OVERVIEW OF THE LDEF MSIG DATABASING ACTIVITIES

Joan G. Funk
NASA Langley Research Center
Hampton, Va 23681-0001
Phone: 804/864-3092, Fax: 804/864-4449

ABSTRACT

The Long Duration Exposure Facility (LDEF) and the accompanying experiments were composed of and contained a wide variety of materials, representing the largest collection of materials flown in low Earth orbit (LEO) and retrieved for ground-based analysis to date. The results and implications of the mechanical, thermal, optical, and electrical data from these materials are the foundation on which future LEO spacecraft and missions will be built. The LDEF Materials Special Investigation Group (MSIG) has been charged with establishing and developing databases to document these materials and their performance to assure not only that the data are archived for future generations but also that the data are available to the spacecraft user community in an easily accessed, user-friendly form. This paper gives an overview of the current LDEF Materials Databases, their capabilities and availability. An overview of the philosophy and format of a developing handbook on LEO effects on materials is also described.

INTRODUCTION

The LDEF is a reusable, unmanned spacecraft designed to accommodate a wide variety of technology and science experiments which require long-term exposure to a known LEO environment. The LDEF was designed to be transported into LEO via the Space Shuttle, free-fly for an extended time period, and be retrieved by the Space Shuttle for return to Earth. The LDEF was deployed on April 7, 1984 into a nearly circular 257 nautical mile orbit with a 28.4 degree inclination. On January 29, 1990, the LDEF was retrieved at a decreased altitude of 179 nautical miles after 69 months in space. During the mission life, the LDEF was exposed to the range of solar conditions including solar minimum and maximum. As LDEF was gravity gradient stabilized, the leading edge of the spacecraft saw the greatest atomic oxygen (AO) exposure, 5.8×10^{22} atoms/in^2, with the trailing edge of the spacecraft having only minimal AO exposure. The environment that the LDEF was exposed to is described in reference 1.

The LDEF MSIG was formed to investigate the effects of long-term LEO exposure on structure and experiment materials which were not original test specimens. A significant part of the MSIG's charter is to establish and develop electronic databases which will eventually contain the wide variety and vast quantity of electrical, thermal, optical, and mechanical materials data being generated by the MSIG members and other LDEF investigators (ref. 1, 2). The MSIG chose to accomplish this task by a three-pronged approach as shown in figure 1. The first approach was to build on the Optical Materials Database developed by the Boeing Defense & Space Group under the auspices of the Systems Special Investigation Group (ref. 3). The Optical Materials Database was expanded and four other IBM/Macintosh software-based databases, commonly referred to mini-databases, were developed.[1] The second approach utilized a pre-existing global access database system, the Materials and Processes Technical Information System (MAPTIS), as the host for the LDEF Materials Database. The third approach was to develop a version of the LDEF Materials Database for use with PDA Engineering's

---

[1] Work done under NASA Langley Research Center contract NAS1-19247.

M/VISION®[2,3] software. An overview of the capabilities and requirements of the databases is discussed. Information on availability and how to access these databases is also given.

MINI-DATABASES

Under contract to the SSIG and MSIG, Boeing Defense & Space Group has developed a series of databases containing results from LDEF on specific topics. These databases were developed to provide the user community with early access to LDEF data. The databases were developed for use with IBM and Macintosh versions of Filemaker® Pro software[4]. Filemaker Pro is a flat file database which means that the user can retrieve multiple data types such as tabular data, text, graphs, diagrams, and or picture files. The databases' simple interface allows for easy use of the database by the novice user. The individual databases are password protected, allowing the user full access privileges to read, print, or download the data but not allowing the user to edit the data. The software allows the user to search and retrieve specific information in a variety of layouts. Data can be exported to a variety of formats including ASCII. All data is traced back to its original data source. A more detailed report of the capabilities of these mini-databases can be found in reference 3.

