ENGINEERING MATERIALS & TECHNOLOGY

RESOURCES ON CD-ROM

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Abstract

This paper presents a new CD-ROM, (*EMSET2*, ISBN 0-13-030534-0) which provides useful resources for courses in engineering and technology. A product of a fifteen-year effort, this CD contains hundreds of demonstrations and experiments which have been classroom tested and peer reviewed. These resources are available in the popular Adobe Acrobat PDF format, accessible thorough the Acrobat Reader, which is included. The contents are useful for such courses as materials science, materials technology, mechanics and strength of materials, as well as for pre-college level course and school visitations. Additional PDF-formatted resources on the CD-ROM include a short course on Microscopy of Fiber-Reinforced Polymer Composites, an Image Gallery showing materials, applications photos, photomicrographs of a wide range of materials, a structural models gallery, and related web site hyperlinks. There is also a section on how we made the PDFs. The manner in which the demonstrations and experiments are written provides useful tips on securing supplies and construction of devices. Topics include Structure, Testing & Evaluation, Metals, Polymers, Ceramics, Composites, Electronic & Optical Materials, as well as ideas for Materials Curriculum development.

Background - Annual NEW:Updates & Publications

The National Educators' Workshop (NEW:Update) series of workshops has been in existence since 1986. NEW:Update workshops focus on strengthening materials education through technical updates and publication of laboratory experiments and demonstrations for materials science, engineering and technology, involving new and traditional content in the field.

The National Aeronautics and Space Administration (NASA), the Department of Energy (DOE), National Institute of Standards and Technology (NIST), and Norfolk State University (NSU), have provided the major funding for these workshops. Joining in support are the American Society for Engineering Education, ASM International, American Society for Testing & Materials, Battelle Pacific Northwest Laboratory, Boeing Airplane Company, Ford Motor Company, Martin Marietta Energy Systems, Inc, The International Council for Materials Education, Oak Ridge National Laboratory, DaimlerChrysler, General Motors and Gateway Coalition.

Workshop participants witness presentation of experiments and demonstrations, developed by faculty, scientists, and engineers throughout the United States. They discuss issues of MSE (materials science and engineering) with people from education, industry, government, and technical societies, and hear about new MSE developments. Half-day mini workshops in small groups are conducted in state-of-the-art laboratories

at the host laboratories including NASA Langley Research Center, National Institute of Standards and Technology, Oak Ridge National Laboratory, Los Alamos National Laboratory, Boeing Airplane Company-Seattle, Columbia University/Brookhaven National Laboratory, University of Michigan/DaimlerChrysler.

An extensive peer review process of experiments is followed. After submission of abstracts, selected authors are notified of their acceptance and given the format for submission of experiments. Experiments are reviewed by an international panel through the cooperation of the International Council for Materials Education. Authors receive comments from the panel prior to workshops allowing them to make necessary adjustments to their experiments. Participants who attend NEW:Updates, observe demonstrations of the experiments and provide critiques for the authors to make further modifications prior to this publication. Final editing and publication of the annual workshop proceedings has been done by the publication staff of the National Aeronautics and Space Administration.

The CD-ROM Compendium

After several years of NEW:Update Workshops and the popularity and increasing number of the experiments resulting from the workshops, the organizing committee, with assistance from the Materials Division of ASEE, began work on a compendium of selected experiments. Support for this collection came from a broad range of individuals, agencies, and technical societies, much like the support for the NEW:Updates Workshops themselves.

The original idea aimed to produce hard copies of about 50 selected experiments. However, at NEW:Update 94, Alfred and Evelyn McKenney and Robert Berrettini presented a concept by which all experiments could be placed on a CD-ROM in a format that would provide materials educators an easy way to find and use any of the experiments. Additionally, instructors could customize the experiments to meet their students' needs. After further research on methodology and efforts to secure funding, we were able to put together a project that used several sources of funds, much volunteer help and resources, and a publisher who would produce and package the *Experiments in Materials Science, Engineering and Technology (EMSET)* CD-ROMs from the master and distribute them.

The structure of *EMSET* allows materials educators to manipulate individual papers in a variety of ways for either hard copy or digital output. They can edit their selection to fit their own environment and to suit their students' needs. The first edition of *EMSET*, containing papers from the first decade of the Workshops, was released in 1997. This second edition, *EMSET2*, containing an additional three years of papers and expanded teaching content, was published in the fall of 2000.

