



# Conversion of LDEF Experiment M0003 Sample Observation Database to MS-DOS Formats

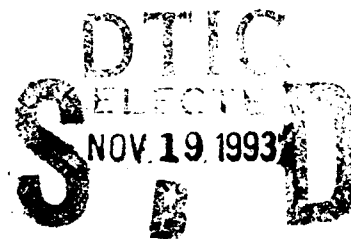
1 October 1993

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Prepared for

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Engineering and Technology Group

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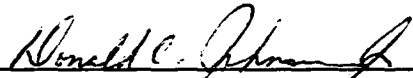
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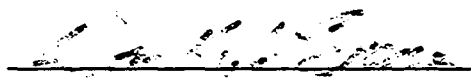
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This report has been reviewed by the Public Affairs Office (PAS) and is releasable to the National Technical Information Service (NTIS). At NTIS, it will be available to the general public, including foreign nationals.

This technical report has been reviewed and is approved for publication. Publication of this report does not constitute Air Force approval of the report's findings or conclusions. It is published only for the exchange and stimulation of ideas.



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## INTRODUCTION

### THE LONG DURATION EXPOSURE FACILITY

In January 1990, a large collection of common spacecraft materials was retrieved after extended exposure to the space environment of low Earth orbit on the Long Duration Exposure Facility (LDEF). The LDEF was a 30-ft-long, 14-ft-diameter unmanned spacecraft that was designed to be a retrievable experiment platform. Originally deployed into orbit by the Shuttle Challenger in April of 1984 on what was to be an 11-month mission, the LDEF was not recovered until 69 months later. By the time the LDEF was captured by the Shuttle Columbia, the experiments had been exposed to the natural space environment longer than any previously retrieved for study. During the 69 months, materials on LDEF were subjected to roughly 11,000 hours of UV radiation, 32,422 thermal vacuum cycles (-39 °F to 134 °F), an electron dose of  $2.5 \times 10^5$  rd, a proton dose of  $1.6 \times 10^3$  rd, and thousands of micrometeoroid and space debris impacts.

The LDEF was gravity-gradient stabilized and, therefore, maintained a constant orientation in orbit so that only experiments on the side of the spacecraft facing into the velocity vector (leading edge) were subjected to the significant atomic-oxygen dose (maximum  $\sim 8.5 \times 10^{21}$  atoms/cm<sup>2</sup>) encountered at low Earth orbit. Experiments on the side away from the velocity vector (trailing edge) were exposed to UV-thermal vacuum cycling-space debris/micrometeoroid conditions comparable to those experienced by all spacecraft, regardless of orbital altitude. The electron and proton doses on LDEF were lower than those encountered by satellites at geosynchronous altitudes. The space debris environment was also less severe than that faced at higher altitudes. The return of the 57 experiments on board 86 trays arrayed around the LDEF presented investigators with a unique opportunity to analyze physical samples exposed to natural space conditions.

### THE M0003 EXPERIMENT

One of the most comprehensive materials experiments aboard LDEF, the M0003 experiment was designed to study the effects of the space environment on current and developmental spacecraft materials. The M0003 experiment, planned and integrated by The Aerospace Corporation Mechanics and Materials Technology Center, was a collection of 20 subexperiments from The Aerospace Corporation Laboratories, Air Force and Navy Laboratories, and Department of Defense (DOD) contractors. A summary of the M0003 subexperiments is presented in Appendix B.

The M0003 hardware consisted of four experiment trays, two on the leading edge (trays D8 and D9) and two on the trailing edge (trays D3 and D4). Over 1270 material samples of more than 200 material types were mounted on modules within the trays. Many subexperiments contained duplicate samples on both the leading- and trailing-edge trays to compare and contrast the effects of atomic oxygen exposure.

The complete sample complement represented a broad range of materials, including thin-film optical coatings, paints, polymer sheets and tape, adhesives, and composites, for use in various spacecraft applications, including thermal control, structures, optics, and solar power, as well as others.

### **M0003 DEINTEGRATION**

The four M0003 trays were unpacked and disassembled in a class 10,000 clean room at The Aerospace Corporation. As test samples were removed from the trays, they were individually examined and photographed through high-resolution optical microscopes using bright-field, dark-field, and Nomarski techniques. The samples experienced various space-induced damage such as crazing, surface roughening, discoloration, erosion, and contamination, as well as other damage mechanisms. Observations of the effects seen were recorded by a single examiner who maintained a consistent criteria for the qualitative descriptions of the condition of all M0003 samples and hardware.