The mini-databases cover the optical materials, silverized Teflon thermal blankets, treated aluminum hardware, thermal control paints, and the LDEF environment areas of interest. The Optical Materials Database is a compilation of the results on the optical materials flown on LDEF and was originally developed by the SSIG. The Silverized Teflon Thermal Blankets Database covers the results from the silverized Teflon thermal blankets utilized on LDEF. The Treated Aluminum Hardware Database is a compilation of data from the various types of aluminum hardware flown on or as part of the LDEF structure including different alloys, surface conditions, etc. The Thermal Control Paints Database contains information on the wide variety of paints flown on LDEF. The LDEF Environments Database contains information on the environment that LDEF was exposed to, including thermal profiles, and solar UV, and AO exposures levels. An order form for the mini-databases is given as figure 2.

MAPTIS VERSION OF THE LDEF MATERIALS DATABASE

NASA Marshall Flight Center has incorporated the LDEF Materials Database as a part of their automated storage, retrieval, and display database system. The preliminary version of the LDEF Materials Database was released on MAPTIS in June of 1992 and an updated version is currently available to all interested parties in the international space community. The goal of MAPTIS is to provide an efficient, reliable means of supplying the information needed for the selection and application of materials and processes to produce the hardware required for NASA's and industry's current and future space missions. MAPTIS uses ORACLE Corporation's relational data management system and can be accessed via modem and a 1-800 phone number or via Internet. There are several different databases in MAPTIS, one of which is the LDEF Materials Database.

The LDEF Materials Database allows the user to view and search a listing of the materials flown on LDEF, a listing of materials by specific material or material type, a listing of materials by property and property value, and original data source. All of the data is traced back to the original reference. Only tabular data is given as output of the MAPTIS version of the LDEF Materials Database. An order

---

[2] The use of trademarks or names of manufacturers in this report is for accurate reporting and does not constitute an official endorsement, either expressed or implied, of such products or manufacturers by the National Aeronautics and Space Administration.

[3] M/VISION is a registered trademark of PDA Engineering.

[4] Filemaker Pro is a registered trademark of Claris Corporation.

form for the MAPTIS version of the LDEF Materials Database is given in figure 3.

M/VISION VERSION OF THE LDEF MATERIALS DATABASE

M/VISION is a materials software system, developed and marketed by PDA Engineering, which facilitates the organization and visualization of materials engineering data. M/VISION allows the user to analyze, manipulate, query, and graph materials data. The M/VISION software includes graphics, spreadsheet, imaging, and modeling capabilities as well as databasing capabilities. Multiple data types, such as tabular data, graphs, and raster images (e.g., C-scans, photomicrographs, etc ...) can be stored in a single M/VISION database. M/VISION is a hybrid hierarchical/relational database with both hierarchical and standard Structure Query Language (SQL) interfaces. An integrated engineering spreadsheet is included in the software that provides the user an efficient means to manipulate and visualize the information in the database. Databases can be manipulated via user-written FORTRAN and C codes.

A version of the LDEF Materials Database that runs on M/VISION is current available to the international space materials community to run on their own licensed M/VISION software. The user can examine data based on specific materials, environmental parameters such as UV or AO exposure, experiment number, and data source. Once again all data is referenced to the original data source. Data from the LDEF Materials Database can be operated on and graphed using this software tool. An order form for the M/VISION version of the LDEF Materials Database is given in figure 4.

HANDBOOK

The results from LDEF and other LEO experiments and spacecraft are being used to determine the "rules of thumb" governing the relationship between the LEO environment and materials effects and life performance. The "rules of thumb" and the data to support them are being compiled into a handbook by TRW, Inc. under contract to NASA Langley Research Center. The principal audience for the handbook is the LEO spacecraft designer. The handbook is expected to be available in early 1995.

SUMMARY

Data from the materials and systems flown on LDEF experiments or as part of the LDEF structure is available in a variety of formats to suit the needs of the international space user community. All forms are available free-of-charge by filling out the request forms found in figs. 2-4.

ACKNOWLEDGMENT

The author would like to thank Dr. Gary Pippin and Gail Bohnhoff-Hlavacek of Boeing Defense & Space Group for their work on the mini-databases, Marshall Space Flight Space Center and their contractor's BAMSI, Inc. specifically John Strickland and Frankie Leath for their work on the LDEF Materials Database and PDA Engineering for their support of the M/VISION version of the LDEF Materials Database. The support of the LDEF principal investigators in allowing us to utilize their data is gratefully acknowledged.

