In The News

NEW ASM International Electronic Media

Training Library on CD-ROM

To better serve the materials and metals community's training needs, ASM International has created a training CD-ROM that covers basic metallurgy, heat treating, materials engineering/science, mechanical working/forming/joining, nonferrous metals, and testing & inspections/quality control.

Anyone who needs to learn more about manufacturing metal parts, or related process or testing, can benefit from the **Training Library on CD-ROM.** The Training Library on CD-ROM contains 25 home study courses totaling 298 individual lessons from ASM's Materials Engineering Institute. A test is included at the end of each lesson so users may gauge their knowledge of the lesson. Training staff with the Training Library on CD-ROM allows for maximum flexibility," said Bob Uhl, ASM's director of new product development. "Users can adapt the lessons to their needs because of the 'mix and match' capabilities of the CD. The CD can also be used in order to satisfy specific training needs in the company or provide broad, ongoing sequential training all on-site."

Users will be able to access information on the CD specific to their interest. For example, if a user wants to review all of the lessons covering "steel," they may search by key-word to find all of the lessons relating to that topic. Copies of the lessons may be printed and distributed as needed to a company's employees. The CD also provides additional resources for users to access for more information. Listings of reference books and seminars allow users to discover the other formats available to receive clarification or additional information on a topic.

The Training Library on CD-ROM is available through a yearly site license to assure companies unlimited usage for the duration of the year. The cost of the license will depend on the size of the company: (i) 0-99 employees—$750/ per year, (ii) 100-249 employees—$1,500/ per year, and (iii) 249+ employees- $2,500/ per year. Through ASM headquarters, users may also earn Continuing Education Units (CEU). The accreditation service includes grading of each lesson test, final course examination, and a certificate of achievement. Permanent records for transcripts purposes are also maintained as part of this service.

To order the Training Library on CD-ROM preview CD ($10 credited toward purchase) contact ASM's Member Service Center, ASM International, Materials Park, Ohio 44073-0002. Tel: (800) 336-5152, ext. 300. Fax: (216) 338-4634. E-mail: mem-serv@po.asm-intl.org.

CD-ROM of Binary Alloy Phase Diagrams

A new CD-ROM from ASM International provides metallurgists and materials scientists a better way to find and use binary alloy phase diagrams. **Binary Alloy Phase Diagrams plus Updates on CD-ROM** allows users to search by keying in specific alloys, to print diagrams as needed, to view original assessed diagrams against the updated diagrams, to zoom in on specific parts of a diagram without losing quality, to search for intermetallic compounds with equivalent structure type and immediately access the system diagram and text.

This CD-ROM includes the data from the three-volume, 3600-page *Binary Alloy Phase Diagram, Second Edition* (4700 diagrams, abstracts of phase diagram evaluations for 3000 binary alloy systems, and special points and crystal structure tables), the updated data from the *Binary Alloy Phase Diagram Updating Service* (300 updates published in a loose-leaf binder), and the Journal of Phase Equilibria up to the end of 1994. Binary Alloy Phase Diagrams plus Updates on CD-ROM is available on a site license basis and previous buyers of the print version will receive a discount on the cost of the CD. Periodic updates with the most current data are planned. For a demo disk, contact ASM International, Member Services Center. Order #7756NR.

AccessASM Online

Welcome to ***Access*ASM** Online. Now it is possible to log on to the ASM International electronic bulletin board service. *Access*ASM makes available the latest society news, calendars for the latest events, detailed information about member benefits, the ability to search databases on specific topics, opportunities to network via member forums on specific interests, e-mail capability, and more.

When you're online with *Access*ASM, you'll see the Main Menu. From this menu, you can enter a number of different areas. Here's a brief summary of what each area offers.

- **What's New At ASM** is just that—the latest news and information on society events, products, services, and member events, as well as chapter news and calendars, too. If it's new and notable at ASM, you'll find it here.
- **All About ASM & How To Join** is a complete overview of the society, its members, the services and benefits it offers, and how to become a member.
- **Career/Employment Services** brings you in touch with the ASM ResumeLink service, and more. You'll find information on positions open and wanted, resumes, employment opportunities, job search and career strategies—everything you need to get a job and keep your career on track.
- **Discussion Forums** are where users can post and read comments on general

topics, or topics of specific interest. Included are individual forums for all of ASM's Affiliate Societies, like the ASM Heat Treating Society, the ASM Thermal Spray Society, and the International Metallographic Society.

- **Products & Services Database** is your complete link to every product and service offered by ASM. This area can be searched by topic to find everything available on a specific subject of interest.

- **Electronic Mail** gives you an easy way to communicate with anyone else on the BBS. Send and receive, share files and information. It's quick and easy.

- **Send/Receive Files** is your way to download and upload information to and from any database or area on *Access*ASM. Save articles, files you've researched, mail you've received, or send similar information out.

- **User Registry and Directory** lists everyone that's on-line with *Access*ASM, and may eventually provide a complete directory of ASM members around the world.

- **Polls and Surveys** helps us get constant feedback from you on this service, as well as other aspects of ASM. It's your opportunity to provide input on the issues and topics that matter to you most.

- **Help** is the area to go to with any questions or problems you have in using *Access*ASM. For more information, see the box titled "Need Some Help?" below.

Logging On Is Easy! Before you use *Access*ASM, the software needs to be up and running. Dial (216) 338-5140 with your modem, or you can telnet to bbs.ASM-Intl.org. To receive technical support by phone contact the *Access*ASM Online staff by calling (800) 336-5152, ext. 575.

New Literature/Data

Sixth Edition of *Steel Castings Handbook*

The ***Steel Castings Handbook*** is an authoritative source of information on the properties, applications, selection, design, and properties of these important engineering materials. Published by ASM International and the Steel Founders' Society of America, the completely revised and updated Steel Castings Handbook, sixth edition, features new coverage of rapid prototyping techniques and advanced molding methods, and the latest information about U.S. and international standards.

Volume editors of the 500-page handbook, **Malcolm Blair** and **Thomas L. Stevens,** have included major sections covering design of castings; manufacturing of castings, including casting and molding processes, heat treatment, and quality control; and materials selection including mechanical, chemical, and physical properties, and processing characteristics. The volume also features numerous appendices of useful engineering data, a comprehensive glossary of foundry terms, and an index.

This volume will be of value to materials engineers, product designers, purchasing agents, and engineering students—or anyone who must specify, design, work with, or understand the capabilities of cast steel components. To order the *Steel Castings Handbook, Sixth Edition,* (ISBN: 0-87170-556-7), contact the ASM Member Services Center, Materials Park, OH 44073-0002; Tel: 800/336-5152; fax: 216/338-4634. E-mail: mem-serv@po.asm-intl.org Order #6520NR.

Guide to ASM Training Available

ASM International has provided training solutions to the metals and materials community through the Materials Engineering Institute (MEI). Now, ASM has compiled all of its MEI programs in a fast-reference training resource guide, "**Training: Making a Difference.**" "This guide will enable you to match the right training program to the specific training needs of an individual, a shift, a department, or a plant," said Peg Weir, ASM director of education.

According to Ms. Weir, the new brochure will combine the best of many smaller ASM brochures on the subject of training. "Managers responsible for training tell us they want to know the totality of what we offer on subjects like 'failure analysis' or 'heat treating,' and are not as concerned with the way the training is delivered," she said. "Rather than receive 15 different catalogs and mailings, they would rather choose the course and the format that's right for them from a single guide."

The new brochure is divided into subject areas of primary importance to most people in the materials and metals industries, including heat treating; metallurgy (ferrous and nonferrous); corrosion/electrochemistry of metals; mechanical working, forming, welding, joining of metals; materials testing, characterization, quality control; failure analysis; and management. To make the guide easier to use, each course description is coded by the training's delivery method. "Individual training" is available through seminars and self-paced study, and "group training" is available through print study, video, customized, and CD-ROM. Graphic icons quickly enable the user to assess the options available for each subject.

In addition, each course is rated according to job level—shop floor, technician, engineer, management and nontechnical. For a free copy of the 1996 ASM Training Resource Guide, contact the ASM Member Services Center.

Alloy Digest

Alloy Digest, one of industry's leading sources for materials property data on worldwide metals and alloys, will be published by ASM International starting in 1996. Published since 1952, *Alloy Digest* is available as a set of 12 loose-leaf bound notebooks containing a total of more than 3500 data sheets. Annual subscribers receive an additional eight data sheets every month.

"It's a 'natural' for ASM to publish," said ASM Technical Director William W. Scott, Jr. "This new relationship is in direct alignment with ASM's strategy: to continue to be the world's leading information resource on materials engineering. In addition, we're pleased to be able to offer this publication at a special discount to ASM members." "ASM is the

ideal publisher for *Alloy Digest*," added **Dennis W. Rahoi**, editor. "We're pleased to be working with ASM, and look forward to continuing our tradition of technical excellence."

Through data sheets containing graphs, charts, and tables, *Alloy Digest* provides information on composition or characterization, physical and mechanical properties, heat treatment, machinability, workability (or castability for castings and processability for nonmetallics), joinability, corrosion resistance, cleaning and pickling, specification equivalents, general characteristics, forms available, and applications, as well as on manufacturers and distributors. According to Rahoi, the digest's comprehensive cross-referencing makes it an indispensable tool for those who know only a trade name or other designation, and wish to find out more about the properties or suppliers of a particular material.

"Down the road, we will explore the possibility of reformatting *Alloy Digest* as a CD-ROM with quick searching capability," said Fran Cverna, manager for ASM's Center for Materials Data (CMD). "Through electronic media like CD, we feel we can broaden the publication's usefulness, while meeting the changing needs of ASM members and other users." Information on annual subscriptions, as well as a complete 12-volume set containing data sheets from September 1952 to the present, can be obtained by contacting the ASM Member Services Center.

ASM's *Engineered Materials Handbook*

Engineered Materials Handbook, Desk Edition, probably the most comprehensive single volume on the most important nonmetallic materials in use today, is now available from ASM International. This 1000-page handbook contains a wealth of information on the basic nonmetallic structural engineering materials—plastics, composites, ceramics, and glasses. Data has been included on properties, selection, applications, and testing. All of it has been peer-reviewed and synthesized to focus on the most pertinent points.

Based on ASM's four-volume ***Engineered Materials Handbook*** series, this book contains substantial new information. The "Guide to Materials Selection" gives comparative data about the characteristics and advantages/disadvantages of these materials. There are also new sections on recycling plastics, metallizing of plastics, recycling and environmental impact of ceramics, and ceramic-matrix composites.

Contents include: General Information; Introduction to Polymeric Materials; Properties and Characteristics of Engineering Plastics and Elastomers; Processing and Fabrication of Engineering Plastics and Elastomers; Testing of Polymeric Materials; Polymer-Matrix Composites; Adhesives and Sealants; Introduction to Ceramics and Glasses; Applications/Processing/Characterization of Ceramics; Advanced Ceramics; Ceramic-Matrix Composites; Glasses; Appendix: Carbon-Carbon Composites; and an Index.

