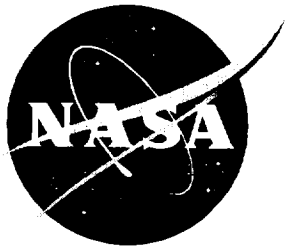

NASA Contractor Report 4656

Long Duration Exposure Facility Mini-Data Base User's Guide

Macintosh Version

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LDEF MINI-DATA BASE USER'S GUIDE

FOREWORD

Included in this document is a short user's manual for the LDEF Mini-Data Bases. The user's manual contains examples from the actual data base records on specifically how to access and work with the LDEF information. Compiling this information into an easily accessible data base format, and making it available to the space community, was a major task accomplished by the System and Materials Special Investigation effort beginning in 1991. Boeing's activities were supported by the following NASA Langley Research Center contracts; "LDEF Special Investigation Group Support" contracts NAS1-18224, Tasks 12 & 15 (October 1989 through January 1991), NAS1-19247 Tasks 1&2 (May 1991 through October 1992), and NAS1-19247 Task 8 (initiated October 1992). Sponsorship for these programs was provided by National Aeronautics and Space Administration, Langley Research Center, Hampton, Virginia and The Strategic Defense Initiative Organization, Key Technologies Office, Washington, D.C.

Mr. Lou Teichman, NASA LaRC, was the inital NASA Task Technical Monitor. Following Mr. Teichman's retirement, Ms. Joan Funk, NASA LaRC, became Task Technical Monitor. The Materials & Processes Technology organization of the Boeing Defense & Space Group performed the five contract tasks with the following Boeing personnel providing critical support during the program.

Bill Fedor	Program Manager
Sylvester Hill	Task Manager
Dr. Gary Pippin	Materials Special Investigation Group Lead
Harry Dursch	Systems Special Investigation Group Lead
Gail Bohnhoff-Hlavacek	Design and Development of Data Base, Collation and Data Entry, Final Report and User's Guide

Table of Contents

Section	Title	Page
	Foreword	iii
	Table of Contents	v
	List of Figures	vi
	List of Appendices	vi
	Trademark Identification	vi
1.0	Mission Profile	1
2.0	Data Base Background	2
3.0	Installation	3
4.0	Computer Start-up and Data Base Password Access	4
5.0	Checking the Memory Used	5
6.0	Data Base Layout Structure	5
7.0	Working with Information	5
	A. finding information	5
	B. browsing records	5
	C. moving from record to record	6
	D. sorting information	7
	E. refind	7
	F. view as list	7
	G. sort	7
	H. omit multiple	7
	I. copy	8
	J. check spelling	8
	K. window / hide window	8
8.0	Previewing and Printing	9
9.0	Exchanging Information	10
10.0	Help Function	11
11.0	Quitting Filemaker Pro	11
12.0	Conclusions	12
	Appendices	A1-E1

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List of Figures

Figure 1.	Schematic diagram of the LDEF experiment location(s)	13
Figure 2.	Computer screen showing the Layout command	14
Figure 3	Browsing through data base information.	14
Figure 4.	Browsing through data base information.	15
Figure 5.	Browsing through data base information.	15
Figure 6.	Using the Find command to find experiment S0050	16

List of Appendices

Appendix A.	Field Descriptions for Optical Materials Data Base	A1
Appendix B.	Field Descriptions for Silverized Teflon Data Base	B1
Appendix C.	Field Descriptions for Treated Aluminum Data Base	C1
Appendix D.	Field Descriptions for Environmental Data Base	D1
Appendix E.	Field Description for Thermal Control Coatings Data Base	E1

Trademark Identification

Claris and FileMaker are registered trademarks of Claris Corporation. Apple, Macintosh, AppleWorks and Multifinder are registered trademarks of Apple Computer, Inc. PostScript is a registered trademark of Adobe Systems Incorporated. dBASE is a registered trademark of Ashton-Tate Corporation. Wingz is a trademark of Informix Software, Inc. Helvetica and Times are registered trademarks of Linotype AG and/or its subsidiaries. 1-2-3, DIF, Lotus, and Visicalc are registered trademarks of Lotus Development Corporation. Microsoft, MS-DOS and Windows are registered trademarks of Microsoft Corporation. Novell and Netware are registered trademarks of Novell Corporation. IBM is a registered trademark of the International Business Machines Corporation.

1.0. LONG DURATION EXPOSURE FACILITY (LDEF) MISSION PROFILE

The LDEF was a large (about 9 meters in length, 4.3 meters in diameter), reusable, unmanned spacecraft designed to accommodate technology, science, and applications experiments which require long-term exposure to the space environment. LDEF was transported into space in the payload bay of a Space Shuttle, free-flown in low Earth orbit (LEO) for an extended time period, and then retrieved by a Shuttle during a later flight. The LDEF was passively stabilized, and each surface maintained a constant orientation with respect to the direction of motion.

The LDEF was deployed by the Space Shuttle Challenger into a 482 kilometers nearly circular orbit with a 28.4 degree inclination on April 7, 1984. LDEF carried 57 experiments during the planned 10-month to 1-year mission. A schematic diagram of the location(s) of each experiment on the LDEF is shown in figure 1. Due to schedule changes and the loss of the Space Shuttle Challenger, the duration of this flight was extended well beyond the original planned exposure period.

The LDEF was retrieved by the Space Shuttle Columbia on January 12, 1990 after spending 69 months in orbit. In these 69 months, LDEF completed 32,422 orbits of Earth and decreased in altitude to 340 kilometers, where it was grappled, photographed extensively from the Shuttle crew cabin, and then placed in the Shuttle payload bay for return to Earth. The LDEF remained in the payload bay of the Space Shuttle Columbia for the landing at Edwards Air Force Base and during the ferry flight to Kennedy Space Center (KSC). The LDEF was removed from Columbia at KSC and brought to the Spacecraft Assembly and Encapsulation Building (SAEF-2) where the LDEF and its experiments were examined visually and photographed, radiation measurements were conducted, and the experiments removed from the structure tray by tray. Each tray was photographed individually subsequent to removal. System level tests were carried out for particular experiments and support hardware. External surfaces were examined for evidence of impacts, contamination, and other exposure induced materials changes.

The trays were then shipped to the experimenters' laboratories for additional testing. Published investigator's results from the 57 experiments were compiled onto the LDEF mini-databases. The mini-data bases were continually updated with new information and distributed to the LDEF community through December 1994.

2.0 DATA BASE INTRODUCTION

One of the main objectives of the LDEF Special Investigation Groups (SIGs) was to develop LDEF data bases that identified the experiment objectives and hardware flown, summarized experimental results and conclusions, and provided a system analysis overview which would include spacecraft design guidelines and space environmental effects. Compiling this information into an easily accessible data base format, and making it available to the space community, was a major task accomplished by the System and Materials SIG efforts beginning in 1991.