EMSET2 might also be used as a resource by students in independent study.

EMSET2 Content

EMSET2 contains three major sections as shown on the Main Menu (Fig 1).

The INTRODUCTION TO *EMSET2* section contains further information about *EMSET2*'s content, contributors and provides help in getting started.

The ADDITIONAL RESOURCES section contains supplemental teaching material. Examples are shown below.

The EXPERIMENTS & DEMONSTRATIONS section contains over 400 demonstrations and experiments. It is the heart of the NEW:Update workshops and the *EMSET2* CD-ROM and is further described below.

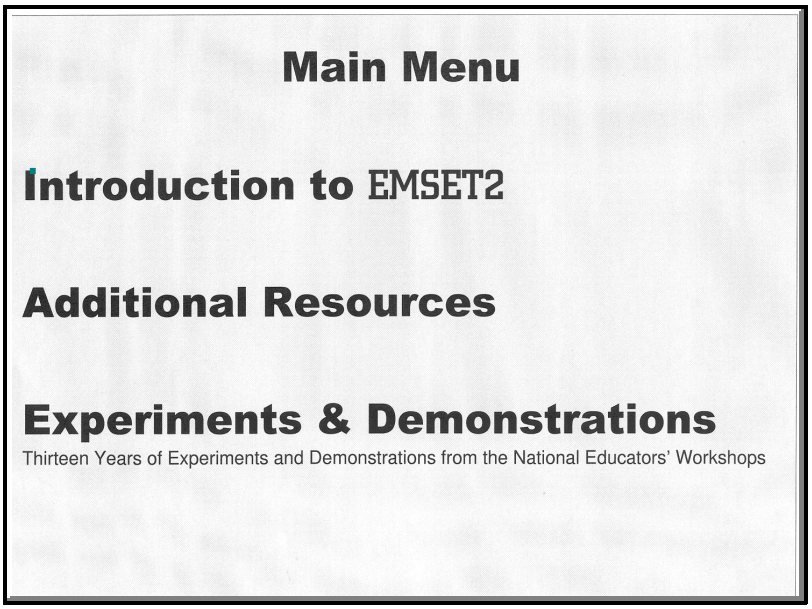


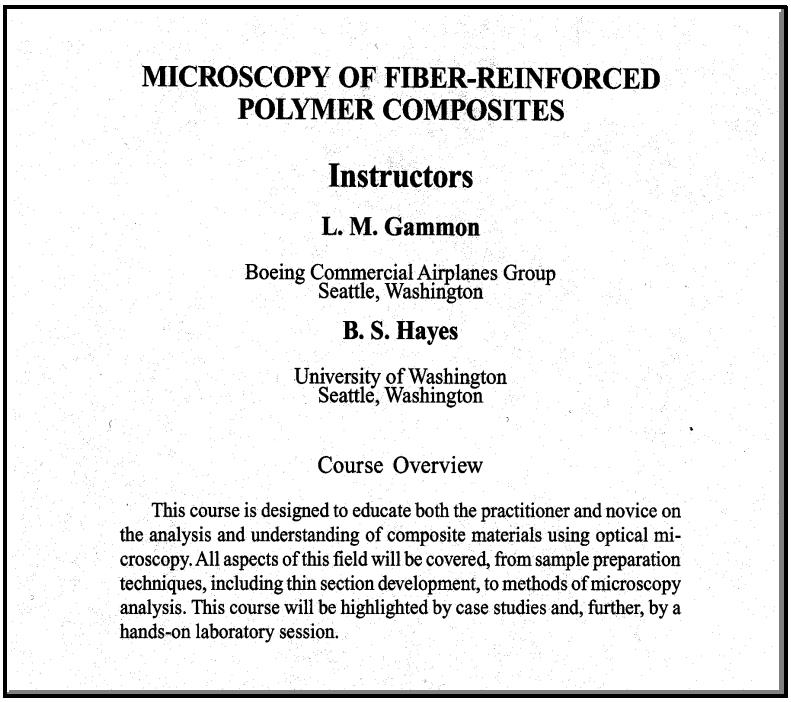
Fig 1 - Main Menu

While it is difficult to demonstrate the richness of the teaching resources contained in *EMSET2* in a brief space, we will present some description and examples of its content over the next few pages.

