-15807, NT-15814, NT-15820, NT-15823, NT-15825, NT-15826, NT-15837, NT-15860, NT-15862, NT-15863, NT-15864, NT-15866, NT-15869, NT-15876, NT-15881, NT-15884, NT-15885, NT-15887, NT-15893, NT-15898, NT-15900, NT-15908, NT-15909, NT-15914, NT-15915, NT-15920, NT-15926, NT-15927, NT-15934, NT-15935, NT-15938, NT-15941, NT-15943, NT-15952, NT-15964, NT-15967, NT-15968, NT-15969, NT-15980, NT-15983, NT-15984

Fluorescent oil
NT-15724, NT-15750, NT-15760, NT-15761, NT-15766, NT-15819, NT-15936, NT-15962

Visible dye
NT-15718, NT-15770, NT-15832

Particles, atomic
NT-15732, NT-15736, NT-15829, NT-15846, NT-15853, NT-15889, NT-15910

Ion, alpha, positron radiation
NT-15769, NT-15828, NT-15836

Radio isotope tracer
NT-15759, NT-15888, NT-15891, NT-15935

Particles, macroscopic
NT-15753, NT-15756, NT-15771, NT-15835

Electrified particles
NT-15876

Magnetic particles
NT-15718, NT-15722, NT-15723, NT-15724, NT-15726, NT-15730, NT-15733, NT-15739, NT-15745, NT-15747, NT-15750, NT-15761, NT-15766, NT-15770, NT-15776, NT-15781, NT-15783, NT-15790, NT-15793, NT-15795, NT-15804, NT-15806, NT-15807, NT-15813, NT-15816, NT-15819, NT-15820, NT-15823, NT-15825, NT-15826, NT-15832, NT-15837, NT-15838, NT-15860, NT-15862, NT-15866, NT-15869, NT-15881, NT-15884, NT-15885, NT-15886, NT-15893, NT-15900, NT-15904, NT-15909, NT-15914, NT-15915, NT-15920, NT-15927, NT-15935, NT-15936, NT-15938, NT-15941, NT-15943, NT-15951, NT-15952, NT-15962, NT-15964, NT-15967, NT-15968, NT-15969, NT-15980

Particles, sub-atomic
Electrons, beta particles
NT-15756, NT-15769, NT-15836

Beta particle thickness gaging
NT-15802, NT-15828, NT-15853, NT-15960, NT-15963

Electron diffraction
NT-15747, NT-15768

Electron microscopy
NT-15737, NT-15747, NT-15768, NT-15863, NT-15870, NT-15905, NT-15935

Exo-electrons
NT-15853

Neutrons
NT-15732, NT-15833

Neutron activation analysis
NT-15736, NT-15769, NT-15800, NT-15813, NT-15828, NT-15836, NT-15847, NT-15853, NT-15873, NT-15888, NT-15922

Neutron radiography
NT-15730, NT-15737, NT-15748, NT-15788, NT-15800, NT-15806, NT-15828, NT-15831, NT-15836, NT-15847, NT-15889, NT-15892, NT-15895, NT-15922, NT-15937

Positron annihilation
NT-15769, NT-15836

6.1.5. Services Offered

Consultants
NT-15719, NT-15720, NT-15721, NT-15722, NT-15724, NT-15726, NT-15728, NT-15729, NT-15730, NT-15736, NT-15757, NT-15759, NT-15761, NT-15762, NT-15766, NT-15770, NT-15771, NT-15773, NT-15776, NT-15777, NT-15778, NT-15781, NT-15783, NT-15786, NT-15787, NT-15790, NT-15801, NT-15804, NT-15819, NT-15820, NT-15821, NT-15825, NT-15827, NT-15829, NT-15831, NT-15832, NT-15836, NT-15851, NT-15852, NT-15859, NT-15862, NT-15863, NT-15866, NT-15874, NT-15876, NT-15878, NT-15881, NT-15882, NT-15883, NT-15884, NT-15885, NT-15887, NT-15889, NT-15893, NT-15904, NT-15910, NT-15915, NT-15918, NT-15920, NT-15921, NT-15922, NT-15924, NT-15928, NT-15930, NT-15933, NT-15934, NT-15935, NT-15938, NT-15940, NT-15943, NT-15945, NT-15949, NT-15951, NT-15954, NT-15961, NT-15968, NT-15973

Failure analysis
NT-15718, NT-15737, NT-15762, NT-15776, NT-15777, NT-15801, NT-15835, NT-15861, NT-15863, NT-15874, NT-15876, NT-15882, NT-15884, NT-15885, NT-15887, NT-15915, NT-15921, NT-15928, NT-15934, NT-15935, NT-15938, NT-15943, NT-15948, NT-15951, NT-15964, NT-15973

Field test
NT-15718, NT-15720, NT-15721, NT-15724, NT-15764, NT-15807, NT-15837, NT-15839, NT-15872, NT-15873, NT-15876, NT-15878, NT-15880, NT-15882, NT-15883, NT-15885, NT-15887, NT-15888, NT-15893, NT-15904, NT-15915, NT-15921, NT-15922, NT-15934, NT-15935, NT-15938, NT-15943, NT-15946, NT-15959, NT-15964, NT-15973, NT-15980, NT-15983

Inspection
NT-15718, NT-15736, NT-15739, NT-15740, NT-15747, NT-15749, NT-15753, NT-15764, NT-15775, NT-15778, NT-15790, NT-15801, NT-15802, NT-15812, NT-15834, NT-15845, NT-15862, NT-15883, NT-15885, NT-15893, NT-15896, NT-15910, NT-15914, NT-15936, NT-15983, NT-15985

Manufacturing, equipment

NT-15719, NT-15720, NT-15721, NT-15723, NT-15725, NT-15726, NT-15727, NT-15733, NT-15734, NT-15735, NT-15739, NT-15741, NT-15742, NT-15743, NT-15744, NT-15745, NT-15746, NT-15751, NT-15753, NT-15754, NT-15757, NT-15758, NT-15759, NT-15760, NT-15762, NT-15765, NT-15767, NT-15769, NT-15770, NT-15771, NT-15773, NT-15774, NT-15779, NT-15780, NT-15781, NT-15782, NT-15784, NT-15785, NT-15787, NT-15788, NT-15789, NT-15790, NT-15792, NT-15793, NT-15794, NT-15795, NT-15797, NT-15798, NT-15799, NT-15802, NT-15803, NT-15808, NT-15809, NT-15810, NT-15811, NT-15815, NT-15816, NT-15818, NT-15822, NT-15824, NT-15826, NT-15827, NT-15828, NT-15830, NT-15831, NT-15833, NT-15834, NT-15836, NT-15837, NT-15840, NT-15842, NT-15843, NT-15844, NT-15846, NT-15847, NT-15848, NT-15849, NT-15850, NT-15851, NT-15852, NT-15853, NT-15854, NT-15855, NT-15856, NT-15857, NT-15858, NT-15859, NT-15860, NT-15862, NT-15864, NT-15865, NT-15866, NT-15867, NT-15868, NT-15869, NT-15870, NT-15871, NT-15873, NT-15875, NT-15877, NT-15879, NT-15880, NT-15882, NT-15884, NT-15885, NT-15886, NT-15888, NT-15889, NT-15890, NT-15891, NT-15892, NT-15894, NT-15895, NT-15896, NT-15897, NT-15898, NT-15899, NT-15900, NT-15901, NT-15902, NT-15905, NT-15907, NT-15908, NT-15909, NT-15911, NT-15912, NT-15913, NT-15914, NT-15915, NT-15916, NT-15917, NT-15919, NT-15920, NT-15921, NT-15924, NT-15925, NT-15927, NT-15928, NT-15931, NT-15932, NT-15933, NT-15937, NT-15939, NT-15941, NT-15942, NT-15944, NT-15945, NT-15946, NT-15947, NT-15948, NT-15949, NT-15950, NT-15952, NT-15953, NT-15954, NT-15955, NT-15956, NT-15957, NT-15958, NT-15959, NT-15960, NT-15962, NT-15965, NT-15966, NT-15967, NT-15969, NT-15970, NT-15971, NT-15972, NT-15974, NT-15975, NT-15976, NT-15978, NT-15979, NT-15980, NT-15981, NT-15982, NT-15985, NT-15986

Research

NT-15720, NT-15721, NT-15722, NT-15726, NT-15732, NT-15736, NT-15737, NT-15743, NT-15747, NT-15748, NT-15750, NT-15754, NT-15757, NT-15759, NT-15765, NT-15771, NT-15773, NT-15776, NT-15780, NT-15786, NT-15799, NT-15801, NT-15806, NT-15812, NT-15817, NT-15823, NT-15827, NT-15833, NT-15834, NT-15835, NT-15836, NT-15849, NT-15851, NT-15862, NT-15863, NT-15870, NT-15882, NT-15884, NT-15885, NT-15887, NT-15889, NT-15894, NT-15906, NT-15915, NT-15920, NT-15921, NT-15922, NT-15928, NT-15931, NT-15933, NT-15934, NT-15935, NT-15938, NT-15943, NT-15949, NT-15954, NT-15959, NT-15961, NT-15968, NT-15973, NT-15980, NT-15985, NT-15986

Training, Personnel

NT-15720, NT-15721, NT-15722, NT-15724, NT-15726, NT-15729, NT-15731, NT-15745, NT-15759, NT-15761, NT-15764, NT-15770, NT-15776, NT-15783, NT-15790, NT-15792, NT-15804, NT-15808, NT-15814, NT-15819, NT-15823, NT-15829, NT-15832, NT-15838, NT-15851, NT-15862, NT-15876, NT-15878, NT-15882, NT-15884, NT-15885, NT-15887, NT-15889, NT-15904, NT-15910, NT-15915, NT-15918, NT-15921, NT-15931, NT-15933, NT-15935, NT-15936, NT-15938, NT-15943, NT-15945, NT-15955, NT-15968, NT-15974

6.1.6. Types of Measurements

Flaws

Corrosion

NT-15718, NT-15723, NT-15727, NT-15825, NT-15917, NT-15938, NT-15980, NT-15981

Cracks

NT-15723, NT-15727, NT-15745, NT-15855, NT-15856, NT-15858, NT-15981

Holes

NT-15727, NT-15981

Inclusions
NT-15727, NT-15981, NT-15997

Porosity
NT-15723, NT-15727, NT-15739, NT-15756, NT-15757, NT-15980, NT-15981

Material Properties

Acoustic properties
NT-15736, NT-15852, NT-15859, NT-15877

Atomic properties
NT-15800, NT-15873, NT-15986, NT-15989, NT-15991

Chemical properties
NT-15726, NT-15740, NT-15772, NT-15850, NT-15867, NT-15876, NT-15891, NT-15911, NT-15912

Composition
NT-15791

Elastic properties
NT-15736, NT-15833, NT-15859, NT-15863, NT-15961

Electrical properties
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6.3. Bibliography of NDT Organizations

NT-15718

AMF Tuboscope, Inc
P O Box 808, Houston, TX 77001; 713/749-5100

AMF Tuboscope, Inc serves the petroleum industry with advanced nondestructive inspection of tubular goods, and protective plastic coatings designed to withstand severe, corrosive environments. Tuboscope employs its amalog, sonoscope, linascan, linalog, tuboscan and vertilog equipment, all developed by the company, in nondestructive inspection of drill pipe, casing, tubing, sucker rods and line pipe. Tuboscope's development of new resins and coatings and applications techniques has contributed to a rapid growth in the

coatings industry. The company applies a wide range of specialized coatings including polyesters, vinyls, fluorocarbon resins, epoxies, polyurethanes and phenolics using both liquid and powder technologies. Tuboscope's inspection and coating services are available all over the world.

NT-15719

ACCO (American Chain & Cable Co, Inc). Wilson Instrument Division
P O Box 430, Bridgeport, CT 06602; 203/335-2511; Branches: Los Angeles, Houston, Chicago, Detroit, Boston

The Wilson Instrument Division of ACCO is a supplier of testing equipment for Rockwell hardness measurements. It manufactures and markets Wilson standard testers for Rockwell hardness measurements including microhardness, microficial and mobile testers; Brinell hardness testers and automated testing systems incorporating Rockwell hardness, Brinell hardness and eddy current tests. A wide range of models and accessories is available for testing materials of virtuany any size, shape or thickness. Engineered testing systems can be developed for automatically feeding, testing, classifying, and sorting parts at up to 3,600 pieces per hour, and recording the results. Principal industries served are transportation equipment (including automotive, aircraft, and marine), ordnance, oil field equipment, primary metals, heat treating, farm equipment, and metal fabrication. The Wilson Instrument Division has a nationwide network of service representatives, and has operations in Canada, England, and Germany.

NT-15720

Acoustic Emission Technology Corporation
1828A Tribute Road, Sacramento, CA 95815; 916/927-3861

The Acoustic Emission Technology Corporation designs, manufactures, sells, and services acoustic emission instruments, systems, and accessories. Contractual studies, research and development programs, field service testing, and inspections are also performed. Special instrumentation systems for structural testing, nondestructive inspection and testing and for destructive testing are supplied. Worldwide representation for sales, service and inspection is provided.

NT-15721

AGFA-GEVAERT, Inc, Industrial X-Ray Department
275 North Street, Teterboro, N J 07608; 201/288-4100; Branches: Atlanta, Boston, Chicago, Dallas, Los Angeles, San Francisco

The Industrial X-Ray Department of AGFA-GEVAERT, Inc offers a line of X-ray films, plates, screens, and film processors. Holographic films and plates are also offered.

NT-15722

Allegheny Ludlum Steel Corp, Research Center
Brackenridge, PA 15014; 412/226-2000

The Allegheny Ludlum Steel Corp, Research Division is equipped to conduct research and development programs in most major nondestructive examination methods including ultrasonic, penetrant, eddy current, and magnetic particle. Limited radiographic facilities are available. In-depth and broad studies are possible. Support facilities exist which are well experienced in preparing reference standards, constructing test apparatus, and performing complementary tests to substantiate or augment NDE results. Consultation services by a recognized NDE authority are available. Considerable experience background exists in development and establishment of personnel qualification and certification programs, training personnel, preparation and evaluation of reference standards, checking performance of NDE equipment including determination of ultrasonic search unit characteristics, and reviewing as well as preparing NDE specifications and procedures. Activities include conducting NDE investigative programs aimed at improving and innovating production nondestructive examination of a broad spectrum of products. Services are provided to meet practical production inspection needs.

NT-15723

Allis-Chalmers Corp, Advanced Technology Center
P O Box 512, Milwaukee, WI 53201; 414/475-2805; Branches worldwide
The Allis-Chalmers Corporation is a highly diversified, multinational manufacturer of capital and consumer goods that are aimed at basic markets such as mining, agriculture, industrial, electrical, consumer, and government.

NT-15724

Allis-Chalmers Corp, Nuclear Components Division
P O Box 712, York, PA 17405; 717/848-1126
Nondestructive testing personnel qualified to ASME and military specification are available to perform all standard methods of testing with Level III and engineering personnel on hand to provide consulting services in the various NDE methods. Field services also provide training for customer's personnel at the customer's site in the various NDE methods. Welder training and qualification are among the many services offered by the Weld Engineering Section. A complete metallurgical laboratory is also available for weld and metals analysis. Other services offered by the field services group include vendor surveillance, in-house and vendor procedure audits, procedure writing and test development. The field services group can, in most cases, be at a customer's site providing the required service in less than 24 hours.

NT-15725

Alloy Stainless Products Company
611 Union Blvd, Totowa, N J 07512; 201/256-1616
ASP, the trademark that means Alloy Stainless Products Company, was founded in 1944 and remains an owner-operated company to this day. ASP is an independent manufacturer of stainless steel pipe fittings with a wide range of products, sizes, and ratings. All ASP pipe fittings are produced from selected domestic raw materials. Major suppliers are carefully surveyed for their capabilities and methods and must meet quality standards. Forgings, the priority products for nuclear power piping, are produced to ASP tooling and specifications by one of America's leading forgers. Castings and bar stock are drawn from reputable firms. All raw materials are received with complete chemical and physical histories. Identity is permanently marked, logged, and maintained throughout ASP manufacturing processes. When the finished product is ready for shipment, each fitting goes out fully and permanently identified with the ASP trademark and all other important information for assured traceability. All ASP pipe fittings are machined on modern production equipment under qualified supervision. Rigorous inspections assure quality and uniformity of threads, sockets, angles, and concentricity. When required, penetrant and ultrasonic nondestructive testing examinations are performed to detect flaws on or below survaces such as cracks, seams, laps, laminations and particular discontinuities.

NT-15726

American Gas and Chemical Co, Ltd
5 Tenakill Park, Cresskill, N J 07626; 201/569-5200; Branches: London, Toronto
The American Gas and Chemical Company (AMGAS) offers a complete line of chemical leak detectors. These detectors range from leak tec, a thin film bubble fluid, to immersion testing liquids and colormetric developers. To complement this product area, Testing Systems, Inc, an AMGAS affiliate company, offers a line of fluorescent and dye penetrants and associated production line equipment. In keeping with modern technology, AMGAS has entered into the electronic leak detection equipment market. Included are systems which operate on the principles of electron capture, thermal conductivity, heated anode halogen detectors, and resistivity. A production line leak testing system which can monitor pressure change, flow measurement, or a freon tracer gas has been recently introduced. AMGAS also conducts courses in leak testing which comply with ASNT training requirements. Personnel from AMGAS sit on leak testing committees of ASNT and ASTM.

NT-15727

American Optical Corp, Scientific Instrument-Fiber Optics Division
14 Mechanic Street, Southbridge, MA 01550; Branches: Buffalo, N Y, Keene, N H

American Optical manufactures a line of rigid and flexible fiber optic devices for the inspection of internal or remote areas. Both portable and 110 volt fiberscopes are available in flexible fiber optic lengths ranging from 2 feet to over 15 feet. American Optical fiberscopes have integral fiber optic illumination and can be easily converted from front viewing to right angle operation. Special flexible fiber optic devices are also available for use with photographic and CCTV equipment. American Optical has fiber optic dealers in most major cities and throughout the world.

NT-15728

American Society of Mechanical Engineers
345 East 47th Street, New York, N Y 10017; 212/644-7785; Branch: Dallas

The American Society of Mechanical Engineers is a technical society engaged in dissemination of technical information via meetings and publications including codes and standards. Several technical divisions have a direct interest in NDE, i.e., applied mechanics, pressure vessels and piping, and materials.

NT-15729

American Society for Quality Control; Society Headquarters
161 W Wisconsin Ave, Milwaukee, WI 53203; 414/272-8575; 171 local sections throughout USA, Mexico, Canada, and Japan

The American Society for Quality Control (ASQC), a non-profit technical society of about 28,000 individuals was founded in 1946. It describes itself as the society of professionals engaged in the management, engineering, and scientific aspects of quality and reliability. The Society's technical activities are conducted by 26 divisions and technical committees whose chairmen comprise the general technical council. The council is structured in five groups: process and fabrication; energy, transportation and construction; food and health; communication and management sciences; and technologies.

NT-15730

American Society for Testing and Materials
196 Race Street, Philadelphia, PA 19103; 215/299-5400

The American Society for Testing and Materials (ASTM) is a non-profit corporation formed in 1898 for the development of standards on characteristics and performance of materials, products, systems, services, and the promotion of related knowledge. In ASTM terminology, standards include test methods, definitions, recommended practices, classifications, and specifications. ASTM is a primary management system for standards development with more than 5700 standards under copyright.

NT-15731

American Welding Society; Headquarters
2501 Northwest 7 St, Miami, FL 33125; 312/642-7090

The American Welding Society (AWS), founded in 1919, is the national organization for advancing the art and science of welding and its allied processes. Among other programs designed to serve that aim, the Society offers a qualification and certification service to personnel in the quality assurance community. Although specifically designed for welding inspectors, welding and NDT technicians, foremen, and engineers have found certification an attractive and beneficial credential. Certification requirements are given in the standard for qualification and certification of welding inspectors, AWS QC1-77. Details are explained in the guide to AWS welding inspector qualification and certification which also includes the standard QC1-77 and is available from the Society's headquarters upon request.

NT-15732

Amersham Corporation
2636 S Clearbrook Dr, Arlington Heights, IL 60005; 312/593-6300
Amersham Corporation is part of a large international organization with additional facilities in Europe, supplying radioactive products on a worldwide basis. Some production facilities exist in Chicago but the main emphasis is on providing a marketing and distribution service for the group's products in the U.S.A. The products are used in a wide range of applications in industry, medicine, and research. One large business area, particularly for radiation sources, is in nondestructive testing.