After a trade study of data base software packages, FileMaker Pro™ was chosen as the data base software application program. FileMaker Pro is a data base manager produced by Claris™ Corp, for both the Macintosh™ and IBM™-compatible computers. Data between the two platforms is transparent, and the user interface is the same. FileMaker Pro is a flat, text-retrievable data base that provides access to the data via an intuitive user interface, without tedious programming. "Relational" data bases were examined for this application, but found to have certain features too limiting for this application.

Within the FileMaker Pro application, the LDEF information is placed within one of five data bases including Optical Materials, Thermal Control Paints, Silverized Teflon, Treated Aluminum Hardware, and the LDEF Environment. Within a data base, each individual LDEF experiment or special investigation report has its own "record". Each record contains specific information using "field name" headings, from which one can view or print reports from the provided layout. The data bases were designed to be easy to use, even though they contain detailed numerical data, interpretations and conclusions of the principal investigators. Further the data bases are upgradeable, and all information is traceable to a specific source as well as giving full acknowledgements to the authors and principal investigators. All data can be viewed and downloaded into other formats, but access to editing the data base is restricted to protect the information content of the data base.

Included in this document is a user's manual for the LDEF Mini-Data Bases. The user's manual contains pertinent excerpts from the Claris FileMaker Pro manual on specifically how to access and work with the LDEF information. (For general information on creating and updating databases, the readers are encouraged to consult

the Claris manual for full Filemaker Pro information.) The User Guide is divided up into the following sections:

- Installation
- Computer start-up and data base password access
- Checking the memory used
- Data base layout structure
- Working with information
- Previewing and printing
- Exchanging information
- Help function
- Quitting FileMaker Pro

If the information from these data bases is used in the production of a published article or proceedings, please acknowledge that the data bases were used and reference it as being a product of Contract NAS1-19247 for NASA-Langley Research Center by the Boeing Defense & Space Group, as well as the original source of the data documented in each record of the data base.

3.0 INSTALLATION

These instructions assume the user has reviewed the Claris manual *FileMaker Pro Installation* and the *FileMaker Pro User Guide* for the Macintosh computers. There are two options for using the FileMaker Pro Installer for the Macintosh computers.

- Easy (complete) installation is the recommended method. The Installer installs the entire FileMaker Pro package and puts all files and folders in their prefered locations--some in the Claris folder in the system folder and some in the FileMaker Pro folder it creates. If a Claris folder does not exist, the Installer creates one.

- Custom installation lets the user choose the files to be installed. The Installer puts all files into the Filemaker Pro 2.0 Folder it creates.

4.0 COMPUTER START UP AND DATA BASE PASSWORD ACCESS

If working from a hard disk, open the FileMaker Pro folder and click on the FileMaker Pro application icon. If you do not have a hard disk, insert the working copy of the FileMaker Pro application disk in one drive, double click the disk icon, and double click the FileMaker Pro application icon. Highlight the file name containing the LDEF data base of interest (e.g. LDEF Optical Materials Data Base) and click it open. *Type the password "LDEF" and click okay. This password gives you access to read, search the data base, download data to other formats, or print information from the data base; the password does not give the user the ability to edit information in the data base, or change the layout.* This prevents user from inadvertently introducing errors into the data.

Even though the Optical Materials Data Base will be used in the following examples, this set of instructions can be used with any of the other diskettes as well. Simply follow the directions, trying out your own examples. The following list outlines what commands are available to the user, including the menu (in italics) where they can be found.

Apple Menu: About the Finder or About the Macintosh

File Menu: New, Open, Close, Preferences, Change Password, Single User/ Multiuser, Page Set-Up, Print, Import/Export, Save A Copy As, Recover, Quit

Edit Menu: Copy, Spelling

Select Menu: Browse, Find, Layout, Preview, Refind, View as List, Omit, Omit Multiple, Sort

Window: Hide Window, Show Window

Note that in the following pages of this document the commands will be highlighted in bold as they are introduced and discussed for easy reference.

5.0 CHECKING THE AMOUNT OF MEMORY USED

From the Apple menu on the Macintosh desktop (the Finder screen), choose **About The Finder** if using System 6, or **About This Macintosh** if using System 7. The user will see a system information window. If the user is working on this set of data bases or would like to work with multiple files, the user might need to change the amount of memory used. The Macintosh requires at least 1 megabyte of RAM available to utilize the data basing function (with System 7, it requires 2MB of RAM and the System 7 tune-up installed). Further, the FileMaker Pro application requires at least 1.2 MB of disk space to install; 4 MB of disk space for complete installation, including HELP, utilities, and sample files.

6.0 LAYOUT STRUCTURE OF DATA BASE

The layout structure of the data base can be examined to get an overview of how the data is organized into fields. By clicking on **Layout** in the Select Menu an empty record appears showing just the field labels as shown in figure 2. You can familiarize yourself with these field labels by using the tab button to move through the various fields. Alternatively, review Appendices A-E which list the field labels for the five different data bases.

7.0 WORKING WITH INFORMATION

To find all the LDEF experiment records for viewing, choose **Find All** from the Select menu. FileMaker Pro displays one of the thirty-seven LDEF optical experiment records stored in the data base. To move from one record to the next, click either the bottom or top page of the book (to the left of the screen) to view each record. Or slide the bookmark up and down to move more quickly through the records.

After using the Find All command, the user should be in the browse mode and ready to read through the data in each record. (If you are not in Browse, choose **Browse** from under the Select menu.) To read through that record, one can either use the the up-down arrows on the right margin to scroll line by line; or use the push box also in the right margin to move more quickly through the data. Alternatively a third way to move from one field name to the next, is to use the Tab key. Examples of browsing through a record are shown in figures 3, 4 and 5.

For instance, to find one specific record from the thirty-seven records available in the Optical Materials Data Base, without having to go through each and every record, simply choose **Find** from the Select menu. An empty LDEF layout appears on the screen as shown in figure 6. Depending on what information is available to the user to begin a data base search, (i.e. name of the principal investigator, experiment number, etc.) begin by clicking on the field name box associated with that information. The computer evaluates only the data stored within this field name record for the criteria the user has requested. For example, after clicking on the Experiment Number box, the indicator bar begins blinking in that box. The user puts in the number of the experiment of interest (e.g. S0050) and than clicks Enter or Find. The data base instantly retrieves the S0050 experiment records. One could have just as easily typed the principal investigator's name in the Present Principal Investigator box, and it would have found the same experiment records. The computer search results in five records being found. While paging through these records, the user will see the records are called S0050, S0050-1, S0050-2, S0050-3 and S0050-sum. These are either subexperiments of S0050, the main experiment itself, or a summary. Of course, if the user had by mistake typed the investigator's name in the Experiment Number box instead of into the Present Principal Investigator box, no record would have been found.