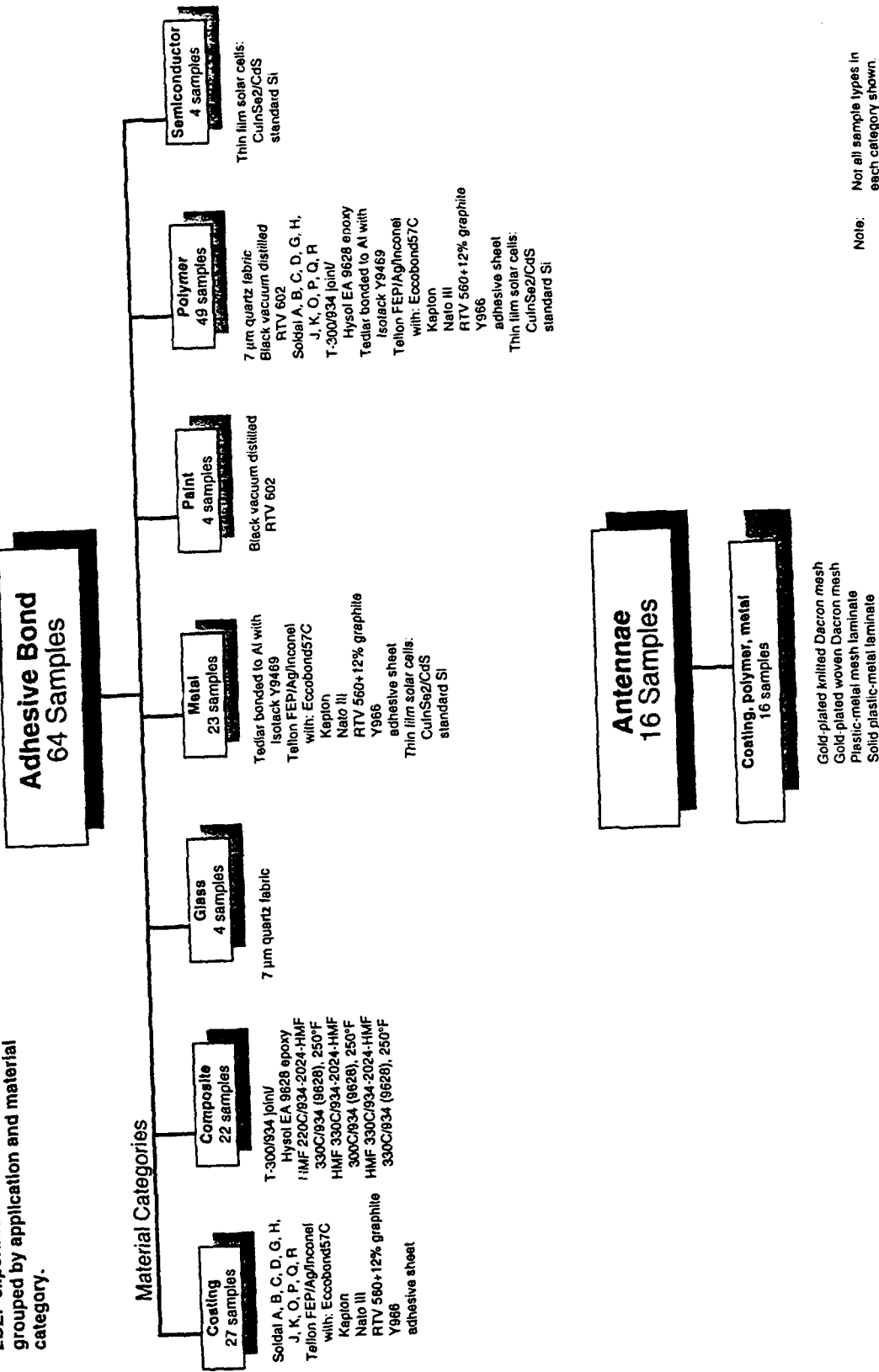
### **M0003 SAMPLE OBSERVATION DATABASE**

The M0003 Sample Observation Database contains the observations made for all samples on the four M0003 trays that could be examined, including thermal-control surfaces that were part of the tray hardware. In addition to being assigned a database number and description to each sample, the samples were categorized by spacecraft application, sample type, and damage observed, for easy sorting. A breakdown of the samples by spacecraft application and material category appears on pages 3 – 9. Note that some materials fall into more than one application or category. A complete description of the M0003 Sample Observation Database is presented in Ref. 1.