NT-15733

Ametek, Inc, Schutte and Koerting Division
2249 State Road, Cornwells Heights, PA 19020; 215/639-0900; Branch: Bethayres, PA
Ametek, Inc, Schutte and Koerting Division manufactures valves, strainers, desuperheaters, variable area flow meters, orifice flanges, eductors, steam jet syphons, steam jet vacuum systems, mechanical vacuum pumps, and heat exchangers. Users of the equipment are the power, process, chemical and food industries. Complete engineering and manufacturing facilities are available for the products line.

NT-15734

R. B. Annis Company
1101 N Delaware St, Indianapolis, IN 46202; 317/637-9282
The R.B. Annis Company is a manufacturer of balancing machines, split core transformers, pocket magnetometers, demagnetizing equipment, high flux magnetic units, magnetic comparators, and other special magnetic equipment.

NT-15735

Apollo Lasers, Inc
6357 Arizona Circle, Los Angeles, CA 90045; 213/776-3343
Apollo Lasers, Inc is one of the oldest dedicated laser manufacturing firms. Solid state lasers with ruby, ND: glass and yag rods are designed and built for research, education, government and industry. Also, CO2 lasers (tunable and fixed) are built for research and light industrial applications. The company recently introduced a tunable, far infrared CO2 pumped laser. Since its inception, the company has built laser systems for high speed and dynamic holographic applications. These applications include nondestructive testing, acoustic propagation testing, and aerosol particle studies.

NT-15736

Applied Nucleonics Company
1701 Colorado Ave, Santa Monica, CA 90404; 213/829-2624
The nondestructive testing activities of the Applied Nucleonics Company (ANCO) include in-situ dynamic tests of structures, electrical and underground equipment, piping systems, dynamic qualification of equipment on in-house shake tables, and the use of nuclear techniques such as activation analyses, radio-tracer applications, and mechanical testing of components. ANCO was founded in 1971 and since that time, has had major responsibilities on over 300 projects in the United States and Europe. A major activity area is meeting the testing and analysis needs associated with nuclear power facilities. ANCO's power experience includes more than a dozen nuclear stations sited in the U. S. and abroad. ANCO has performed dynamic excitation tests on more nuclear facilities than any other organization.

NT-15737

Argonne National Laboratory, Materials Science Division
9700 Cass Avenue, Argonne, IL 60439; 312/739-7711
Argonne National Laboratory (ANL) is a multidisciplinary institute operated by the University of Chicago

for the U. S. Department of Energy for the purpose of providing technical leadership in the development of advanced energy systems. The general objective of the Materials Science Division programs is to develop materials for advanced energy systems and to determine properties and behavior of materials in extreme environments. The scope of the NDT program is concerned with the development and application of various test techniques to measure changes in mechanical properties and dimensions of materials, and to assess and monitor the integrity of components and systems. The task requires the implementation of various methods and equipment such as ultrasonics, pulsed and continuous eddy current, infrared, X-ray and neutron radiography, holography, dye penetrants, acoustic emission, and computer data handling. Materials for which tests are devised include metals, ceramics and metal-ceramic composites. Failure analysis capability increases the groups effectiveness in solving problems. As a national laboratory, ANL must observe certain restrictions in performing tasks for others.

NT-15738

ARI Industries, Inc
9000 King Street, Franklin Park, IL 60131; 312/671-0511
ARI Industries, Inc has complete test facilities meeting the requirements of RDT-F2-2T, RDT-F2-4T, MIL-C-45662, CMC-49, CFR-50, ASTM 3-235, and ASTM 3-230, as applied to thermocouple and RTD temperature sensors. The facilities include temperature calibration, radiography, mechanical inspection, liquid penetrant, helium leak detection, electrical inspection, time response, spurious EMF, and metallurgical structure.

NT-15739

ARMCO Steel Corp, National Supply Co, NDE Department
1524 Border Ave, Torrance, CA 90509; 213/328-4111
The Torrance, California plant of the National Supply Company, Division of ARMCO Steel Corporation, is the largest completely integrated machinery manufacturing plant in the West. There are facilities for steelmaking, casting, forging, machining, heat-treating, plating, welding, and assembly. Inspection facilities include chemical, metallurgical, and nondestructive testing. In the area of nondestructive testing, there are facilities for radiography, ultrasonics, magnetic particle, and liquid penetrant. These facilities are available to industry for commercial services.

NT-15740

Atomergic Chemetals Corporation
100 Fairchild Ave, Plainview, N Y 11803; 516/822-8800
The Atomergic Chemetals Corporation is a supplier of piezoelectric transducers for ultrasonic testing, chemical spot test kits for alloy determination, and portable 80 KEV X-ray machines.

NT-15741

B and K Instruments, Inc
5111 W 16 St, Cleveland, OH 44142; 216/267-4800; Branches: West Caldwell, N J; Livonia, MI; Bensenville, IL; Anaheim, CA
B and K Instruments is a subsidiary of Bruel and Kjaer, Copenhagen, Denmark. In the NDT field, B and K designs and manufactures vibration exciters and associated electronic instrumentation for control, amplification, vibration detection, measurement, analysis and recording. Sales offices are located throughout the USA.

NT-15742

Babcock and Wilcox Co; Belfab, Bailey Meter Co
P O Box 9370, Daytona Beach, FL 32020; 904/253-0628
The Belfab, Bailey Meter Company manufactures self powered neutron detector assemblies for nuclear reactors as well as assemblies used in fuel management.

NT-15743

Babcock and Wilcox Co, Lynchburg Research Division
P O Box 1260, Lynchburg, VA 24505; 804/384-5111
The Lynchburg Research Division of Babcock and Wilcox pursues research and development in nondestructive examination (NDE) and the design and fabrication of special measuring and monitoring systems. Primary NDE activities are with the ultrasonic acoustical holography, acoustic emission, and eddy current methods. Special instruments are generally computer based, field worthy, and customized to special applications for which commercially available systems do not apply.

NT-15744

Bailey Instruments, Inc
515 Victor St, Saddle Brook, N J 07662; 201/845-7252
Bailey Instruments is mainly involved with temperature related items. The main product lines are: (1) digital thermometers with a temperature range of – 200 to 1400 degrees C, a complete line of interchangeable thermocouple probes for all applications including high temperature, skin surface, and microprobe; (2) freezing stages for use with microtomes and temperature stress testing, temperature range from – 40 to 100 degrees C; (3) recorders and recorder accessories.

NT-15745

Balteau Electric Corporation
Box 385, Stamford, CT 06902; 203/324-6118; Branches: Mentor, OH; Mundelein, IL
Balteau Electric Corporation is solely involved in nondestructive testing equipment, sales, and service. The products encompass X-ray, ultrasonic, eddy current, acoustic emission, magnetic particles and crack depth measurement. Training courses are available in ultrasonic inspection. The territories which are served include Canada, Central America, Mexico, United States, and certain outlying islands such as Puerto Rico.

NT-15746

Barnes Engineering Company
30 Commerce Rd, Stamford, CT 06904; 203/348-5381
The Barnes Engineering Company designs, develops, and manufactures infrared and electro-optical components, instruments, and systems for industry, science, space exploration, and defense. Products produced range from infrared detectors, through research and industrial radiometers, intrusion detectors, industrial noncontact thermometers, temperature controls and infrared sensors for near-earth and deep space environmental sensing and navigation. For use in nondestructive testing, the company produces two lines of noncontact infrared thermometers and temperature controllers—a pocket-size, portable infrared thermometer, and a single-line thermal scanner. Aids for spectral analysis include sample cells and ATR equipment. Also produced are two infrared microscopes and an infrared microimager. Distribution is national and international through engineering representatives.

NT-15747

Battelle Memorial Institute, Columbus Laboratories, Fabrication and Quality Assurance Section
505 King Ave, Columbus, OH 43201; 614/424-7375
The Fabrication and Quality Assurance Section of Battelle Columbus Laboratories has a group of fifteen to twenty people engaged in contract research and development in broad areas of nondestructive testing. Well qualified personnel and appropriate equipment and facilities are available to conduct programs in the major NDT areas of radiography, ultrasonic, eddy current, penetrant and magnetic testing as well as less common areas such as optical, acoustic emission and microwave. Programs have been conducted using standard NDT techniques or the development of improved techniques to design and fabricate prototype NDT systems to solve production or field inspection problems.

NT-15748

Battelle-Northwest, Nondestructive Testing Section
P O Box 999, Richland, WA 99352

Battelle Pacific Northwest Laboratories (BNW), Nondestructive Testing Section, is engaged in the research and development of advanced nondestructive test systems, instrumentation procedures, and applications. Research is concentrated in the fields of ultrasonics, eddy currents, acoustic emission and high speed electrooptical inspection. Capabilities include both the theoretical and engineering aspects associated with development and demonstration of principles and concepts. Present research includes use of ultrasonic arrays for pulse echo and holographic imaging, multiple frequency eddy current systems development, digital recording acoustic emission instrumentation, and automatic electro-optical inspection. Full laboratory facilities exist for instrument and system design and development.

NT-15749

Bearing Inspection, Inc
10041 Shoemaker Ave, Santa Fe Springs, CA 90670; 213/944-6251

Bearing Inspection, Inc reconditions used ball and roller bearings by refinishing working surfaces and replacing worn components as necessary to make used bearings like new. This work has produced a capability to nondestructively inspect and evaluate ball and roller bearing dimensions, running accuracy, failures, and types and degrees of wear. In addition, specialized gages and inspection equipment for ball and roller bearings are produced along with the bearing analyzer, an instrument for the evaluation of noise produced by ball and roller bearings.

NT-15750

Bell Helicopter, Textron, Methods and Materials Lab NDT Lab
Fort Worth, TX 76101; 817/280-2510

The NDT Lab is part of the Methods and Materials Laboratory in the Engineering Laboratories Department. Activities are strictly in-house; no development, testing, or inspection services are offered to the outside community. The NDT lab primary functions are: (1) planning and conducting independent research and development programs to establish more reliable and cost effective nondestructive inspection of helicopter components and to establish nondestructive testing procedures for new materials and components, (2) developing inspection techniques and preparing written procedures for use in production inspection of components, (3) performing special nondestructive examinations of production and engineering components, and providing support for the product assurance department, (4) specifying NDT equipment, systems, and supplies, (5) coordinating with BHT customers, suppliers, and subcontractors, (6) providing information and assistance to engineering design, metallurgical, field investigation, and bonding groups upon request. The principle NDT method utilized is ultrasonic inspection. Radiography and eddy current techniques are also being used. Other NDT methods are used on occasion, and future activities will include evaluations of acoustic emission techniques and optical holography to accomplish various inspection tasks.

NT-15751

Bell and Howell, CEC Division

360 Sierra Madre Villa, Pasadena, CA 91109; 213/7969381; Branches: Huntsville, AL; Los Angeles, CA; San Francisco, CA; Orlando, FL; Chicago, IL; Boston, MA; Detroit, MI; St Louis, MO; Cherry Hill, N J; Albuquerque, N M; Dayton, OH; Dallas, TX; Houston, TX; Salt Lake City, UT; Norfolk, VA; Seattle, WA

The CEC Division of Bell and Howell is a major manufacturer of primary pressure standards, pressure and vibration transducers and associated monitoring equipment, signal conditioning amplifiers, recording oscillographs, and galvanometers.

NT-15752

The Bendix Corporation, Automation and Measurement Division
P O Box 1127, Dayton, OH 45401; 513/254-5377; Branches: Detroit, Chicago, Indianapolis, Cleveland
The Automation and Measurement Division of the Bendix Corporation offers standard systems and special or automated equipment for measurement of part feature thickness dimension, location, roundness and geometry relationships. Instruments are also available for measuring surface roughness and X-ray thickness of steel, glass, aluminum, etc., strip.

NT-15753

The Bendix Corporation, Electric/Fluid Power Division,
211 Seward Avenue, Utica, N Y 13503; 315/797-2500
The Electric/Fluid Power Division of the Bendix Corporation is a custom manufacturer of ground support equipment and automatic test equipment of all types, usually combining fluid power technology with electrical/electronic controls and instrumentation.

NT-15754

Benthos, Inc
Edgerton Drive, North Falmouth, MA 02556; 617/563-5917
Benthos Inc manufactures and sells Taptone quality inspection systems for food and beverage packers. These are nondestructive machines which automatically test and reject improperly packed containers (low vacuum or pressure, leaks, cracked jars, etc.). This work involves testing of the customers products in the Benthos laboratory to determine machine set-up, etc as well as research and development into system advancements. Benthos also maintains deep sea pressure testing facilities and underwater pool facilities to check operation of instruments such as acoustic devices, camera systems, bottom grabs, flotation equipment, underwater flash and lighting equipment, and other electrical-mechanical devices and instruments.

NT-15755

Bently Nevada Corporation
P O Box 157, Minden, NV 89423; 702/782-3611; Branches: USA, Canada, Italy, France, Japan, The Netherlands, Venezuela, England, West Germany
Eddy current probes are used by the Bently Nevada Corporation to detect vibration and as an electronic micrometer to measure shaft position.

NT-15756

Boeing Technology Services, Boeing Commercial Airplane Company
P O Box 3707, M/S 73-43, Seattle, WA 98124; Branches: Renton and Auburn, WA
Boeing Technology Services is marketing a full range of nondestructive testing. Complete laboratories in the following disciplines are available: chemical, metallurgical, polymer, rubber, structural, environmental, quality assurance, materials, fluids and liquids, plastics, finishes, physical testing and calibration laboratories. Nondestructive testing of plating porosity is offered for hydrogen detection using the Boeing plating porosity meter which is marketed.

NT-15757

James G. Biddle Company
Township Line and Jolly Rd, Plymouth Meeting, PA 19462; 215/646-9200
The James G. Biddle Company manufactures instruments that are used for nondestructive testing by electrostatic, electric current, and magnetic methods. Typical uses of these instruments are testing of various types of electrical insulating systems.

NT-15758

Big Three Industries, Inc, Tempil Division
2901 Hamilton Blvd, South Plainfield, N J 07080; 201/757-8300
The Tempil Division is a manufacturer of temperature indicating crayons, liquids, paints, and labels. These products are used in determining pre- and post-heat temperatures in welding applications, and the calibration of laboratory and commercial ovens and equipment.

NT-15759

Biochemical and Nuclear Corporation
749 West Burbank Blvd, Burbank, CA 91503; 213/849-1788
The Biochemical and Nuclear Corporation manufactures radiochemicals and biochemicals for research and industry for tracer studies and testing. The isotopes used are tritium, carbon-14 and iodine-125. It has a standard line catalog. The company is also involved in sample analysis, consulting services, research and development of labeled compounds, and training of personnel in radiochemical laboratory technology.

NT-15760

Boride Products, Inc
2879 Aeropark Drive, Traverse City, MI 49684; 616/946-2100
Boride Products, Inc manufactures ceramic and powdered metals parts as well as abrasive and polishing compounds. The company also performs laboratory analysis services on boron.

NT-15761

C. F. Braun and Company
1000 South Fremont, Alhambra, CA 91802; 213/570-1000
C. F. Braun and Company has engineers and constructors associated principally with the petroleum, petrochemical, chemical, and power industries. The operations are worldwide. The company can and does provide visual, liquid penetrant, ultrasonic, magnetic particle, radiographic, and qualification and certification of NDT personnel services in support of its engineering activities and on a consulting basis to others. Both laboratory and field services can be provided.

NT-15762

Brewer Engineering Laboratories, Inc
P O Box 288, Marion, MA 02738; 617/748-0103
Brewer Engineering Laboratories, Inc (BEL) provides a specialized consulting and testing service to industrial and engineering organizations. BEL comprises a group of graduate engineers from a number of disciplines including mechanical, aeronautical, civil, ocean engineering, and materials sciences. This group is supported by a trained group of electromechanical technicians and engineering secretaries. An extensive inventory of data acquisition and recording instruments also support this group. Complete engineering studies include: material properties and product design testing; theoretical and experimental stress analysis; static, dynamic, and vibratory testing; certification of equipment structure integrity; troubleshooting machinery or equipment malfunctions; laboratory model testing; special transducer design and development; design of laboratory test fixtures and loading mechanisms; and formal engineering report preparation.

NT-15763

Brunswick, Filterite Corporation
2033 Greenspring Drive, Timonium, MD 21093; 301/252-0800

NT-15764

Burns and Roe, Inc, Quality Assurance Division
496 Kinderkamack Rd, Oradell, N J 07649; 201/265-2000; Branches: Connecticut, Los Angeles, Washington, D C, Australia, Hong Kong, Paraguay, Puerto Rico, London, Spain

Burns and Roe, Inc, is an engineering organization providing engineering, design, and construction management, and quality assurance services to the power generation industries. Services provided in the field of nondestructive testing include: personnel training — radiography, ultrasonics, liquid penetrant, magnetic particle, leak and eddy current testing; auditing of NDT programs and processes; verification inspection of NDT performed by others; and evaluation of NDT methods and procedures for compliance to government and industry codes and standards. Burns and Roe personnel providing the above services are certified to government and industry standards.

NT-15765

C. J. Enterprises, Pace Transducer Company
P O Box 834, Tarzana, CA 91356; 213/996-4131; Branches: Van Nuys, CA

NT-15766

CBL Industries, Inc
13810 Enterprise Avenue, Cleveland, OH 44135; 216/267-4142

CBL Industries, Inc provides nondestructive testing services for aircraft, aerospace, nuclear, automotive, and other industries requiring sophisticated testing with ultrasonic (UT), radiographic (RT), magnetic particle (MT), penetrant (PT), and eddy current (ET). UT capabilities include multi-tank setups for immersion scanning of plate, bar, forging and products such as honeycomb and bonded structures. Precision contact scanning with surface shear and other techniques is available. Multi-channel tubing and bar testing is available. High resolution UT with B and C scanning is available.RT capabilities from 25 kV BE window to 300 kV CP radiography is available, as are X-ray sensitive vidicon techniques for small components. Real time imaging with image intensifiers and mirror optics or TV is available for production on investigative work. MT and PT are available in most sensitivity levels from the fluorescent to the visible powder and dyes. ET testing can be done to customers' requirements. NDT consulting services are also available.

NT-15767

CSP Incorporated
209 Middlesex Turnpike, Burlington, MA 01803; 617/272-6020

CSP Incorporated manufactures signal processors, array processors, and FFT computers.

NT-15768

Cambridge Instrument Company, Inc, Cambridge IMANCO
40 Robert Pitt Drive, Monsey, N Y 10950; 914/356-3331; Branches: Morton Grove, IL; Mountain View, CA; Montreal and Toronto, Canada

Cambridge IMANCO is essentially a sales and service organization for a British company. The U.S. company consists of approximately 70 people located throughout the U.S. and Canada. The company demonstrates and markets special purpose image analysing computers (Quantimet), scanning electron microscopes and microprobes, plus related equipment used in the manufacture of semi-conductor equipment (electron beam microfabrication equipment, crystal growth systems, cutting saws, polishing equipment and vapor disposition equipment). The image analyzer is used in NDT. This system scans a sample and classifies the sample accurately to its size, area, perimeter, grey level or other parameters depending on the operators requirements. It is used in evaluating pin-holes on samples, dust on wafers, fibre configuration in textiles, biological cell anomalies, metallurgical grain size, and most any other application where the sample can be visually observed and classified without magnification. The scanning electron microscope (Stereoscan) is used to visually examine almost any sample that requires magnification beyond the range of a light microscope. Additionally, other accessories are available to identify chemical composition, etc.

NT-15769

Canberra Industries, Nuclear Systems Division
45 Gracey Avenue, Meriden, CT 06450; 203/238-2351

Canberra Industries manufactures a complete line of solid state detectors, multichannel analyzers (MCA), and nuclear instrument modules (NIM) for application in the nuclear physics research community, materials analysis, nuclear medicine, and the total nuclear fuel cycle. Canberra is a worldwide organization with manufacturing facilities in the United States and Europe. There are fourteen sales offices in the United States and fifty-two in the rest of the world. Field service support is available on an international basis. Solid state detectors provided by Canberra are GE(LI), HPGE, SI(LI) and silicon surface barrier. In addition, a complete line of gas filled detectors and NAL(TI) scintillation detectors are carried. MCA's include small portable types up to large standalone research grade types providing quantitative analysis and MCA's with mini computers. The NIM products include analog and digital modules for high resolution, high count rate spectroscopy work and automation of X-ray diffractometers. Specialized applications include special nuclear material waste assay systems, whole body counting, and liquid and gaseous effluent monitoring systems for the nuclear reactor facility and low level environmental counting systems.