The Additional Resources Section

This section contains a wide range of material aimed at providing instructors with additional resources to supplement their classroom curriculum. This material ranges from a short course on microscopy for advanced composite materials, an extensive listing of relevant web sites, through applications of materials, photos, photomicrographs, structures and models.

There are examples on this page and the next (Figs 2, 3 and 4).


MICROSCOPY OF FIBER-REINFORCED POLYMER COMPOSITES

Instructors

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Course Overview

This course is designed to educate both the practitioner and novice on the analysis and understanding of composite materials using optical microscopy. All aspects of this field will be covered, from sample preparation techniques, including thin section development, to methods of microscopy analysis. This course will be highlighted by case studies and, further, by a hands-on laboratory session.

Fig 2 - A Short Course on Microscopy of Fiber-Reinforced Polymer Composites

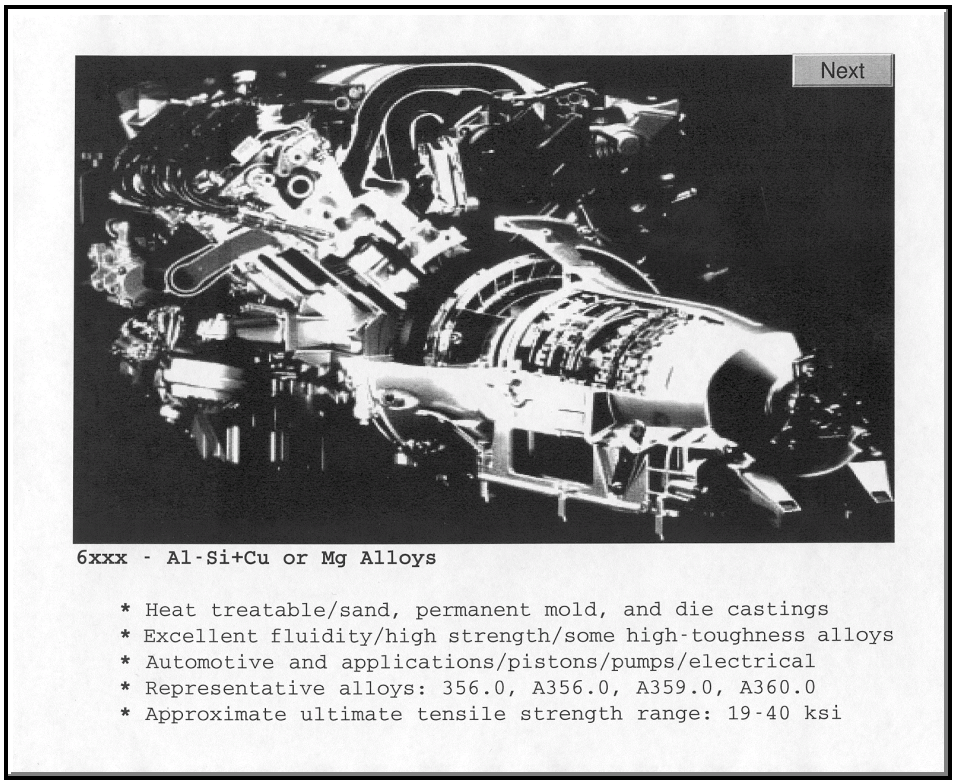

Fig 3 - Application of Materials in the Automotive Industry