REFERENCES

1. Levine, Arlene S., ed.: *LDEF- 69 Months In Space: First Post-Retrieval Symposium,* NASA CP-3134, January 1992.

2. Stein, Bland A.: "An Interim Overview of LDEF Materials Findings," NASA TM-107664, August 1992.

3. Bohnhoff-Hlavacek, Gail: "Databases For LDEF Results," *Second LDEF Post-Retrieval Symposium*, NASA CP-3194, Part 3, April 1993, pp. 1223-1233.

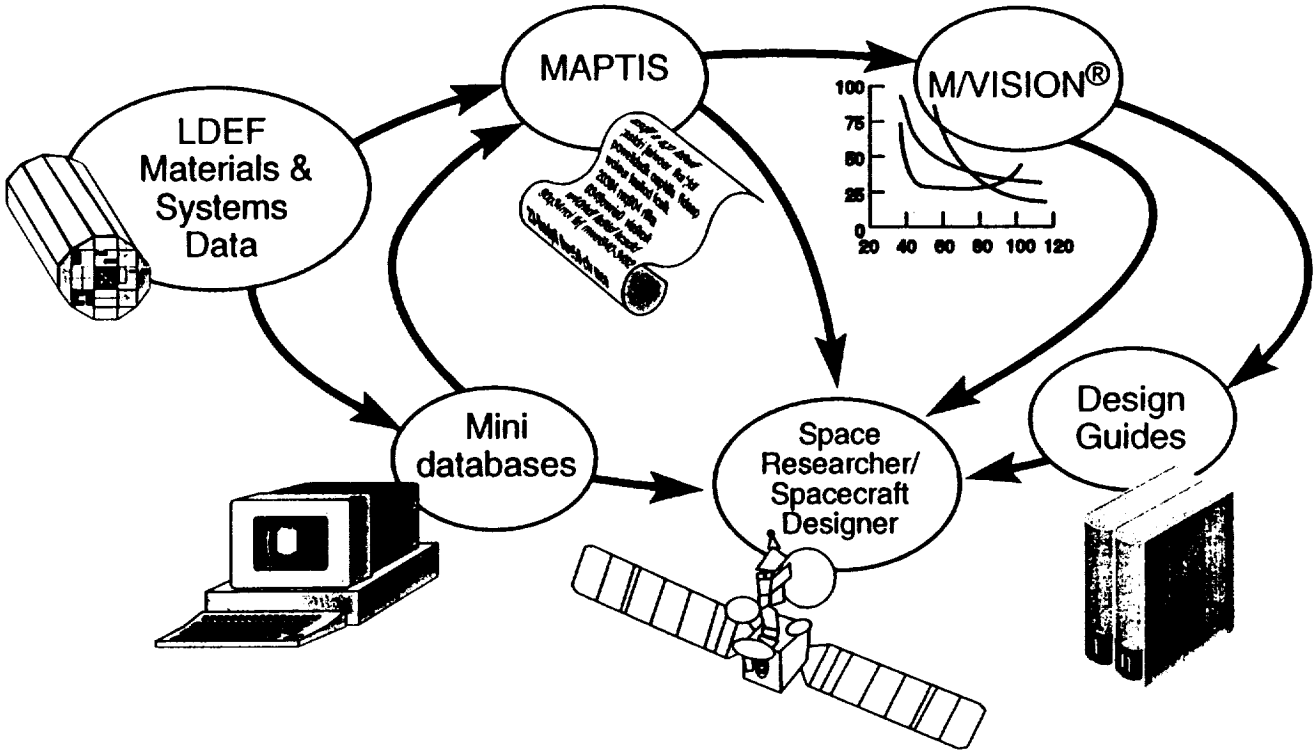

Figure 1. LDEF Materials databasing approach.

User Request Form for the Long Duration Exposure Facility (LDEF)

Materials Mini-Databases

Date: ____/____/____

Format: _____ IBM-compatible or _____ Macintosh

(runs on Claris Corporation's FileMaker® Pro version 2.0 or later software)

Databases requested:

_____ LDEF Optical Materials Database

_____ LDEF Treated Aluminum Database

_____ LDEF Thermal Control Coatings Database

_____ LDEF Silverized Teflon® Database

_____ LDEF Environment Database

Name: _____

Company: _____

Address: _____

City: _____ State: ____ Zip Code: _____

Phone Number: (_____)_____-_____

Complete and return this form along with one High Density Diskette (1.44MB) for each database requested to Gary Pippin, Boeing Defense & Space Group, P.O. Box 3999, M/S 82-32 , Seattle, WA 98124. If you have any questions contact Gary Pippin (206)773-2846 or Joan Funk at (804)864-3092.