NT-15770

Catalytic, Inc, Operations Division, Power Projects
Centre Square West, 1500 Market Street, Philadelphia, PA 19102; 215/864-8000; Branches: Charlotte, N C

Catalytic, Inc, Operations Division, Power Projects offers worldwide services in architect-engineering, construction, and contract maintenance. Users of these services include the government as well as industries such as nuclear and industrial power, chemical processing, petrochemical processing, pharmaceutical, and plastics.

NT-15771

Circle Chemical Company, Inc
P O Box 1184, Henckley, IL 60520; 815/286-3271

Circle Chemical Company, Inc produces and markets the following items for the nondestructive testing industry: fluorescent magnetic particles for wet applications, using either a water or an oil media; wetting agents for water media applications; a wide range of fluorescent and non-fluorescent magnetic dusting powders; marking chalk for marking discontinuities on wet or dry surfaces; and underwater magnetic particles and marking chalk. In addition to the proprietary product line, the company, through its salesmen and technicians, serves the nondestructive testing industry by developing unique products for specific applications where special problems demand a variance from the Circle Chemical Company product line. The company maintains its plant, laboratory and research facilities in Hinckley, Illinois. Its products are warehoused in various locations throughout the country. The company's products are marketed internationally.

NT-15772

Cleveland Technical Center, Inc
13600 Diese Avenue, Cleveland, OH 44110; 216/451-6455

The Cleveland Technical Center, Inc, offers an engine oil analysis service. The purpose of this analysis is to determine potential engine wear and malfunctions before an engine failure occurs.

NT-15773

Cober Electronics, Inc, Industrial Microwave Heating Equipment
7 Gleason Avenue, Stamford, CT 06902; 203/327-0003

The company is based on microwave power generation. It designs, engineers, manufactures, tests, and services microwave power supplies, transmission systems, devices, and ovens. Individual components are supplied along with complete conveyors and batch ovens. Supplied also are RF test devices and systems along with communication systems. Cober Electronics serves military, communication, medical, and diverse industrial markets, e.g., rubber, foundry, and food.

NT-15774

Coherent, Inc. Tropel Division
1000 Fairport Park, Fairport, N Y 14450; 716/377-3200

Tropel is in the field of optical nondestructive testing of materials (specifically optical materials and components). The following is a list of major characteristics tested and specific products or services: (1) optical transfer function — Tropel's system 2000 measures the OTF of all optical components; i.e., lenses, mirrors, image intensifiers, filar, etc in the UV, visible or IR regions; (2) optical surface figure — Tropel's model 4000 and 2500 surface testing interferometers are used to determine the optical surface figure. System 70 allows the total automation of fringe analysis by using a digital computer to analyze wavefronts; (3) aspheric optical surface figure — Tropel's modified model 4000 uses holographic interferometry and shearing interferometry to analyze aspheric surfaces. System 70 facilitates the automatic, objective analysis of aspheric wavefronts also; (4) lens design — Tropel has computer lens design programs and designers; (5) products for optical spectroscopy — the Fabry Perot Plano and Confocal Cavity, interferometers are used for the analysis of optical spectra.

NT-15775

W. B. Coleman Company
P O Box 4461, Philadelphia, PA 19140

The W. B. Coleman Company is a testing laboratory specializing in metallurgical and chemical tests. Among the tests and inspections which are offered are the following: chemical analysis of ferrous and nonferrous metals, as well as other compounds both organic and inorganic; optical spectroscopy; arc or spark spectroscopy; X-ray spectroscopy; metallurgical examination; welding qualification; and mechanical testing.

NT-15776

Col-X Corporation
981 East Hudson Street, Columbus, OH 43211; 614/2671201

The NDT services of the Col-X Corporation include PT, MT, contact UT, leak testing and visual inspection along with welding engineering consulting. Welding engineering services include welding procedure preparation and testing, individual welder performance testing, QA manual preparation on a tailor-made basis, accident and failure investigation, welder training and development of various testing procedures. The laboratory and offices include an extensive welding library with up-to-date code references, a machine shop, a clean room, and versatile manual and semiautomatic welding equipment. The field equipment includes portable hardness testing, magnetic particle testing, liquid penetrant testing, black lights, ultrasonic testing, and leak testing units. Services are provided throughout the United States and parts of Canada to industrial concerns both nuclear and non-nuclear. Clients include utilities, steel mills, fabricators, erectors, designers, marine equipment owners, attorneys, and a wide variety of others.

NT-15777

Continental Testing Labs, Inc
763 U.S. Highway 17-92, Fern Park, FL 32730; 305/831-2700

CTL Inc is an independent testing laboratory specializing in the testing of electronic and electrical components, assemblies, and systems. The laboratory is 15 years old and employs approximately 150 people. Although the work performed is, to a large extent nondestructive, such tests are not those tests generally considered so by ASNT. The exceptions are electronic component, X-radiography and leak testing. The services offered include consulting, testing, and failure analysis. Tests include flaws and electrical, optical, and plastic properties.

NT-15778

Control Data Corporation, Computer Development Division
4201 North Lexington Ave, St Paul, MN 55112; 612/482-2829

The Hardware Product Qualification Center (HPQC) of Control Data Corporation offers consulting and testing services for electronic equipment in the areas of acoustic emissions, electromagnetic compatibility (EMC) and temperature/humidity phenomena. The HPQC provides a centralized source for design guidance, product testing, and engineering analysis. The acoustic lab provides both ANSI S1.21-1972 and ISO STD 3742 testing capability. Compliance to MIL-STD 740? and 1472B can also be checked. Laboratory facilities include a reverberation room (236 M³) and a semi-anechoic room (200 M³). The EMC laboratory provides testing capabilities for MIL-STD 461 testing as well as German VDE testing. A large selection of test instruments allows detection analysis, measurement and recording of signals from 3 Hz to 10 GHz as well as the generation of high level fields from 2 Hz to 8 GHz. Laboratory facilities include two shielded enclosures and an open test area. The temperature/humidity laboratory is capable of testing electrical equipment to most commercial temperature/humidity requirements. The laboratory has a large temperature/humidity chamber (100 M³) which can develop – 10 degrees C to 70 degrees C and 10—90% relative humidity. The HPQC normally serves customers in the upper Midwest region of the United States.

NT-15779

Custom Machine, Inc
9200 George Ave, Cleveland, OH 44105; 216/341-3994

The Custom Machine Corporation performs approved contract machining for components and assemblies to nuclear and aerospace QC requirements. Special machinery is also designed and built for various industries. Transport mechanisms and systems have been designed and built for ultrasonic inspection of parts such as forgings, castings, plate, bar, billet, tubing, etc. Equipment ranges from simple manual operation to fully automated inspection lines utilizing computer control.

NT-15780

Custom Scientific Instruments, Inc
P O Box A, Whippany, N J 07981; 201/538-8500

Custom Scientific Instruments, Inc (CSI) is a manufacturer of physical testing instruments for performing tests on plastic, paper, rubber, textiles, wood, concrete, etc. Also manufactured are nondestructive test instruments. The staff includes 3 design engineers and a 15-man machine shop. The standard product line of instruments is made to ASTM, ISO, and Federal specifications. CSI also designs and manufactures special equipment of customer designs or prototypes. This includes test jigs and fixtures that can be used with existing test equipment. The instruments are used in quality control and research laboratories. CSI sales are worldwide.

NT-15781

Daniel International, Inc
P O Box 1327, Orangeburg, S C 29115; 803/534-2424

The Applied Engineering Company, Inc (a subsidiary of Daniel International, Inc) are designers and manufacturers of custom equipment for industry such as industrial and commercial standby gas plant and LP-gas vaporizers; LPG storage, handling and processing equipment; turn key liquid natural gas (LNG) plants and systems; heat exchangers and waste heat recovery systems; modular chemical process plants for the general chemical, petro-chemical and textile industries; hydrocarbon fume abatement systems; and nuclear power plant components, parts, and appurtenances. The company also performs NDT on in-house equipment and provides NDT consulting and inspection services to industry on UT, MT, PT, and RT.

NT-15782

Datametrics, Inc
340 Fordham Rd, Wilmington, MA 01887; 617/658-5410
Datametrics is a prime manufacturer of precision pressure and vacuum measuring systems, time code generators, and Trump-Ross shaft encoders. Also manufactured is a complete line of velocity and mass flow (hot wire) systems. Facilities include primary pressure and calibration facilities to 100 pounds-per-square-inch and 250 standard-cubic-feet-per-minute, respectively.

NT-15783

Dayton X-Ray Company, Inc
1150 West 2nd St, Dayton, OH 45407; 513/228-4176
Dayton X-Ray Company provides commercial NDT services to the Dayton, Ohio area. The service area normally ranges from Richmond, Indiana east to Columbus, Ohio north to Lima, Ohio and south to Cincinnati, Ohio. The inspection services include radiography, both X-ray and gamma ray, magnetic particle, penetrant, and ultrasonics. These services are provided both in the company's laboratories and on site. Dayton X-Ray Company has marketing agreements with two large NDT equipment suppliers and a very comprehensive stock of radiographic film, developing chemicals and radiographic accessories and supplies. Training courses are offered for Levels I and II personnel and examination services for general and specific written tests for these levels are provided. Consulting services and certified Level III personnel in radiography, magnetic particle, penetrant, and ultrasonics are available.

NT-15784

Defelsko Corporation
P O Box 676, Ogdensburg, N Y 13669; 315/393-4450
Defelsko Corporation of Ogdensburg, N Y, was incorporated in 1965. The main line is selling and servicing testing instruments, mikrotest thickness gages, and minitest thickness gages. The employment averages six persons. A new Mikrotest II instrument is being introduced.

NT-15785

Del Electronics Corporation
250 E Sandford Blvd, Mt Vernon, N Y 10550; 914/699-2000
Del Electronics designs and manufactures high voltage power supplies, transformers, precision and high voltage capacitors.

NT-15786

University of Denver, Physics Department
Denver, CO 80208; 303/753-2238
A complete modern acoustic emission laboratory has been developed over the past several years in the Physics Department of the University of Denver, which allows for detection and presentation of the data in a wide variety of ways, including RMS voltage, number of bursts, rate of bursts, amplitude distribution, time duration, frequency distribution, and energy distribution. A high frequency video tape system is available which makes a permanent record of the acoustic emission. The playback of the tape can then be used to investigate the acoustic emission in many different representations. A unique feature of the system is the inclusion of a microprocessor which provides a digital output on paper tape of the acoustic emission and other test parameters. The arrangement currently allows a digital output of six variables during the actual testing operation. An integral part of the laboratory is a paper tape reader and a Hewlett Packard 9810 programmable calculator equipped with a plotter. This equipment provides a rapid and detailed analysis of the test data.

NT-15787

Detoronics Corporation
P O Box 3805, South Elmonte, CA 91733; 213/579-7130
The Detoronics Corporation serves the continental U.S. and Canada with high reliability glass to metal hermetically sealed electrical connecting devices and products. The products are engineered, designed and manufactured in corporation facilities. Also provided are services to the electronic industry in helium leak, electrical, pressure, and environmental testing.

NT-15788

Dosimeter Corporation of America, Nuclear Accessories Division
6106 Interstate Circle, Cincinnati, OH 45242; 513/793-6051
The Dosimeter Corporation of America (DCA) provides radiation detection auxiliary equipment and supplied for measuring gamma, X-rays, and neutrons during X-, gamma, and neutron radiography. This includes radiation dosimeters and survey meters. It also includes ancillary equipment such as dosimeter chargers, calibrators, logbooks, racks, and clips. The Dosimeter Corporation of American was previously known as the Bendix Dosimeter Product Line and the Landsverk Electrometer Corporation. It is the largest manufacturer of radiation dosimeters in the world and is the only United States manufacturer of multiple types of dosimeters to meet all NDT customer requirements.

NT-15789

Dunegan /Endevco
Rancho Viejo Road, San Juan Capistrano, CA 92675; 714/ 831-9131; Branches: Houston, Atlanta, Chicago, East Brunswick, N J; Palo Alto, CA; Nashua, N H
Dunegan /Endevco manufactures acoustic emission instrumentation and provides testing services for flaw detection and location. Applications include detection and location of discontinuities, delaminations, voids, porosity, inclusions, fatigue cracks, stress corrosion cracks, corrosion, leaks, etc, in a wide variety of engineering materials and structures. Instrumentation manufactured ranges from low cost single channel systems to complex multichannel computerized flaw location systems. Testing services find primary application in the recertification of pressure vessels and piping in the petrochemical and nuclear power industries.

NT-15790

Dynamold, Inc
P O Box 9617, Fort Worth, TX 76107; 817/335-0862
Dynamold, Inc is the sole licensee under U.S. Patent Number 3,862,047 for the manufacture and distribution of magnetic rubber inspection (MRI). MRI is an innovative NDT technique for ferromagnetic metals that combines the principles of magnetic particle inspection with a novel replicating system. The outstanding capabilities of MRI include the inspection of: (1) blind holes, (2) gear roots and thread roots, (3) coated inspection areas, and (4) areas of limited visual or mechanical access. MRI is employed internationally by the aerospace industry, power generation facilities, all branches of the military, and industrial NDT areas concerned with a need for a high degree of sensitivity and dependability. It is qualified to MIL-I-83387 (USAF) and has a national stock number, NSN-6850-01-037-9015. Technical assistance with applications and parameters is readily available at no charge.

NT-15791

EMI Therapy Systems, Inc, EMI Technology, Inc
570 Del Rey, Sunnyvale, CA 94086; 408/245-3136; Branches: Chicago; Hayward, CA; Tampa, FL; Dallas, TX; Wayland, MA

NT-15792

Eastman Kodak Company, .Radiography Markets Division
343 State St, Rochester, N Y 14650; 716/325-2000; Branches: Chicago; Dallas, Atlanta; San Francisco; Whittier, CA; New York, N Y; Rochester, N Y
Kodak Industrex products include: X-ray films, X-ray paper, processing chemicals, film processors, and intensifying screens. Services offered by Kodak include: technical sales representatives who assist with product application in all areas of NDT; a two-week basic seminar on industrial radiography designed to help industrial radiographers prepare for qualification under the recommended practice of the American Society for Nondestructive Testing (SNT-TC-1A).

NT-15793

Ebasco Services, Inc, Materials Engineering Laboratory
Bldg 100 A, Port Kearny, South Kearny, N J 07032; 201/344-8400; Branches: New York; Atlanta; Washington, D C; Jericho, N Y; Houston; Chicago
The scope of services performed by the Ebasco Materials Engineering Laboratory includes radiographic, ultrasonic, liquid penetrant, magnetic particle, and visual examination. These services may be performed both in-shop and in the field. Piping, pressure vessels, structural steel, weldments, castings, and forgings may be examined. The Ebasco Materials Engineering Laboratory has received a quality system certificate (materials) (N-stamp) from the ASME as a material supplier of carbon, alloy, and stainless steel castings and forgings.

NT-15794

Echo Laboratories .
P O Box 552, R D No. 4, Box 76, Lewistown, PA 17044;717/248-4993; Branches: Titusville, PA
Echo Laboratories is a manufacturer of ultrasonic couplants and ultrasonic transducers used in nondestructive testing. Ultrasonic couplants include: Echogel II, an inexpensive production couplant that meets some (but not all) nuclear specifications; Ultragel II, a superior coupling agent with less than 50 PPM total halogens and sulphur used extensively in the nuclear and aircraft/aerospace industries; Sonotrace, a modestly priced production couplant with less than 50 PPM halogens and sulphur and used in the nuclear, aerospace and metals industry; Pyrogel, a high temperature ultrasonic couplant useful to 1000 degrees F; Pyrodiscs, high temperature coupling discs useful from 1000 to 2500 degrees F; fluorescent ultrasonic couplants, unique high transmission couplants with fluorescent tracers designed to insure complete removal; immersion ultrasonic additives, additives for immersion systems for de-airing, wetting, corrosion protection, and prevention of fungus or bacteria formation; and ultrasonic couplants for shear wave coupling, i.e., permanent transducer bonding at elevated temperature, and medical ultrasonic couplants. Ultrasonic transducers are also supplied for industrial, medical and specialized applications.

NT-15795

Econospect Corporation
1757 Tanen St, Napa, CA 94558; 707/226-9833
Econospect manufactures magnetic particle testing equipment and accessories.

NT-15796

Electrical Testing Laboratories, Inc
Industrial Park, Cortland, N Y 13045; 607/753-6711
Electrical Testing Laboratories, Inc (ETL) is an independent testing lab wholly owned and controlled by employees. It is completely independent of any outside financial interest. The organization is comprised of six divisions which conduct performance and safety tests on a broad spectrum of industrial, commercial and con-

sumer products. The six divisions are as follows: acoustical, air conditioning/refrigeration and thermal operations, chemical, electrical/electronic, mechanical, and photometric. ETL, which is located in Cortland, N Y, consists of three buildings having 92,000 sq ft of floor space and containing some of the latest, up-to-date equipment in the industry. ETL has approximately 120 employees.

NT-15797

Electromatic Equipment Company, Inc, Check-Line Division
600 Oakland Ave, Cedarhurst, N Y 11516; 516/295-4300
The Electromatic Equipment Company, Check-Line Division, supplies a series of portable instruments designed to measure the thickness of coatings applied to ferrous and non-ferrous base (substrate) materials. Two types of instruments are offered. One type employs the magnetostatic method for thickness measurement and the other type makes use of eddy currents.

NT-15798

Emerson and Cuming, Inc, Flotation Products Division
869 Washington St, Canton, MA 02021; 617/828-3300
In connection with work in developing and manufacturing high-performance, deep sea buoyancy materials, Emerson and Cuming, Inc maintains a high-pressure hydrostatic test laboratory. The laboratory is equipped with a variety of pressure vessels which enable materials samples to be subjected to water pressures up to 30,000 pounds-per-square-inch. Sizes range from small vessels intended for standard 1-inch diameter by 2-inch diameter. ASTM samples to a giant tank over 3-feet in diameter by 50 feet long. The services of the high-pressure laboratory are offered on a time-available basis.

NT-15799

Eocom Corporation
19722 Jamboree Blvd, Irvine, CA 92715; 714/833-2781
The Eocom Corporation performs infrared analysis using Fourier transform. A complete facility exists for performing spectral analysis of liquids, solids, and gases on a measurement service basis. Products include infrared monitoring system, FMS 7200 for toxic gas analysis, OSHA area monitoring, and quality control.

NT-15800

Explosive Technology, Inc, Aerotest Operations, Inc
3455 Fostoria Way, San Ramon, CA 94583; 415/837-4248
Aerotest Operations, Inc is a service organization providing the industrial community with neutron radiography and activation analysis.

NT-15801

Failure Analysis Associates
750 Welch Road, No. 116, Palo Alto, CA 94304; 415/321-6350; Branches: Los Angeles, Houston
Nondestructive inspection services are offered in laboratory, production, and in-service environments. Failure Analysis Associates has developed advanced methods for evaluating and optimizing inspection services. Specific capabilities include ultrasonic testing, dye penetrant testing, eddy current testing, and acoustic emission testing.

NT-15802

Fife Corporation, Instrument Systems Division
P O Box 26508, Oklahoma City, OK 73126; 405/755-1600; Branches: England, Germany
The Fife Corporation develops and manufactures beta-ray gauging and control systems for on line process control of thickness or coating thickness. Manufacturing subsidiaries are located in England and Germany.

NT-15803

Flow Technology, Inc
P O Box 21346, Phoenix, AZ 85036; 602/268-8776
Flow Technology, Inc (FTI) manufactures fluid flow measurement equipment and repairs and calibrates any type of turbine flowmeter. The FTI plant was specifically laid out for the design, development, and manufacture of fluid flow measurement equipment.

NT-15804

Fluor Pioneer, Inc, Welding and Metallurgy Division
200 West Monroe St, Chicago, IL 60606; 312/368-6717
Fluor Pioneer is engaged in the design and construction of both nuclear and fossil power plants. Nondestructive examination is the responsibility of the welding and Metallurgy Division. The Welding and Metallurgy Division provides nondestructive examination consulting services that include: code and standard interpretation, preparation of specifications and procedures, review of vendor procedures, supervision of field and laboratory nondestructive examinations, review of test reports, nondestructive examination personnel training, witnessing of nondestructive examination of components, welds and materials, and serving as Level III examiner for utility in-house nondestructive examinations. Fluor Pioneer maintains a complete facility for radiographic film interpretation and film storage at the corporate offices in Chicago. The Welding and Metallurgy Division provides expertise in radiography, ultrasonics, magnetic particle, liquid penetrant, visual inspection, acoustical holography, leak testing, and coatings.