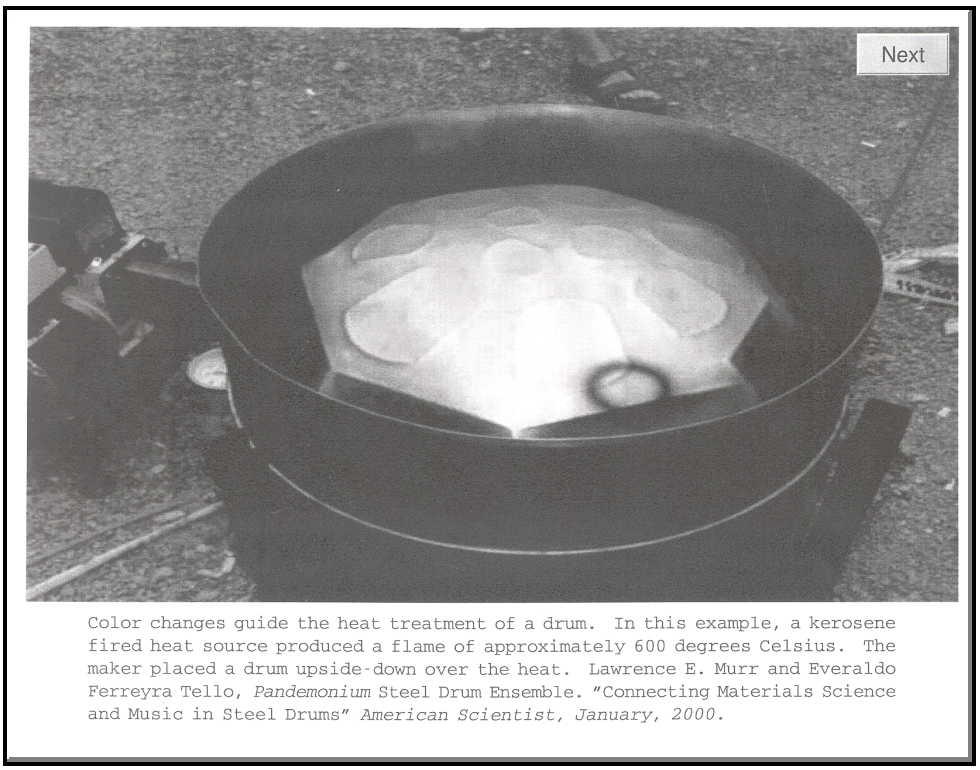

Fig 4 - Application of Materials in the Field of Art

The Experiments & Demonstrations Section

This section is the heart of the publication. It includes over 400 experiments and demonstrations in PDF format from the annual NEW:Update workshops. They have been reproduced in their original peer-reviewed form, preserving the individuality among the papers and reflecting the author's style and method.

The TABLE OF CONTENTS (FIG 5) classifies the papers into seven categories: Structure, Testing & Evaluation, Metals, Polymers, Ceramics, Composites, Electronic & Optical Materials and Materials Curriculum.

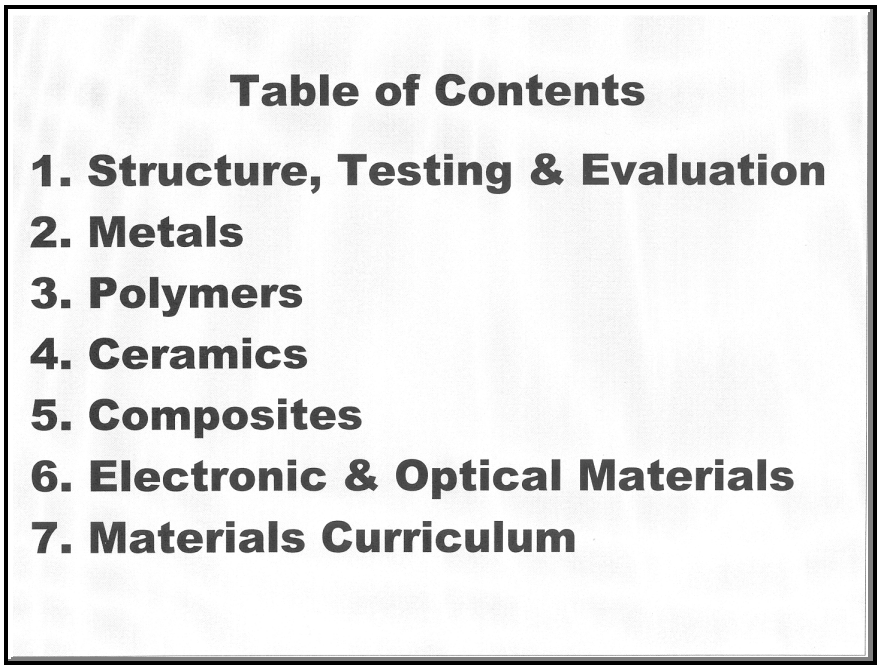

Fig 5 - Table of Contents

To find desired document(s) the user can:

- Browse the Table of Contents which is organized by types of materials or processes, or
- Use the full Text Search capability, searching by:
  - Author
  - Title
  - Subject
  - Text words in context

The PDFs are indexed for full text search when using the ADOBE™ ACROBAT READER (WITH SEARCH) program. Enabling the "word stemming" and "sounds like" features allows the greatest freedom in locating the content desired.