The editor, **Dr. Michelle Gauthier,** works for the Raytheon Company in their Missile Systems Division. She is also a member of the ASM Handbook Committee. To order the *Engineered Materials Handbook, Desk Edition,* (ISBN: 0-87170-283-5), contact ASM International, Member Services Center; Order number #6560NR.

Advanced Materials in the Marketplace

ISBN: 0-901716-92-8, Pub. 1995, 198 pages, $110.00, Cloth. This volume, edited by **J.E. Castle** and **M.J. Kelly,** contains the proceedings of a symposium held at the University of Surrey in September 1994, n nthony Kelly's retirement as V... ...cellor.

Advanced Materials in the Marketplace brings together the viewpoints of top researchers, producers, visionaries, and all those who tailor materials to today's needs. From academic goals in the attainment of specific properties to pragmatic goals in the manufacture of products, this book addresses the most important issues in materials today.

Contents: Editors' Foreword; Foreword; Introduction and Background; The New Materials/Market Development Cycle: A Perspective on the Historical Changes; Research Priorities for Thermostructural Ceramics and Ceramic: Composites; Dual-Use Structural Materials; Carbon Fibre: A European View of the Applications; The Power of New Materials; High-Temperature Materials for Gas Turbines—Technology by Design; Developing Composites for Market Needs; The Implementation of Composite Materials Technology in an Engineering Environment; Picking Winners from New Concepts in Advanced Materials; The New Industrial Ecology; A "Wish List" for New Materials; Research and Marketing: The Essential Interface; Foresight in the Materials Sector; Final Word: Materials and Measurement; List of Publications; List of Contribution; and a Subject Index.

Published by The Institute of Materials, distributed by Ashgate Publishing Company, Old Post Road, Brookfield, VT 05036-9704. Tel: (800) 535-9544, (802) 276-3162; fax: (802) 276-3837; E-mail: AshgatePub@aol.com.

A Guide to Surface Engineering Terminology

A Guide to Surface Engineering Terminology, (General Editor: **Eugeniusz Tyrkiel;** Consulting Editor: **Peter Dearnley**), published by the Institute of Materials in association with the International Federation of Heat Treatment and Surface Engineering (IFHT), is designed to cut through the confusion created by the plethora of terms generated by rapid changes and developments in surface engineering. Extensively illustrated with line, halftone, and color figures, the guide is more than a collection of definitions.

The many terms solicited from academic and industrial experts throughout the world, on the initiative of the Terminology committee of IFHT, have been augmented, expanded to provide more technical detail, and, where appropriate, provided with reference citations and examples of practical applications. In encapsulating in an authoritative manner the current state of an important discipline, *A Guide to Surface Engineering Terminology* is an informative and rapid reference source of value to expert and non-experts alike.

ISBN: 0-901716-64-2, Pub. 1995, 173 pages, 35 diagrams, 21 b/w & color photos, $80.00, Cloth. Distributed by Ashgate Publishing Company.

High Temperature Materials Chemistry

This book, edited by **B.C.H. Steele,** contains the proceedings of the Symposium held at Imperial College in October 1993 to celebrate to 70th birthday of

Professor Charles Benjamin Alcock, a recognized authority on the thermodynamics and kinetics of high temperature materials chemistry. The 20 papers included in the volume, including contributions by Alcock himself, represent the work of dozens of scientists in this field.

Selected contents: Charles Benjamin Alcock; Solutions in Progress; "T-Jump" Experiments for Determining High Temperature Transport Properties of YBCO; The Phase Transformation in β-$(Bi_2O_3)1-x(SrO)x$; Gas-Solid Electrolyte Interactions for Chemical Sensing; Miniaturised Sulphur Oxide Integrated Sensor; Developments in Solid Electrolyte Sensors for On-Line Measurements; Investigations in Dispersed Phase Systems; Hot Corrosion of Coatings for Superalloys; Thermodynamic Calculations for the Growth of Alumina by Direct Melt Oxidation; Activity Coefficients of Oxygen in Liquid Antimony, Tellurium and Antimony-Tellurium Alloys; Control of Inclusions in Steel; Surface and Interfacial Tension Studies in the Mette/Slag Systems; Physical Property Measurements for Melts at High Temperatures; and Plasma Enhanced Reactions.

ISBN: 0-901716-55-3, Pub. 1995, 274 pages, $120.00, Cloth. Distributed by Ashgate Publishing Company.

Surface Modification Technologies VII

Surface Modification Technologies VII, edited by **T.S. Sudarshan, K. Ishizaki, M. Takata,** and **K. Kamata,** contains the proceedings of the Seventh International Conference on Surface Modification Technologies held in Japan in 1993. It is devoted to increasing the awareness in the practical applications of surface modifications technologies and their integration into manufacturing in various types of industries. The 73 papers given represent the broad nature of the subject and emphasize the need for developing interactive approaches that could lead to practical application of processing technologies.

ISBN: 0-901716-60-X, Pub. 1994, 992 pages, $220.00, Cloth. Distributed by Ashgate Publishing Company.

Surface Modification Technologies VIII

This volume, edited by **T.S. Sudarshan** and **M. Jeandin**, contains the proceedings of the Eighth International Conference on Surface Modification Technologies, held in September 1994 in Nice. The meeting was co-sponsored by the National Science Foundation in the U.S. The conference was attended by scientists, engineers, and businessmen, allowing for a good blend of academic and practical discussion. The 102 papers given represent the broad nature of the subject.

ISBN: 0-901716-69-3, Pub. 1995, 976 pages, $200.00, Cloth. Distributed by Ashgate Publishing Company.

Testing and Research in High Temperature Corrosion

The great need for testing in the field of high temperature oxidation and corrosion is obvious, but there are as yet no standards or even guidelines for material testing for high temperature corrosion. This volume, edited by **H.J. Grabke** and **D.B. Meadowcroft,** presents research and advice from European experts on developing guidelines and standards for high temperature corrosion research and testing.

Guidelines for Methods of Testing and Research in High Temperature Corrosion is based on eleven presentations from a European Federation of Corrosion workshop in Frankfurt in January 1994. The guidelines are intended to help people in this field to avoid mistakes and to obtain reliable relevant data. Scientists and engineers concerned with the problems of high temperature corrosion will be grateful for the efforts made by the authors of this book.

Selected contents: Guidelines for Plant Measurements of High Temperature Corrosion; *In Situ* Measurement Techniques; Thermogravimetry; Definition and Preparation of Gas Atmospheres; Corrosion in the Presence of Melts and Solids; Corrosion and Wear or Erosion; Oxidation/Corrosion of Advanced Ceramics: Surface Microsurgery Preparation Procedures for High Temperature Corrosion Characterisation; and The Application of Surface Analysis Techniques in High Temperature Corrosion Research.

ISBN: 0-901716-78-2, Pub. 1995, 224 pages, $80.00, Cloth. European Federation of Corrosion Publications No. 14. Distributed by Ashgate Publishing Company.

An Introduction to Metallurgy, Second Edition

This classic textbook by **Sir Alan Cottrell** has been reprinted by The Institute of Materials to provide undergraduates with a broad overview of metallurgy from atomic theory, thermodynamics, reaction kinetics, and crystal physics to elasticity and plasticity.

Contents: Preface; Prologue; The Atomic Nucleus; Atomic Structure; Chemical Bonding; Heat and Energy; Entropy and Free Energy; Free Energies of Metallic Compounds; Extraction of Metals; Electrochemical Extraction and Refining Processes; Extraction of Reactive and Refractory Metals; Iron and Steel Making; Kinetics of Metallurgical Reactions; Solids, Liquids and Solidification; Alloys; The Phase Diagram; Ternary Phase Diagrams; Metal Crystals—Periodicity; Metal Crystals—II Directionality; Metal Crystals—III Energies and Processes; Heat-Treatment of Alloys; Mechanical Properties; Plastic Working; Oxidation and Corrosion; Electronic Structure and Properties; Properties and Uses; and an Index.

Reviews of the First Edition: "This book forms a comprehensive survey of metallurgical knowledge, covering all aspects of metallurgical science and technology. There is little which has escaped mention and with the aid of a good index it is possible to read up any topic easily." "This book is more than an excellent introduction to metallurgy for undergraduates, for it reaffirms in a very positive manner that metallurgy is a discipline worth pursuing in its own right."

ISBN: 0-901716-93-6, Pub. 1995, 548 pages, $25.00, Paper. Distributed by Ashgate Publishing Company.

Window on World Manufacturing Research

A ***Window on World Manufacturing Research*** is designed to keep manufacturing, university, and research professionals informed about the latest trends in the manufacturing science and technology research fields. *Window on World Manufacturing Research,* published in two volumes annually, summarizes and evaluates the findings from the world's leading-edge research in manufacturing. **Dr. M.E. Merchant** has evaluated the findings of cooperative research activities, international confer-

ences, and seminars sponsored by CIRP (the International Institution for Production Engineering Research). Dr. Merchant also includes other related international conferences on manufacturing.

This book provides a global perspective on research in manufacturing and helps professionals overcome the difficulty of keeping informed on new technologies and manufacturing techniques emerging in the world's industrialized countries. By joining the Window on World Manufacturing Research program, you will receive two reports per year from Dr. Merchant based on his personal attendance at CIRP's international meetings and other international conferences. The annual fee for the 1995 service is $295, or $275 for Institute members.

REPORT 1: Third Quarter 1995 incorporates:

- CIRP's 25-27 January1995 Scientific Technical Committee Meetings on Optimization, Design, Machines, and Assembly in Paris, France.
- The 27th CIRP International Seminar on Manufacturing Systems held in Ann Arbor, MI on 21-23 May 1995.
- The 5th International Conference on Flexible Automation and Intelligent Manufacturing in Stuttgart, Germany on 28-30 June 1995.

REPORT 2: Fourth Quarter 1995 incorporates:

- The 45th CIRP General Assembly held in Enschede, The Netherlands on 20-26 August 1995.
- The 4th International Conference on Monitoring and Automatic Supervision in Manufacturing held in Warsaw, Poland on 28-29 August 1995.

Contact: Institute of Advanced Manufacturing Science, Inc., An Edison Technology Center, 1111 Edison Drive, Cincinnati, Ohio 45216-2265. Tel: (513) 948-2000; fax: (513) 948-2109.

News from Industry

General Magnaplate—Cited by Guinness

Charles Covino—the inventor of HI-T-LUBE—has known all along; HI-T-LUBE is about as slippery as anything can get! General Magnaplate is the creator and manufacturer of a wide variety of "synergistic" coatings for the aerospace, defense, and many civilian industries. It is traded on NASDAQ under the symbol "GMCC."

HI-T-LUBE, a patented dry film lubricant for metals, is available from General Magnaplate, Linden, NJ. Applied in a multilayer electrodeposition process to wear surfaces, HI-T-LUBE forms a metallic/oxide matrix of controlled thicknesses (± 0.0003 in. for 0.001 in. thickness range) with self-healing qualities, excellent adhesion and near perfect shear properties. The resulting malleable lubricating surface reduces wear and friction at extreme temperatures (from –360 °F up to +1000 °F) by maintaining a coefficient of friction of 0.03 while withstanding compression loads in excess of 150 ksi. Parts treated with HI-T-LUBE can operate in a vacuum of 10^{-7} Torr and in high radiation environments.