Try another example. This time use A0056 in the Experiment Number box. Notice that to the left it says the computer correctly found only one record out of the thirty-seven total Optical Materials Data Base records which satisfies the user's search request.

Please note this data base uses a specific form of the alphanumeric code for the LDEF experiment numbers. The experiment number designation uses a letter followed by four numerals without spaces between letters and numbers for searching, e.g. A0056. If the user mistakenly inputs AO 056 or AO056, the search will be blank. Subexperiments follow the same designation with an affix that goes at the end of the designation, e.g. S0050-1.

One can limit the search by inputting items in more than one Field name. For instance, if the search began by inputting A0138 in the Experiment Number box, then inputting the name Bourrieau in the Original Principal Investigator box, the computer would have searched and found only one record...A0138-7. (This is sometimes known as a logical AND search because it finds records that contain both this

information and that information.) Enter criteria into as many fields as needed to make your request specific, and then click Find.

Any one of the field name boxes can be searched. Try typing in "fused silica" in the Optical Materials box. The user will see that nine records out of the thirty-seven have fused silica listed as a material that flew on LDEF.

Be aware that unless the user gets the exact search word in the correct field, the search may come up blank. If one doesn't know which field to search in, the user should not hesitate to search in a number of the possible fields. Then if the search word still comes up blank in all the fields searched, try using a synonym, a broader term, or other related words. The alternate search word may suggest a clue, that will lead the user on the correct route within the data base to complete the original search. In other words, do not hesitate to experiment with the data base, and be creative trying different searches to find information.

In the event that one does not know the exact nomenclature to input to find records, the user can augment a search by using the **wildcard characters @ and ***. For instance, to find records with words that vary by one or more characters, use one wildcard character @ for each unknown character. Or if the user is sure of all but one character in a word, use @ to substitute for that character in the find request. To find records with words that vary by more than one character, use the wildcard character *. Or if not sure of the number of or order of certain characters in a word, use * to substitute for them in the find request. Remember though, wildcard searches take longer to do--especially in a large data base. Wildcard searches are much faster if the user specifies other criteria along with the wildcard criterion.

To find all the records that match one set of criteria OR another, you need to fill out separate requests. For example, to find all records in the Optical Materials field that contain the name "fused silica" OR "fiber optics", you need to use separate requests, or it will look for only those records that satisfy both requests.

FileMaker Pro allows the user to put in actual numerical values for searching, as is appropriate for the Cumulative Sun Hours field name box. In addition, the data base allows the user to search the data base within a range of values, (e.g. between 11,000 and 15,000 Sun Hours), by using the **range symbol** (...). For example, type "11,000...15,000", in the Sun Hours box and than click "Find". The computer finds

eighteen of the thirty-seven records that have LDEF experiment records with Cumulative Sun Hours between 11,000 and 15,000.

Also of interest, is the < **and** > search commands. The user can search for all numbers that are smaller than the number inputted by using <value, or all numbers greater than the number inputted by using >value. The same is true for words, where <value will be words that are alphabetically before the inputted value, and >word will be alphabetically after the inputted value. (The word value in this case is used to show where the word, number or date should be typed.)

Most of the search commands frequently used with the LDEF mini-data bases have been described. However, additional criteria for finding records can be found in the Claris FileMaker Pro manual.

The **Refind** command under the File menu switches FileMaker Pro from Browse, Layout, or Preview, to Find, and displays the request or group of requests that was last used. One can edit or add requests before continuing the Find operation.

The **View as a List** Command under the File menu determines whether records are displayed one at a time or as a continuous list when browsing. A checkmark next to the command name indicates that View as a List is on.

The **Sort** command under the File menu opens a dialogue box that allows the user to determine the sort order---the order in which records are displayed and printed. The data base is generally arranged by the Experiment Number, but this is easily changed by using this command to sort based on a requirement of the user.

The **Omit** command under the File menu omits the current record from the records being browsed. The omitted record is not used in calculating the results of summary fields in the records you are browsing. To see the omitted record again, the user clicks on the Find, Refind, Find Omitted, or Find All commands.

The **Omit Multiple** command under the File menu opens a dialogue box that lets the user designate the number of records, starting from the current record, that are to be temporarily left out of the set of records you are browsing. The omitted records are not used in calculating the results of summary fields in the records you are browsing. To

see the omitted records again, the user can use Find, Refind, Find Omitted, or Find All commands.

Two commands are available under the Edit Menu, despite the password access limitations. Those two commands are **Copy**, and **Check Spelling**. The copy command copies the selected data onto the Clipboard, replacing the Clipboard's previous contents. The user can then use the Paste command on another data base or software application to paste the selection into a new location.

The **Check Spelling** command presents a submenu of commands to check the spelling automatically. To check spelling, FileMaker Pro needs to be able to locate the Main Dictionary and the User Dictionary.

The **Window** menu lets the user select another file when several are open. The names of all open files are listed on the Window menu. Files in parentheses are hidden files. **Hide Window** option will hide the window of any open file. When Hide Window is chosen, the file remains open but the file is not displayed. This option is used with lookup files so they remain open but are not displayed.

8.0 PREVIEWING AND PRINTING

In preparing the selected LDEF data base material for printing, as exhibited on the screen, FileMaker Pro needs to know what printer and pre-defined paper size will be used. To specify a printer, use the **Chooser** function on the Apple menu. Then choose **Page Setup** from the File menu, which allows one to choose the paper size and other desired printing options, then click okay. Check how a report will look when printed by using the **Preview** command. Previewing eliminates errors without wasting time or paper. To do this:

1) Open LDEF data
2) Find and browse the records you want to print
3) Choose Preview from the Select menu.

With Preview the records look exactly as they will be printed. Move from page to page by clicking the pages in the book or dragging the bookmark. Use the zoom controls to zoom in to see objects on the screen in detail, or zoom out to get an

overview. To return to Browse, choose Browse from the Select menu. In summary, to print copies of the LDEF records, follow this sequence of steps:

1) Use Chooser on the Apple Menu to select printer, if necessary.
2) Browse the records you want to print. Use Find, Omit, or Find All as necessary.
3) Sort the records, if necessary. Filemaker Pro prints the records in the order of the LDEF data base layout, unless you use the sort command to change the order.
4) Choose Page Setup from the file menu, and make your choices in the Page Setup dialog box.
5) Use Preview to check report before printing.
6) Go to File menu and choose Print.
7) A screen will appear asking the user further questions about what is to be printed. For example, a user can choose to print just this record, or all records being browsed. After making that choice, click Okay. The screen will tell the user when the printer has begun to print.

9.0 EXCHANGING INFORMATION

FileMaker Pro allows the user to exchange information (i.e. import/export) between Filemaker Pro and many other programs. To import data, means data is brought from another application or FileMaker Pro file into a FileMaker Pro file. To export data, means data is taken from a FileMaker Pro file and make it accessible to another application.