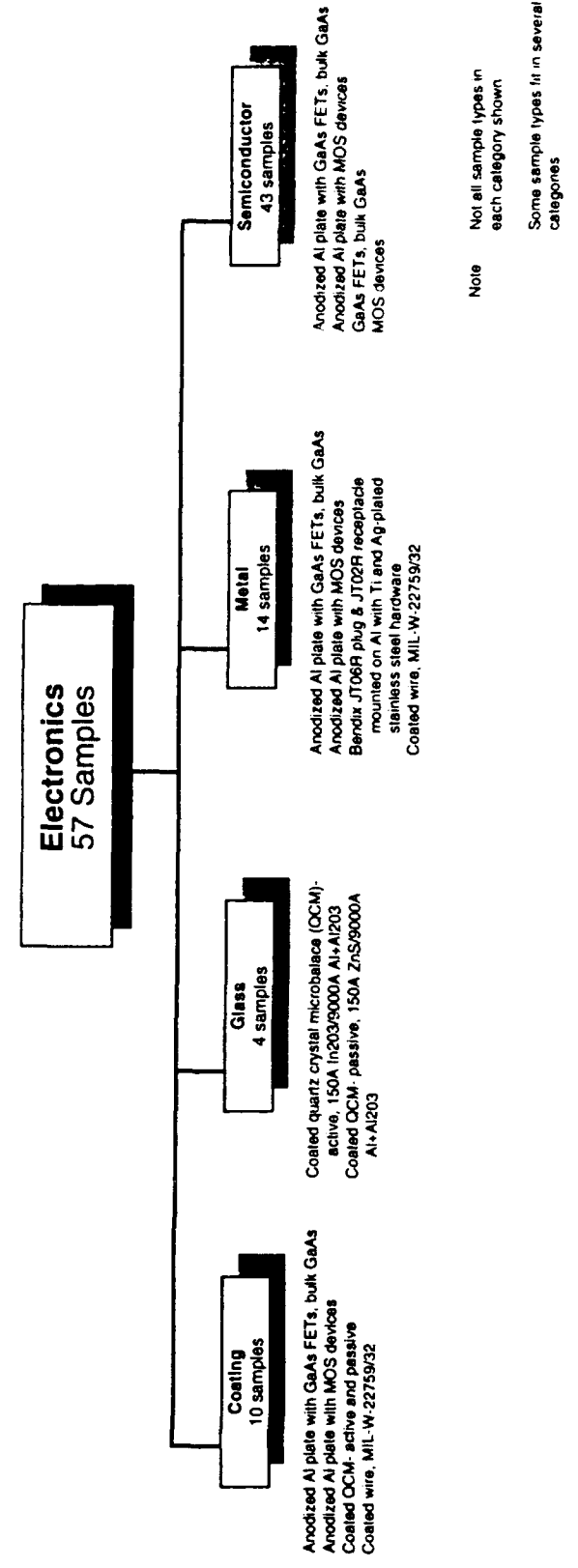
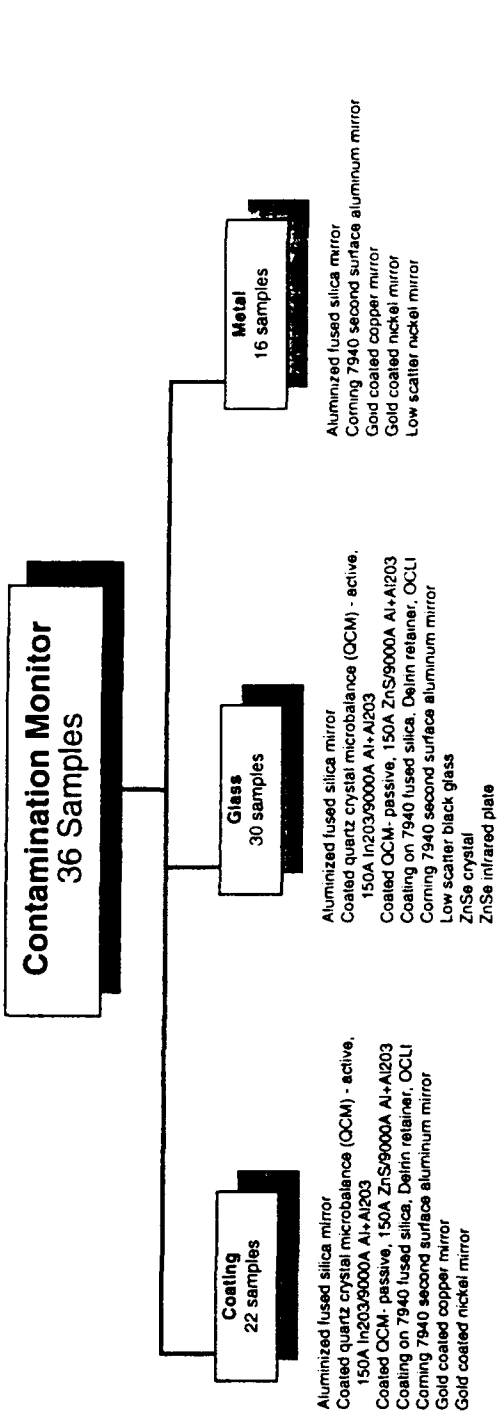
The database was originally written in 4th Dimension™ for the Macintosh; due to the high demand for a PC-DOS compatible version, however, it was ported to two PC database programs — dBase IV and Paradox 4.0. This report details the conversion of the database to the two DOS formats. Instructions for installation and use, including example searches and printouts, are presented. Copies of the database are available on floppy disk by request, in both DOS formats, as well as the original 4th Dimension™ version for the Macintosh.