The HI-T-LUBE dry lubricant composite matrix process was first applied in aerospace vehicles to ensure low friction in critical moving parts at extreme temperatures and high vacuums. Because of its unique properties, the 1995 edition of the *Guinness Book of Records* named HI-T-LUBE the solid with the lowest coefficient of friction in the world. With excellent adherence to the base metal irrespective of temperature and environmental changes, metals treated with HI-T-LUBE exhibit a long life under extreme operating conditions of sliding and rolling frictions. They are compatible with hydrocarbons and synthetic lubricants, HI-T-LUBE can be applied to virtually all metals that are normally used when the components are subjected to high compressive forces: steel, stainless steel, copper, copper alloys, etc.

More information on HI-T-LUBE and other Magnaplate products is available from the company at 1331 Route One, Linden NJ 07036. (800) 852-3301. Fax (908) 862-6110. (HI-T-LUBE is a registered trademark of General Magnaplate Corporation.)

General Magnaplate Describes Thermal Spray Coatings

THE PLASMADIZE group of composite coatings composed of layers of metallic and/or ceramic particles infused with polymers is described in an illustrated brochure available from General Magnaplate Corp., Linden, NJ. Unlike conventional, single component thermal sprayed coatings, these coatings offer unsurpassed corrosion resistance. They eliminate porosity by sealing surface voids.

Available as a release (nonstick) or gripping surface, PLASMADIZE coatings may be used on most metals, including aluminum. When parts are too big for shipping, coatings can be applied on-site. The coatings are particularly effective for such parts as dryers , winders, reels and rolls used in printing plants, and in the pulp, paper, and converting industries.

For a copy of the PLASMADIZE brochure, contact General Magnaplate Corp., 1331 Route 1, Linden, NJ 07036. Tel: (800) 852-3301. Fax (908) 862-6110.

TAFA and Metallurgical Technologies Announce Agreement

TAFA Incorporated and Metallurgical Technologies Incorporated have entered into an agreement in principle contemplating the purchase by TAFA of the assets of Metallurgical Technologies, Houston, TX. The terms were not discussed.

Metallurgical Technologies is a producer of thermal spray powders. TAFA Incorporated, a member of the global Eutectic + Castolin group, is a manufacturer of thermal spray products.

NIST Chooses New ATP projects

In August NIST announced 21 new R&D projects that would receive cost-shared funding under its Advanced Technology Program (ATP). The ATP provides cost-shared funding to industry for high-risk R&D projects that have the potential to reap important economic

benefits for the United States. The new projects include: Intelligent Processing of Materials for Thermal Barrier Coatings, General Electric Co.; Ceramic Coating Technology for the Internal Surfaces of Tubular/Cylindrical Components, Praxair Surface Technologies Inc., and Aqueous Injection Molding for Low-Cost Fabrication of SiN Components, Allied Signal Inc.

EWI and TWI Sponsor HVOF Project

Edison Welding Institute, Columbus, OH, and The Welding Institute, UK, launched in February a group-sponsored project on corrosion-resistant metallic coatings. Recent developments in high-velocity oxygen fuel (HVOF) thermal spraying equipment have enhanced production of dense, adherent coatings and offer a lower-cost alternative to weld overlays for the deposition of corrosion- and wear-resistant coatings. One cost study estimates potential savings from 25 to 60% compared with conventional processes.

The project identifies the most cost-effective routes to reliable corrosion protection of stainless steels, nickel alloys, cobalt alloys, and carbides using HVOF. The work will compare technical and cost performance of the HVOF process to weld overlays and other competing thermal spraying processes. For complete information contact Ian Harris at EWI, Tel: (614) 487-5842, Fax: (614) 486-9528.

Sandia Launches Internet Site for Advanced Manufacturing

Industry, government, and academia can now access and exchange information on the most recent developments in agile and advanced manufacturing via a new Internet site launched by Sandia National Laboratories, Albuquerque, NM. Agile manufacturing is a flexible manufacturing system that can reduce product cycle time, increase quality, and allow rapid changes in design. The Sandia site provides a single point of access for Internet users to reach information worldwide regarding agile and advanced manufacturing. Access to the service is free. Users are only asked to contribute to the exchange of ideas and new information, said Chris Forsythe of Sandia's Statistics and Human Factors department.

The network began operation 19 December and consists of 28 participants in industry, government, and academia located at sites throughout the United States and Europe. Sandia serves as a hub in the exchange of the information through its electronic on-line service called TIE-In (Technology Information Environment for Industry). The participants presently include Honeywell, General Electric, Lockheed, Stanford University, University of California at Berkeley, Georgia Institute of Technology and the National Institute of Standards and Technology, Gaithersburg, MD.

The goal of the new web site is to create a desktop tool with which users can easily access and exchange the latest information on agile and advanced manufacturing, Forsythe said. "The initial objective is to provide a forum to find things on the web that are manufacturing related and to keep up with what's new," he added. "But, we see it growing quickly into an electronic environment that fosters collaboration and serves as a beginning point for the development of virtual corporations." Virtual corporations are defined as temporary partnerships that develop and produce new products and then are disbanded. "The web," he said, "can help users to identify partners to produce that product in an agile way." For technical information contact Forsythe at (505) 844-5720. The Agile and Advanced Manufacturing Web may be accessed at URL address: http://www.sandia.gov/agil/home_page.html.

European Collaborative Projects on Surface Engineering

European collaboration and partner searching for projects in surface engineering were initiated by the Eureka brokerage event from 30-31 March in Montreux, Switzerland. Organized by Eureka, the Eureka umbrella Eurosurf, and the European Commission, this event was focused on R&D projects near to industrial implementation and with a market orientation.

Special attention was given to: SMEs involved in surface treatment activities; users with specific problems to solve; coating equipment suppliers and process developers with recent technical achievements; material producers as substrate suppliers within surface engineering; and suppliers of products to be coated.

For further information contact: Mr. Vernon Brown, DTI—Vehicles, Metals & Minerals, Tel: 0171-215 1105, fax: 0171-215 1070.

Air Products Honored for Outstanding Safety Performance

Air Products and Chemicals, Inc., announced that several of its Polymer Chemicals manufacturing facilities have been recognized by the National Paint and Coatings Association (NPCA) for outstanding safety performance in 1994. The City of Industry, CA; Elkton, MD; Piedmont, SC; and Cleveland, OH production sites were awarded the Associations' highest honor, the Award of Excellence, for safety performance over the last five years. In addition, the Calvert City, KY, plant received the Award of Commendation and the Langley, SC, and Dayton, NJ, facilities received the Award of Honor.

Each award was presented to those manufacturing facilities satisfying an established safety parameter. The Award of Excellence was presented for zero fatality and total lost-work-day cases for the previous five-year period; the Award of Honor for the lowest fatality rate and total lost-work-day cases per total employee hours for a calendar year; and the Awards of Commendation for the lowest fatality rate and away-from-work cases for the reported calendar year.

More than 250 paint and coatings plants submitted data to NPCA in connection with the 1994 awards program, according to Kevin Sall, the association's manager for hazardous materials. Sall said that while the purpose of the awards is to recognize superior safety performance by members of the paint industry, the information collected is also used to compile overall industry safety statistics. "The information helps companies assess the effectiveness of their own safety programs compared to others, while the program helps reinforce the industry's total commitment to workplace safety," Sall said.

Air Products manufactures polymer emulsions used in water-based paints and coatings. The plants that received the safety awards are undergoing significant expansions to meet growing demands for the company's products. Recently the company announced its

plans to invest more than $50 million to expand its overall U.S. emulsion production capabilities by more than 250 million lb per year. NPCA is an industry trade association headquartered in Washington, D.C., and represents more than 500 paint and coatings manufacturers and raw material suppliers.

Air Products and Chemicals, Inc., is an international supplier of industrial gases and related equipment, intermediate and specialty chemicals, and environmental and energy systems. The company has annual sales of $3.5 billion, operations in 30 countries, and 13,300 employees. Corporate headquarters are located near Allentown, PA.

Air Products Researchers Honored for Scientific Contributions

Three research scientists from Air Products and Chemicals, Inc., have received honors in the Roon Awards competition for their scientific contributions to the coatings industry. The award—presented during the 1995 Federation of Societies for Coatings Technology Paint Industries Show in St. Louis, MO—recognized Charles R. Hegedus, Andrew G. Gilicinski, and Robert J. Haney for their work in identifying film formation mechanisms of two component waterborne polyurethane coatings. Their findings, presented in a paper delivered at the show, provides insight on the dynamic series of interrelated events which occur during a coatings' film formation process, as well as its effects on film property development after application.

The Roon Awards, presented annually, were established in 1957 by the late Leo Roon, founder of Nuodex Products Co., and are supported by funds provided through the Roon Foundation. The awards are open to those involved in work related to the protective coatings industries, including paint, varnish and lacquer manufacturers, raw material suppliers, research laboratories and universities.

Hypertherm Enforces European Patents

Hypertherm has successfully enforced its European Patents against two German companies. Hypertherm's vast patent portfolio includes European Patent Nos. 0350486 (contact start technology), 0375747 (spiral groove electrode), and 0391984 (shielded torch technology) for its plasma arc torches.

One German company agreed to refrain from manufacturing, using, offering for sale, and selling shields in violation of Hypertherm's European Patent No. 0391984. The company also agreed to pay Hypertherm's attorneys fees and damages for its past sales of shields.

The other German company agreed to refrain from manufacturing certain electrodes for use in Hypertherm's MAX42/43 torches and certain shields for use in Hypertherm's MAX100/200 torches in violation of Hypertherm's European Patents. The company also agreed to offer for sale and sell only genuine electrodes and shields in accordance with Hypertherm's European patent rights.

Hypertherm's ongoing campaign to enforce its intellectual property rights was highlighted by its success over American Torch Tip Company in an action for patent infringement and false advertising in March 1994.

Hypertherm's President, Richard W. Couch, Jr., stated "Hypertherm is pleased with the outcome in both situations, as they reaffirm our ongoing commitment to vigorously protect our intellectual property. Hypertherm is a worldwide leader in the development, manufacture, and sale of plasma arc cutting equipment, and our intellectual property is the foundation of our leadership role."

Merging of Orthopedic Composites

To cope with the changing market conditions for medical devices in Europe and to take advantage of the new opportunities in this environment, the three orthopedic companies of Sulzermedica in Switzerland, Allo Pro AG (Baar), Protek AG (Mnsingen) and Sulzer Medical Technology Ltd. (Winterthur), will merge as of 1 January 1996. The new company will be named Sulzer Orthopedics Ltd. and integrates all current activities of the merged firms. Its headquarters will be in Baar and Winterthur. The existing local Protek and Allo Pro sales organizations will be maintained as separate networks and will market the two product brands in the various countries under a coordinated market policy.