NT-15805

Forneys, Inc
RD No. 2, Route 18 South, Wampus, PA 16157; 412/5354341

NT-15806

Foster Wheeler Energy Corporation, Corporate Quality Assurance Department
110 South Orange Ave, Livingston, N J 07039; 201/533-1100; Branches: worldwide
Nondestructive testing is performed to ensure product quality. Limited research and development is also performed to establish testing methods not yet available commercially. Testing is performed on metallic materials, structures, and weldments only. A fully equipped research laboratory is available to perform most of the standard ASTM testing methods.

NT-15807

Froehling and Robertson, Inc, Metals and Nondestructive Testing Division
814 West Cary St, Richmond, VA 23261; 804/644-3025; Branches: Charlotte, N C; Fayetteville, N C; Ashville, N C; Greenville, S C; Baltimore, MD
Froehling and Robertson is an independent testing laboratory specializing in geotechnical and materials engineering. The services offered include concrete and cements design, test and inspection; chemical and bacteriological testing, routine and special testing of asphalts and bituminous products; geophysical site investigation, field test, and laboratory testing and analysis; soils testing; structural steel inspection; and NDT including radiographic, ultrasonic, magnetic particle, and liquid penetrant in both shop and field.

NT-15808

GAF Corporation, Photo and Repro Group, X-ray Products
140 West 51 St, New York, N Y 10010; 212/582-7600
GAF offers the following products and services to the nondestructive testing market: industrial X-ray films, industrial X-ray processing chemicals (manual), industrial X-ray processing chemicals (automatic),

illuminators, industrial intensifying screens, exposure holders, lead protective devices (aprons), darkroom accessories, safelights, process quality control systems and services, radiographic cassettes, and personnel training.

NT-15809

GCA Corporation, Vacuum Industries Division
34 Linden St, Somerville, MA 02143; 617/666-5450

GCA/Vacuum Industries manufactures a broad range of vacuum/thermal processing systems for laboratory and production use. Temperatures to 3000 degrees C and vacuum to 10^{-7} torr are attainable. Certain laboratory vacuum furnaces are routinely adapted for various analytical test procedures by the users but no specific test equipment is offered as standard catalogue items.

NT-15810

Gaertner Scientific Company
1201 Wrightwood Avenue, Chicago, IL 60614; 312/281-5335

Gaertner Scientific Company manufactures a complete line of optical measuring and testing equipment for scientific and industrial applications. These include microscopes, positioning devices, micrometer slides, coordinate measuring microscopes, cathetometers, comparators, holographic systems, optical benches, interferometers, spectrometers, and ellipsometers for the precise measurement of the thickness of thin films. Gaertner Scientific has dealerships throughout the United States and abroad. In addition to the standard instrumentation mentioned above, Gaertner is prepared to offer special modifications to meet unusual requirements, or to design new instrumentation where the nature of the application requires.

NT-15811

George W. Gates and Company, Inc
P O Box 216, Franklin Square, N Y 11010; 516/352-2904

The George W. Gates and Company, Inc furnishes special light sources such as sodium, mercury, zirconium, deuterium, xenon, spectral, and filament lamps and their operating auxilliaries. These sources can be used in conjunction with nondestructive test instruments or test procedures. The company is a small business incorporated in the state of New York and occupies a building with 4000 square feet with a total of 12 employees. Sales are nationwise to all types of laboratories and manufacturing facilities.

NT-15812

GATX Corporation, GARD, Inc Div
7449 North Natchez Ave, Niles, IL 60648; 312/647-9000; Branches: Washington, D C

The GARD Inc Division of GATX, Inc performs research and development under contract to both government and industry in the fields of technique development, specialized instrument design and fabrication, physical testing, and failure analysis. An NDT laboratory is available with radiography, eddy current, ultrasonic, infrared, and acoustic emission capability. Specialized capabilities include adhesive bond inspection, rubber inspection, tire inspection, and acoustic emission inspection of welds.

NT-15813

General Activation Analysis, Inc
11575 Sorrento Valley Rd, No. 214, San Diego, CA 92121; 714/755-5121

General Activation Analysis, Inc performs neutron and photon activation analysis for the determination of trace elements.

NT-15814

General Dynamics Convair Division, Convair School for NDT (M/Z 41-1414)
P O Box 80847, San Diego, CA 92138; 714/277-8900
The General Dynamics Convair Division serves the training needs of industry through its school for nondestructive testing in San Diego, California. In a concentrated, three-week course, covering the material specified in SNT-TC-1A for Category II qualification-certification, theory and practice are offered in the five most widely used NDT methods: radiographic, eddy current, ultrasonic, magnetic particle, and liquid penetrant testing. The 120-hour course combines programmed instruction, laboratory exercises, practical training, and interpretation of test results. Instructors are the specialists who created the 18-volume NDT training manual widely used throughout this country and 45 other nations for NDT training. In session the year around, the school offers classes with a student-instructor relation of four to one. Laboratory equipment and NDT instruments worth more than a quarter of a million dollars are available for student use, as are Convair manufacturing facilities, where training is offered under actual productive-line conditions.

NT-15815

General Eastern Instruments Corporation
36 Maple Street, Watertown, MA 02172; 617/923-2387
The General Eastern Instruments Corporation manufactures a complete line of humidity instruments (dew point and relative humidity, parts-per-million, wet/dry bulb) for laboratory, industrial, and meteorological applications.

NT-15816

General Electric Company, Fast Breeder Reactor Department
M/C 408 NDE Laboratory, 175 Curtner Ave, San Jose, CA 95125; 408/925-2641
The Fast Breeder Department's NDE Laboratory designs and builds specialized inspection equipment for application to breeder reactor or liquid metal systems. Inservice inspection equipment as well as manufacturing equipment has been built. Pulse eddy current, computer ultrasonic, and steam generator IDI methods have been developed. The laboratory possesses tube and bar stock scanners, a computer controlled C-scan system with turntable. A variety of metrology instruments and the usual assortment of conventional equipment. Electronics support is provided by an electronics laboratory which can fabricate instruments on request.

NT-15817

Geoscience Ltd, Thermal Testing Division
410 South Cedros Ave, Solana Beach, CA 92075;
The laboratory operated by Geosciences Thermal Testing Division specializes in the measurement of thermal conductivity of all materials. Specialized apparatus is available for measuring thermal conductivity of metals, ceramics, liquids, liquid metals, gases, building insulations, biological samples and thermal radiation shielding. Standard ASTM apparatus is utilized for certified measurements of thermal conductivity, U factor, and R factor of commercial products, by either ASTM-177, -236, -518, or their variations. Insulations from a few thousandths of an inch thickness to 12-inch thickness can be measured. Also measured are specific heat, heat of reaction, thermal diffusivity, thermal expansion, saturation temperature-pressure characteristics, and thermal emissivity. The area served by the laboratory includes the West Coast and Southwest. In addition to the testing laboratory, Geoscience operates a research and development laboratory which specializes in applied investigations in heat transfer and fluid mechanics.

NT-15818

Geotest Instrument Corporation
Box 551, Wheeling, IL 60090; 312/459-0710
The Geotest Instrument Corporation manufactures and distributes a line of equipment for testing physical

properties of soil, concrete, asphalt, snow, ice, sand, and gravel. The business is solely involved in selling testing devices.

NT-15819

Gibbs and Hill, Inc, Dravo Utility Constructors, Inc
393 Seventh Ave, New York, N Y 10001; 212/760-4000; Branches: Dallas, Omaha, Spain, France, Iran

Gibbs and Hill (G&H) provides management, engineering, design, consulting, analytical and construction services for utilities, other industrial organizations and government agencies. Through its Dravo Utilities Constructors (DUCI) subsidiary, G&H provides nondestructive test services. G&H and DUCI main offices are in New York City with offices located in Dallas, Texas; Omaha, Nebraska; Madrid, Spain; Paris, France; and Teheran, Iran. G&H and DUCI have the capability of providing varied nondestructive testing services including consulting, providing technical information, performance of inspections and tests, interpretation of test results, preparation of inspection and test procedures, and personnel training on a worldwide basis. Performance of test and inspection activities are limited to construction site locations. Nondestructive test methods utilized by G&H/DUCI encompass magnetic particle, ultrasonic (with emphasis on resonance and defect-echo analysis), X-radiography, gamma radiography, liquid penetrant, gaseous leak testing (utilizing the bubble method), amd eddy current. These tests are applied to castings, forgings, piping, structural members, pressure vessels, other fabricated components and supports, concrete, coatings, and paint. These tests are performed to assess soundness of materials, conformance to specification for materials, components and structures and product dimensions and coating thickness.

NT-15820

Gilbert/Commonwealth, Quality Assurance Division
P O Box 1498, Reading, PA 19603; 215/775-2600; Branches: Jackson, MI

The Quality Assurance Division of Gilbert/Commonwealth, Engineers and Consultants is involved with laboratory testing, field inspection and nondestructive testing and consulting services. The Division's primary projects are nuclear and fossil power plant construction. Additionally, work is done on chemical, refinery, and water treatment plants as well as inspections on structures such as vessels, pipelines, trusses and beams. Nondestructive testing experience includes radiography, ultrasonics, magnetic particles, visual, liquid penetrant, leak testing, and eddy current testing.

NT-15821

Gollob Analytical Service
47 Industrial Road, Berkeley Heights, N J 07922; 201/464-3331

Gollob Analytical Service (GAS) is an independent analytical and consulting laboratory. Services include all types of gas analyses (including industrial hygiene, industrial gas mixtures analyses, environmental analyses and stack emissions), analysis of organic compounds and contaminants, waste and drinking water analyses, and material testing. Facilities include gas chromatographs, gas mass spectrometers, an organic GC/MS system, a liquid chromatograph, internal gas proportional counters, chemical apparatus and other instrumentation. Staff includes 10 professionals and 10 analytical technicians. GAS has been in existence since 1962.

NT-15822

Gould, Inc, Measurement Systems Division
2230 Statham Blvd, Oxnard, CA 93030; 805/487-8511; Branches: Burbank, CA; Orlando, FL; Saddle Brook, N J

Gould Incorporated is a manufacturer of electronic instruments used in measurement and control systems. These include transducers/transmitters for measurement of pressures and temperature in aerospace and industrial applications, amplifying instruments, and display instruments. Products are sold worldwide through sales offices and representatives.

NT-15823

Arnold Greene Testing Laboratories, Inc
6 Huron Drive, Chattick, MA 01760; 617/235-7330; Branches: Everett, MA; Springfield, MA; Auburn, MA

The Arnold Greene Testing Laboratories, Inc offer analytical testing as well as nondestructive testing. Analytical testing includes chemical, metallurgical and physical. Nondestructive tests are conducted using radiography, magnetic particle, penetrant, ultrasonics, eddy current, and magnetic techniques. Welding upgrading, NDT training, and research and development are also offered.

NT-15824

Hacker Instruments, Inc
Mail Code 657, 17 Sherwood Lane, Fairfield, N J 07006; 201/226-8450

Hacker Instruments imports instruments for several applications including NDT. The principle NDT applications for these instruments are: portable hardness tester; high speed bench instrument, hardness tester; microhardness tester; surface finish by two-beam interferometer (micro interferometry); powered bench centers for use with profile meters and gauges; a pocket device for non-magnetic coating measurements on a magnetic substrate; and visual optical inspection by stereo microscope and special fiber optic illuminators.

NT-15825

Edward L Haile and Associates
P O Box 38523, Houston, TX 77037; 713/448-9725

E. L. Haile and Associates is an established consulting firm in the areas of metallurgy, chemistry, corrosion, and NDT. A completely equipped laboratory facility exists for physical, chemical, and corrosion testing and programs. Services are also offered to the petro-chemical industry including on-site NDT inspection, corrosion inspection, and alloy analysis. The company is the local representative for Pitchford Scientific's portaspec portable X-ray spectrograph which is used as a laboratory system as well as for field alloy analysis and verification.

NT-15826

Hamill Manufacturing Company
RD No. 1, Box 295A, Pleasant Valley Road, Trafford, PA 15085; 412/744-2131

The Hamill Manufacturing Company (HMC) is a precision machining and fabrication company, with a diverse range of capabilities which include: design engineering; manufacturing and fabrication; welding; nondestructive testing; and metallographic evaluation. HMC's principle products are nuclear equipment, both for the Naval nuclear program and for commercial nuclear power plant installations. HMC's facility consists of a plant of approximately 25,000 square feet, which is comprised of shop areas, offices, NDT laboratories, metallographic laboratories, drafting, inspection, and cleaning facilities.

NT-15827

Harisonic Laboratories, Inc
7 Hyde Street, Stamford, CT 06907; 203/324-3301

Harisonic Labs, Inc is an engineering and manufacturing organization engaged in the design, manufacturing, and application of ultrasonic search units to nondestructive test problems. Facilities at Stamford include complete engineering, machine shop, assembly, and operations, as well as capabilities for special ultrasonic search units and electronic equipment development and manufacturing, consulting, engineering, and performance of application studies. World markets served include basic metals production, fabrication operations, aerospace, oil, gas and chemical, and power generation, in particular, nuclear.

NT-15828

Harshaw Chemical Company, Crystal and Electronic Product Department
6801 Cochran Road, Solon, OH 44139; 216/248-7400
Harshaw manufactures nuclear radiation detectors and systems and infrared transmitting materials and detectors. Components are furnished to original equipment manufacturers who in turn manufacture nondestructive testing systems. Harshaw also builds custom NDT systems on request.

NT-15829

Health Physics Associated, Ltd
3304 Commercial Ave, Northbrook, IL 60062; 312/564-3330
Health Physics Associates, Ltd are consultants in radiation safety, serving both industrial and medical clients with a variety of technical and advisory programs. Technical services include calibration, preventive maintenance and repair of radiation survey instruments, and leak/wipe test kits for sealed radioactive sources. Kits are mailed automatically when a test is due, and the wipes are returned for analysis. Advisory services cover specific needs such as radiation hazard and shielding evaluation for legal, insurance and public relation purposes, feasibility studies, radiological safety training, and other consultations.

NT-15830

Hewlett-Packard Co, McMinnville Division
1700 S Baker St, McMinnville, OR 97128; 503/472-5101
The McMinnville Division of the Hewlett-Packard Company manufactures two types of specialized X-ray systems. The first category includes a family of shielded-cabinet X-ray systems used in typical nondestructive inspection applications and in the classroom for teaching radiographic fundamentals. The second category consists of pulsed (flash) X-ray systems ranging in output voltage from 100 kV to 2.3 mV. These provide single pulse exposures in the submicrosecond range and are used primarily to record dynamic events which are difficult or impossible to photograph by normal techniques because of smoke, flame, debris, or intervening material. They are widely used in the radiography of ballistic, explosive, and crash injury events. The McMinnville Division is a manufacturing facility of Hewlett-Packard Company. Its products are sold and serviced worldwide by Hewlett-Packard's network of local offices.

NT-15831

High Voltage Engineering Corporation, Industrial Products Division
P O Box 416, South Bedford St, Burlington, MA 01803; 617 272-1313; Branches: Amersfoort, The Netherlands
High Voltage Engineering (HVE) Corporation is a diversified manufacturer of flexible plastic insulating products, electrical connectors and switches, builders' instruments, electron processing systems, and scientific equipment. The majority of this product output, approximately 75% is furnished to the electric and electronic industries, principally as components for products and equipment sold to end users. The balance of the products are provided to the medical, construction, laboratory, and capital equipment markets. Many products offered by high voltage have unique physical properties resulting from the company's pioneering work in radiation technology and atomic particle acceleration. The company was established in 1946 specifically for the commercial manufacture of compact X-ray generators. HVE's efforts were directed toward development of increasing larger and more powerful accelerators as science probed deeper into the workings of the atom.

NT-15832

Hobart Brothers Company, Technical Center
Trade Square East, Troy, OH 45373; 513/339-6218
Testing is done primarily to certify properties of weldments made with company produced welding electrodes. Training in testing is an additional function.

NT-15833

Holosonics, Inc, Industrial Products
4340 Redwood Highway, Suite 150, San Rafael, CA 94903; 415/479-5880

Holosonics provides acoustical holography and acoustic imaging systems and services. These equipment and service capabilities range from simple hand scanning applications to fully configured systems for imaging pipelines, solid rocket motors, nuclear reactor vessels, and well casings for corrosion, integrity of parent material, and weld conditions. Acoustic imaging is applied to a broad range of metallic and non-metallic structures, such as composites and multilayered structures. Proof of principle and feasibility studies are provided on a contract basis bringing to bear a full range of acoustic imaging capabilities from 10 kHz to 50 mHz and a full range of nuclear testing capabilities. In addition to proof of principle and feasibility study contracts, Holosonics provides a full research and development capability for specially configured systems and acoustic imaging testing facilities on a contract or piece-by-piece basis.

NT-15834

Hydro Products, Inc
P O Box 2528, San Diego, CA 92112; 714/453-2345

Hydro Products complete engineering, manufacturing and environmental testing facilities are located in San Diego, California. The complex houses all of the company's activities which includes a wide range of marine offshore instruments and systems, and products for the nuclear industry. The company is a leading supplier of underwater equipment including closed circuit television systems, marine and oceanographic instruments, advanced RCV (remote controlled vehicle) systems, as well as radiation tolerant viewing systems and lighting for the nuclear power industry. The Systems Division of the company specializes in one-of-a-kind requirements, particularly where advanced technology is involved, supplying engineering and manufacturing services that complement the activities of the parent company. Hydro Products has been in its field more than fifteen years and is committed to providing rugged, reliable equipment and responsive worldwide service.

NT-15835

IIT Research Institute
10 West 35 St, Chicago, IL 60616; 312/567-4800; Branches: Rome, N Y; Dayton, OH; Washington, D C; Annapolis, MD; Huntsville, AL

IIT Research Institute (IITRI) is a contract research organization with wide ranging interest. NDT is used in many of these programs. IITRI normally uses NDT as a contributor to these programs and only is involved in NDT where requirements exist. In certain specific NDE efforts IITRI has unique capabilities and or personnel. IITRI has 1400 employees and conducts some 1000 programs annually. Work is done for industry and government agencies throughout the United States. Extensive laboratories are available with state-of-the-art equipment.

NT-15836

IRT Corporation, NDI Systems Division
P O Box 80817, San Diego, CA 92138; 714/565-7171

IRT is an integrated engineering and scientific resource corporation which provides research, development and hardware services in broad areas of nuclear science. IRT's hardware services include definition of the problem, evaluating technical and engineering approaches, prototyping and demonstrating the solution, and finally providing a fully instrumented system. The NDI (nondestructive inspection) Systems Division, specializes in the application of nuclear technology to nondestructive testing in four broad areas: neutron radiography, nuclear materials measurement, radiation gauging, and mineral exploration technology.

NT-15837

ITT Grinnell Industrial Piping, Inc, Industrial Piping Division
P O Box 566, Kernersville, N C 27284; 919/993-4831
ITT Grinnell Industrial Piping, Inc is a piping fabricator and installer. This piping is for nuclear or fossil power plants, paper mills, or petro-chemical plants. The scope of work includes both shop fabrication and field erection. The North Carolina fabricating plant covers approximately 500,000 sq ft and employment is about 1000. Presently, five power plants and one paper mill are being erected.

NT-15838

Industrial NDT Company, Inc
3409 Ridgeway St, Charleston Heights, S C 29405; 803/744-7412; Branches: Savannah, GA; Augusta, GA; Glens Falls, N Y
Industrial NDT Company, Inc is an independent testing organization utilizing innovations in NDT technology. Nondestructive testing experience encompasses magnetic particle, liquid penetrant, ultrasonic, and radiographic inspections. Also provided are physical testing services; welder certification; weld procedure development and certification; concrete and soil inspection; chemical analysis and macrophotography; and a complete range of construction inspection. Industrial NDT Company, Inc is a quality oriented company which has mechanical, civil and chemical engineers employed as office managers and technicians. A continuing training program exists for the employees. Training facilities are located at the Charleston site for certification of customer employees in welding or NDT. Industrial NDT Company, Inc also prepares procedures for implementing quality programs.

NT-15839

Infrared Surveys, Inc
3450 Evergreen, Houston, TX 77087; 713/643-8583; Branches: Rockport, TX
Infrared Surveys, Inc provides an industrial service which gives early warning of breakdown, as well as programmed preventive maintenance and energy conservation programs for all in-plant operations using electrical power or fuel fired energy systems. This is accomplished by locating faulty electrical connections before an outage occurs and by determining where refractory lined vessels are breaking down or wearing.