While the detailed Table of Contents can also be scanned to find the material desired, the user will probably use the Full Text Search more often because the subject matter of papers sometimes fits into more than one category.

Once the desired paper is located, the ACROBAT READER gives the user the ability to:

- View an exact image of the original paper, or
- Print complete or selected parts of the paper, or
- Edit it by copying to a word processor in a new or existing document or by using the Adobe Acrobat program.

This page illustrates the power of the “word stemming” capability. The search word “hardness” (Fig 6) finds such occurrences as “harden,” and “hardening (Fig 7).”

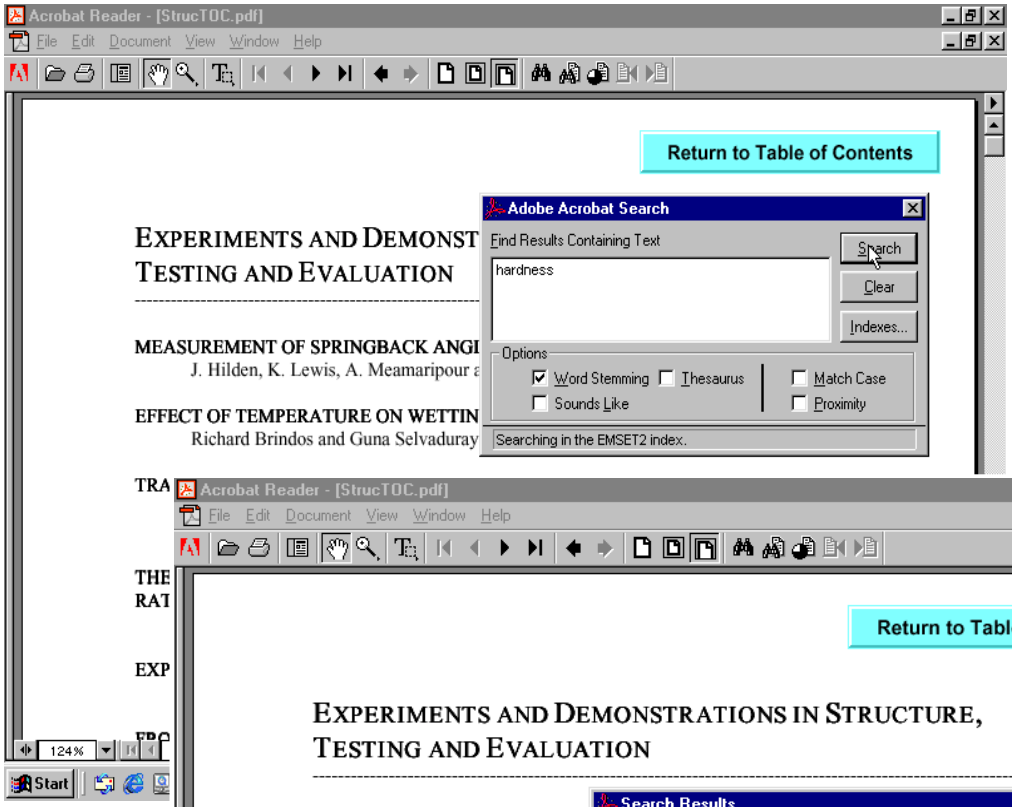

Fig 6 - Search

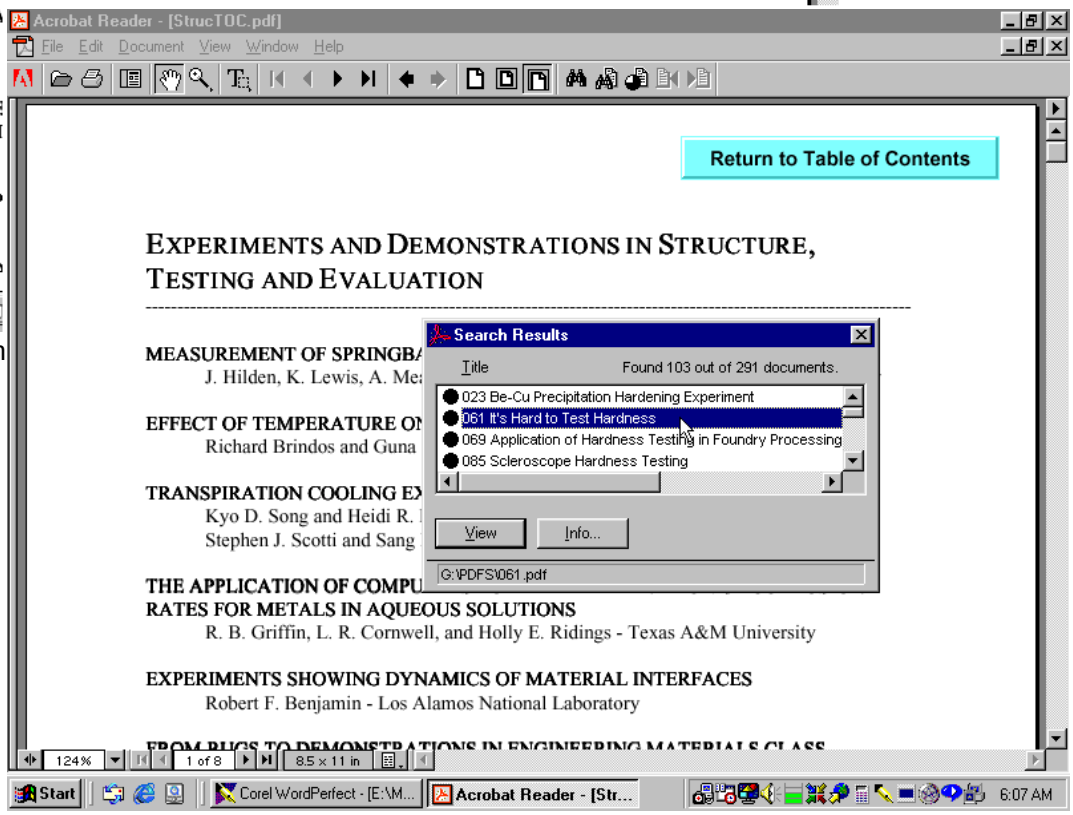

Fig 7 - Showing some of the Full Text Search results for “hardness,” using Word Stemming

Display of the first screen of the highlighted paper is shown on the next page (Fig 8).