Sulzer Metco—Extension in Japan

Sulzer Metco has acquired the 50% Daiichi Metco shares originally held by Daiichi Jitsugyo Co., Ltd. Sulzer Corporation already holds the other 50%. Sulzer Metco now intends to integrate Daiichi Metco and its own previous activities in Japan into Sulzer (Japan) Ltd. The new company has a consolidated turnover of $35 million (U.S. dollars).

The Thermal Spray Society—Join it!

Resistance to wear.
The retardation of corrosion.
The creation of dielectric and thermal barriers.

These are just a few of the things that can be accomplished through thermal spray technology. A technology distinct in its versatility. A technology, the beauty of which lies in its ability to solve a wide variety of challenging surface engineering and materials problems. For industries ranging far wider than its original and traditional defense and commercial aerospace use.

Simply put, thermal spray involves using a variety of heat sources that melt and spray atomized materials onto prepared surfaces. Particles of metals, ceramics, glasses, polymers, and composites solidify and create a coating structure. Form free-standing, near-net shapes. Or even create special materials with unique properties all their own.

Above all, **thermal spray technology creates solutions.** Highly reliable. Cost-effective. For the automotive, electronics, biomedical, paper, textile, metals, petroleum, petrochemical, land transportation, infrastructure maintenance, and marine industries. And more. Thermal spray.

A Technology with Wide Potential, at the Brink of a New Era!

Question—Where is thermal spray technology heading? Answer—To the ASM Thermal Spray Society! Manufacturers. Distributors. Contractors. Users. Workers, scientists, and engineers. From industry, government, universities, and national laboratories. Individuals from every sector of the rapidly advancing thermal spray industry have come to-

gether to form the ASM Thermal Spray Society (TSS), an Affiliate Society of ASM International.

Why? Because TSS is where our members find answers. Answers to the tough technical questions that come up in their work every day. And answers about the key issues affecting thermal spray operations as the technology changes, grows, and finds its niche in the future. It's an exciting time to be involved in thermal spray. And TSS is building on that excitement, harnessing the energy of our members, and providing the focus, opportunities, and services that professionals like you can use to be better at what you do, every day.

TSS benefits answer your needs.

When you don't have any time or resources to spare, TSS Information Central puts you a phone call away from the technical answers you need. Answers that are readily accessible are FREE. If your problem requires significant research, we'll quote you a reasonable fee. When you need answers, let us help. Call (800) 336-5152 and ask for TSS Information Central.

Communicate with other thermal spray practitioners from your PC, any time of day or night, through TSS Online, our new bulletin board service. This new service allows you to network electronically, discuss common problems, and bring up issues relevant to the thermal spray community. TSS Online will put you a mouse-click away from the answers you need, from the experts who know them best—other TSS members!

In addition, your support of TSS enables us to build a stronger National Thermal Spray Conference and Exposition (NTSC), our industry's leading annual event. These events continue to focus on increasing interest in, and use of, thermal spray coatings in diverse world markets. Special focused symposia describe the application of thermal spray technology in petroleum/petrochemical, land transportation, aerospace, infrastructure maintenance, and marine industries; and cover commercial developments; materials, processes, and characterization; and the science of thermal spray jets.

TSS Thermal Spray News, our twice-a-year official newsletter, is filled with timely features, industry trends, and the latest on companies, organizations, and individuals involved with thermal spray. And the annual Thermal Spray Buyer's Guide and thermal spray focus issues of *Advanced Materials & Processes* broadcast the latest advances in thermal spray technology to a wide technical audience.

Our committees answer our industry's needs.

When you join us, you'll be supporting the work of five TSS committees dedicated to:

- **Providing the leading thermal spray forum for the exchange of information.** You'll enjoy meeting other members through technical programs, proceedings and exhibitions at NTSC, ITSC, Materials Week, European events, and other conferences and short courses. And you'll be there when the industry recognizes excellence in thermal spray research, development and commercial endeavors through the Thermal Spray Hall of Fame, TSS awards, and other achievement events.

- **Influencing our industry and enhancing its image through high-quality communications programs.** Through TSS, you'll support the development of public relations programs aimed at widening opportunities for market growth. TSS will also promote synergy between industry, academia, governments, and other professional organizations that serve the worldwide thermal spray community.

- **Providing more of the answers you need to move ahead in your field.** TSS is focused on developing, compiling, and disseminating relevant, high-quality information about the many facets of thermal spray technology. Currently available resources include books, training programs, TSS Information Central, the TSS Online bulletin board service (BBS), and more.

- **Aiding in the professional development of thermal spray personnel through a certification and training program.** We are currently studying the need for new training programs, including the administration of operator and technologist programs. We're also working toward certification programs, health and safety training, training courses, and video training programs.

- **Working toward the development of standards, specifications, and best practices for thermal spray.** Much needs to be discussed on both a domestic and international level to gather input and direction on areas requiring attention, and we are working toward achieving this. In addition, this activity will include health and safety, characterization, and bond strength testing.

For more information about our TSS working committees, including how you can participate, contact the TSS Communications Office at Materials Park, Ohio 44073. Tel: (800) 336-5152, ext. 622. Fax: (216) 338-4634.

Bender Machine Celebrates Its 50th Anniversary

Bender Machine, Inc., has received an ISO 9002 International Quality Standard Certification, is the single reliable source for all mechanical equipment needs, and celebrates its 50th anniversary this year.

Founded in 1946 by Arthur E. Bender, Bender provides engineered solutions that improve the performance of machinery by eliminating wear and corrosion problems. A specialist in the repair of high-wear components, Bender restores valuable wear-prone equipment to OEM specifications or better, seven days a week, 24 hours a day, in-house or on-site. As a job shop, Bender performs emergency repairs and overhauls throughout the country. As a coatings specialist serving many industries, Bender provides on-site services around the world.

With facilities in Vernon, CA, and Bolton, Lancashire, England, Bender has earned an international reputation as a dependable, expert source for high-quality work and responsive service. Its reputation for excellence encompasses machining, grinding, coating, and related surface forming and finishing procedures, notably thermal spray coating processes.

Jack Ritchie, Bender's President, became involved with Bender in 1953 "where we metal-sprayed used automotive and truck crankshafts and camshafts using basic oxyacetylene processes in the very competitive automotive field," he recalled. Today, Jack, and his son, Gary, Vice President/General Manager,

who has been with the company since 1976, own the company.

Partnering with Customers

Bender works closely with its customers as their partner in productivity. It provides the talents of a large staff of seasoned specialists including coating engineers and on-staff metallurgical expertise. These capabilities, when partnered with those of its clients, result in the benefits of increased productivity, reduced downtime, enhanced product quality, and lower operating costs.

Bender's customers frequently avoid the long delays and high costs associated with expensive OEM components by using Bender's expertise to restore equipment to better-than-new performance. With enhanced resistance to wear, chemicals, and corrosive attack, machinery runs longer between scheduled maintenance shutdowns while continuing to turn out superior products with accelerated throughput.

Emergency Services

Bender is also its customer's ally in combating emergency downtime. Experienced in responding on a rush basis, accommodating its customers' operating schedules, and doing whatever is needed to get its customers back in production, Bender is available around the clock, seven days a week—including holidays. ***Its emergency number is (800) 235-4BMI.***

Thermal Spraying Specialists

Bender has the world's largest independent thermal spray operation for coatings with the latest equipment and technology, using seven different processes in applying more than 200 kinds of materials. As an international leader in advanced metal coatings technology, Bender continues to pioneer and perfect these spraying processes.

In fact, Bender is in the forefront of hypersonic flame spraying, a state-of-the-art technique that imparts very high quality surfaces that exhibit exceptionally high resistance to wear and corrosion. High-powered spraying is also a Bender exclusive. Very dense, hard ceramic coatings can be applied as a result of Bender's ongoing commitment to researching new solutions to its customers' wear-related problems.

"Early on, our involvement with the industrial base in the Los Angeles area started and I began to see and help develop thousands of applications for the thermal spray process, utilizing updated equipment and other materials as they became available," explained Jack Ritchie. "The Los Angeles area was ideal at the time for this type of business due to its status as an outpost of major machinery manufacturers and their service organizations, as well as for aircraft manufacturers and maintenance facilities. This 'Westernized' approach to things was to try new applications and undertake the risk of failure in the hopes that success could be achieved. Because local industrial complexes felt that they were not supported well by the major machinery manufacturers, the repair people were eager to try our new techniques and repair, rather than replace, equipment.

"Initial successes included many areas in reciprocating compressors. Applications included spraying pistons with Babbitt, aluminum, bronze, and stainless steel; connecting rods with stainless steel and tungsten carbide; compressor cylinders with stainless steel; and crossheads with Babbitt.

"Applications which have been done successfully by Bender with the early processes and then upgraded through plasma and, eventually, to HVOF, have included printing cylinders and other printing components, turbine shafts, pump components, and almost every type of component connected with all large industry in operation in the Western part of the United States, as well as in Great Britain and Europe.

"The early, highly durable coatings were developed by Union Carbide Corp. and were applied to only a limited group of components in the industrial repair field where extreme wear conditions existed. This was basically due to difficult application requirements. For many years, I longed for that type of coating to be available for application in the manner in which we applied plasma and other processes with a continuous spray application.

"When Dr. Jim Browning invented the Jetkote system, I went to have a look and decided it had potential. We purchased a unit and started developing it. We, at Bender, worked with other thermal spray companies who had the same feeling and, in a short period, we were delivering HVOF coatings to a large segment of the repair industry. New coatings and applications are being developed on a day-by-day basis. Many wear problems have been improved or eliminated in the recent past.

"As we became preeminent in the field, we got involved with technical associations in order to exchange information throughout the U.S. The prime early carrier of this was the Metallizing Service Contractors which, in the beginning, was called Metco Service Contractors. This organization was started in 1948. This was the prime group of companies that Metco recommended as contractors and represented North and South American companies. Now this organization is called the International Thermal Spray Association (ITSA) and has an extended membership including most equipment and material suppliers as well as international participation.

"The early days of thermal spraying included mainly independent job shops such as ours, of course, and Union Carbide, as a well-backed and financed competitor. Through the years, many shops have included the major aerospace companies, General Electric and, in recent years, established companies developing as aerospace, electronic sources including Plasma Technology, General Plasma, Cincinnati Thermal Spray, and others. Today, there are over 375 listed thermal spray-related shops in the U.S. alone," reminisced Ritchie at the 35th Memorial Conference of the Japan Thermal Spraying Society (JTSS) in Osaka, Japan.

"Success stories abound with the thermal spray process," he continued. "From aircraft to nuclear to computer to space exploration, the industry solves a vast number of problems. My favorite has to do with paper. The largest single thermal spray application done regularly is for renewing of a wear surface. A Yankee Dryer Drum is a large cast iron steam-pressured cylinder used in the manufacture of toilet and facial tissue, baby diapers, and other papers which are made soft by a creping process as the paper is removed from the cylinder surface. This drum is the final roll in the paper-making process. The wear sustained comes from a steel or stainless steel blade riding with some 20 pounds per lineal inch pressure against the drum, actually removing the stuck paper at speeds of 2000 meters per minute, as fast as a "bullet" train, on dryers as large

as 6 to 6½ meters in diameter and up to 7 meters in length.