NT-15840

Instrument Technology, Inc
P O Box 381, Main Line Drive, Westfield, MA 01085; 413/562-5132
Instrument Technology, Inc (ITI) is an engineering company specializing in the design, development, and manufacture of remote viewing systems. ITI products include periscopes, borescopes, telescopes, binoculars, and optical devices for inspection and general observation. ITI systems are used visually but are also available with photographic and TV cameras.

NT-15841

International Thermal Instrument Company
P O Box 309, Del Mar, CA 92014; 714/755-4436
The ITI Company possesses facilities for measuring the thermal conductivity, or thermal conductance of any solid material. K factors of barriers may also be tested within ASTM specifications.

NT-15842

Ithaco, Inc
P O Box 818, Ithaca, N Y 14850; 607/272-7640
Ithaco, Inc is the manufacturer of electronic instruments such as: amplifiers, preamplifiers, lock-in instruments, variable electronic filters, and signal conditioning systems.

NT-15843

James Electronics, Inc, Instrument Division
4050 N Rockwell St, Chicago, IL 60618; 312/563-6500
James Electronics, Inc, Instrument Division, has facilities in Chicago, Illinois, and designs nondestructive ultrasonic test instruments for use in concrete testing, wood, ceramic and nuclear applications. An electronic temperature meter is also offered.

NT-15844

JEM Penetrameter Mfg Corp
6 Huron Drive, Natick, MA 01760; 617/653-5950
JEM Penetrameter Mfg Corp manufactures: job-site radiographic film processing darkroom that is carried on a pick-up truck or as a trailer and is capable of withstanding high and low temperature conditions; image quality indicators (IQI-penetrameters) including the DIN, ISO, MIL, ASTM, ASME and other North American specifications as well as foreign specifications; cobalt 60/iridium 192 gamma/ray exposure calculators which are a low-priced tool for the radiographer used to calculate the exposure time for industrial radiographs; and ultrasonic-depth/path flaw calculator that is an easy to operate, low-cost slide calculator which includes the conversion to the metric system of all results.

NT-15845

Jodon Engineering Associates, Inc
145 Enterprise Drive, Ann Arbor, MI 48103; 313/761-4044
Holographic NDT systems (HNDT) are furnished for performing utility and specialized continuous wave (CW) services including real time, time-average, and double exposure holography. These systems include complete turn-key set ups with onsite indoctrination by a qualified holographic engineer. Services are available at the Jodon, Ann Arbor, Michigan facility for performing a wide range of CW holographic experiments. Those experiments include vibration analysis of compressor and turbine components honeycomb bond analysis, composite structure delamination or void analysis, special munitions testing (inert rounds), testing of lenses and mirrors, and optical testing of microelectronic assemblies.

NT-15846

Jordan Nuclear Company
3244 Arroyo Seco Ave, Los Angeles, CA 90065; 213/222-8141
The Jordan Nuclear Company manufactures radiation instrumentation and also repairs, services, and calibrates both commercial and military products. The instrumentation includes gamma and beta radiation survey meters, radiation monitors, ionization chambers, dosimeters, dosimeter chargers, and remote area monitors.

NT-15847

Kaman Sciences Corporation, Products Division
P O Box 7463, Colorado Springs, CO 80933; 303/599-1500
Kaman Sciences manufactures a complete line of 14 MeV neutron generators and transfer systems. They are useful in performing neutron radiography and neutron activation analysis.

NT-15848

Kaye Instruments, Inc
15 De Angelo Drive, Bedford, MA 01730; 617/275-0300
Kaye Instruments manufactures a broad line of data acquisition equipment. Many of these instruments are commonly used for recording voltage signals generated by strain transducers. Equipment supplied includes

standalone data loggers, portable recorders, and remote multiplexing equipment for computer based data acquisition systems. Many instruments include integral signal conditioning equipment.

NT-15849

Konigsberg Instruments, Inc
2000 E Foothill Blvd, Pasadena, CA 91107; 213/449-0016
Konigsberg Instruments, Inc designs and manufactures standard and custom measurement instrumentation, including pressure, acceleration, force transducers, and telemetry electronics to transmit transducer data. These products are used for biomedical and industrial applications. To support these activities, the company has a modern 10,000 square foot facility incorporating clean room assembly areas, prototype and production hybrid circuit assembly equipment, as well as modern research and development laboratories and office areas.

NT-15850

Koslow Scientific Company
7800 River Road, North Bergen, N J 07047; 201/861-2266
Koslow Scientific Company manufactures a complete line of do-it-yourself chemical spot test kits. These are complete self-contained units for the identification of the commonly used alloys. Kits are available for the identification of steels, nickel, aluminum, copper, and titanium alloys, and plated metal coatings identification. Koslow sells in the United States as well as most major non-communist countries.

NT-15851

Krautkramer-Branson, Inc
P O Box 408, Stratford, CT 06497; 203/377-3900; Branches: Lewiston, PA
Krautkramer-Branson, Inc, a subsidiary of Smith Kline Corporation, is a leading manufacturer of ultrasonic nondestructive testing devices. The company's product line includes ultrasonic flaw detectors, thickness gages, hardness testers, and velocity testers. Also manufactured is a variety of eddy-current testing devices and large, computer interfaceable ultrasonic and eddy current test systems. Generally, these instruments are used to measure the dimensions of materials being tested and to check these specimens for internal and/or surface defects, as well as to determine certain other material characteristics of the specimens, such as acoustic velocity and hardness. Industries using these instruments include petrochemical, aerospace, basic metal, glass, plastic, structural, shipbuilding, automobile, nuclear and fossil-fuel power, and a wide variety of other manufacturing industries.

NT-15852

Krautkramer-Branson, Inc, KB-Aerotech
P O Box 350, Lewistown, PA 17044; 717/242-0327
KB-Aerotech designs and builds transducers for use in many different nondestructive testing applications. The product line includes transducers designed for contact testing work, shear wave inspection, immersion testing, applications involving dual element probes, delay, and thickness gaging transducers. KB-Aerotech ultrasonic transducers are the result of research aimed at providing performance, reliability, and reproducibility. As new and improved piezoelectric materials, dampings, epoxies, and techniques are developed, these innovations are incorporated into KB-Aerotech's standard transducer product line.

NT-15853

LND, Inc
3230 Lawson Blvd. Oceanside, N Y 11572; 516/678-6141
LND Incorporated was conceived by physicists and engineers to serve the sophisticated and extremely specialized nuclear detector requirements of engineers, physicists, and scientists in every field of endeavor.

From its inception in 1964, LND had developed and is now manufacturing a broad family of detectors of high quality and reliability. There has been a steady growth in the scope of its operations and the variety of its detector family. LND fully realizes the complex problems involved in the applications and use of nuclear detectors; therefore, services are available around the clock when necessary to aid in solving these problems. The people at LND are continuously striving to overcome problems encountered with existing tube techniques and develop new techniques and tube types in this rapidly advancing field. The strong emphasis LND places on quality in all its products and activities is revealed in the scope of the quality assurance department. LND has a quality control organization set up under the general specifications of the NASA NPC 200-3, and the DCAS MIL-Q-9858 (quality control) and MIL-E-1 (tubes). LND is a quality products list (QPL) approved supplier of the following types: 5979, 5980, 7616, 7840, 8767, and 8204M.

NT-15854

Karl Lambrecht Corporation
4204 N Lincoln, Chicago, IL 60618; 312/472-5442
The Karl Lambrecht Corporation is a designer and manufacturer of specialized optical components and systems. A wide range of optical test devices for both manufacturing and laboratory use is offered.

NT-15855

K. J. Law Engineers, Inc
23660 Research Drive, Farmington Hills, MI 48024; 313/478-3150
K. J. Law Engineers manufacture and distribute verimet, a complete line of eddy current nondestructive test instruments. The line includes production, portable, and laboratory instruments. Typical applications include hardness testing, heat-treat differentiation, alloy tests, conductivity measurement, and crack and seam detection. K. J. Law Engineers' facilities include complete design and fabrication capabilities. The company is a single source outlet for complete automatic test systems. A worldwide organization of representatives assures prompt solutions to quality control problems. K. J. Law also manufactures a Rockwell method digital hardness tester.

NT-15856

Lion Precision Corporation
60 Bridge St, Newton, MA 92159; 617/969-4710
Lion Precision Corporation has been applying advanced electronics to dimensional gaging for many years. A broad array of sensors and circuitry is provided for contact and non-contact gaging and control. Lion is a manufacturer of spring gages and measurement module gaging systems. The 10,000 square foot facility comprises management offices, engineering and drafting departments, test area, assembly line and machine shop production. Services are provided to all areas of the United States, Canada, and Europe.

NT-15857

Litton Industries, Fitchburg Coated Products
P O Box 1106, Scranton, PA 18510; 717/347-2035
Fitchburg Coated Products manufactures electrosensitive recording paper for use in nondestructive testing equipment such as custom machines, automation industries, and others.

NT-15858

Lockwood and McLorie, Inc, Sales Division
P O Box 113, Horsham Valley Industrial Center, Horsham, PA 19044; 215/675-8718
The Lockwood and McLorie Corporation manufactures proprietary analytical process instrumentation and related items. Manufacturing services are provided for the fabrication of special process instrumentation to customer specifications.

NT-15859

Maxwell Laboratories, Inc
8835 Balboa Ave, San Diego, CA 92123; 714/279-5100
Maxwell Laboratories, Inc (MLI) designs and manufactures pulsed power systems for research, industrial, and government programs. The systems include high power equipment which may be applied to laser systems, high current electron-beam generators, Marx generators, trigger generators, energy storage banks, high-voltage power supplies, etc. In addition, Maxwell manufactures high-voltage components such as spark-gap switches and low-inductance capacitors. Maxwell also manufactures magneform machines which are used for metalforming using electromagnetic pressure. The Blackjack 3 and pocobeam flash X-ray and pulsed E-beam facilities are available to users on a non-interference basis with DNA (Defense Nuclear Agency) programs. Both Blackjack 3 and pocobeam are DNA facilities built by Maxwell Laboratories, and operated by MLI in San Diego, California.

NT-15860

McWilliams Forge Co, Inc
Franklin Avenue, Rockaway, N J 07840; 201/627-0200
McWilliams supplies open and closed die forgings in ferrous and non-ferrous materials to the aerospace and nuclear industries. McWilliams forges almost every forgeable grade of material and specializes in high quality forgings. The company is comprised of 250 people and can forge closed die forgings up to 500 pounds and open frame forgings to 3,000 pounds in certain configurations. Forgings are supplied to customers throughout the United States, Canada, and overseas.

NT-15861

MET Electrical Testing Company, Inc
916 W. Patapsco Ave, Baltimore, MD 21230; 301/354-2200; Branches: Pittsburgh, PA
Electrical testing and measurement is offered on electrical systems and components in power transmission, distribution and generation equipment. Services include determining condition of equipment, insulation materials and conductive materials, system operation, and system functioning. Independent testing is performed for compliance to various specifications and evaluation of performance. Investigation of power system accidents, failures, and malfunctions is offered including determinations of causes with recommendations for corrections. Services are performed in the field and in the laboratory as required.

NT-15862

Metals Testing Co, Inc
P O Box 213, South Windsor, CT 06074; 203/289-8225
The Metals Testing Company, Inc performs nondestructive testing of metals such as magnetic particle inspection, fluorescent and dye penetrant inspection, radiography, ultrasonics, anodizing and etching inspection, and alloy testing. Training courses are offered in nondestructive testing as well as on-site nondestructive testing.

NT-15863

Metcut Research Associates, Inc
3980 Rosslyn Drive, Cincinnati, OH 45209; 513/271-5100
Metcut Research Associates, Inc is an independent organization offering technical services and laboratory facilities in the area of materials engineering and evaluation including machinability data and information analysis. Materials engineering at Metcut is aimed primarily at the application and evaluation of both metallics and nonmetallics. Experimental work is carried out in three laboratories. One laboratory is concerned with the microscopic inspection and failure analysis of materials. The other two have responsibility for the mechanical evaluation of specimens as well as testing of components and assemblies under a wide variety of

conditions. Metcut's activities are supported by a fully equipped machine shop used for manufacture of special test equipment fixtures and test specimens. NDT support is provided by facilities to produce ultrasonic and eddy current test standards using custom-built electrical discharge machining units.

NT-15864

MET-L-CHEK Company
1639 Euclid Street, Santa Monica, CA 90404; 213/394-0222
The MET-L-CHEK Company manufactures a complete line of visible and fluorescent penetrants meeting MIL-I-25135 and other government and industrial specifications and codes.

NT-15865

Mikron Instrument Co, Inc
P O Box 211, Ridgewood, N J 07451; 201/891-7330
The Mikron Instrument Company, Inc manufactures non-contact infrared temperature measuring instruments (both a c and battery powered) between the limits of – 100 degrees F to 3000 degrees F and surface emissivity limits of targets from 0.2 to 1.0. Many ranges, spectral responses, and physical configurations to accommodate an extremely wide variety of applications are available.

NT-15866

Mine Safety Appliances Company, Advanced Systems Division
Evans City, PA 16033; 412/538-3510
The Advanced Systems Division of the Mine Safety Appliances Company (MSA) is an engineering organization which offers a range of design, development, fabrication and inspection capabilities to industry, institutions, and government. The facilities include approximately 100,000 sq ft of chemical and engineering laboratories, development and pilot plant structures, clean areas, inspection and test areas, and manufacturing and assembly space. Services offered are worldwide and include the following: (1) total integrated design and or developmental engineering on a project basis; (2) architectural and engineering service to augment the customer A and E effort or organization; (3) complete engineering consulting services; (4) various inspection services including electrical testing and nondestructive examinations.

NT-15867

Monitor Labs, Inc
4202 Sorrento Valley Blvd, San Diego, CA 92121; 714/453-6260; Branches: Silver Spring, MD
Monitor Labs, Inc specializes in air quality instrumentation. The instrument line includes analyzers for ozone, nitrogen oxides, and sulfur. Accessories are offered such as calibrators, signal averagers, sample dilutors, remote analyzers, telemetry links, and gas sample particulate filters. Data logger systems are also offered.

NT-15868

Monroe Electronics, Inc
100 Housel Avenue, Lyndonville, N Y 14098; 716/765-2254
Monroe Electronics, Inc is a manufacturer of specialized instruments for the measurement of electrostatic surface potential without physical contact to the surface measured. Standard instruments can be used for measurements of a few millivolts (contact potentials for example) up to tens of kilovolts. Applications include the testing of photoconductors as used in xerography and electrophotography, testing of the surface condition of aluminum for epoxy bonding, and general research and development on insulators. Additionally, Monroe Electronics manufactures a line of electrostatic field meters which are most often used for monitoring the accumulation of static electricity during production processes.

NT-15869

Monsanto, Fisher Controls Co
Governor Rd, Marshalltown, IA 50158; 515/754-3011
The Fisher Controls Company, Division of Monsanto, is a manufacturer of process control equipment such as valves, regulators, and controllers. Also, a line of digital and analog computers for process control is offered. The valve line includes the manufacture of nuclear power plant components, thus the company has an in-house NDT capability in PT, MT, RT, and UT.

NT-15870

Monsanto Research Corp
Station B, Box 8, 1515 Nicholas Rd, Dayton, OH 45407; 513/268-3411
Monsanto Research Corporation (MRC), a wholly owned subsidiary of Monsanto Company, was established specifically to conduct research, development, and special manufacturing in areas of interest to government agencies. It is staffed, equipped, financed, and managed to facilitate work under contract. MRC operates two laboratories. The Dayton laboratory at Dayton, Ohio, is available for contract research to all agencies. Mound laboratory, at Miamisburg, Ohio, has been operated under contract since it was built in 1948. Personnel at the Dayton laboratory number about 260, of whom one-third are professional employees; approximately 30 have doctoral degrees. The Dayton laboratory is a diversified facility, staffed and equipped for both fundamental and applications oriented research, development, and engineering in polymer, organic, inorganic, physical, biological, analytical, and radiation chemistry. It also has specialized capabilities for development in instrumentation and test apparatus.

NT-15871

NDT Instruments, Inc
15622 Graham St, Huntington Beach, CA 92649; 714/893-2438
NDT Instruments, Inc specializes in the development, manufacturing and marketing of nondestructive test instrumentation. At present, the scope of instrumentation involves ultrasonic and eddy current principles methods. Plans are to advance into other test principles in the near future. Marketing is both national and international. The following products are currently offered: Vector 111 — general purpose portable eddy current tester for detecting fatigue cracks, heat treat condition, alloy sorting, coating plating, gaging, etc; Vector 120 — eddy current digital thickness gage for coatings and layers of nonconductive material on conductive substrates; Vector 131 — eddy current digital thickness gage for metallic foils, thin metallic sheet, cladding, or plating; Nova 201 — digital ultrasonic thickness gage for metals, plastic, glass, ceramics, and some types of rubber; Nova 201D — digital ultrasonic corrosion gage for metals such as tubing, boilers, tanks, etc; 210 bond tester — ultrasonic device for detecting delaminations, unbonds, and certain other defects in laminar, honeycomb, or composite structures.

NT-15872

National Astro Laboratories, Inc
2201 N Hollywood Way, Burbank, CA 91505; 213/849-6701; Branches: San Diego, N Hollywood, CA
National Astro Laboratories is a calibration laboratory for test and measurement instrumentation.

NT-15873

National Nuclear Corporation
3150 Spring Street, Redwood City, CA 94063;
Branches: Menlo Park, CA
The National Nuclear Corporation (NNC) has been in the commercial development and production of nuclear fuel assay, safeguards, and environmental protection equipment for over ten years. During that time,

many of these machines have been manufactured and placed into operation in the nuclear fuel manufacturing and processing industry or are utilized for MMC assay service in the United States and throughout the world. These systems include production machines for assaying fuel rods, pellets or powder, bulk fuel, liquid solutions, waste, etc. Also included are fixed and portable SNM and metal detectors. In addition to equipment, NNC supplies services.

NT-15874

Net Systems, Inc
6405 Independence Ave, Woodland Hills, CA 91367; 213/888-0724
Net Systems, using procedures in X-ray diffraction, ultrasonics, acoustic emission, and eddy current, offers residual stress determinations and advanced flaw detection techniques. Net provides quantitative as well as qualitative results using computer hard copy readouts and four-color chart plotting. In the 6,000 ft inspection testing laboratory and office facilities, Net provides: residual stress determinations, failure analysis, fatigue and fracture critical criteria, damage tolerance information, and initial flaw size evaluation. Specifications and standards may be developed for product reliability, cost reductions, quality assurance, product design modification, engineering and consultation parameters, and educational criteria. The X-ray diffraction techniques allow a determination of residual stress in practically all grades, types, and alloys of metals, including aluminum, inconel, titanium, magnesium, and high-temperature steel. Advanced ultrasonics technology is used to evaluate and detect residual stress as well as flaw detection in plastics, ceramics, advanced compounds, and numerous other materials.

NT-15875

New England Nuclear Corporation, Nuclides and Sources Division
Atomlight Place, N Billerica, MA 01862; 800/225-1572
Radioactive materials are offered for research and industrial applications. Capabilities include manufacture of radionuclide Alpha, Beta, Gamma, positron, and neutron sources for various applications including X-ray fluorescence, gaging, well logging, Mossbauer spectroscopy, and instrument calibration. Only products are offered; NDT services are not available.

NT-15876

Newport News Industrial Corporation, Inspection and Services Division
660 39th Street, Newport News, VA 23607; 804/380-7821; Branches: Gurnee, IL
Newport News Industrial Corporation is a subsidiary of Newport News Shipbuilding, a Tenneco Company. Newport News Industrial provides NDE inspection and services from its two locations at Gurnee, Illinois, and Newport News, Virginia. Newport News Industrial is a supplier of nondestructive evaluation in RT, MT, PT, and UT. NDE, health physics, codes and standards, welding and many specialized courses are offered on customer request. Services are provided dealing with materials testing, instrument calibration, gear and cargo certification (crane inspection), and craft maintenance. Prime customers are utility companies East of the Mississippi, i.e., Commonwealth Edison, Virginia Electric and Power Company, Carolina Power and Light, Duke Power, and many others.

NT-15877

Nicolet Scientific Corporation
245 Livingston St, Northvale, N J 07647

NT-15878

Nondestructive Testing Management Association, Inc
P O Box 1214, Magnolia Park Station, Burbank, CA 91507; 213/842-4604
The Nondestructive Testing Management Association consists of membership by companies alone. The

organization consists chiefly of companies involved in actual nondestructive testing such as independent laboratories throughout the USA, Canada, and Mexico. Further information is available from Mr. Fred W. Rohde, Executive Secretary and Treasurer, P O Box 1214, Magnolia Park Station, Burbank, CA 91507.

