# *Engineering and Technology Laboratory Experiments*

James A. Jacobs
School of Science & Technology
Norfolk State University

**Abstract**

**NEW: Update 2001** builds on 15 years of annual workshops aimed at improving engineering, science, and technology. This Year's workshop was a part of the National Institute of Standards & Technology's (NIST) 100th anniversary celebration. This session provides demonstrations of a sample of experiments presented at the workshop. The **NEW:Update** series has provided over 2560 materials educators with the latest developments in material science and technology while offering strategies for improving teaching. These **NEW:Update** participants have seen about 500 experiments and demonstrations presented live or on videotape and have been provided with supplemental notes for replicating the experiments. Peer review and publication of the experiments and demonstrations have provided the materials education community with current, valuable aids for teaching and research. More than 400 of those experiments are available on ***EMSET2 CD-ROM.***

**Introduction**

This Materials Division session provides a small sampling of experiments for engineering and technology taken from 37 that were presented to the 2001 National Educators' Workshop (NEW:Update 2001). National Institute of Standards and Technology invited us to conduct the 16th annual NEW:Update in celebration of NIST's Centennial. Unfortunately, security restrictions resulting from the September 11, 2001 terrorist attack required moving NEW:Update 2001 to the University of Maryland. As a result of the excellent coordination of Professor Isabel Lloyd and the Chemical and Materials Engineering Department at Maryland along with researchers from NIST coordinated by Said Jahanmir, NEW:Update 2001 proved to be another successful workshop.

**NEW:Updates** - The National Educators' Workshop (NEW:Update) series of workshops has been in existence since 1986. NEW:Updates 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), 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 and other countries. 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.

We use an extensive peer review process of experiments. 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. The publication staff of the National Aeronautics and Space Administration has done final editing.

**A Useful Supplement for Materials, Mechanics and other Engineering Courses**

NEW:Updates provide an excellent forum for faculty to share ideas and resources. Many of us desire simple class demonstrations and laboratory experiments as well as images and video clips that we can project on a screen which related to new and emerging technology as well as website to keep content current. After several years of NEW:Update Workshops and the popularity of the experiments resulting from the meetings, 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. After considerable research on methodology to present the results of NEW:Updates, 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 & Technology CD-ROM* (*EMSET*)*.

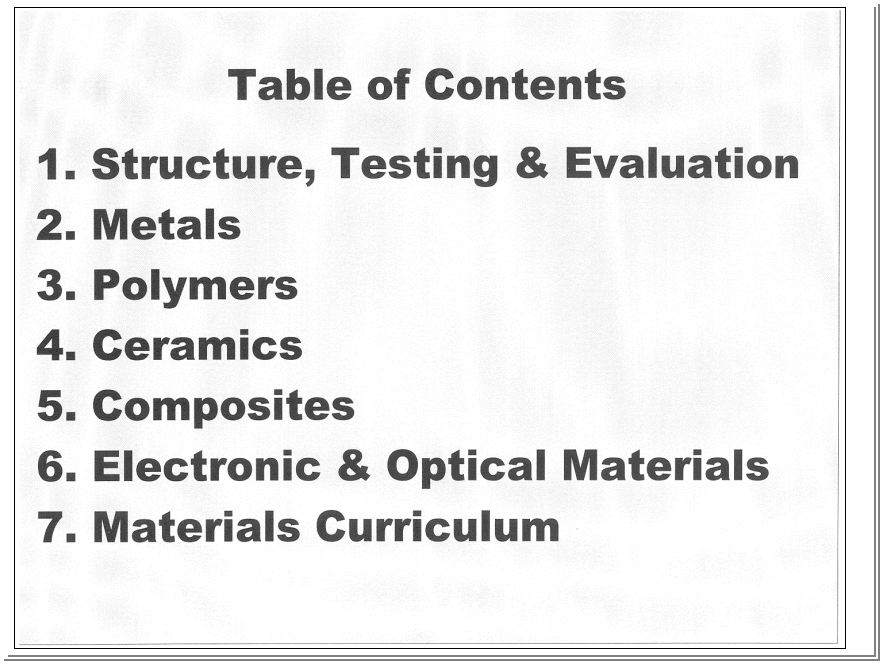
Now in its 2nd edition, the structure of *EMSET2* allows materials educators to manipulate individual papers in a variety of ways for either hard copy or digital output. They can edit their selection to fit their own environment and to suit their students' needs.