"In 1973, we thermally sprayed our first Yankee," concluded Ritchie. Today, Bender has completed more than 375 Full Face Yankee Dryers worldwide.

World-Class Machine Shop

With a commitment to continued investment in the latest technologies, advanced equipment, and talented personnel, Bender has become one of the world's most comprehensive facilities of its type. Its extensive machining and grinding capabilities meet the most demanding surface forming and finishing requirements. Extremely fine finishes are Bender's hallmark.

Available Services

Services are available through three operating companies. Bender Machine is the prime resource for in-house repairs in Southern California. Bender Machine Services focuses on repairs performed on-site. Bender Machine Services, Ltd., provides both of these capabilities for customers throughout the United Kingdom and Europe.

Bender's quality services encompass balancing; grinding; honing; line boring; machining; presswork; straightening; thermal spraying processes including high velocity oxygen fuel, plasma, high power plasma, oxyacetylene; and welding, including submerged arc and TIG. These services are provided to a number of industries including paper, petrochemical, power generation, steel, printing, food processing, film and foil, mechanical seal, oil tool, aerospace, and space.

Bender's Mission

Bender's mission is to enhance its customers' production quality and efficiency through the use of cylindrical reconditioning and thermal spray technology. In addition to solving their problems caused by year and corrosion, Bender intends to delight its customers with 100 percent on-time delivery and satisfaction. While accomplishing these goals, Bender will treat its associates in a fair and dignified manner, keep them involved in the furtherance of its goals while providing a fair return on its stockholders investment.

Recent Developments at Bender Include

- *Paper Industry*—New coatings further enhance paper machinery-Yankee Dryer cylinders. These coatings add longevity and production efficiency by reducing wear and corrosion.
- *Steel Industry*—Newly issued patents and patents pending on coatings reduce the cost of operating sink rolls and support rolls on a continuous galvanizing line. These coatings reduce "dross pickup" and "denting" of steel strip, thereby improving quality while reducing costs.
- *Printing Industry*—Central impression cylinder users experience decreased costs when utilizing Bender's option, reducing orange peel and corrosion when printers move to water-based inks. These coatings are applied at the printer's location, further enhancing printers' productivity.

Bender's Management

Bender has a full staff, including a customer-oriented account management staff, available to assist with solving customer needs. This large staff is available for general or specific applications, as customers require. A Research and Development team is positioned to back any unusual or developmental needs customers may require. This staff has been responsible for developing many unique processes, including propriety and patented information.

"Bender has positioned itself to enable customers' needs to be addressed during the next 50 years," stated Gary Ritchie. "We have shifted our focus from maintaining machinery to enhancing its performance and special characteristics, as required by our customers. This is no longer a simple operation. It is a complex evolution based on specific customer requirements, all aimed at enhancing customers' productivity while reducing downtime. Additionally, we find that more people are out-sourcing their services as a result of having a strong, certified vendor. We have aligned ourselves with many major partners in the industry as our growth vehicle of the 90s," he concluded.

Bender Machine Services is located at 2150 East 37th Street, Los Angeles, CA 90058. Tel: (213) 232-2371.

As Bender Machine begins its 50th year as the source for many mechanical equipment needs, Dave Witt, left, Bender's Controller, and Gary Ritchie, right, Senior Vice President, prepare to celebrate.

Wall Colmonoy Appoints New Sales Engineers

Wall Colmonoy Corporation (Madison Heights, MI) has recently appointed **Joe Antle** as Sales Manager, Northeast Region, and **Bill Kalivas** as Sales Engineer, Midwest Region. Antle and Kalivas will be responsible for expanding Colmonoy hard-surfacing alloys and Nicrobraz high-temperature brazing alloys.

Antle has more than 23 years experience in the thermal spray industry, from systems engineering to sales management. Kalivas has worked in the thermal spray industry 17 years, from R&D to sales engineering.

Joe Antle

Bill Kalivas

Wall Colmonoy Corporation manufactures hard-surfacing alloys for the plastics, glass, and petrochemical industries; and high-temperature nickel-base alloys for the aerospace, automotive, and power generation industries.

CERAC Appoints Daniel A. Verzal as New President

Daniel A. Verzal was recently named President and Chief Operating Officer of CERAC, Inc. He was previously Director of Marketing and Sales for Thiem Automotive Division of National Starch & Chemicals Co. in Oak Creek, WI.

Mr. Verzal joins CERAC at a time when the company is evolving from a small-lot specialty inorganic chemical manufacturer into a production quantity commercial producer. His 24 years of sales, marketing, and production experience are well suited to lead CERAC through continuing stages of growth.

CERAC, Inc., located in Milwaukee, WI, has been manufacturing advanced specialty inorganic chemicals, evaporation materials, and sputtering targets since 1964. It currently occupies over 100,000 sq. ft. of office and manufacturing space and employs 140 people.

Dr. Ervin Colton, the founder and principal owner, remains active as Chairman and chemical consultant. Phone: (414) 289-9800. Fax: [illegible]9-9805.

Gary Ritchie Promoted to Executive Vice President, Gary Ramsdell Joins Bender as General Manager

As **Gary Ritchie** moves up to the newly created post of Executive Vice President, from Vice President/General Manager, at Bender Machine, Inc., **Gary R. Ramsdell** comes on board as Bender's new General Manager. Ritchie has been with the firm since 1976 and, in his newly created position, will assume responsibility for creating an overall vision and strategy with an emphasis on marketing.

"As the company grows, an increased need for developing new products and services is created, an area I will continue to lead," stated Gary Ritchie. "Gary Ramsdell will assume my general management responsibilities with the goal of improving quality and reducing costs to our customers."

Ramsdell comes to Bender after a 25-year career at ROHR Corporation where he was most recently Plant Manager and previously Director of Operations, Metal Bond and Composite Manufacturing at the Riverside, CA, facility. Prior to that he was General Manager at ROHR's Sheridan, AK, and Foley, AL, plants. Ramsdell will have the responsibility for overseeing all operations, including sales, plant operations, and quality at Bender. His expertise is in team building, customer interface product development, and on-time, on-cost delivery. The world-class plant and team he developed in Sheridan, AK, is recognized as a model of empowerment and performance.

George A. Roberts Donates $500,000 & Endows Scholarships

Dr. George A. Roberts retired chairman and CEO of Teledyne, Inc., has endowed ASM International's scholarship program for up to seven outstanding students annually, funded by his personal donation of $500,000. "Scholarships helped me during my college career," said Dr. Roberts, a Fellow of the Society and a past president of ASM. "Now, I'd like to give something back."

Through the ASM Foundation for Education and Research, the George A. Roberts Scholarship Program will encourage the development of capable, well-educated materials engineers, based in part on financial need. The program will be initiated this year with a single recipient receiving $5000 and a framed certificate of recognition. During 1996, three scholarships will be given, and up to seven scholarships will be presented annually by 1997.

This year's founding scholarship recipient is Diane L. Bojanowski, a senior in the Materials Science and Engineering Department at Purdue University. Bojanowski has interned with Caterpillar Large Engine Center in Lafayette, IN, for the past three years. She is certified as a magnetic particle inspection operator and is responsible for developing quality control specifications for the heat treatment of crankshafts. Among her many accomplishments,

Bojanowski has been selected to join the Tau Beta Pi Engineering Honor Society and is a member of Alpha Sigma Mu Honor Society for Materials Science and Engineering and the Alpha Lambda Delta Honorary Society. Upon her graduation, she hopes to establish a career in the steel industry and contribute to the complete processing of steel products.

Since 1953, ASM has provided more than $6 million in scholarships through the combined efforts of the ASM Foundation, leading ASM chapters, and the personal donations of members like George A. Roberts and N.J. Grant. Annually, ASM administers more than 280 scholarships worth more than $180,000—one of the largest scholarship programs serving the metals and materials community.

"My hope is that other professionals in the field will follow the lead of the ASM Foundation and support the endowment of scholarships in whatever way they can," Dr. Roberts said. "Together, perhaps we can get others thinking, 'Maybe I can do something, too.'"

The Undergraduate Scholarship Program is administered by the ASM Education Affairs Committee, the Action in Education Team. For more information about the rules governing application for and granting of all scholarships, contact the ASM Foundation for Education and Research, Materials Park, Ohio 44073-0002; Tel: (216) 338-5151; fax: (216) 338-4634.

Dr. Takeshi Nagano, Mitsubishi Chairman, Receives Medal

Dr. Takeshi Nagano, Chairman, Mitsubishi Materials Corporation, Tokyo, Japan received the Medal for the Advancement of Research from ASM International during Materials Week'95 in Cleveland. He was cited "in recognition for outstanding leadership and foresight to the advancement of materials research at corporate, national, and international levels."

The Medal for the Advancement of Research was established in 1943 to honor an executive of an organization, one of whose important activities is the production, fabrication, or use of metals and other materials. The recipient, over a period of years, shall have consistently sponsored research or development and by foresight and actions shall have helped substantially to advance the arts and sciences relating to materials science and engineering.

Dr. Nagano graduated from the Engineering Department at Tokyo University in 1945 and in the same year joined Mitsubishi Mining Company Limited (formerly Mitsubishi Metal Corporation). From 1953 to 1955 he studied metallurgy at Columbia University. He obtained his Ph.D. in Pyrometallurgy in 1962. From 1963 to 1967, Dr. Nagano worked for Onahama Smelting and Refining Co., Ltd., returning to M.M.C. in 1969 to become General Manager of the Metallurgy Department. He was elected Director of M.M.C. in 1971, Managing Director in 1973, Senior Managing Director in 1977, promoted to Executive Vice President in 1981, and became President the following year. In 1990, Dr. Nagano was elected Chairman of Mitsubishi Materials Corporation (a merged company with M.M.C. and Mitsubishi Mining and Cement Co., Ltd.).

Dr. Nagano served as Chairman of the International Lead and Zinc Research Organization, President of the Japan Mining Industry Association, Chairman of the Mining and Materials Processing Institute of Japan, and in 1991 , he was elected Chairman of the Japan Federation of Employers Association. Numerous honors have been awarded to Dr. Nagano, including the 1977 Ohkouchi Foundation Grand Prize for the development of continuous copper smelting, TMS-AIME's Extractive Metallurgy Technology Award (1978) and Fellow of TMS (1991). During ASM's 75th anniversary in 1988, he received a World Materials Congress Award for his achievements in continuous copper smelting and converting process. In 1984, Dr. Nagano was presented with a Medal by His Imperial Majesty, Hirohito, and in 1994, given the Grand Cordon of the Order of the Sacred Treasure by His Imperial Majesty, Akihito.

ASM Honorary Membership Presented to William Wood

The 1995 Honorary Membership for ASM International was presented to **Mr. William G. Wood,** Retired Vice President, Kolene Corporation, Detroit, MI. He was cited "for outstanding technical contributions in the area of fused salts in metal processing and for exemplary contributions to the development of ASM International as the leading source of materials science information." Honorary Membership in ASM International was established in 1919 to recognize distinguished service to the materials science and engineering profession, to ASM International, and to the progress of mankind.