The access password, "LDEF" gives a user the ability to export data, but does not give the user the ability to import files into the LDEF data bases. This restriction is incorporated into the data bases to protect the information content of the data base.

Performing the export procedure is fairly easy with any of the LDEF Mini-Data Bases, since FileMaker Pro allows the user to save records in a variety of formats (besides the standard FileMaker Pro format) which are compatible with the receiving applications. Listed below are the available formats:

- Tab-separated text (word processing)
- Comma-separated text (ASCII characters)
- SYLK (spreadsheets like Microsoft™ Excel™ and WINGZ™)
- DBF (dBASE™ format)

- •DIF (spreadsheets like Visicalc™ and AppleWorks™)
- •WKS (worksheet format used by Lotus™ 1-2-3™)
- •BASIC (variant of comma-separated text is a format developed to conform to the Microsoft BASIC standard)
- •Merge file (similar to the comma-separated text file format, this format can be used in creating personalized form letters and other documents).

Here are the steps to follow to export data:

1) Open the file you want to export.
2) In Browse, choose **Export** from the File menu. (The Export dialog box appears.)
3) Type a name for the export file, and specify where you want it saved.
4) Choose the file type you want from the pop-up menu.
5) Click New. (You see the Field Order Dialog box.)
6) Move the fields into the order you want to export them.
7) Choose whether you want the fields formatted.
8) Click Okay. (A copy of the data is saved in this format.)

10.0 HELP FUNCTION

The Apple menu supplies on-line information about FileMaker Pro. In this menu, the **Help** command displays the window for the Filemaker Pro Help System, which provides information about FileMaker Pro commands, dialog boxes, and step-by-step procedures for most common tasks. When open, Help appears in the Window menu. The user can switch back and forth between Help and the FileMaker Pro file by clicking the window the user wants to make active.

11.0 QUITTING FILEMAKER PRO

To leave the data base, simple choose **Quit** from the File menu. The user will return to the main window.

12.0 CONCLUSION

In conclusion, compiling data from the LDEF experiments into an organized format has been accomplished. The LDEF Mini-Data Bases have already proven to be an effective research tool for the space community by providing easy transfer of LDEF findings through the database.

The Materials SIG would be very interested in any questions, comments, or suggestions you might have on the content or format of the data base, and any data you might like to have inputted into the data bases. Please contact either Gail Bohnhoff-Hlavacek (206)773-6892 or Gary Pippin (206)773-2846 of the Boeing Defense & Space Group, P.O. Box 3999, M/S 82-32, Seattle, WA., 98124.

ROW \ BAY	A	B	C	
1	A0175	S0001	GRAPPLE	
2	A0178	S0001	A0015, A0187, M0006	
3	A0187	A0138	A0023, A0034, A0114, A0201	TRAILING EDGE
4	A0178	A0054	S0001	
5	S0001	A0178	A0178	
6	S0001	S0001	A0178	P0005 P0003
7	A0175	A0178	S0001	
8	A0171	S0001, A0056, A0147	A0178	
9	S0069	S0010, A0134	A0023, A0034 A0114, A0201	LEADING EDGE
10	A0178	S1005	GRAPPLE	
11	A0187	S0001	A0178	
12	S0001	A0201	S0109	

ROW \ BAY	D	E	F
1	A0178	S0001	S0001
2	A0189, A0172 S0001	A0178	P0004, P0006
3	M0008, M0002	A0187, S1002	S0001
4	M0003	S0001	A0178
5	A0178	S0050, A0044, A0135	S0001
6	A0201, S0001	A0023, S1006 S1003, M0002	A0038
7	A0178	S0001	S0001
8	M0003	A0187	M0004
9	M0003, M0002	S0014	A0076
10	A0054	A0178	S0001
11	A0178	S0001	S0001
12	A0023, A0019, A0180	A0038	S1001

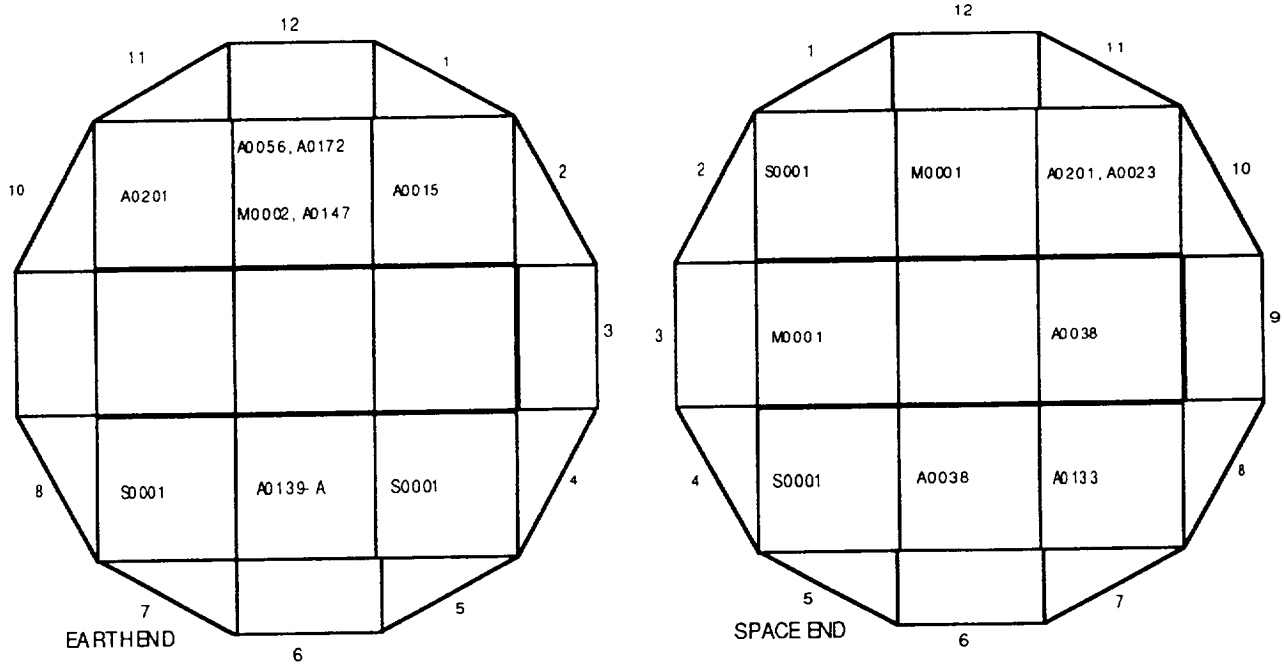

Figure 1. Schematic diagram of the location(s) of each of the 57 experiments on LDEF.