**Using EMSET2**

***EMSET2* Content -** The *EMSET2 CD-ROM* contains three major sections:
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 including photo galleries with many photomicrographs, "A Short Courses on Microscopy of Fiber-Reinforced Polymer Composites" and many urls of engineering and technology websites.

The EXPERIMENTS & DEMONSTRATIONS section contains over 400 demonstrations and experiments. It is the heart of the NEW:Update workshops.




**Experiments & Demonstrations Section-**
This section 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 Content classifies the papers into seven categories shown on the right. One can view the titles and or search the CD for desired content.
To find the document(s) meeting your needs, the user can:

- Browse the Table of Contents which is organized by types of materials or processes, or

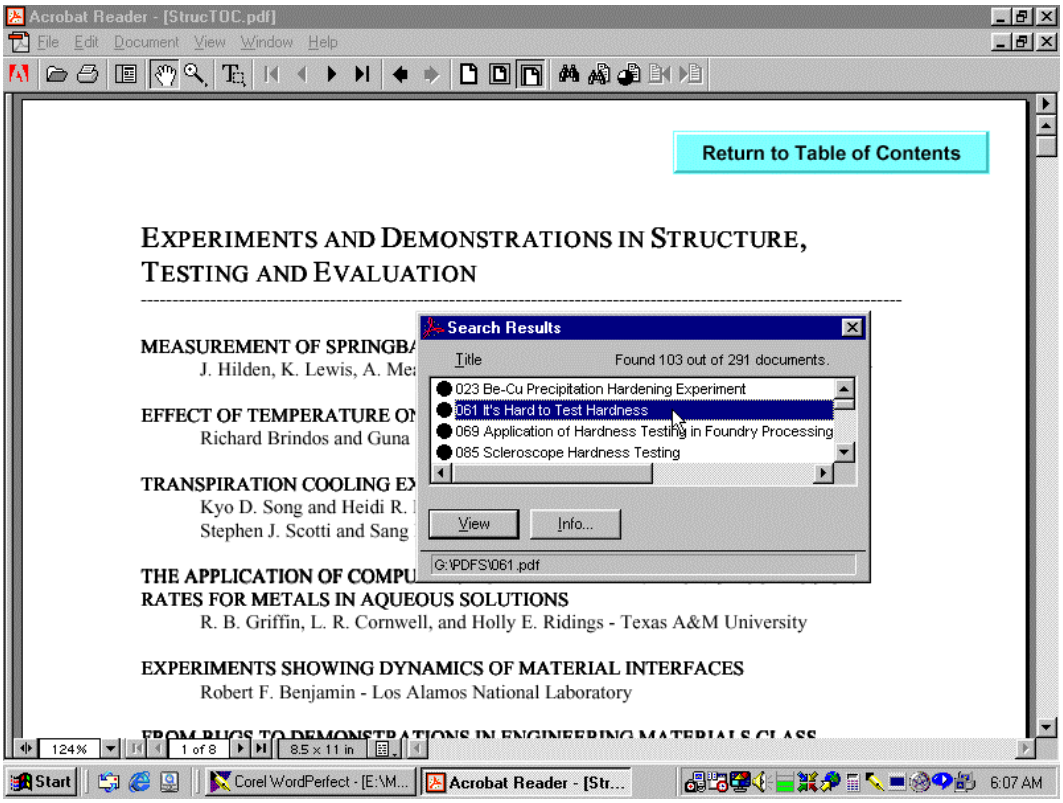
- Use the full Text Search capability, searching by:
  - Author
  - Title
  - Subject
  - Text words in context

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 it in its entirety or by selecting parts of the paper, or
- Edit it by copying to a word processor in a new or existing document or by using the Acrobat Exchange program.