Mr. Wood earned his Bachelor's degree in Chemical Engineering and Master's degree in Metallurgical Engineering both from Wayne State University. Prior to his tenure with Kolene, Mr. Wood was Vice President of Research and Manufacturing at Park Chemical Company and Chief Chemist at Federal Mogul. He retired as Vice President of Research from Kolene Corporation in 1984 and has been a Research Consultant to Kolene since. His research has been recognized worldwide for investigating new processes utilizing cleaning and nitriding fused salt compositions.

A Past President and Fellow of ASM, Mr. Wood has been affiliated with the Society for more than 48 years. In addition to his work at the chapter level, Mr. Wood served as Chairman of many ASM committees including, Chapter Advisory, Metals Engineering Institute, Education Council, Technical Divisions Board and served as the 1995 Chair of the Nominating Committee. In 1986, Mr. Wood was the recipient of ESD's Gold Award and ASTM's Award of Merit. He is an ESD and ASTM Fellow and is an active member in AIME, AISI, and SAE. He holds eight U.S. patents and is the author of numerous technical papers.

Julian Szekely, 61, Researcher of Metal-Production Technology

Dr. Julian Szekely, a metallurgist and professor of materials engineering at the Massachusetts Institute of Technology, passed away in December at the M.I.T. In-Patient Unit in Cambridge. Dr. Szekely was 61 and lived in Weston, MA. The cause was cancer, said M.I.T. spokesman Charles Ball.

Dr. Szekely, a native of Budapest, was best known for his role in creating mathematical methods to analyze how economics, technology, and the environment are involved in the production of metals. He developed a comprehensive mathematical model of fluid flow, electromagnetics, and heat transfer in metal processing. He wrote or contributed to seven textbooks and hundreds of papers and, as a consultant he helped the

steel industry look for new technologies, greater efficiency, and less pollution.

His work covered a wide range of subjects, like gas-solid reactions, the flow and mix of fluids in steel processing, and various phenomena in blast furnaces, welding, and electromagnetic processing. His latest research focused on welding and soldering problems in metal processing.

He also produced the mathematical model for a complex microgravity experiment that was performed on a space shuttle last year and is to be done again in 1997. Many leading researchers in metal processing, in this country and abroad, had been his students. In August he helped organize a meeting in Austria of top steel executives at which the future of steelmaking was debated and contacts were sponsored among equipment manufacturers and steelmakers around the world.

Dr. Szekely was a 1959 science graduate of Imperial College in London, where he also earned his Ph.D. in chemical engineering in 1961. He taught at Imperial College before coming to the United States in 1966 to join the faculty of the State University of New York at Buffalo. He became a professor in the department of materials science and engineering at M.I.T. 20 years ago.

Dr. Szekely is survived by his wife of 32 years, Joy; four sons, M.Thomas, of Telluride, CO, and Richard J.M. Tarquin, and David A., all of Weston; a daughter, Rebecca, of Washington, and an aunt, Lilo Racz of Budapest.

(Written by Wolfgang Saxon and extracted from the New York Times, 12 December 1995.)

Awards to Industry

Automotive Exhaust Systems Awarded Achievement Award

Armco Inc. and **AK Steel Corporation,** Middletown, OH, received the 1995 Engineering Materials Achievement Award from ASM International "for the development and commercialization of aluminum coated ferritic stainless steels for automotive exhaust applications extending exhaust system life and providing significant economic and environmental benefits."

This coating was developed in response to the need for a long-lasting corrosion-resistant material for the cooler section of automotive exhaust systems. Automotive exhaust systems made of aluminum-coated Type 409 stainless steel last years longer than those made of conventional materials.

Established in 1969, the Engineering Materials Achievement Award recognizes an outstanding achievement in materials or materials systems relating to the application of knowledge of materials to an engineering structure or to the design and manufacture of a product. The purpose of this award is to seek out and recognize outstanding developments in the application of materials in products or in engineering structures and to honor the organization or individuals responsible for them.

The award was accepted by: Dr. Stephen W. Gilby, Vice President, Research & Technology, Armco Inc. and Mr. Richard M. Wardrop, Jr., President and Chief Executive Officer, AK Steel Corporation. Dr. Farrell M. Kilbane, Principal Research Engineer, AK Steel Corporation, Research and Technology, will receive recognition for his technical contributions.

Greenwood Furnace Recognized

Nominated by the York Chapter of ASM International, the **Greenwood Furnace,** located in central Pennsylvania, was designated an ASM Historical Landmark. It is a site that has made a significant contribution to the industrial growth as well as the westward expansion of this country beginning more than 160 years ago.

One of the society's most prestigious awards, the ASM Historical Landmark award was established in 1969 with the objective of preserving our metallurgical heritage, while at the same time providing recognition as a means to increase the awareness of the many pioneering milestones in engineering materials technology.

In the early 1830s, two brothers decided to go into business for themselves. Their furnace, using a common design of its time, went into blast in June 1834 with a rated annual capacity of 1200 gross tons of iron. Then, the ownership changed and the company fell into hard times. Eventually, John Wright became the principal figure and the works again prospered, due to a great degree to the expansion of the railway system. By the mid-1850s, Greenwood was among the largest works in the state, producing 1600 tons annually. The decision to enter into the production of various railway products came in 1856 when the company was reorganized as the Freedom Iron Company.

The company erected a new forge and rolling mill for making wrought iron locomotive tires. The new furnace, erected next to the initial furnace, began operations around 1860 and became the largest charcoal furnace ever built. By 1860, the combined Greenwood and Freedom works produced 1800 tons of metal. Company President John Wright traveled to England and purchased the latest Bessemer machinery: two five-ton converters, which were first blown in May 1868. The intention was to produce tires and boiler plates. About a year later, the plant had failed—the first Bessemer Plant failure in the United States. Tests showed the same problem that had plagued Bessemer in England: *too much phosphorus in the iron.*

Prior to the first blow of the Bessemer Plant, the company began to expand its production of raw pig iron with the construction. The Greenwood Furnace community reached its zenith in 1870 with production of 3000 tons of metal. But the failure of the Bessemer Plant was an utter disaster to the company. Finally the plants were sold to the newly formed Logan Iron and Steel Company in 1871. They were to continue to operate both Greenwood Furnaces for the next decade, reverting to the production of wrought iron tires.

By the 1890s, technical change was again affecting the operation of Greenwood Furnaces. The upheaval of the industry due to the introduction of modern steel was diminishing the market formerly occupied by Greenwood and other furnaces. Timber for charcoal—once plentiful—was virtually exhausted, and long-proposed rail lines to service the area had not been built. By November 1903, the furnace had shut down. Operations were resumed for a

short time in 1904, but the furnace was to close down for good in December of that year.

Daniel Elliott, member of the York Chapter of ASM, presented the Historical Landmark plaque to Barry Wolfe, park manager, Greenwood Furnace State Park. The inscription on the plaque reads: "Beginning in the 1830s, Greenwood Furnace produced a superior grade of charcoal iron that was made into axles, wheels and other locomotive parts."

A total of 95 Historical Landmarks have been named. These are located in 24 states of the United States including the District of Columbia, two provinces of Canada, two states of Mexico, as well as in Japan, England, Spain, Wales, France, Austria, India, Brazil, Germany, Sweden, and Italy.

Champion Spark Plug Mine Designated Historical Landmark

ASM International has designated the **Champion Spark Plug Mine,** also known as the Jeffrey Mine, located in Mono County, CA, an ASM Historical Landmark. Nominated by the ASM Santa Clara Valley Chapter, the Jeffrey Mine site played a major role in the nurturing and development of the transportation industry worldwide during its active operation.

Prior to the early 1900s, most of the insulators and spark plugs used in this country were imported from Europe. Some manufacturing in the United States began in 1903, and the Champion Spark Plug Company began operations in Boston in 1906, moving to Toledo, OH, in 1910. Champion scientists, Dr. Joseph Jeffrey and his brother, Benjamin, in their search for a better insulating material, had applied vastly higher temperatures than were practical in production to one of their formulas, resulting in an amazing material in terms of strength, heat resistance, and conductivity — qualities ideal for spark plug insulation. Analysis proved they had produced a form of synthetic sillimanite, a substance known to possess some peculiar properties, but an extremely rare mineral with no known commercial quantities in existence.

After nearly two years of unsuccessful search, Dr. Jeffrey stumbled on some excellent samples in a canyon in the White Mountain Range in California. He found millions of tons of the most ideal material then known to science for spark plug insulators. Dr. Jeffrey's discovery in 1919 brought about a major technical advance in the spark plug and a tremendous competitive advantage for Champion. Mining operations began in 1922 to extract the andalusite ore, part of the sillimanite group.

The mine remained in operation until 1945, the only commercial deposit of andalusite in the United States. The close-down occurred when Champion's stockpile reached sufficient magnitude for several years projected use. There was also a trend toward pure alumina spark plug insulators by that time. The perseverance and talent of Dr. Jeffrey and the researchers at Champion provided one of the major advances to the automotive and aircraft industries.

ASM Associate Managing Director Stanley C. Theobald provided background on the ASM Historical Landmark Program. ASM President 1995-1996 William E. Quist gave a history of the mine site and presented the plaque to JoEllen Keil, District Ranger of the Inyo National Forest. The inscription on the plaque reads: "In 1919, discovery of andalusite at this mine led to the commercialization and development of advanced ceramic spark plug insulators for internal combustion engines and the growth of the world's transportation industry."

Tannehill Ironworks Recognized for Historical Significance

Tannehill Ironworks, located in Birmingham, AL, was honored as an ASM Historical Landmark. The pioneer antebellum ironworks, "Old Tannehill," is accepted by historians as the birthplace of the iron and steel industry in the area. Daniel Hillman, a furnaceman from New Jersey, built what was to become "Old Tannehill" forge on the banks of Roupes Creek. His pioneer forge, fired by charcoal made from wood cut in the immediate area along with brown ore from nearby pockets, produced iron that sold for 10 cents a pound. Hillman's forge thus became the first formal iron operation in the Birmingham area in 1830. Hillman died several years later, and the forge lay dormant until 1836 when it was sold to Ninian Tannehill.

Although the ironworks had a number of other owners, it was Tannehill's name that stuck. He operated the works until 1857 when John Alexander purchased it and a family friend and colleague, Moses Stroup, was engaged to oversee a major expansion of the plant. Stroup's forge improved upon Hillman's operation, and within several years he built a cold blast charcoal furnace, Tannehill No. 1. After the beginning of the Civil War, John Alexander sold the ironworks in 1862 to William L. Sanders, who completed two new furnaces, Tannehill No. 2 and No. 3, and expanded production to twenty tons a day to aid in the war effort.

In the closing months of the war, the Alabama ironmaking facilities became a logical target for Northern forces. A Union Cavalry force on 31 March 1865 totally destroyed the Cast House and Charging Bridge, which shut down the Tannehill operation. Although there were some post-war plans to rebuild the operation, it was never to occur. The restoration of the site as a part of the Tannehill Historical State Park is said to be one of the best preserved 19th century ironworks in America.