NT-15879

Nortec Corporation
3001 George Washington Way, Richland, WA 99352; 509/943-9141
Nortec Corp is a manufacturer of a broad range of portable eddy current and ultrasonic nondestructive testing instruments, probes, and transducers.

NT-15880

Nuclear Assurance Corp, Engineering and Transportation Services
24 Executive Park West, Atlanta, GA 30329; 404/325-4200; Branches: Zurich, Switzerland
The Nuclear Assurance Corporation, Engineering and Transportation Services Division, offers the following inspections: visual and dimensional inspection of irradiated nuclear fuel assemblies, out-of-core sipping of irradiated fuel assemblies, gamma scanning of irradiated fuel assemblies. Field inspections are performed for U.S. utilities and equipment is manufactured for domestic and overseas customers.

NT-15881

Nuclear Components, Inc
P O Box 60, Stockbridge Rd, Great Barrington, MA 01230; 413/528-2560
Nuclear Components Incorporated (NUCOM) is a modern plant that performs machining and welding including electron beam, heat treating, prototype, production services, NDT testing, testing services, metallograph services, and consulting. For many years, Nuclear Components Incorporated has been involved in the Naval nuclear program to fabricate control rods core structures, pressure vessels, and piping. This same type of work is also being done for power reactor operations for major utility companies. NUCOM is involved in the manufacture of fuel transportation cask neutron absorber sleeves and fuel racks manufactured to ASME boiler and pressure vessel code, Section III quality program. NUCOM currently holds a ASME N, NPT, and U certificate with complete facilities and experienced personnel for quality control, NDT Level III for the Navy and ASME, and laboratory services.

NT-15882

Nuclear Consulting Services, Inc
P O Box 29151, Columbus, OH 43229; 614/846-5710
Nuclear Consulting Services, Inc is an independent engineering, consulting and testing company providing service worldwide. About half of the company activity is nuclear related, split between field testing of gaseous systems per ANSI, ASME, ASTM, and company developed procedures and laboratory testing. Laboratory tests include I121, XE133, KR85, and H3 work in both gas and liquid phases. Analysis to determine nonradioactive contaminants is an important part of this work. In the non-nuclear area a comprehensive general analytic laboratory provides backup for a number of specialized test areas. Detailed analysis is provided for process gas streams in stack and solvent recovery systems, detailed particulate analysis by particle size and number in both gas and liquid streams. Various other special field and laboratory services are offered to industry for process and effluent streams. A unique and valuable part of our service is the ability to provide consulting and engineering to help solve problems uncovered by our NDT services. Participation in ASME, ASTM and ANSI committees ensures that Nuclear Consulting Services personnel are aware of the latest relevant standards.

NT-15883

Nuclear Diagnostic Labs, Inc
P O Box 791, Peekskill, N Y 10566; 914/737-7330
Nuclear Diagnostic Labs, Inc offers the following services: radioactive waste disposal, radiation detection meter calibrations, laboratory wipe testing, radioactive source leak testing, radiation safety consultants, and radioactive isotope laboratory inspections.

NT-15884

Nuclear Energy Services, Inc, Conam Inspection Division
Shelter Rock Road, Danbury, CT 07810; 203/748-3581; Branches: Chicago, Minneapolis, Houston, Richmond, CA, Rahway, N J, Columbus, OH
Nuclear Energy Services, Inc is a wholly owned subsidiary of Automation Industries, Inc. The company combines the nuclear power plant capabilities of the NES Division with the nationwide network of NDT laboratories of the Conam Inspection Division. The Conam laboratory testing facilities are located throughout the United States. Through these labs, the latest equipment is available for conducting laboratory or field tests using techniques such as: ultrasonic contact and immersion with C-scan, polar and helical recording; eddy current testing; X-ray or isotope radiography; magnetic particle inspection (wet or dry); visible dye or fluorescent penetrant; leak testing (helium mass-spectrometer method); and visual inspection. In addition, welding procedure qualification and surveillance can be provided. Consulting services for NDT methods are available.

NT-15885

Nuclear Energy Services, Inc, NES Division
Shelter Rock Rd, Danbury, CT 06810; 203/748-3581
Nuclear Energy Services, Inc is a wholly owned subsidiary of Automation Industries, Inc. The company combines the nuclear power plant capabilities of the NES Division with the nationwide network of NDT laboratories of the Conam Inspection Division. The NES Division specializes in providing complete construction inspection and inservice inspection services to the nuclear power industry. Construction inspection capabilities include vendor surveillance, visual weld inspection, radiographic testing, eddy current testing, ultrasonic testing, magnetic particle testing, liquid penetrant testing and leak testing. NES has been providing a full range of inservice inspection (ISI) services to the requirements of ASME Code Section XI since 1971. The scope of services include: access engineering; preparation of the detailed inspection program; design and manufacture of all specialized inspection equipment; and performance of both baseline and inservice examinations.

NT-15886

Nuclear Equipment Corporation
963 Industrial Road, San Carlos, CA 94070; 415/591-8203
The Nuclear Equipment Corporation manufactures: energy dispersive X-ray fluorescence spectrometers, energy dispersive X-ray diffraction spectrometers, and X-ray spectrometers for use with electron microprobes and SEMS. X-ray fluorescence systems range from small portable units utilizing radioisotopic sources to large computer-based systems using X-ray tubes. Systems have been adapted for on-stream and in-stream use, to constituents of process streams.

NT-15887

Nuclear Services Corporation, Construction and Operations
1700 Dell Avenue, Campbell, CA 95008; 408/446-2500; Branches: Pittsburgh, PA
The Nuclear Services Corporation (NSC), Construction and Operations Division, performs engineering, laboratory and field NDE for vibration testing; rotating machinery, trend monitoring, and signal analysis;

strain measurement; nuclear power plant PSI/ISI; tube eddy current, etc. Engineering services include equipment development and design, program preparation, personnel training, audits and reviews, etc. NSC generally serves the energy industry in a broad-based engineering and field consultant role.

NT-15888

Nuclear Sources and Services
P O Box 14023, Houston, TX 77021; 713/641-0391
Nuclear Sources and Services performs pipe inspection utilizing through-wall and backscatter gaging; activation analysis using a one mw reactor; tracer studies in refinery, industrial plants, subsurface items; and in medical applications. Construction of inspection equipment and sources is also offered.

NT-15889

Nuclear Systems, Inc, Gamma Industries
P O Box 2543, Baton Rouge, LA 70821; 504/383-7791
Gamma Industries serves its customers through two locations — one in Baton Rouge, Louisiana, and one in Houston, Texas. Nuclear energy (radioisotopes) provides the technology base for its products and services. Sealed radioisotope sources are manufactured and shipped to industrial customers who use them for nondestructive testing (radiography), oil well logging, industrial gaging, research, and education. Health physics instruments (survey meters, area monitors, and instrument calibrators) are designed and manufactured by gamma for customers using ionizing radiation sources. Gamma Industries also offers consulting services for developing and designing nuclear laboratories and nuclear equipment. Specialized training programs are periodically presented to professional and technical personnel who plan to use radiation and radioisotope techniques.

NT-15890

Nucleometrics, Inc
11522 W Jefferson Blvd, Culver City, CA 90230; 213/390-1657
Nucleometrics, Inc provides density gaging of agricultural products using low energy, low intensity, X-ray sources. It has developed an instrument which gages lettuce for maturity.

NT-15891

Nuclide Corporation, Nuclide Analysis Associates
642 East College Avenue, State College, PA 16801; 814/238-0541; Branches: Acton, MA
Nuclide Corporation is a major manufacturer of mass spectrometers, gas chromatograph mass spectrometer systems, mass spectrographs, mass spectrometer automation systems, and mass spectrometer components.

NT-15892

Nucor Corporation, Research Chemicals Division
P O Box 14588, Phoenix, AZ 85063; 602/936-1481
Research Chemicals produces equipment for neutron radiography. Included are gadolinium and dysprosium metal foils, gadolinium metal screens on aluminum support plates, antiscatter grids, vacuum cassettes, and metals and chemicals for absorbing radiation.

NT-15893

H.C. Nutting Company
4120 Airport Road, Cincinnati, OH 45226; 513/321-5816; Branches: Covington, KY
Geotechnical engineering services offered by the H.C. Nutting Company include test drilling, soil

mechanics laboratory, and engineering recommendations. The construction inspection services consist of quality assurance inspection of soil, concrete, steel and welding, roofing, bituminous paving, masonry, pipe, and castings. A full range of testing for construction materials is also offered. Nondestructive testing is offered in radiography (X-ray and gamma ray), ultrasonics, magnetic particle, and penetrants. The company has laboratory facilities available although it specializes in on-site testing of tanks, pressure vessels, aircraft (FAA certificate), pipe lines, structural steel, welds and welder certification. Analytical testing service is offered in water and pollution analysis spectrometric analysis, wet bench analysis, lubricating oil analysis.

NT-15894

Ohio Semitronics, Inc
1205 Chesapeake Ave, Columbus, OH 43212; 614/486-9561

Ohio Semitronics, Inc manufactures a complete line of voltage, current, watt transducers and meters. The research and development facilities include materials such as bismuth telluride, indium antimonide, indium arsenide, and associated materials. Ohio Semitronics, Inc has the facilities and equipment to manufacture custom built panels, special semiconductor materials, and power test panels. Transducers are supplied to government agencies, private industry, and testing laboratories for checking efficiencies of motors, heaters, and other electrical devices. Transducers are especially useful in monitoring, control, protection, and regulation circuits. Their fast response results in accurate power measurements even when distorted or chopped waveforms are present.

NT-15895

Oldelft Corporation of America, Commercial Department
2735 Dorr Ave, Fairfax, VA 22030; 703/573-7020; Branches: San Jose, CA

The Oldelft Corporation of America is a totally owned subsidiary of N.V. Optische Industrie, Delft, Holland. Oldelft manufactures X-ray fluoroscopic systems, delcalix, and indeca. Realtime electronic imaging systems are used in neutron radiography, gamma radiography, and low and high energy X-ray radiography. Oldelft also manufactures equipment using 100 by 100 mm film formats such as X-ray reduction copiers, photo-spot film cameras, processor/film feeders, and framing equipment. Other products include the Combilabor 16/35 mm cine processor; ODSS III scanning stereoscope for viewing stereo pairs; and Oldelft darkroom goggles for use in color film processing areas.

NT-15896

Olympus Corporation of America, Industrial Fiberoptics
2 Nevada Drive, New Hyde Park, N Y 11040; 516/488-3880

The Olympus industrial fiberscope is a flexible fiberoptic borescope which permits internal inspection of U.S. military air frames and power plants for cracks, erosion, foreign object damage, etc., without disassembly. Brilliant cold light is supplied from a 150 Watt external source. The OM 35-mm, slr cameras, slr polaroid camera, CCTV, and dual-viewing scopes can be utilized with the system. The brand new Olympus Selfoscope, a single fiber borescope, only .067 inch in diameter, is now available for quality control inspection within a very small cavity.

NT-15897

Optronics International
7 Stuart Road, Chelmsford, MA 01824; 617/256-4511

Optronics manufactures image processing equipment designed to aid NDT technicians in computer assisted image evaluation. Our scanning microdensitometer enables the technician to take advantage of pattern recognition and image enhancement techniques now in use by the space and satellite industry. Details as small as 0.0005 inch can be resolved. Film can be plotted in color or black and white from any computed data array. The entire instrument line can be interfaced to a mini-computer or magnetic tape recorder.

NT-15898

Oxy Metal Industries Corporation, Parker Division
32100 Stephenson Highway, Madison Heights, MI 48071; 313/583-9300
Parker Division of Oxy Metal Industries Corporation (OMIC), is an industrial chemical manufacturer supplying chemicals to the automotive, metal finishing, appliance, and aerospace industries. Biodegradable liquid penetrants, fluorescent and visible red, manufactured under license from Rockwell International, are supplied to the commercial and military manufacturing and repair facilities for nondestructive testing. Bio-pen penetrants feature high flash point (above 400 degrees F), low odor, brilliant indications, low dwell time, ultra low contaminants, and are approved to military specification requirements. The water washable penetrants are highly resistant to overwashing, yet wash quickly from surfaces regardless of configuration or sensitivity level used. Biodegradable penetrants are called Bio-pen, non-biodegradable penetrants are called Accupen. All penetrants are manufactured in a dedicated clean room and are certified as to contaminants and flash point by batch number to all users.

NT-15899

PCB Electronics, Inc
P O Box 33, Buffalo, N Y 14225; 716/684-0001
PCB supplies quartz transducer instrumentation for dynamic measurement of pressure, force, shock, and vibration.

NT-15900

P.X. Engineering Company, Inc, Nuclear Division
P O Box 565, Woburn, MA 01801; 617/935-6900
P.X. Engineering Company, Inc is a steel fabrication shop engaged in the design and manufacture of heavy steel structurals primarily for public utilities and petrochemical industries. Products include tanks, pressure vessels, heat exchangers, fuel racks, and other specialty weldments. Many jobs are for nuclear power plants and require welding of X-ray quality. P.X. Engineering Company, Inc has its own machine shop as well as its own radiography department and therefore requires little or no sub-contracting of orders. The radiography department does accept sub-contract work from others. A multi-building facility exists near Boston and employment is about 75 people. Both rail and water transportation is ready available. Service is offered to all of the continental United States as well as to the international market.

NT-15901

Pako Corporation
6300 Olson Memorial Highway, Golden Valley, MN 55440; 612/540-6300
The Pako Corporation manufactures an industrial X-ray film processor with several accessories.

NT-15902

Panametrics, Inc, NDT Products Division
221 Crescent St, Waltham, MA 02154; 617/899-2719
Panametrics is a manufacturer of various products in the ultrasonics field of NDT. These products can be divided into four groups: transducers — made in the U.S. by Panametrics, suitable for flaw detection, thickness gaging, research, and other applications; thickness gages — made by Panametrics, highly accurate digital thickness gages capable of making measurements in a wide variety of materials; instrumentation — made by Panametrics, suitable for both research and specialized industrial applications; flaw detectors — made in West Germany by Karl Deutsch, suitable for most portable flaw detection applications.

NT-15903

Parr Instrument Company
211-53rd Street, Moline, IL 61265; 309/762-7716
Parr Instrument Company performs hydrostatic testing on Parr Instrument Company pressure reaction vessels sold by Parr Instrument Company and for owners of Parr Instrument Company pressure reaction vessels.

NT-15904

Peabody Testing X-Ray Engineering Company
1118 Chess Drive, Foster City, CA 94404; 415/573-6000
The Peabody Testing X-Ray Engineering Company has over 30 years' experience in the performance of nondestructive examinations in labs, shops, and at field construction sites throughout the U.S. and around the world. Major projects include nuclear power plants, conventional power plants, LNG tanks, pipelines, and petroleum plants. NDE services include X- and gamma-ray radiography, magnetic particle, ultrasonics, liquid penetrant, bubble testing and mass spectrometer leak detection. Extensive experience exists in the application of these methods to welds (piping and structural), castings, forgings, bars, rods, and electronic components. NDE is performed in accordance with ASME, ANSI, ASTM, API, AWS, AMS, military and aerospace specifications and codes. NDE consulting and vendor surveillance services are provided. Training courses and certification examinations for SNT-TC-1A Levels I, II, and III are available.

NT-15905

Philips Electronic Instruments, Inc
85 McKee Drive, Mahwah, N J 07430; 201/529-3800
Philips Electronic Instruments, Inc (PEI) is part of North American Philips Corporation. It is represented in the non-destructive testing equipment market through its X-ray spectrometers, X-ray diffractometers, and accessories for these systems. PEI also offers transmission electron microscopes, scanning electron microscopes, and X-ray fluorescence systems. Closely related to the NDT field is Philips' complete line of industrial X-ray inspection equipment. Philips Electronic Instruments is represented by nationwide sales offices, service force, and dealers.

NT-15906

Phoenix Chemical Lab, Inc
3953 W Shakespeare Ave, Chicago, IL 60647; 312/772-3577
The Phoenix Chemical Lab, Inc performs research, development, and analysis in the field of fuels, lubricants, hydraulic fluids, and protective coatings.

NT-15907

Prewitt Associates, Mechanical Strain Recorder Division
1634 N Broadway, Lexington, KY 40505; 606/299-9646
Prewitt Associates is the inventor and the manufacturer of the record-a-strain, self-activated, mechanical, direct recording strain gages. Free from external (electric) power requirements, these recorders produce a permanent record of strains under most severe environmental conditions. Engineers, mechanics, as well as geophysicists use them.

NT-15908

Purex Corporation, Turco Products Division
Box 6200, M/C C-15, 24600 South Main St, Carson, CA 90749; 213/775-2111; Branches: Oakland, Lakewood, CA; Rockdale, IL; Philadelphia, PA; Cleveland, OH; Woodbridge, NJ; Tucker, GA;

Chatanooga, TN; Houston, TX; Mission, KA

The Turco Products Division of the Purex Corporation is a manufacturer and distributor of visible and fluorescent penetrant inspection products and systems for applications in aerospace, nuclear, and general industrial operations. Office and service personnel are maintained in key cities throughout the U.S., Canada, Europe, and the Far East.

NT-15909

Radiation Equipment Co, Inc, Inspection Systems Division
1495 Old Deerfield Rd, Highland Park, IL 60035; 312/831-2900

Radiation Equipment Company (REC) specializes in equipment and systems for inspection, gaging, and quality. Among the materials materials offered are radiographic supplies, lead screens, penetrameters, cassettes, magnet holders, magnifiers, complete darkroom equipment; magnetic particle powders; dye penetrants, visible and fluorescent; optical testing utilizing microscopes, metallographs, optical comparators, measuring methods to micro inch resolution; and borescopes for internal optical viewing. Facilities encompass a display room where the newest equipment is available for demonstration and trial on customer's parts, machine shop for construction of special systems as well as standard products, engineering offices, and a warehouse. REC distributes these products through local sales engineers in the Midwest area and through mail and telephone outside the Midwest.

NT-15910

Radiation Management Corporation
3508 Market St, Philadelphia, PA 19104; 215/243-2950; Branches: Washington, D C; Chicago, IL

The Radiation Management Corporation offers services involving radiation environment protection and control, health surveillance, emergency management programs, and medical assistance.

NT-15911

Ramsey Engineering Co, Texas Nuclear Division
P O Box 9267, Austin, TX 78766; 512/836-0801

Texas Nuclear provides nucleonic, noncontacting instrumentation for the process, mining, oil, gas, and power industries. Located in Central Texas, Texas Nuclear offers a Model 9200 portable metal analyzer which will directly help quality testing teams. It is especially designed and calibrated to be used in both field and laboratory NDT to accurately identify important metal alloys. Texas Nuclear goes further by offering noncontacting level and density measurement instrumentation. Noncontacting instrumentation can be applied to both quality and nondestructive testing.

NT-15912

Ranger Engineering Corporation
3132 Bryan St, Fort Worth, TX 76110; 817/921-5176

Ranger Engineering is a small company, primarily involved in the manufacturing of Mossbauer spectrometers and related instruments. The facility is equipped to handle transmission as well as backscattering samples of iron bearing material. A radioactive materials hood and counting system is available. Production facilities include a complete machine shop, electronics manufacturing and testing facility. Darkroom and printed circuit board manufacturing facilities are also available. Ranger Engineering has supplied Mossbauer spectrometers on a worldwide basis. The research facilities include a Mossbauer spectrometer, proportional and scintillation detectors, multichannel analyzer, survey meter, and ultra fast linear amplifier and single channel analyzer.

NT-15913

Reactor Experiments, Inc
963 Terminal Way, San Carlos, CA 94070; 415/592-3355
Reactor Experiments, Inc has been specializing in the development and manufacture of equipment for nuclear reactors, particle accelerators, and nuclear laboratories for 18 years. The company's scientific staff has designed and developed a number of highly original products which have been widely used in nuclear power plants, universities, and hospitals as well as industrial and government laboratories.

NT-15914

Ridge Instruments Co, Inc
4432 Bibb Blvd, Tucker, GA 30084; 404/939-1554; Branches: Oak Ridge, TN; Huntsville, AL; Panama City, FL
Ridge Instruments is a designer and manufacturer of specialty nondestructive testing systems which are designed to meet the customers' specific needs. The largest applications are in film and real-time X-ray imaging with in-motion radiography being a specialty. Large magnetic particle inspection equipment is also designed and built for both wet and dry techniques. Ultrasonic, eddy current, and dye penetrant inspection systems are also within the Ridge Instrument Company capability. Ridge Instruments also offers a unique microfocus, rod anode, X-ray system having an 18-inch rod anode only 3/8 inch in diameter. Special positioners for this equipment are also offered. Ridge Instruments has an NDT catalog covering a complete line of X-ray, ultrasonic, magnetic particle, and dye penetrant accessories.