Figure 2. Request form for the mini-databases.

User Request Form for the Long Duration Exposure Facility (LDEF)

Materials Database on

the Materials and Processes Technical Information System (MAPTIS)

Date: ____/____/____

Employee Name: _____ ____. _____
(first) (mi) (last)

Company/Mail Code: _____

Work Address:_____

City:_____ State: _____ Zip Code: _____

Office Telephone Number: (____)____-_____ FAX: (____)____-_____

Do you have access to a NETWORK? (Yes/No) _____ Network: _____

Check one only:

Govt Contractor ____ Industry User ____ NASA (MSFC) _____

Bamsi/BCSS Programmer ____ EH02 Personnel ____ NASA (other) _____

Signature _____ Date:___/___/____

Do Not Write Below This Line- System Information

User name: _____ Uic:[_____,_____]

Password: _____

NPSS/PSCN ID: _____ Initial Password:_____

Creation Date: ___/____/____ By: _____

Deletion Date: ___/____/____ By:_____

Complete and fax this form to Rene Hitson at (205)544-5786. If you have any questions contact Rene Hitson at (205)544-6972 or Joan Funk at (804)864-3092.

Figure 3. Request form for the MAPTIS version of the LDEF Materials Database.

User Request Form for the Long Duration Exposure Facility (LDEF) Materials Database in the M/VISION ® Format

Date: ____/____/____

Employee Name: _____ ____. _____
(first) (mi) (last)

Company/Mail Code: _____

Work Address:_____

City:_____ State: _____ Zip Code: _____

Office Telephone Number: (____)____-_____ FAX: (____)____-_____

Do you have access to a NETWORK? (Yes/No) _____ Network: _____

Check one only:

Govt Contractor ____ Industry User ____ NASA (MSFC) _____

Bamsi/BCSS Programmer ____ EH02 Personnel ____ NASA (other) _____

Signature _____ Date:___/___/____

Do Not Write Below This Line- System Information

User name: _____ Uic:[_____,_____]

Password: _____

NPSS/PSCN ID: _____ Initial Password:_____

Creation Date: ___/____/____ By: _____

Deletion Date: ___/____/____ By:_____

Complete and fax this form to Rene Hitson at (205)544-5786. If you have any questions contact Rene Hitson at (205)544-6972 or Joan Funk at (804)864-3092.

Figure 4. Request form for the M/VISION version of the LDEF Materials Database.

•U.S. GOVERNMENT PRINTING OFFICE: 1995-628-064-23071

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	February 1995	Conference Publication

4. TITLE AND SUBTITLE

69 Months In Space:
Third LDEF Post-Retrieval Symposium

5. FUNDING NUMBERS

233-03-02-03

6. AUTHOR(S)

Arlene S. Levine, Editor

7. PERFORMING ORGANZATION NAME(S) AND ADDRESS(ES)

NASA Langley Research Center
Hampton, VA 23681-0001

8. PERFORMING ORGANIZATION REPORT NUMBER

L-17430B

9. SPONSORIING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSORING/MONITORING AGENCY REPORT NUMBER

NASA CP-3275, Part 2

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified—Unlimited

Subject Category 99

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This volume is a compilation of papers presented at the Third Long Duration Exposure Facility (LDEF) Post-Retrieval Symposium. The papers represent the data analysis of the 57 experiments flown on the LDEF. The experiments include materials, coatings, thermal systems, power and propulsion, science (cosmic ray, interstellar gas, heavy ions, micrometeoroid, etc.), electronics, optics, and life science. In addition, papers on preliminary data analysis of EURECA, EOIM-3, and other spacecraft are included.

14. SUBJECT TERMS

Space Experiment

15. NUMBER OF PAGES

354

16. PRICE CODE

A16

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	