Merle L. Thorpe, President, Thorpe Thermal Technologies, Inc., New London, CT, and ASM Trustee, gave a history of the facility, then presented the Historical Landmark plaque to James R. Bennett, Secretary of the State of Alabama; Jack Crouch, Chairman, Tannehill Furnace & Foundry Commission; and Tim Wuska, Chairman, ASM Birmingham Chapter Historical Committee, who nominated the site. The inscription on the plaque reads: "Founded in 1830 and known as the birthplace of the Birmingham Iron Industry, Tannehill became a major supplier of iron for cannons and naval plate to the Confederacy."

Edgar Thomson Plant of U.S. Steel Honored

ASM International has designated the **Edgar Thomson Plant** of U.S. Steel's Mon Valley Works, Braddock, PA, an ASM Historical Landmark. The Pittsburgh Chapter of ASM nominated the Edgar Thomson Plant, a site that has played a major role in the steel industry for more than a century.

During a trip to Europe in the summer of 1872, Andrew Carnegie took note of how easily and inexpensively European manufacturers produced steel rails using the Bessemer method. Carnegie decided to build his own Bessemer rail plant and

went to Pittsburgh to search for a site. He secured 107 acres of land at Braddock along the Monongahela River. Ground was broken for construction in April 1873 and, in a smart bit of sales promotion with an eye to future business, the plant was named the Edgar Thomson Works after J. Edgar Thomson, president of the Pennsylvania Railroad. Construction of the plant proceeded, and the first Bessemer blow was made on 26 August 1875, with the first rail rolled just six days later. The plant turned out 25 tons of steel per day.

By April 1901 the Edgar Thomson Plant had grown significantly since its opening because of the acquisition of new land, the erection of nine blast furnaces, and the construction of two ingot mold foundries, as well as other facilities. Throughout its operation, the plant evolved with the technology of the time. The Bessemer Converters were replaced by open hearths in 1913 and in the early 1970s, the open hearth operations were replaced in turn by the then-new oxygen converter facility. Then, in August of 1992 came the startup of the Edgar Thomson dual strand slab caster, the beginning of an era of high-tech steelmaking for U.S. Steel's Mon Valley Works. With this state-of-the-art facility, traditional ingot steel production is a thing of the past, moving steelmaking into the world of computers, lasers, and robotics.

The Edgar Thomson Plant has been at the forefront of technical innovation and commitment to excellence throughout its long and eventful history. It is among the oldest continuously operating steel plants in the world. Its history is that of the steel industry as a whole.

At the award presentation, ASM Managing Director Edward L. Langer provided background of the ASM Historical Landmark Awards Program. ASM Trustee Ash Khare gave a history of the plant and presented the ASM Historical Landmark plaque for the Edgar Thomson Plant of U.S. Steel's Mon Valley Works to John F. Kaloski, General Manager. The inscription on the plaque reads: "Built in 1873 by Andrew Carnegie, the Edgar Thomson Plant pioneered numerous technological advances in the production of quality steel products for the railroad, automotive and appliance industries."

NTSC'95 Exhibitors are Honored with Awards

Two exhibitors at the National Thermal Spray Conference won awards of excellence in the New Development Competition Showcase. **MetCon Thermal Spray** won for its AxiJet Plasma Spray System, and **SprayTech** won for its one-step fluoropolymer metal ceramic composite coatings.

The purpose of the National Thermal Spray Conference New Development Competition Showcase is to promote and recognize new developments in products, processes, and applications related to thermal spraying. Awards are presented for the most innovative developments and are judged on uniqueness, creativity, and the potential impact on the industry.

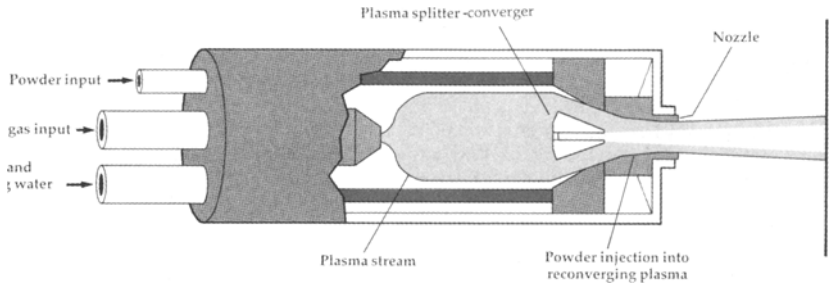
Axial Injection Plasma Spray

In the AxiJet system, a plasma stream is generated from a single cathode-anode, then is split into two individual plasma streams. The separate streams are then re-converged back into a single plasma jet within the torch nozzle. By splitting the initial plasma stream, a core region is created, and powder can be injected axially through an injection channel machined through the core. The use of a single plasma source makes the two converging plasma streams symmetrically equal and uniform. Also, the more uniform heating of the powder improves the bonding of the coating. Other axial injection systems generally provide for multiple sources, which can produce unpredictable, nonuniform, and unequal plasma streams that often result in deleterious effects on the coating quality.

Additional proprietary technology enables the system to generate extremely high arc voltages, in the range of 250 volts. This allows operation at relatively low currents of less than 400 A, which enable improved arc stability, thermal efficiency, and electrode life. Another advantage of the system is that it reduces powder injection difficulties. Powders are injected along the axial direction, in the direction of travel of the plasma jet. This eliminates the negative effect of radial powder injection on plasma laminarity, resulting in lower turbulence in the free-expanding plume outside the nozzle. It also results in extended isotherms and higher gas and particle velocity. Thus, reduced turbulence substantially increases plasma loading capacity and allows spray rates 100% to 200% higher than possible with conventional systems.

The nearly full entrainment of the powder stream within the plasma plume increases deposition efficiency by 50 to 80% compared with other thermal spray systems. Powder costs are reduced by 50 to 70%, and gas costs per square inch of coating are reduced by 50 to 60%.

For more information: D. Shane Herrington, President, MetCon Thermal Spray, Unit # 27, 2337 Townline Rd., Abbotsford, B.C., Canada V2T 6G1; Tel: (604) 852-4233; fax: (604) 852-6311.



In the Axi-Jet system, a plasma stream is generated from a single cathode-anode, then is split into two individual plasma streams. The separate streams are then re-converged back into a single plasma jet within the torch nozzle. By splitting the initial plasma stream, a core region is created, and powder can be injected axially through an injection channel machined through the core. This results in lower turbulence and faster spray rates

One-Step Composite Coatings

One-step fluoropolymer metal/ceramic composite coatings have been developed at Spray-Tech, Newtown, CT. The coatings are the result of a development project to replace the conventional two-step process, which is very expensive and cannot be applied on-site. Other limitations of the two-step process are that the surface layer wears off, and the fluoropolymer fills only surface pores rather than penetrating deeply into the coating.

The solution developed at Spray-Tech was to surround the fluoropolymer particles with a ceramic thermal barrier coating of proprietary composition. Fluoropolymer powders clad with high-temperature metals or ceramics are readily sprayable via high-temperature thermal spray processes. These clad particles withstand the effects of high-temperature plasma and deposit after blending with accompanying materials to form unique composite coatings.

A particularly unique feature of these coatings is that release properties improve when the surface is exposed to rubbing. Continuous rubbing spreads plastic over the surface, reducing wear and friction. Furthermore, the volume of fluoropolymer may be varied to change release properties, and the matrix material may be selected based on requirements for high wear resistance, corrosion resistance, or thermal conductivity. Matrix materials include alumina-titania, tungsten carbide, and nickel alloys.

Any of four fluoropolymers may be selected, depending on the application. For example, perfluoroalkoxy (PFA) is preferred for its excellent release and nonstick properties, and continuous service temperature of 260 °C (500 °F). Coatings containing ethylene tetrafluoroethylene (ETFE) could be used for applications requiring high wear resistance and low coefficient of friction. ETFE is extremely tough and abrasion resistant, and has good nonstick properties. Melting point is ~270 °C (520 °F), with continuous service temperature of 150 °C (300 °F). Coatings containing polytetrafluoroethylene (PTFE, DuPont Teflon S) may be used for applications requiring some release properties with good dry lubrication. Coatings containing Teflon S can be post-spray cured at temperatures as low as 180 °C (360 °F) to achieve maximum density and excellent corrosion resistance. A major advantage of this powder is that it emits no volatile organic compounds.

Fluorinated ethylene propylene (FEP) may be used for applications in the food and drug industry. FEP has the best nonstick and nonwetting characteristics of the four fluoropolymers, and could be FDA (Food and Drug Administration) approved when used with FDA-approved metal or ceramic-base coatings. Continuous service temperature is 200 °C (400 °F).

For more information: Frank N. Longo, SprayTech Inc., 15 Commerce Rd., Newtown, CT 06470; Tel: (203) 426-5112; fax: (203) 426-5498.

News from NASA

Testing and Analysis of Rubbing of Turbine-Blade Tips

A unique combination of established techniques of experimentation and theoretical analysis has been devised to study the stresses induced in turbine blades by intermittent or periodic rubbing of the tips of the blades in turbine housings. Rubbing is an inevitable consequence of modern high-speed, high-efficiency turbine designs, which call for blade-tip clearances to be as small as possible. This is because thermal and centrifugal growth of blade-tip radii during operation sometimes reduces the already small blade-tip clearances to zero. It is necessary to quantify the stresses caused by rubbing in order to predict the fatigue lives of the blades.

In the initial application, the theoretical analysis involved time-domain numerical simulation of the responses of the blade to various rubbing excitations. For this purpose, the blade was represented by a conventional, linearly responding finite-element mathematical model. The simulated rubbing excitation was a once-per-revolution half sine pulse of tangential force at the blade-tip/housing seal interface, with a duration equal to the tip/housing contact time. Between excitatory pulses the simulated tangential force on the tip was zero.

In a parametric study, these computations were performed to map the response of the blade as a function of the length of the rubbing-contact arc and the speed of rotation of the turbine shaft. For each pair of values of these parameters, the simulation of dynamic response was continued until a steady-state dynamic motion was reached—typically in 30 to 40 revolutions. Figure 1 shows some of the results of this parametric study.

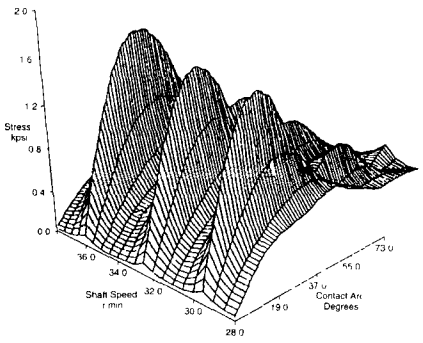


Fig. 1 Stress at the root of the blade shank was computed as a function of speed and contact arc in a parametric numerical simulation study of the dynamic response

The experimental part of the effort involved the construction of a unique testing apparatus (see Fig. 2), A turbine rotor was instrumented with strain gages on its blades, and slip rings were used to pass the outputs of the gages to external tape recorders. A simulated tip-seal segment of a housing was connected to a hydraulic actuator coupled with a control system and a displacement transducer. The motion of the tip-seal segment could thus be controlled precisely, In the tests, the turbine was driven at speeds up to 32,700 rpm. and the tip-seal segment was moved in to

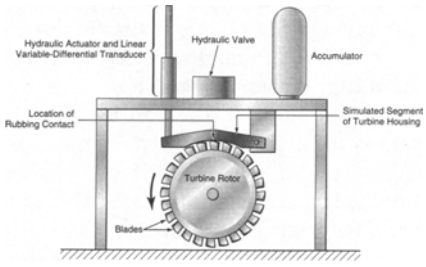


Fig. 2 The testing apparatus simulates blade-tip rubbing and measures responses of the blades.

effect rubbing contact for short periods of time. The results of tests verified analytical predictions that the dynamic behavior consists of once-per-revolution rubs alternating with periods of free vibrations.