Using the Papers

In many cases, the instructor will probably use the experiments as they were published.

However, it may sometimes be desirable to edit a paper for a particular need, even combining it with other papers. The easiest way is to use Adobe Acrobat (not the Reader) program. However, if this program is not available, there are two other methods of editing to chose from:

- Print the paper, then cut and paste as needed, the old-fashioned way, or
- Copy blocks of text and graphics to the clipboard, then paste into a word processor or graphics program.

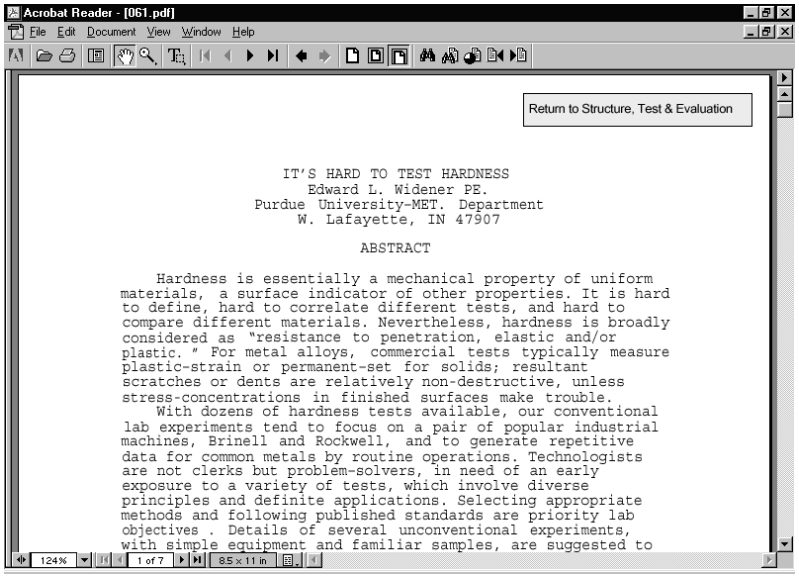

Fig 8 - A Selected Paper on hardness, Ed Widener's, *It's Hard to Test Hardness*

When all of the desired material has been copied into the word processor, the instructor can create additional material to suit the specific needs of his or her class. Figure 9 is an example of a data sheet which could accompany the paper on "hardness."