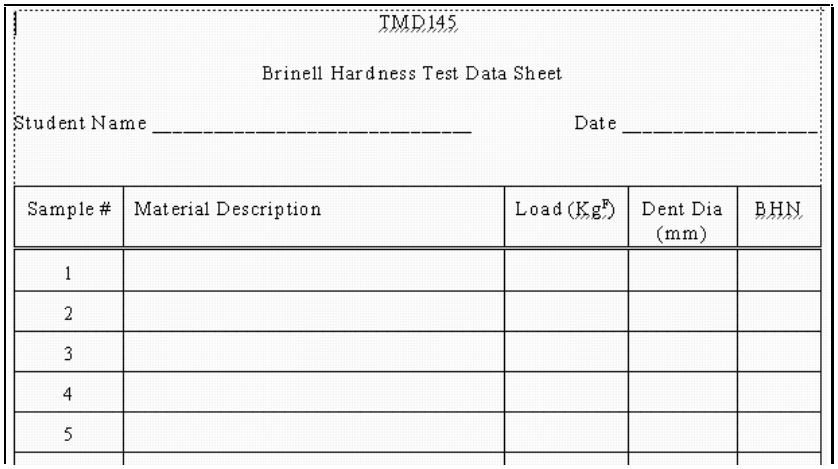
This page illustrates the power of the word stemming capability. The search word “ hardness” finds such occurrences as “harden”, and “hardening”




Selection of the first page of the highlighted paper is shown below.

- Using the Papers

In many cases, you will probably use the experiments as they were published. However, you may sometimes wish to edit a paper for a particular need, even combining it with other papers. You can use the Acrobat Exchange program. However, if you do not have access to this program, there are two other methods of editing to chose from:



TMD145

Brinell Hardness Test Data Sheet

Student Name _____ Date _____

| Sample # | Material Description | Load ($Kg^P$) | Dent Dia (mm) | BHN |
|---|---|---|---|---|
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |
| 4 | | | | |
| 5 | | | | |

- Print the paper then cut and paste as needed. You all know how to do this. - or, Copy blocks of text and graphics to the clipboard, then paste into a word processor or graphics program.

When all of the material desired has been copied into the word processor, the instructor can create additional material to suit the specific needs of his or her class. The sample data sheet above could accompany the paper on “hardness”.

## Acknowledgments and Fair Use

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 has the right to cut and paste papers from the CD-ROM to suit their needs. However, users should give credit to the original authors.

## *EMSET2* in the Classroom

The above tutorial provides steps for integrating experiments into the laboratory environment. The wide range of experiments on the CD ROM developed by scores of faculty and industry specialists help to keep labs current. However, often introductory courses such as engineering materials, statics or thermodynamics, especially in community colleges, do not use laboratories. *EMSET2* also has resources for the classroom.

In the Photo Gallery with many useful images with sound, I select from them to project onto the screen to supplements my discussion. In the Relevant Web Sites section, I

access from numerous URLs to take students into websites with streaming video, more photomicrographs and other useful graphics and information. CAUTION: Be sure to check these out before hand class; due to the ever changing nature of the web some may note be available.

Demonstrations in Class - I also find many useful demonstrations on the CD ROM which require little time but effectively supplement my discussion. Some examples from scores include Bob McCoy's, " How a Heat Pack Works", Alan Karplus's, "Kraft Stick [Popsicles sticks] Beams" and Jim Masi's, "Bubble Rafts, Crystal Structures and Computer Animation"

_____

* To order *Experiments in Materials Science, Engineering and Technology, 2nd Edition (EMSET2) CD ROM,* ISBN 0-13-030534-0 from Prentice-Hall, Inc. by phone call 1-800-922-0579 or e-mail Melissa_Osborn@prenhall.com or go to www.prenhall.com.

## BIBLIOGRAPHICAL INFORMATION


Prior, Edwin J., James E. Gardner, James A. Jacobs and Louis A. Luedtke and (August, 2001) *National Educators' Workshop:Update 2000 Standard Experiments in Engineering Materials, Science and Technology, NASA Conference Publication- CP-2001-211029.*

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.


***JAMES A JACOBS***

He developed the concept and has been co-director of all the NEW:Updates. He has thirty-five years of teaching experiences in public schools, community colleges, and universities. He co-authored *Engineering Materials Technology*, now in its 4th edition, and the CD-ROM set, *Experiments in Materials Science, Engineering and Technology* both published by Prentice-Hall Inc.