This work was done by Gary A. Davis and Ray C. Clough of Rockwell International Corp. for Marshall Space Flight Center, AL. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-29981. (Article extracted from *NASA Tech Briefs,* Vol 19 [No. 10], 1995, p 85-86.)

Dynamic Light Scattering with Improved Fiber-Optic Probes

Improved fiber-optic probes have been developed for use in dynamic light-scattering measurements. More particularly, the probes are intended for measuring dynamic backscattering of laser light from concentrated suspensions of particles in liquids, for the purpose of determining statistical distributions of sizes of the particles. Such determinations are important for monitoring and controlling many industrial processes.

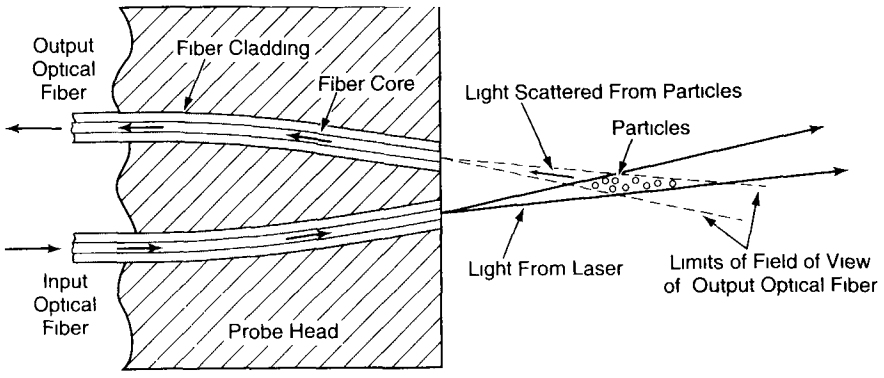
Conventional light-scattering apparatuses are too bulky and delicate for routine use in hostile environments like those of industrial processes. Furthermore, conventional systems yield useful data on dilute suspensions only; the large amount of multiple scattering of light in concentrated suspensions complicates the light-scattering physics to such a degree that there is no practical way to interpret the light-scattering data correctly.

Fiber-optic probes offer the obvious advantages of compactness and ruggedness and are thus more suitable for industrial environments. Fiber-optic probes can even be immersed in the suspensions to be characterized. The associated lasers, photodetectors, and signal-processing circuits can be located remotely in safer environments, coupled to the probes via optical fibers.

With improved fiber-optic probes, the backscattering regime of operation was chosen because the receiving and detection paths traveled by the photons are so short that the amount of multiple scattering is negligible in the back-scattering direction. A fiber-optic probe of older design contains a single optical fiber that both carries the laser light into the scattering medium and carries the scattered light back to the photodetectors. Many problems are associated with this design, and they include mechanical complexity and fragility.

In a fiber-optic probe of the improved type, there are two monomode optical fibers: one fiber carries the laser light into the scattering medium, while the other carries the scattered laser light to a photomultiplier. A digital correlator computes the temporal correlation of intensities as represented by the photon-pulse-train output of the photomultiplier. Inversion of the autocorrelation data leads to the particle-size distribution.

The use of two fibers makes it possible to measure backscattering at an angle that differs enough from 180° to eliminate the scattered-light/laser-light ambiguity, yet is close enough to 180° to suppress multiple scattering. Also, by choice of both the angle and the distance between fibers, one can select not only the scattering angle but also the location of the center of the scattering region at the intersection of the optical axes of the two fibers.



Particles illuminated via the input fiber scatter light in various directions, including toward the output fiber. Particle-size distributions can be determined from dynamic light-scattering measurements.

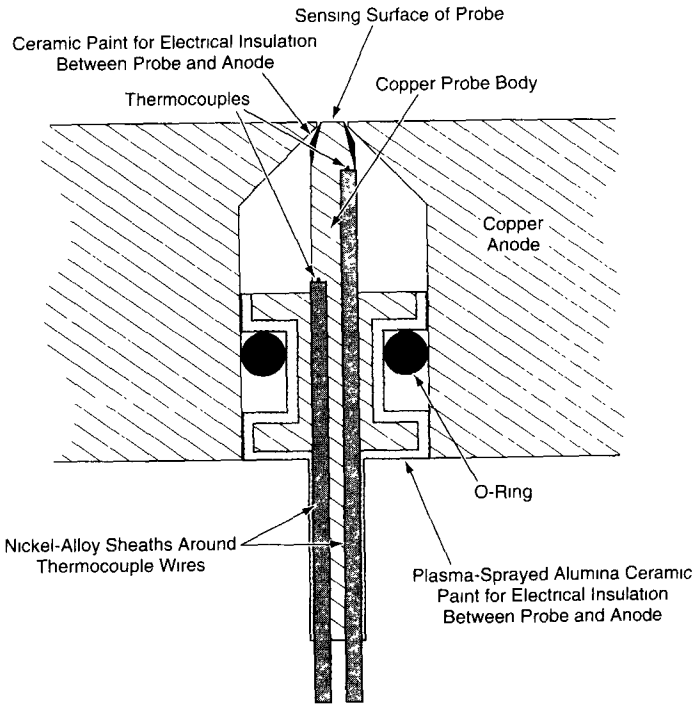
This work was done by Harbans Singh Dhadwal of the State University of New York at Stony Brook, Rafat R. Ansari of Case Western Reserve University, and William V. Meyer of the Ohio Aerospace Institute for Lewis Research Center, Cleveland, OH. For further information contact Walter Kim, Lewis Research Center; Tel: (216) 433-3742, e-mail: wskim@lims01.lerc.nasa.gov. Refer to LEW-15461. (Article extracted from *NASA Tech Briefs,* Vol 19 [No. 9], 1995, p 86.)

Measuring Fluxes of Heat to a Plasma-Arc Anode

Three probes have been constructed to provide measurements indicative of the conductive, convective, and radiative transfer of heat from a free-burning plasma arc to a water-cooled copper anode used in generating the arc. During a plasma experiment, one of these probes is installed in a cavity in the anode, with the sensing surface of the probe flush with that surface of the anode that faces the plasma (see figure on next page). The probe is electrically insulated from the anode; the potential of the probe is allowed to float at the potential of the plasma so that there is no spurious heating of the probe by impact of electrons.

Each probe consists mainly of a copper body with two thermocouples embedded at locations 4 mm apart along its length. The thermocouples provide a measure of the rate of conduction of heat along the probe and thus the transfer of heat from the plasma to the sensing surface at the tip of the probe. The three probes are identical except that the sensing surface of one is uncoated and the sensing surfaces of two of them are coated with different materials to make them sensitive to different components (conductive, convective, and radiative) of the overall flux of heat.

The probe with the uncoated (copper) tip is designed to absorb the same conductive, convective, and radiative fluxes of heat as does the surrounding area of the anode. The tip of one probe is coated with platinum to make it sensitive primarily to the conductive and convective fluxes. The tip of the third probe is coated with carbon black to make it absorb nearly all of the incident radiant



A heat-flux-measuring probe (one of nearly three identical probes) is installed in an anode to measure some of the components of the flux of heat from a plasma to the anode

flux plus the same conductive and convective flux as that into the platinum-coated probe. The conductive, convective, and radiative fluxes of heat to the anode can be computed by computing differences among the heat-flux readings of the three probes.

This work was done by John M. Sankovic of Lewis Research Center and James A. Menart, Emil Pfender and Joachim Heberlein of the University of Minnesota. For further information contact Walter Kim, Lewis Research Center; Tel: (216) 433-3742, e-mail: wskim@lims01.lerc.nasa.gov. Refer to LEW-16076. (Article extracted from *NASA Tech Briefs,* Vol 19 [No. 9], 1995, p 88.)

Wire-Arc-Sprayed Aluminum Protects Steel against Corrosion

Aluminum coatings wire-arc sprayed onto steel substrates have been found to be effective in protecting the substrates against corrosion. These aluminum coatings also satisfy stringent requirements for adhesion and flexibility, both at room temperature and at temperatures as low as that of liquid hydrogen [–423 °F (–253 °C)]. The wire-arc-sprayed aluminum coatings were developed as alternatives to corrosion-inhibiting primers and paints that are required by law to be phased out because they contain and emit such toxic substances as chromium and volatile organic compounds.

Wire-arc spraying offers important advantages over other thermal deposition processes and over painting. Unlike in painting, there is no need for drying or curing time, In comparison with other thermal processes, the substrates can be kept at relatively low temperatures, and rates of deposition are high.

An aluminum coating forms a galvanic cell with a steel substrate, the steel acting as the cathode and the aluminum as the anode. In this arrangement, the aluminum corrodes preferentially, thus protecting the steel. In an experiment, aluminum coatings were wire-arc-sprayed on plates and on a duct made of 21-6-9 corrosion-resistant steel, then the plates and duct were tested as follows:

- Adhesion and flexibility at room temperature. The aluminum coating did not crack when the plate was bent around a mandrel of 0.3 in. (7.6-mm) diameter. The plate was then subjected to a tape-pull test, and the coating continued to adhere.
- Adhesion and flexibility at low temperature, A plate submerged in liquid nitrogen at –320 °F, (–196 °C) was bent around a mandrel of 2.8 in. (71 mm) diameter without cracking or loss of adhesion of the aluminum coat.
- Resistance to corrosion. Plates survived 120 days in a salt fog, without corrosion or pitting of the substrate.
- Thermal shock. By turning a flow of liquid hydrogen on and off, the duct was thermally cycled to –423 °F (–253 °C) 17 times in 16 hours. The aluminum coating did not crack or lose adhesion.

The optimum aluminum-coating thickness has been found to lie between 0.004 and 0.008 in. (between 0.1 and 0.2 mm). Thicker coats are less flexible and tend to blister in salt-fog tests. Grit blasting to prepare substrates for adhesion of wire-arc sprayed aluminum is unnecessary and may be unacceptable in situations in which substrates are required to be smooth; hand sanding has been found to result in the required degree of adhesion.

This work was done by Frank R. Zimmerman and Richard Poorman of Marshall Space Flight Center, AL, and Heather L. Sanders, Timothy N. McKechnie, James W. Bonds, Jr., and Ronald L. Daniel, Jr., of Rockwell International Corp. Inquiries concerning rights for the commercial use of this invention should be addressed to the Patent Counsel, Marshall Space Flight Center; (205) 544-0021. Refer to MFS-30044. (Article extracted from *NASA Tech Briefs*, Vol 19 [No. 9], 1995, p 94.)