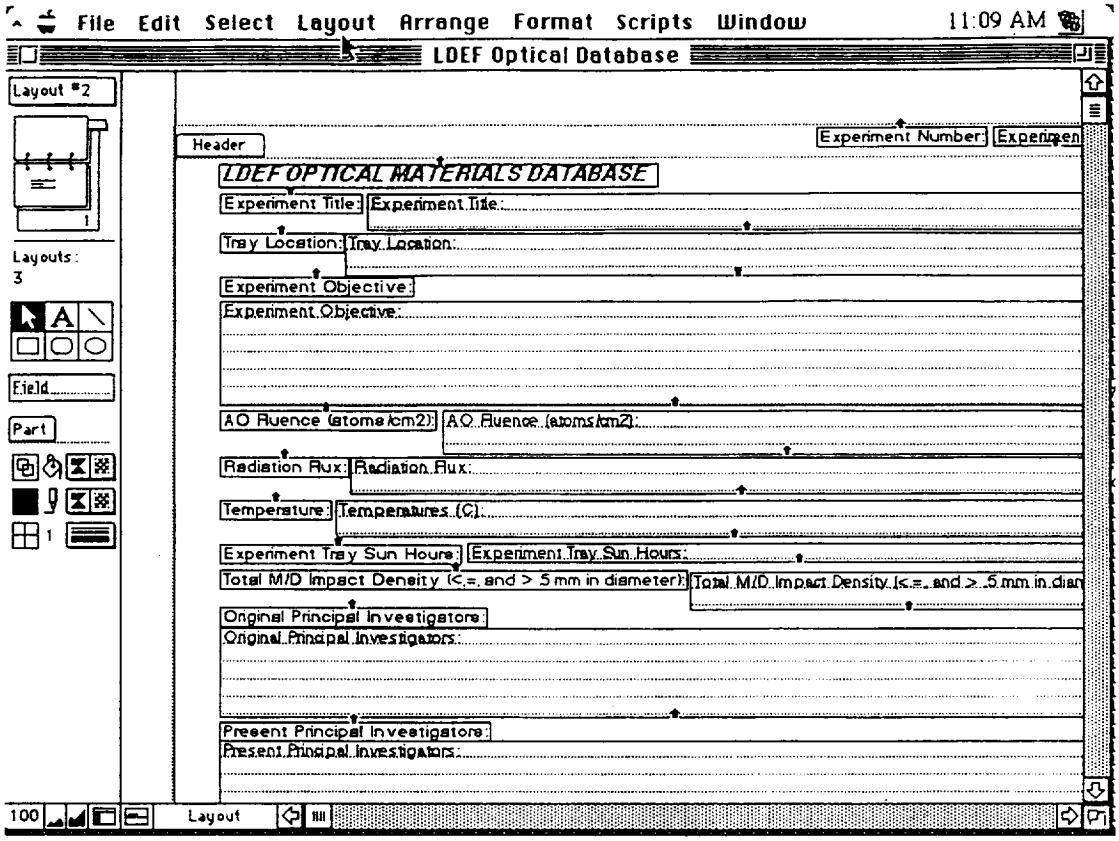

Figure 2. Computer screen showing the Layout command and data base structure.

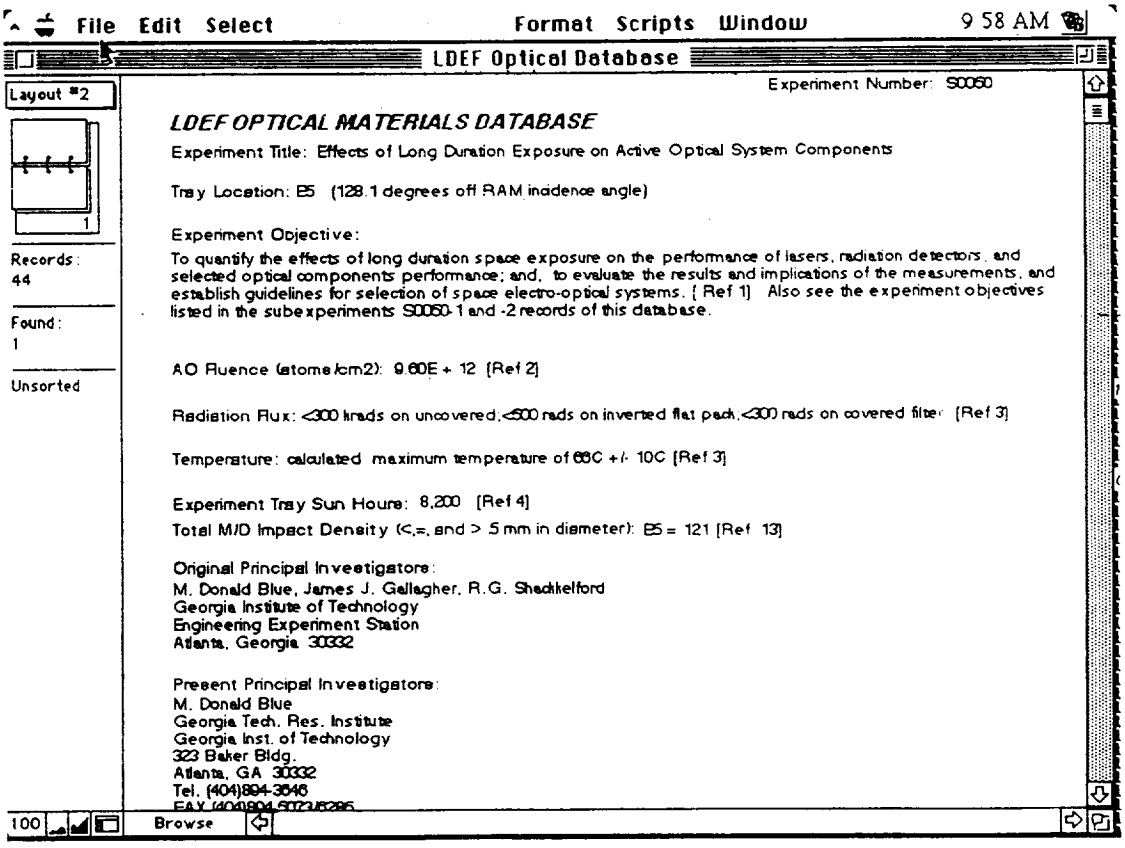

Figure 3. Browsing through the data base information.