NT-15915

Rockwell International Corp, Los Angeles Division
International Airport, Los Angeles, CA 90009; 213/670-9151
The Los Angeles Division (LAD) has investigated and developed innovative improvements in virtually every NDT discipline. Consultants are available to conduct feasibility studies, research new methods, or establish NDT system for difficult NDT problems. The program can be conducted at the LAD or the consultants can travel to the problem. Production inspection with ultrasonics, X-ray, magnetic particles, and penetrants, is available. Laboratory testing and analysis of metals, paints, and various fluids is also available.

NT-15916

Roentgen Industrial Corp
1491 Old Deerfield Rd, Highland Park, IL 60035; 312/831-2980
A series of products are offered for application in the field of X-ray examination. These products include intensifying screens, magnetic casette holders, film cassettes, safe lights, lead figures, optical measuring equipment, and penetrameters.

NT-15917

Rohrback Corporation, Magna Instruments Division
11861 E Telegraph Rd, Santa Fe Springs, CA 90670; 213/695-0421; Branches: West Germany; Schiedam, Holland
Magna Instruments designs, manufactures and sells instruments and sensors used to monitor corrosion and related effects in process and laboratory systems. The principal product lines are based on electrical resistance and linear polarization resistance techniques. Also, the manufacture and development of sensors for hydrogen embrittlement, erosion, scaling tendency, PH, cooling water quality control and similar types of devices has been accomplished. The organization operated for over two decades as the Instrument and Control Division of Magna Corporation, and was recently split off to become the nucleus of Rohrback Corporation. The company operates from a modern 23,000 square foot building near Los Angeles and sells to industry world wide.

NT-15918

St John X-Ray Laboratory
Box 192, RD No. 2, Califon, N J 07830; 201/832-2449
The St John X-Ray Laboratory, established in 1925, is the oldest industrial radiation laboratory in the U.S. Services offered include consultation, engineering, training, and expert testimony in litigation.

NT-15919

Scandpower, Inc, Fuel Technology Division
4853 Cordell Ave, Bethesda, MD 20852; 301/652-0883
Scandpower, Inc manufactures equipment which provides a measurement of the distortion of nuclear fuel rods.

NT-15920

Schonberg Radiation Corporation
2560 Wyandotte St, Mountain View, CA 94043; 415/964-6214; Branches: Seattle
The Schonberg Radiation Corporation is a distributor for NDT equipment and supplies. The equipment which is represented includes X-ray systems, Philips-Torr; ultrasonic instruments, Nortec; eddy current instruments, Nortec; penetrant, Sherwin Dubl-Chek; magnetic particles, Econospect; film and chemicals, Kodak, GAF, and DuPont; processors, Kodak, Pako; survey meters, dosimeter, Victoreen; and densitometers, X-rite, MacBeth. Miscellaneous NDT supplies offered are: magnetic powders and pastes, black lights, penetrameters, lead figures, step wedges and blocks, cassettes, lead and fluorescent screens, film hangers and dryers, film storage and darkroom cabinets, silver recovery units, densitometers. X-ray machines and other NDT instruments are also serviced. Real time X-ray viewing systems and special handling systems are built for automated NDT inspection.

NT-15921

Schumacher and Associates, Inc
Suite 120, 2550 Fair Oaks Blvd, Sacramento, CA 95825; 916/481-5362
The primary specialty of Schumacher and Associates, Inc is analytical and experimental structural mechanics. Also provided is security system design and installation for homes, businesses, institutions, nuclear power plants, and other facilities. In experimental structural mechanics, recent NDT contracts have been completed for: design, fabrication, and installation of a laser instrumentation system for measuring structural deflections of a large liquid metal primary coolant pump, execution of test, monitoring, test data reduction, analysis, and reporting; and design and installation of an instrumentation system for studying hydrodynamic effects in nuclear power plant components. The facility in Sacramento has a small lab where some NDT is performed. However, the above projects were performed on-site, away from the office. This is the case with most work in accordance with customers requirements. To date, NDT efforts have been concentrated in the Los Angeles, Sacramento, and San Francisco Bay areas. However, such testing may be performed anywhere.

NT-15922

Science Applications, Inc, Radiation Applications Division
P O Box 2351, La Jolla, CA 92038; 714/459-0211; Branches: 50 offices nationwide
Science Applications, Inc (SAI) has a large group of professionals whose specialization include experimental, theoretical, and instrumentation expertise involving atomic, nuclear, acoustical, and optical phenomena. These personnel have successfully developed techniques and instrumentation in the areas of acoustics, holography, nuclear gauging, activation analysis, thermal and cold neutron radiography, X-ray radiography, and electro-optics. The Radiation Applications Division consists of approximately 25 professional physicists and engineers, most of which have a doctorate in the nuclear field. The interests and expertise of the staff range from basic measurements of nuclear cross-section data to more applied activities such as development

of nondestructive testing instrumentation, development of 252CF-based neutron radiography equipment. Development of techniques for monitoring radiation environments, and application of neutron activation analysis to the detection of pollutants in the environment. This division has the capability to design, develop, and fabricate innovative custom instrumentation to meet the challenging needs imposed by government and industry. Examples of custom instrumentation include: the coal slurry sensor, multi-ray ablation gauge for missile re-entry vehicles, real-time X-ray imaging system, snow depth gauge, solid state photomultiplier tube, radon monitor, and real-time X-ray casting inspection system.

NT-15923

Science Applications, Inc, Nuclear Environmental Services
3 Choke Cherry Rd, Rockville, MD 20850; 301/977-4480
Tracer gases are used to leak test condensers.

NT-15924

Scientific Atlanta, Inc, New Jersey Division
Randolph Park West, Rt 10, Randolph Township, N J 07801; 201/361-3100; Branches: Atlanta, GA; England; France, Canada

The New Jersey Division's most recent efforts have been in the vibration testing field and a diversified line of vibration analyzers is now available to detect breakdown in rotating machinery before it occurs. Instrumentation for measuring torsional vibration is also available. A complete line of low frequency wave and spectrum analyzers is offered as well as component noise test sets. Also offered are instrumentation amplifiers and telecommunication test sets. Many standard options and accessories are available for the products and modifications can be made to meet a specific requirement upon request. Rental and lease purchase plans are available for standard instruments to meet customers short term requirements. An active R&D program is in effect and the engineering staff has the experience and capability to design custom equipment to fit individual user's needs. Products are developed, manufactured, and marketed from facilities in New Jersey both nationally and internationally.

NT-15925

Seifert X-Ray Corporation
P O Box 294, Fairview Village, PA 19409; 215/539-4700

Seifert X-Ray Corporation is engaged in the manufacture of industrial X-ray equipment for radiography and real time fluoroscopic inspection. An applications laboratory is available where prospective customers can forward their parts and components to evaluate the most appropriate inspection method. Two industrial lines of equipment are manufactured: one, the Eresco line of portable X-ray units, and two, the Isovolt line — a stationary constant potential unit. In addition, the company also manufactures the Iso-debyeflex line of X-ray diffraction units.

NT-15926

Shannon-Glow, Inc, Tracer-Tech Division
7356 Santa Monica Blvd, Los Angeles, CA 90046; 213/876-2660

Shannon-Glow, Inc, Tracer-Tech Division, is a specialist in luminous materials, fluorescent and phosphorescent; luminous paints, inks, dyes, stains, marking materials; inspection penetrants; leak tracers; identification and security marking inks; and measuring instruments for fluorescence.

NT-15927

Sherwin Incorporated
5007 East Washington Blvd, Los Angeles, CA 90040; 213/261-0251

A manufacturer of liquid penetrants, fluorescent and visible, the products include penetrants, emulsifiers, removers, cleaners, and developers. A complete line encompassing water-washable penetrant systems, pre-wash hydrophilic emulsifier systems, post-emulsifiable systems, and solvent removable systems is also available. The products are approved to military specifications and commercial specifications such as ASME codes. Aerospace, nuclear power, and other critical industries requirements are met. The products are available in aerosol spray cans as well as bulk such as gallon cans, pails, and drums. Sherwin Incorporated also manufactures the electro-magnetic yoke, a hand-held magnetic testing instrument for use with the magnetic particle method. Also available are dry and wet oxides, including fluorescent, for use in the process.

NT-15928

Shiron Associates, Inc, NDT Division
1205 Greeby St, Philadelphia, PA 19111; 215/533-2154

The Shiron NDT Division performs custom equipment manufacturing and consulting activities for acoustic emission and vibration monitoring systems used by government and industry. Typical equipment applications include real time, multichannel monitoring of motors, engines, bearings, and oscillating mechanical structures found in automated production and transportation environments. These monitoring systems can rapidly locate components whose acoustic emission properties have changed and thereby pinpoint structures that either have failed or are about to do so. Consulting activities are performed for all NDT techniques with special emphasis on acoustic emission and vibration analysis techniques for major components of large scale mechanical systems.

NT-15929

Society for Information Display
654 Sepulveda Blvd, Los Angeles, CA 90049; 213/472-3550

The Society for Information Display was founded in April 1963 to provide the proper environment for information exchange between individuals involved in information display technology. The Society promotes the use of information display, encouraged its advancement, maintains a library of display information, exchanges and disseminates knowledge, promulgates definitions and standards, and stimulates new ideas in information display by providing a forum.

NT-15930

Society of Photo-Optical Instrumentation Engineers (SPIE)
P O Box 10, Bellingham, WA 98225; 206/676-3290

SPIE is an independent, tax exempt, 501-C (3) organization, established in 1956 as a technical and scientific professional society. It is dedicated to advancing engineering and scientific applications of optical, electro-optical, laser, and photographic instrumentation systems and technology. Current membership is approximately 2000 physicists, engineers, and other technical persons in the U.S. and 30 foreign countries who work in the optical sciences and related fields. The national offices of SPIE at Bellingham, Washington employ approximately 25 people. Services SPIE offers to members and to the scientific and engineering community include numerous seminars and technology utilization programs on specialized topics held throughout the United States, liaison and cooperation with conferences held in Europe and the Far East, publishing of proceedings of these seminars, and publication of a bimonthly journal, Optical Engineering. Journals and proceedings are sold by subscription, by standing order, and by single orders.

NT-15931

Soiltest, Inc
2205 Lee Street, Evanston, IL 60202; 312/869-5500; Branches: Cranford, N J; Denver, CO
Soiltest, Inc, a member of the Cenco Incorporated Companies, is a supplier of equipment for quality control testing of soil, rock, concrete, asphalt, and other materials used in construction. In addition, Soiltest also supplies circular chart recorders, mobile units (truck- and trailer-mounted), vacuum valves and seals, geophysical investigation equipment, and a line of agricultural testing and handling equipment. International headquarters is in Evanston, Illinois. A sales office, training facility, and environmental research center are located at Baraboo, Wisconsin. Sales offices are located in Cranford, New Jersey and Denver, Colorado. Sales representatives handle products in all other sections of the U.S. and abroad. Soiltest Canada manufactures and sells Soiltest products in Canada. About two-thirds of total sales at this time are overseas. Soiltest customers are: contractors; public agencies responsible for construction; engineers; research personnel; teachers; agricultural organizations; mining firms; laboratory operators; manufacturers and processors of a broad range of products — building materials, textiles, food, plastics, and in fact, just about any raw or processed materials that may be subject to physical and chemical testing.

NT-15932

Soltec Corporation
11684 Pendleton St, Sun Valley, CA 91352; 213/767-0044
The Soltec Corporation offers a line of strip chart recorders, X-Y recorders, cathode ray tubes, oscillographic recorders, DOT printing recorders, and voltage-current recorders.

NT-15933

Sonic Instruments, Inc
1018 Whitehead Road Extension, Trenton, N J 08638; 609/883-5030; Branches: Somers, CT
Sonic Instruments, Inc is a manufacturer of ultrasonic instrumentation and transducers as used in the field of NDT as it applies to materials testing. Sonic's main location and manufacturing facility is located in Trenton, New Jersey, and is supplemented by numerous sales offices throughout the world to provide both industrial and private users of UT equipment with both sales and applications assistance. Sonic is active in the development of ultrasonic testing techniques. Major advancements have been realized in a wide facet of applications; examples being: Sonic's ID OD system providing complete dimensional characterization of tubular products, and most recently, the development in conjunction with E. I. DuPont DeNemours and Co, Inc of the Rota-Sonic system for both dimensional and flaw characterization of plastic tubular products.

NT-15934

Southern Research Institute, Mechanical Engineering Department
2009 9th Avenue South, Birmingham, AL 35205; 205/323-6592
The Southern Research Institute is engaged in the nondestructive characterization of aerospace materials through the use of ultrasonics, X-ray, radiometry, eddy current, porosity and visual inspection. Nondestructive monitors are related to mechanical, thermal, and physical properties to guide quality control efforts.

NT-15935

Southwest Research Institute
P O Drawer 28510, San Antonio, TX 78284; 512/684-5111; Branches: Houston, Corpus Christi, TX; Washington, D C
The Southwest Research Institute is a not-for-profit corporation having activities in applied research and development encompassing most of the basic technologies in science and engineering. The Institute has conducted programs covering a wide range of nondestructive testing disciplines. Specialized nondestructive testing equipment and instruments have been developed for a number of industrial applications. Significant work has been done to advance the state-of-the-art techniques, adaptations of conventional methods in-

corporating automation, and the detection of metal fatigue prior to failure. The nondestructive examination of nuclear power plant steam supply systems is a large activity at the Institute and is conducted on a worldwide basis. Also located at the Institute is the Nondestructive Testing Information Analysis Center (NTIAC) which is operated under contract to the Defense Logistics Agency. This Center collects and maintains a computerized information bank in the field of nondestructive testing for dissemination to both government and private requestors.

NT-15936

Spartan School of Aeronautics
8820 E Pine Street, Tulsa, OK 74151; 918/836-6886
The Spartan School of Aeronautics offers a number of courses in the field of aeronautics. One of the courses offered is nondestructive testing which provides training in the following areas to SNT-TC-1A, Level II standards: radiography, X-ray, gamma-ray; magnetic particle; penetrant testing; eddy current; and ultrasonics.

NT-15937

Spatial Data Systems, Inc
P O Box 249, Goleta, CA 93027; 805/967-2383
Spatial Data Systems manufactures image enhancement and analysis equipment. This equipment can be used to view real images, images from a microscope, or images recorded on film. The images recorded on film can be processed using either analog or digital techniques to improve the visualization of the image or to measure the optical density of the recorded image. Spatial measurement may also be made using a cursor to define points of interest. The primary fields of interest in which the equipment is being used are: (a) analysis of aircraft engine parts using X-radiography; (b) flaw detection of ordnance devices using X- and neutron radiography; (c) automatic and semi-automatic classification of cells; (d) semi-automatic classification of earth resources for land use planning; and (e) analysis of thermal imaging for power plant monitoring and heat loss in buildings.

NT-15938

Spectrum Laboratories, Inc
P O Box 565, Piscataway, N J 08854; 201/752-1400
Spectrum Laboratories, Inc is an independent organization engaged in metallurgical testing including general quality control testing, chemical analysis, physical and mechanical testing, nondestructive testing, metallurgical failure analysis, and engineering and corrosion testing.

NT-15939

Spellman High Voltage Electronics Corporation
7 Fairchild Ave, Plainview, N Y 11803; 516/822-2130
Spellman High Voltage Electronics Corporation manufactures a wide variety of high voltage power supplies, suitable for such applications as CRT displays, capacitor charging, lasers, electron microscopes, ionization chambers, corona testing, X-ray supplies, ion implantation, and electron beam accelerators. This type of equipment has been manufactured for 30 years and customers are serviced worldwide.

NT-15940

Stafco, Inc
621 S W Morrison, Portland, OR 97205; 503/227-4214; Branches: Idaho Falls, ID; Richland, WA
Stafco is a consulting firm comprised of engineers and scientists who are also skilled writers and editors. The corporate headquarters are located in Portland, Oregon, with technical subsidiaries in Portland, Idaho Falls, Idaho, and Richland, Washington. The firm's services are primarily in the areas of technical review, evaluation, and documentation in the energy and environmental fields. Emphasis is placed on helping client

firms meet various state and federal regulatory requirements for technical information. Examples of products of this service, particularly those with possible NDT association include: reliability assurance programs for a thermal power plant (coal); operating and test procedures; project management procedures to implement quality assurance programs; ANSI standard preparation; and test reports. A subscription service, designated rapid for reporting assurance program identification documents,is offered which provides detailed information concerning reporting requirements for thermal power plants. The principal clients are electric utilities, government agencies, and government contractors involved in energy research and development, nuclear fuel processing, and miscellaneous related programs.

NT-15941

Struthers Wells Corporation
Box 8, Pennsylvania Ave, Warren, PA 16365; 726-1000
Struthers Wells has a 4 mev linear accelerator and performs ultrasonic, liquid penetrant, and magnetic particle inspection but does not normally perform such inspections for other organizations.

NT-15942

Sundstrand Data Control, Inc, Instruments Division
Overlake Industrial Park, Redmond, WA 98008; 885-3711
Sundstrand Data Control Corporation, Instruments Division, is a large manufacturer of pressure, load, force, vibration, and acceleration transducers and related electronic instruments.

NT-15943

J. G. Sylvester Associates, Inc
900 Hingham St, Rockland, MA 02370; 617/878-9000; Branches: Ponce, Puerto Rico
Although the firm is fundamentally based (for over 25 years) in NDE and materials testing, methods and equipment have been developed to perform accurate code quality underwater ultrasonic inspection. The approach utilizes an equipment system named the Ultrascan III which avoids many of the problems of current practices used in underwater ultrasonic inspection. The method allows comprehensive, accurate, code quality underwater shearwave inspection of welds as well as straight beam and shearwave inspection for corrosion, general and pitting, in pipes and plates. The basis of the system is the underwater television monitor which is built into the diver's helmet. This monitor displays the cathode ray tube of the ultrasonic instrument which is located at the surface. Thus, the diver has the ability to move his transducer relative to CRT indications allowing the optimization of signals and tracking and defining defects. Another important feature of this system is the surface presentation of an underwater television camera affixed to the diver's helmet which allows the topside personnel to observe transducer placement on the workpiece. The system has been used on two different platforms in 75 feet of water. It will soon be used to inspect a natural gas pipeline; the pipe wall will be inspected for interior corrosion.

NT-15944

Systems Scientific Labs
1295 Boulevard Way, Walnut Creek, CA 94595; 415/937-6748
The Systems Scientific Laboratories, Inc offer a series of metal alloy identification kits. The kits detect alloying elements by means of chemical spot tests utilizing electrographic methods

NT-15945

TAC Technical Instrument Corp
Scotch Rd, Mercer County Airport, Trenton, N J 08628; 609/882-2894
TAC Technical Instrument Corp manufactures an extensive line of ultrasonic inspection systems primarily for pipe, tubing, and bar stock. The company also performs in-house ultrasonic inspection of these and similar materials. In addition, the company manufactures a proprietary line of sequential access memories

used to control down stream marking or sorting of inspected material on moving conveyors. Feasibility studies, design, and consulting services and operator training are provided covering applications of ultrasonics for nondestructive testing. Ultrasonically inspected pipe and tubing is employed in critical applications which include: nuclear (fuel cladding, coolant plumbing, etc); heat exchangers; chemical reactors; aircraft (fuel and hydraulic lines); submarine plumbing and other high-strength, high-reliability uses. Ultrasonically inspected bar stock is typically employed for machined, cold headed, and forged parts for applications which include turbine blades, engine valves, bearings, high-strength fasteners, etc.

NT-15946

TFI Corporation, NDT Products Division
P O Box 1611, West Haven, CT 06516; 203/934-5211; Branches: Tucker, GA

TFI Corporation is a manufacturer of X-ray equipment and systems used in nondestructive testing. In addition to its standard line of X-ray equipment, TFI will design and fabricate special purpose X-ray generators, as well as incorporate standard or custom products into complete systems, consisting of material handling and radiation protective components. TFI has extensive experience in real time X-ray imaging with image intensifiers and various equipment for image processing. TFI maintains a completely staffed and equipped applications laboratory in West Haven, Connecticut. The purpose of the laboratory is to establish radiographic and fluoroscopic techniques for prospective users of TFI equipment and demonstrate equipment or systems sensitivity capabilities on customer samples. Other investigative work may be performed on a free basis. The company will also furnish accessory items for radiography and is active in the film processor marketplace. Complete mobile radiographic laboratory trailers for field site use are also available to standard or custom specifications.