TMD145

Brinell Hardness Test Data Sheet

Student Name _____ Date _____

Sample #	Material Description	Load (Kg^F)	Dent Dia (mm)	BHN
1				
2				
3				
4				
5				

Fig 9 - A Locally-created Student Data Sheet

Fair Use and Credit

This CD-ROM resulted from scores of people contributing experiments and demonstrations to the annual National Educators Workshop:Updates in Engineering Materials, Science, and Technology (NEW:Updates). Their names are listed with their experiments on the CD-ROM, as are the many other people and agencies who helped in this project. Cooperative funding among private industry, academia, and NASA allowed for production of the CD-ROM master, with the understanding that production and distribution would be done by a publisher. Prentice-Hall, Inc. agreed to become the publisher.

Faculty have the right to copy, cut and paste papers from the *EMSET2* CD-ROM to suit their needs. However, users should give credit to the original authors.

Getting Started

To assist in finding the way around *EMSET2*, the user may wish to print out the *Getting Started* section to use as a reference. To do this, select the GETTING STARTED button from the Introduction Menu. After *Getting Started* appears, select and execute PRINT from the File Menu.

References

Gardner, James E, Ginger L Freeman, James Jacobs and Don Parkin (July, 1997) *National Educators' Workshop:Update 96, Standard Experiments in Engineering Materials, Science and Technology, NASA Conference Publication 3354*

Gardner, James E, Ginger L Freeman, James Jacobs, Alan Miller and Brian Smith (November,1998) *National Educators' Workshop:Update 97, Standard Experiments in Engineering Materials, Science and Technology, NASA Conference Publication 1998-208726.*

Arrington, Ginger L F, James E Gardner, James K Jacobs, Karl J Swyler and Leonard W Fine (October,1999) *National Educators' Workshop:Update 98 Standard Experiments in Engineering Materials, Science and Technology, NASA Conference Publication-1999-2-09549*.

Jacobs, James A and Alfred E McKenney (2001) *Experiments in Materials Science, Engineering and Technology, 2nd Edition (EMSET2)* CD-ROM, ISBN 0-13-030534-0.Prentice-Hall, Inc.

URL: http://www.PrenHall.com or phone 1-800- 922-0579 to obtain an examination copy of the *EMSET2* Demonstration CD-ROM , ISBN 0-13-019475-1.

URL: http://MST-OnLine.nsu.edu/new for more information about the annual NEW:Update workshops or an on-line demonstration of the *EMSET2* CD-ROM .

Biographies

JAMES A JACOBS is Professor of Engineering Technology at Norfolk State University. He developed the concept and has been co-director of all the NEW:Updates. He has thirty-three years of teaching experiences in public schools, community colleges, and universities. He has developed curricula offerings at all three levels, including courses in material science, materials and processes technology, engineering materials technology, and principles of manufacture. He has industrial experience with Westinghouse Corp., Tenneco, Ford Motor Co., and completed an intensive ten-week program with International Business Machines Manufacturing Technology Institute.

He is the author of numerous articles, books, and technical papers and presentations. Dr. Jacobs co-authored *Engineering Materials Technology,* now in its third edition, and the CD-ROM set, *Experiments in Materials Science, Engineering and Technology,* both published by Prentice-Hall Inc. He has been involved as consultant and director with numerous grants, seminars, and curriculum development efforts in engineering materials, manufacturing, robotics and CAD/CAM.

Professor Jacobs is a member of the International Council for Materials Education, ASM International, Society of Manufacturing Engineers, American Society for Engineering Education, American Association of University Professors, American Ceramics Society, and is a Certified Senior Technologist and member of the National Association for Industrial Technology.

ALFRED E McKENNEY received his BS in engineering from the US Coast Guard Academy. After service as a line officer, he earned his MBA at Harvard Business School. He was employed by IBM where he specialized in the design of large manufacturing planning and control systems. He was later assigned on a sabbatical to the School of Technology at Norfolk State University where he taught for four years. He continues to work on NEW:Update and is Project Manager for the *Experiments in Materials Science, Engineering and Technology* CD-ROM.