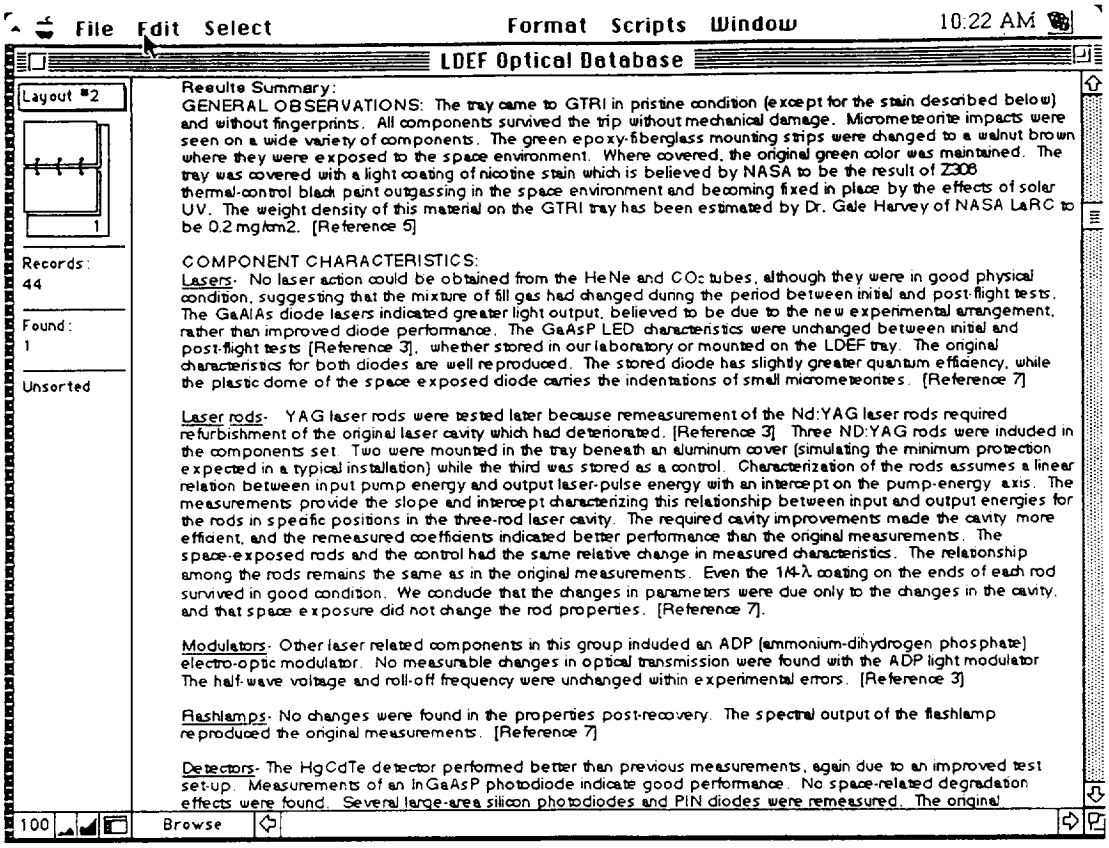

Figure 4. Browsing through data base information.

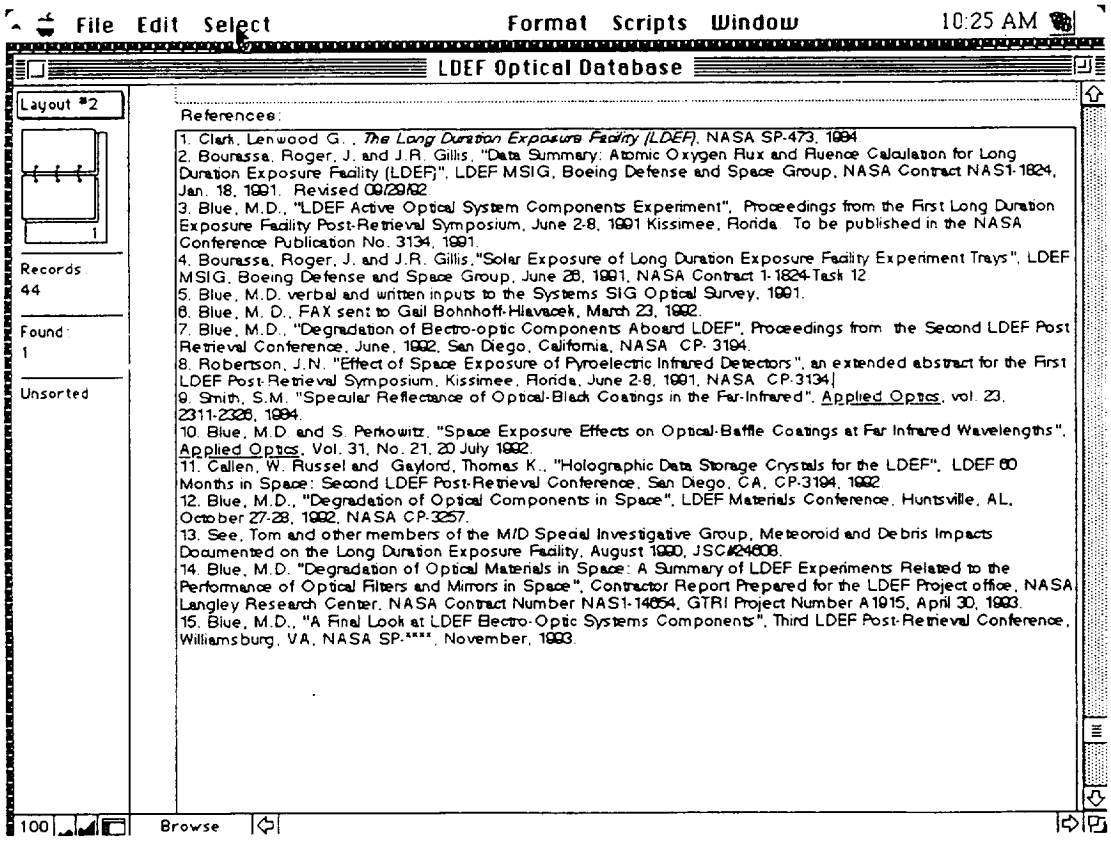

Figure 5. Browsing through data base information.