NT-15947

TGM Detectors, Inc
166 Bear Hill Rd, Waltham, MA 02154; 617/890-2090

TGM Detectors, Inc manufactures a line of Geiger Meuller tubes and ionization chambers.

NT-15948

Techalloy Company, Inc
Rt 113, Rahns, PA 19426; 215/489-7211; Branches: Union, IL; Perris, CA; City of Industry, CA

A reliable and convenient metals testing and analysis service is now being offered by Techalloy to metalworking companies, testing centers, research laboratories, and other firms requiring metals evaluation. This service involves the use of the Bausch and Lomb Optical emission quantometer, in addition to the De-Tech eddy current metals analyzer. Other highly sophisticated electronic equipment is also employed. The quantometer determines multi-element concentrations of many different metals and alloys in a matter of a minute, with a print-out record of elements and their percentages. This instrument has established a new high standard of accuracy, reliability, and speed. Other types of tests are also available such as obtaining physical, mechanical, and electrical properties of metals. As producers of wire, rod and strip in over 90 different alloys, Techalloy maintains one of the most complete assortments of testing and analysis instruments in the alloy industry as part of its rigid quality control program operating in each one of its four producing mills.

NT-15949

Tektran-NDT Products, Aircair Company Division
P O Box 406, Lancaster, OH 43130; 614/653-5618

Tektran-NDT Products is a supplier and manufacturer of ultrasonic and eddy current testing equipment for both flaw detection as well as thickness measurement. The company is a large scale producer of total turnkey ultrasonic test systems, including mechanical transportation equipment, ultrasonic instrumentation, and transducers, as well as computer interfacing for data acquisition, storage and recall. All of the logic, software, programming, etc, for computer work is performed in-house. Test systems have been supplied using 100 separate transducers/channels operating from one single instrument as well as aircraft gantry systems with eleven axes of freedom, computer controlled.

NT-15950

Telatemp Corp
P O Box 5160, Fullerton, CA 92635; 714/879-2901
The Telatemp Corporation is a manufacturer of surface thermometer devices. The product line consists of infrared thermometers, 0-2000 degrees C (various models); Telatemp temperature labels, 100-500 degrees F; and paint/crayons, 40-1350 degrees C.

NT-15951

Teledyne Engineering Services
303 Bear Hill Rd, Waltham, MA 02154; 617/890-3350; Branches: Palo Alto, CA
Teledyne Engineering Services provides engineering consultation and services, primarily in mechanical engineering, but including structural, metallurgical, civil and electrical engineering. It also provides specialized materials testing, experimental stress analysis, and nondestructive examination services. NDT services are offered in: ultrasonics, magnetic particle, and liquid penetrant. Other services are offered in: design and analysis of mechanical systems and structures; theoretical and experimental stress analysis; piping system design and analysis; design, design review, and installation management of nuclear and fossil fuel power plant modifications; technical support of codes and standards for nuclear and non-nuclear pressure vessels; failure analysis; and materials testing.

NT-15952

Teleflex, Inc, Aerospace-Nuclear Division
P O Box 218, North Wales, PA 19454; 215/699-4861; Branches: Limerick, PA; Troy, MI; Los Angeles, CA
Teleflex, Inc, Aerospace-Nuclear Division, manufactures push-pull controls for aircraft, vehicles, boats, and engines. Flux mapping systems are manufactured for nuclear reactors and related devices. Service is offered in the United States as well as internationally. In addition, Teleflex manufactures and processes sermetel coatings for aircraft turbine engines and similar applications. A specialty is the manufacture of special stranded cables and conduits. Complete NDT inspection facilities are available for flaw detection in ferromagnetic and non-magnetic materials using Zyglo penetrant inspection and magnetic particle inspection equipment with qualified personnel. Complete mechanical inspection facilities are available for measuring dimensional accuracies and surface conditions of complex castings; forgings and machined parts; and cables (stranded wire type).

NT-15953

Tenney Engineering, Inc
1090 Springfield Rd, Union, N J 07083; 201/686-7870
Tenney Engineering, Inc, is a manufacturer of environmental equipment. The company manufactures standard environmental test chambers ranging in size from 1.4 cubic feet to 64 cubic feet, and in capability from a simple, mechanically refrigerated temperature chamber to those that simulate temperature/humidity/altitude pressure/test conditions. Tenney also custom designs and manufactures a broad range of controlled environment rooms capable of simulating any combination of temperature/humidity/altitude/pressure test conditions to meet customers special testing requirements.

NT-15954

Terra-Tek, Inc
420 Wakara Way, Salt Lake City, UT 84128; 801/582-2220
Terra-Tek, Inc provides services in the United States and some foreign countries. The company offers materials testing and research, geotechnical sciences and consulting, manufacture of special testing equipment, and drilling and energy recovery research. Facilities include well-bore simulators, hydraulic testing machines, hydro-static pressure vessels, fatigue machines, and ultrasonic test equipment.

NT-15955

Testing Machines, Inc, Advanced Instrumentation Division
400 Bayview Avenue, Amityville, N Y 11701; 516/842-5400; Branches: Montreal; Carson, CA

The Lock eddytester, available from Testing Machines, Inc (TMI), is a complete nondestructive inspection system used to locate physical defects such as seams, cracks, holes, laminations, inclusions, etc. Virtually any metal of regular cross-section may be tested. Specifically designed for tube and wire testing, the eddytester utilizes an encircling coil sensor. Solid-state design allows for high production speed testing and speeds up to 2500 fpm can be accommodated. Conversely, off-line cut length piece testing is also easily implemented. Defect marking, segregation by amplitude, and automatic accept/rejection facilities are also available. Complete material conveyor systems to custom designed specifications are available for use with the eddytester.

NT-15956

Tinker and Rasor
417 Agostino Rd, San Gabriel, CA 91778; 213/287-5259

Tinker and Rasor offers an electrical holiday detector which is commonly used for inspection of brushed, sprayed or dip-applied protective coatings on electrically conductive materials. The detector uses an electrode consisting of a cellulose sponge dampened with an electrically conductive liquid such as tap water. When a holiday is encountered by the electrode, current will flow from the electrode to the base material causing an audible signal to sound.

NT-15957

Torr X-Ray Corporation
6837 Hayvenhurst Avenue, Van Nuys, CA 91406; 213/787-7420

Torr X-Ray Corporation manufactures cabinet type X-ray units operating in a range of 0-120 kvp and 0-150 kvp. 3 and 5 MA. These systems are offered in standard 24-inch or 48-inch cabinets with or without fluoroscopic capabilities. Special electronic fluoroscopy, complete systems with image intensifiers, image enhancers, and television readout are also available. These systems may be supplied in conveyorized revisions, if desired. All of these systems are offered throughout the world. Torr X-Ray Corporation is located in Van Nuys, California, and offers these products through a dealer organization. Torr X-Ray Corporation also manufactures an automatic exposure device which automatically controls the exposure parameters assuring uniform density film regardless of thickness or density of the material being radiographed.

NT-15958

Travenol Laboratories, American Instrument Company Division
8030 Georgia Avenue, Silver Spring, MD 20910; 301/589-1727; Branches: Carrollton, TX; Savage, MD

The magne-gage tester offered by the American Instrument Company, Travenol Laboratories, Inc Division, employing NBS certified standards is used to nondestructively measure (a) non-magnetic coatings on steel or iron base metal, in four ranges of thickness, (b) electro-plated nickel on steel or iron in two ranges, (c) electro-plated nickel on non-magnetic basis material in one range, (d) delta-ferrite (2 to 28 fn) in austenitic weld metal, and (e) delta-ferrite (2 to 28 fn) in stainless steel castings.

NT-15959

Trodyne Corporation
900 Corporate Drive, Mahwah, N J 07430; 201/529-1800

NT-15960

Twin City Testing Corp
P O Box 552, North Tonawanda, N Y 14120; 716/693-6303
The Twin City Testing Corporation specializes in the manufacture of nondestructive coating thickness measuring devices. According to the system to be measured, different physical principles are used: beta backscatter and/or transmission, eddy current, and magnetic reluctance.

NT-15961

URS — John A. Blume and Associates, Engineers, San Francisco, California Division
130 Jessie Street, San Francisco, CA 04105; 415/397-2525
URS/Blume is dedicated to meeting client needs in a responsive and professional manner. The staff of civil and structural engineers and professionals in geology, architecture, and computer technology offers services in its areas of expertise. These areas include civil and structural engineering design, architect-engineer services, earthquake engineering and risk analysis, marine engineering, engineering services for the nuclear industry, earth-sciences, research, and construction management. In the application of structural dynamics in analysis and design procedures, URS/Blume has developed nondestructive procedures for determinations of structural properties. Nondestructive evaluation capability has been employed on nuclear power plants, hospitals, and institutional buildings. Techniques have ranged from visual inspection through indirect measurements of properties. Part of the research efforts have been in conducting structural response investigations for the Nevada operations office of the U.S. Department of Energy. URS/Blume has participated in prediction measurement, and analysis of the response of low- and high-rise structures to ground motion generated by underground nuclear explosions at the Nevada Test Site and in natural hazards evaluation for DOE involving full-scale measurement of wind effects on high-rise structures. Additionally, URS/Blume identified the applicability of nondestructive testing techniques to the inspection of structures, utilities, and equipment under the cognizance of the Naval Shore Establishment. URS/Blume is a California based firm with affiliates throughout the U.S. Services are available in any location in the United States, particularly in California.

NT-15962

Ultra-Violet Products, Inc
5100 Walnut Grove Ave, San Gabriel, CA 91778; 213/285-3123; Branches: Maryland, MI
Ultra-Violet Products, Inc manufactures a complete line of ultraviolet light sources and equipment for fluorescent inspection techniques such as magnetic particle inspection.

NT-15963

Unit Process Assemblies, Inc
60 Oak Drive, Syosset, N Y 11791; 516/364-1080

NT-15964

United States Testing Co, Inc
1415 Park Ave, Hoboken, N J 07030; 201/792-2400; Branches: Reading, PA
United States Testing Company's activities in the nondestructive testing community consists of providing inspection and testing services, including ultrasonic, radiography, magnetic particle, liquid penetrant, and eddy current. Coverage is basically in the northeastern region of the United States, with field installation at major nuclear power generating stations throughout the U.S.

NT-15965

Unitek Corporation, Equipment Division
1820 South Myrtle Ave, Monrovia, CA 91016; 213/358-0123
Unitek manufactures precision resistance welding equipment, precision 1200 degree C furnaces, and pull testing equipment (both destructive and nondestructive). Pull test equipment ranges from 10 grams to 100 pounds maximum.

NT-15966

Unitron Instruments, Inc, Ehrenreich Photo-Optical Industries, Inc
101 Crossways Park West, Woodbury, NY 11797; 516/364-8046
A full line of microscopes, metallographs, telescopes, and related optical products is manufactured and marketed, by Unitron Instruments, Inc.

NT-15967

Universal Technical Equipment, Inc
P O Box 372, Collingdale, PA 19023; 215/586-3070; Branches: Glenolden, PA
Universal Technical Equipment, Inc represents leading manufacturers of materials and equipment used for X-ray, magnetic particle, liquid penetrant, and leak detection. Related items are also imported.

NT-15968

Universal Technical Testing Labs, Inc
P O Box 372, Collingdale, PA 19023; 215/586-3070
Universal Technical Testing Labs, Inc, founded in 1950, is a full service laboratory specializing in X-ray, gamma ray, ultrasonics, liquid penetrant and magnetic particle inspection. The 6000-sq ft facility includes four exposure rooms. A fleet of mobile units handle field site operations. Personnel have all NDT qualifications, including Navy nuclear and ASME. Physical testing, research, and development, consulting, and training are also performed.

NT-15969

Uresco, Inc
10603 Midway Ave, Cerritos, CA 90701; 213/773-3828
Uresco manufactures magnetic particle, liquid penetrant, and ultrasonic testing systems and supplies. Uresco distributes Pantak and scanray X-ray systems and equipment. In Southern California, a complete line of X-ray film and supplies, as well as other nondestructive testing apparatus is distributed. The principal office and plant has over 20,000 square feet of space. Engineering and assembly operations are carried on there.

NT-15970

Validyne Engineering Corporation
19414 Londelius St, Northridge, CA 91324; 213/886-8488
The Validyne Engineering Corporation supplies electronic instrumentation and transducers. The product line includes pressure transducers, carrier demodulators, digital manometers, digital barometers, digital pressure transfer standards, and multi-channel modular signal conditioning systems.

NT-15971

Veeco Instruments, Inc
Terminal Drive, Plainview, N Y 11803; 516/681-8300
The Veeco Instrument Corporation markets a helium mass spectrometer leak detector. This instrument is used to detect small leaks employing helium tracer gas. The electronic component industry uses the helium mass spectrometer.

NT-15972

Vibra-Metrics, Inc, Vibration Measurement and Control Equipment Division
150 Bradley Street, East Haven, CT 06512
Vibra-Metrics is a manufacturer of vibration transducers of the piezoelectric type and the electromagnetic type for conversion of motion into an electrical signal proportional to cyclic velocity, acceleration, or displacement. Associated electronic instrumentation to read out, monitor, alarm and analyze for predictive maintenance, quality assurance, safety and structural analysis is also offered.

NT-15973

Viking Laboratories, Inc
440 Bernardo Ave, Mountain View, CA 94043; 415/969-5500
Viking Laboratories, Inc provides complete product reliability and evaluation test services to the military, industrial, and commercial markets. These services provide a full range of physical environments (climatic and dynamic), electrical components (active, passive and black box hardware), and metrology (calibration and repair of electronic and electromechanical equipment with NBS traceability).

NT-15974

Vishay Intertechnology, Inc, Photoelastic Division, Measurements Group
67 Lincoln Highway, Malvern, PA 19355; 215/644-4587
The Vishay Intertechnology Corporation, Photoelastic Division, Measurements Group provides specialized instrumentation for measuring strain/stresses. Reflection, and transmission polariscopes, photoelastic equipment, materials and supplies are offered.

NT-15975

Voland Corporation
27 Centre Avenue, New Rochelle, N Y 10802; 914/636-2014
The Voland Corporation is the manufacturer of high precision, mass measuring equipment which is also used for hydrostatic density measurement.

NT-15976

Volumetrics
1025 West Arbor Vitae, Inglewood, CA 90301; 213/641-3747
Volumetrics offers instruments for leak rate measurements of valves, seals, and vessels using both the volumetric replacement method and flow rate measurements.

NT-15977

Walker Scientific, Inc
17 Rockdale St, Worcester, MA 01606; 617/852-3674
Walker Scientific, Inc is part of the Walker Magnetic Group which has been in magnetics since the late 1800's. This long dedication to the science of magnetics has led to the development of two product lines which have been instrumental in advancing the state of the art in this field; Walker/Magnemetrics magnetic measuring instrumentation and Walker/Magnion laboratory magnet systems. Together these products have made Walker Scientific, Inc a leader in magnetic systems and instrumentation throughout the world.

NT-15978

Williamson Corporation
1152 Main st, Concord, MA 01775; 617/369-9607
Williamson Corporation manufactures noncontact temperature measuring instruments and control systems ranging from portable instruments for general troubleshooting to complete on-line temperature monitoring and control systems. Typical industrial users include plastics, glass, paper, textile, steel, chemical, petrochemical, metal, research, and development. This equipment is sold all over the world.

NT-15979

Winton Products Co, Inc
P O Box 3332, Charlotte, N C 28203; 704/399-5151
The Winton Products Co, Inc is a manufacturer of chemical leak detection fluids and application equipment for all pressurized systems such as air, natural gas, LP gas, bulk plants, tanks, hydraulic systems, ship hulls, barge hulls, pipelines, etc. Pure oxygen systems such as are used in hospitals, aircraft, aerospace, nuclear, etc, may also be leak tested with Winton products.

NT-15980

Worthington Pump Corporation, Engineered Pump Division
Box 16, Harrison, N J 07029; 201/484-1234
The Worthington Pump Corporation, Engineered Pump Division, provides RT, UT, MT, PT, and leak test services on nuclear castings, forgings, bars, plate, and steel weldments for customers. NDE for pump materials and rotation equipment is a specialty. Also provided is ASME N stamp equipment and military equipment per MIL-I-45208.

NT-15981

Xmas, Inc
8186 East 44th St, Tulsa, OK 74145; 918/663-4555
Xmas is a manufacturer of portable, gas-insulated, lightweight X-ray machines from 75kV to 300kV, 3MA. A specialty is manufacture of X-radiography products for pipelines and the oil and gas industry. Xmas serves all of the United States and many foreign markets.

NT-15982

X-Ray Industrial Distributors
P O Box 1015, Clifton, N J 07014; 201/773-9400; Branches: Philadelphia
X-Ray Industrial Distributors is both a distributor of industrial radiographic equipment and supplies as well as a designer and manufacturer of radiographic systems. Distribution and manufacturing is conducted from facilities in Clifton, New Jersey. The office portion is approximately 1200 sq ft with a warehouse and manufacturing facility of 8000 sq ft. A complete NDT laboratory and darkroom is available for inspecting prospective materials. Sales are throughout the United States as well as international. Of special interest is the laboratory/production cabinet X-ray inspection systems incorporating X-ray from 50kV to 430 kV, with image intensification (three field), amplification, edge enhancement, digital storage (mini-computer), VTR, and conveyor operation for production examination.

NT-15983

X-Ray Products Corporation
7829 Industry Avenue, Pico Rivera, CA 90660; 213/723-0741
X-Ray Products started business in 1939 primarily in the manufacture of medical X-ray equipment. The XRP lab division performs nondestructive testing primarily for industry in Southern California but does receive parts and components from the entire USA. The lab is contained in 35,000 square feet of buildings

with 20 X-ray machines from 50 kvp to 1 mev along with other NDT and destructive testing equipment and processes. XRP also has on-site capabilities using X- and gamma radiation equipment along with UT, PT, and MT capabilities. This division also performs as an applications lab for the NDT apparatus and supply sales division.

NT-15984

X-Ray Products Corporation, NDT Apparatus and Supply Sales Division
7825 Industry Avenue, Pico Rivera, CA 90660; 213/723-0741

The NDT Apparatus and Supply Sales Division of X-ray Products Corporation is a wholesale and retail outlet for various X-ray machines, equipment, and accessories as manufactured by its affiliate, Schneeman Electronics, Inc. It is also the importer/distributor of the Seifert line of industrial X-ray equipment as manufactured by Rich Seifert and Co of West Germany. With its branch office in Portland, Oregon, it has dealerships for all major brands of X-ray films and chemicals as well as ultrasonic equipment, penetrant chemicals and all manner of other supply and accessory items for industry. X-Ray cabinet systems including real-time imaging and material handling systems are installed throughout the United States with primary activities in the eleven western states.

NT-15985

Xetex, Inc
1486 Oddstad Drive, Redwood City, CA 94063; 415/366-8401

Xetex, founded in 1969, was the first company specializing in the commercial application of scintillation scanning (scintillography). Since the introduction in early 1970 of the Scintaflex system, the company has developed a variety of custom systems for specific applications. The automatic density scanner, is a typical example of these systems. This unit automatically scans a large carbon billet over its full length in four angular positions. A 12 CI CS-137 source in a completely shielded and interlocked enclosure is used. Density is determined to a two sigma accuracy of 0.25 percent every quarter of an inch. Data are simultaneously digitized for computer entry and display on a strip chart recorder. In addition to NDT products, the company has also pioneered a line of portable digital radiation monitors. These units provide direct digital display of radiation dose or dose rate, eliminating the confusion and uncertainty often caused by meters and meter multipliers. Because of the extensive use of integrated circuits, these devices are small and consume little power making them especially suitable for difficult field assignments. Xetex plans to continue its strong product development program in these and related areas and to expand its capability for handling systems development.

NT-15986

Carl Zeiss, Inc
444 Fifth Ave, New York, N Y 10018; 212/730-4400; Branches: Atlanta, Boston, Chicago, Columbus, Houston, Los Angeles, San Francisco, Washington, D C

Carl Zeiss is a subsidiary of Carl Zeiss of West Germany, and the sole distributor in the U.S. of its precision-optical products such as: light and electron microscopes for routine examinations and research; surgical microscopes and opthalmic equipment; analytical and precision measuring instruments; photogrammetric and geodetic equipment; special and industrial optics, lenses; planetaria; binoculars. The company has 9 regional and branch offices and a network of dealers throughout the U.S.

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