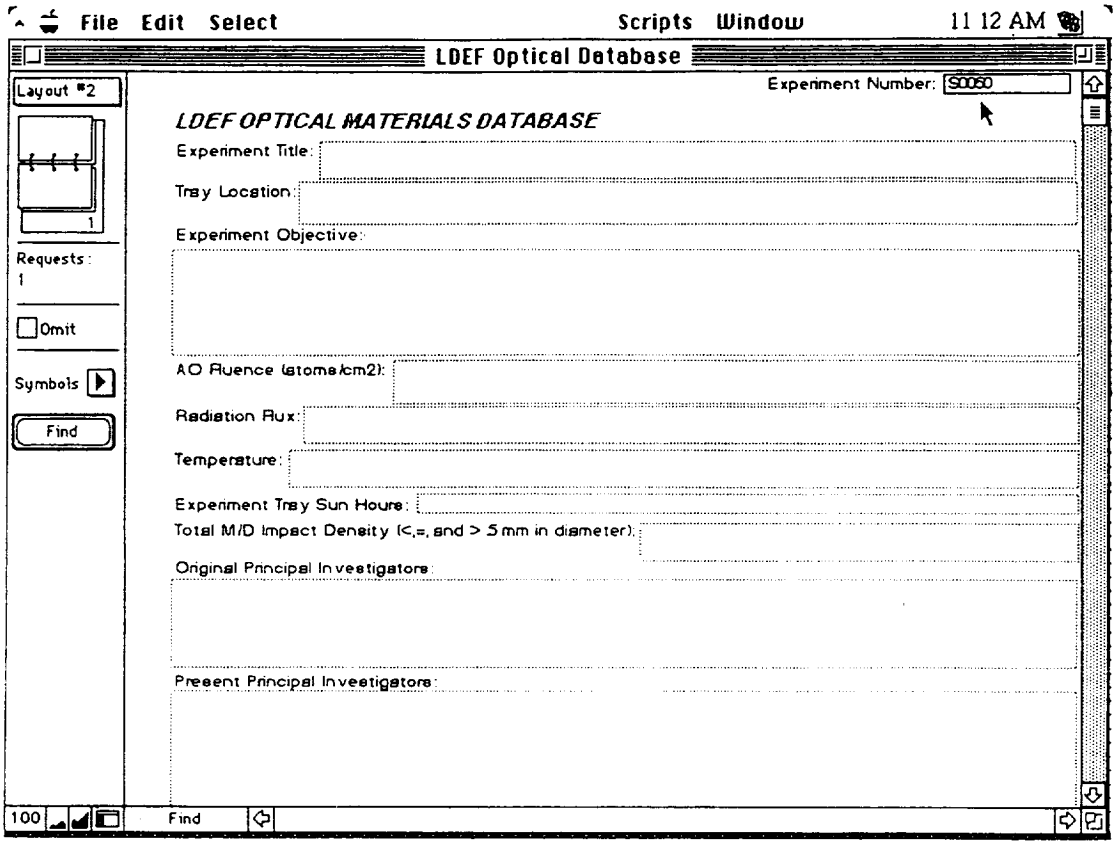

Figure 6. Using the **Find** command to find experiment S0050 on the data base.

APPENDIX A.

FIELD DESCRIPTIONS FOR OPTICAL MATERIALS DATA BASE

Experiment Title: Name of experiment flown on LDEF.
Experiment Number: Number assigned the experiment by the LDEF Science Office.
Tray Location: Location coordinates where the experiment tray was located.
Experiment Objective: Goals of the specified experiment.
Original Principal Investigator: Name of the responsible investigator during the assembling and launch of LDEF.
Present Principal Investigator: Researcher responsible for the LDEF experiment post-flight.
AO Fluence: Atomic Oxygen fluences at end of mission for all row, longeron and end bay locations including the fluence received during the retrieval attitude excursion.
Radiation Flux: Description of the amount of ionizing radition received at the specific location.
Temperature: Description of the thermal environment at a specific tray location.
Experiment Tray Sun Hours: Cumulative equivalent sun hours for solar radiation normal to the surface of the LDEF tray and longeron locations.
Total M/D Impact Density: Total number of meteroid and debris impacts <, =, or > 0.5 mm in diameter resulting in a crater or disbonded area.
Optical Materials Flown: Optical material types flown on LDEF for the specified experiment.
Measurements Performed on Samples: Type of experiments performed on the samples during pre-flight, space flight and post-flight.
Results Summary: Experimental results extracted from the published papers and compiled in the data base.
Conclusions: The Principal Investigator's (PI) and the PI team's interpretations of results, words taken directly from their papers.
System Analysis and Future Design Considerations: Based on their own findings, the principal investigator often gave suggestions for future spacecraft designs which are recorded in the data base.
Additional Reading: Additional sources of information that are not already listed in the reference section of the data base record.
References: Every piece of information in the data base has been referenced for follow-up by the user.
PI's Database: Some investigator's created data bases for their individual experiments. If that was the case, a note is made in this field to direct the user to additional data bases.
Data Upgrade Date: As data is entered into a specific data base record, the date is automatically recorded on the data base record.
Experiment Status: The status of the post-flight investigation on a specific experiment.
Hardware Archive: This field describes where the samples and hardware are physically located from a specific experiment.

APPENDIX B.

FIELD DESCRIPTIONS FOR SILVERIZED TEFLON DATA BASE

Experiment Task: Objective of the specified LDEF experiment.
Task Investigators: Names of the responsible experiment investigators throughout the mission.
Thermal Control Coatings: The type of material used as a thermal control coating.
Samples Provided to: Principal investigators gave samples to other laboratories for additional analyses.
Location / Angle off RAM / AO Fluence / Sun Hours: Location coordinates where the experiment tray was located. Incidence angles for LDEF tray and longeron locations. Atomic oxygen fluences at end of the mission for all row, longeron, and end bay locations including the fluence received during the retrieval attitude excursion. Cumulative equivalent sun hours for solar radiation normal to the surface of the LDEF tray and longeron locations.
Ionizing Radiation: Description of the amount of ionizing radiation which was received at a specific location.
Thermal Environment: Description of the thermal environment at a specified tray location.
Measurements Performed on Samples: Type of measurements performed on the samples during pre-flight, space flight, and post-flight.
Results Summary: Experimental results extracted from published papers and compiled in the data base.
Conclusions: Final interpretations of the Principal Investigator and associated team.
Ground Simulation Comparison Data: Describes what ground simulation tests have been conducted for comparison to LDEF data.
References: Every piece of information in the data base has been referenced for follow-up by the user.
Data Upgrade Date: As data is entered into a specific data base record, the date is automatically recorded on the data base record.
Photographic Documentation Available: Describes what photographs are available for this specific experiment.
Hardware Archive: Describes what LDEF hardware is available and where it is stored for a specific experiment.
Meteoroid and Debris Impacts: Total number of meteroid and debris impacts <, =, or > 0.5 mm in diameter resulting in a crater or disbonded area.
Experiment Number: Number assigned the experiment by the LDEF Office.
Figure 1. Important photographs, graphs, plots, etc. can be inputted into the data base in this section.
Figure 2. "
Figure 3. "

APPENDIX C.

FIELD DESCRIPTIONS FOR TREATED ALUMINUM DATA BASE

Experiment Task: Objectives of the specified LDEF experiment.
Treated Aluminum Material: Type of treated aluminum discussed in this record.
Task Investigators: Names of the responsible investigators on a specific LDEF experiment throughout the mission.
Experiment Title: Title of specified LDEF experiment.
Experiment Number: Number assigned the experiment by the LDEF Science Office.
Location / Angle Off RAM / Sun Hours: Location coordinates where the experiment tray was located. Incidence angles for LDEF tray and longeron locations. Atomic oxygen fluences at end of the mission for all row, longeron, and end bay locations including the fluence received during the retrieval attitude excursion. Cumulative equivalent sun hours for solar radiation normal to the surface of the LDEF tray and longeron locations.
Result Summaries: Experimental results extracted from published papers and compiled on the data base.
Measurements Performed on Samples: What type of measurements were performed in the specified experiment
Conclusions: Final interpretation of data by the experiment investigators.
Ground Simulation Data: Describes what ground simulation tests have been conducted for comparison to LDEF data.
Ionizing Radiation: Description of the amount of ionizing radiation which was received at a specific location.
Temperature: Description of the thermal environment at a specific location on the LDEF.
References: All data inputted into the data base has been referenced for follow-up and/or traceability.
Data Upgrade Date: As data is entered into a specific data base record, the date is automatically recorded on the data base record.
Sample Description: Details the samples used in analysis.
Photographic Documentation Available: Describes what photographs are available for this specific experiment.
Hardware Archive: Describes what LDEF hardware is available and where it is stored for a specific experiment.
Meteoroid and Debris Impacts: Total number of meteroid and debris impacts $<$, $=$, or > 0.5 mm in diameter resulting in a crater or disbonded area.

APPENDIX D.

FIELD DESCRIPTIONS FOR ENVIRONMENTAL DATA BASE

Mission: Formal NASA mission identification.
Mission Information: 1) Historical and background mission information, 2) overall mission goals, and 3) general flight information.
Tray Numbering System: Experiment tray numbering system.
RAM Incidence Angle: Angle between the z-axis and the ram vector.
Atomic Oxygen Fluence for Trays and Longerons: Atomic oxygen fluences at end of mission for all row, longeron, and end bay locations including the fluence received during the retrieval attitude excursion.
Cumulative Equivalent Sun Hours: Cumulative equivalent sun hours for solar radiation normal to the surface of the LDEF tray and longeron locations.
Thermal Environment: Description of thermal environment around the spacecraft: a) maximum and minimum structure temperature, 2) space- and Earth-end temperatures, 3) internal emissivity, 4) solar radiation, 4) albedo, 5) Earth radiation, 6) space sink temperature, 7) average incident heat flux (solar + albedo) / Hr-FtSq by beta angle at a specific tray location.
Radiation Environment: Description of the amount of ionizing radiation received at specific locations on the spacecraft.
Micrometeoroid and Debris Impacts on LDEF: Total number of meteroid and debris impacts <, =, or > 0.5 mm in diameter resulting in a crater or disbonded area.
Contamination Effects: A description of the impact of contamination on the spacecraft.
Contamination Map: A map indicating the visible contamination on the spacecraft.
Radiation Environment I. Graph depicting the mission dose (Rads-tissue) versus electron, proton and total.
Radiation Environment II. Fluence comparison graph depicting the LDEF mission fluence (cm^{-2}) versus depth in aluminum (g/cm^2).
Radiation Environment III. Contribution to dose by source graph depicting the LDEF Mission Tissue Dose versus the depth in aluminum.
Micrometeroid and Debris Impacts on Painted Metal: Drawing of the resulting structure of an impact on painted metal.
Micrometeroid and Debris Impacts on Glass: Drawing of the resulting structure of an impact on glass.
Micrometeroid and Debris Impacts on Thermal Blankets: Drawing of the resulting structure of an impact on a thermal blanket.
LDEF Sources of Ionizing Radiation: Graph depicting sources of ionizing radiation.
Vacuum Exposure: Details of the vacuum exposure of the spacecraft.
Gravity / Acceleration: Details of gravity and acceleration values.
References: Sources of the information in the data base.
Microenvironments: Details on the "microenvironments" surrounding the spacecraft, e.g. accounts for local geometry variations and surface conditions affecting atomic oxygen exposure such as for angle brackets, blanket edge attachments, copper grounding straps, cover plates, etc.
Database Upgrade Date: Date the Environmental Data Base was last upgraded.
Contamination Studies: Several overview studies on contamination from a panel of investigators studying the spacecraft.
Contamination References: References for the information contained in the contamination study.
LDEF Activation Foils: Graph of activation foil data.

Appendix D continued...

Variation of Solar Flux: Solar variation during LDEF mission, solar flux versus mission day.
Cumulative Mission Fluences: Cumulative proton fluence versus mission day.
Directionality Radiation Exposure to Trapped Protons: LDEF mission fluence of
trapped protons versus proton energy (MeV).
Summary of Ionizing Radiation Dose on LDEF: LDEF mission dose (rads-tissue) versus minimum shielding (g/cm^2).

APPENDIX E.

FIELD DESCRIPTIONS FOR THERMAL CONTROL COATINGS DATA BASE

Experiment Number: Name of the specific experiment flown on the spacecraft.
Experiment Task: Goals of the specified experiment.
Thermal Control Coating: Specific coatings described in the database record.
Measurements Performed on Samples: Type of measurements performed on the samples during preflight, space flight, and post-flight.
Results Summary: Experimental results extracted from published papers and compiled on the data base.
Conclusions: Final interpretation of data by the experiment investigators.
Ground Simulation Comparison Data: Describes what ground simulation tests have been conducted for comparison to LDEF data.
Location / Angle Off RAM/ AO Fluence / Sun Hours: Location coordinates where the experiment tray was located. Incidence angles for LDEF tray and longeron locations. Atomic oxygen fluences at end of the mission for all row, longeron, and end bay locations including the fluence received during the retrieval attitude excursion. Cumulative equivalent sun hours for solar radiation normal to the surface of the LDEF tray and longeron locations.
Ionizing Radiation: Description of the amount of ionizing radiation received at the specific location.
Temperature: Description of the thermal environment at a specified location.
References: All data inputted into the data base has been referenced for follow-up and/or traceability.
Database Upgrade Date: As data is entered into a specific data base record, the date is automatically recorded on the data base record.
Task Investigators: Names of the responsible investigators during the entire experiment (assembly, pre-flight, flights, and post-flight).
Sample Description: A short description of the sample.
Photographic Documentation Available: What photographs are available and how to access them.
Hardware Archive: Describes what LDEF hardware is available and where it is stored for a specific experiment.
Figure 1: Important photographs, graphs, plots, etc. can be inputted into the data base in this section.
Figure 2: "
Figure 3: "
Meteoroid and Debris Impacts: Total number of meteroid and debris impacts <, =, or > 0.5 mm in diameter resulting in a crater or disbonded area.
Experiment Title: Title of specified LDEF experiment.

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One of the objectives of the LDEF Special Investigation Group (SIG) was to develop a LDEF data base that identified the experiment objectives and hardware flown, summarizes results and conclusions, and provides a system analysis overview which would include spacecraft design guidelines and space environmental effects. Compiling this information into an easily accessible data base format, and making it available to the space community was a major task accomplished by the System and Materials SIG effort beginning in 1991. Included in this document is a short user's manual for the LDEF Mini-Data Bases. The user's manual contains pertinent examples from the data base on spacifically how to access and work with the LDEF information. Accompanying this document are the mini-data bases on disk.

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