# Spacecraft Application

LDEF experiment M0003 samples, grouped by application and material category.



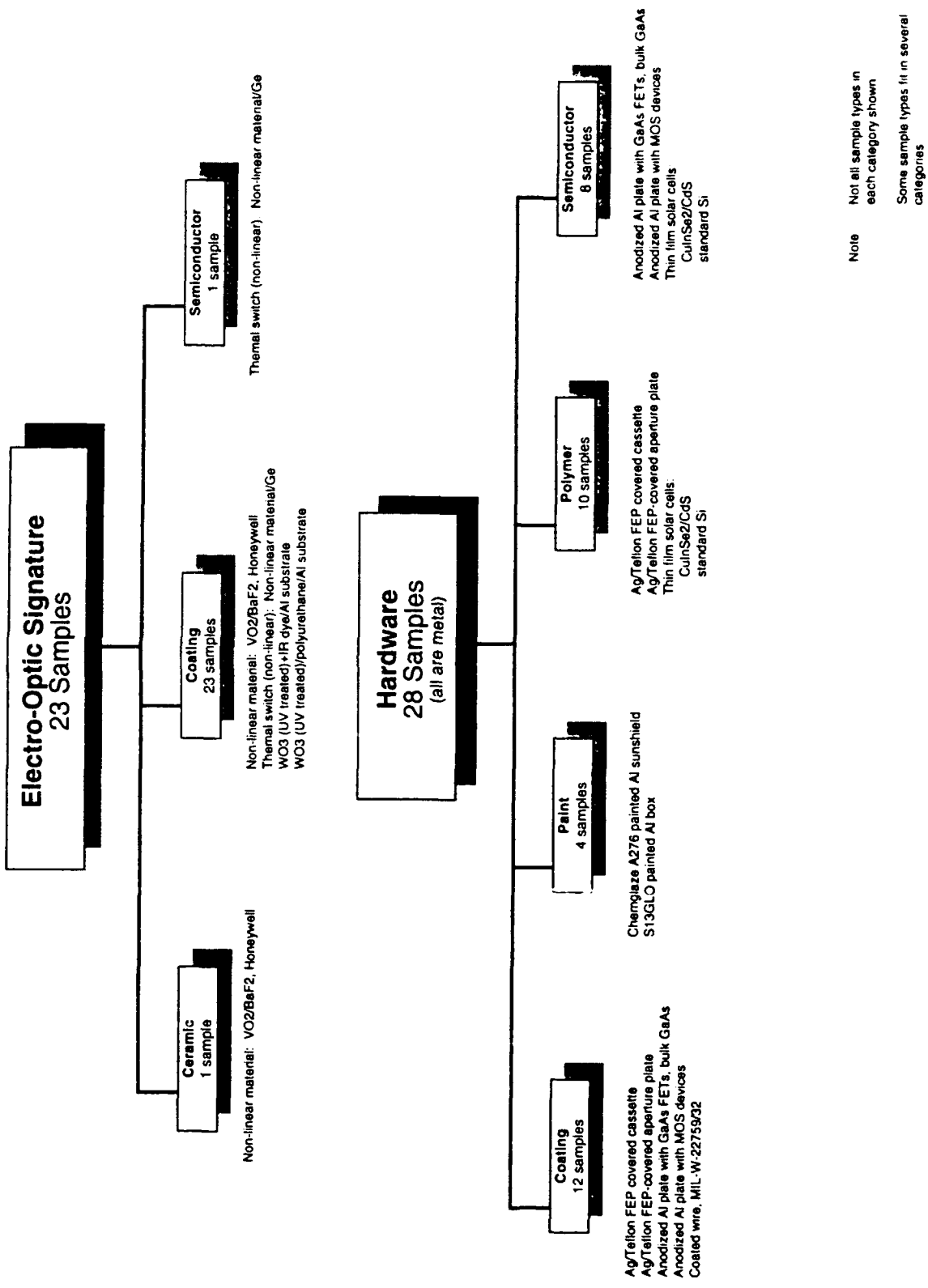
Note:  
Not all sample types fit in several categories.  
Some sample types fit in several categories.



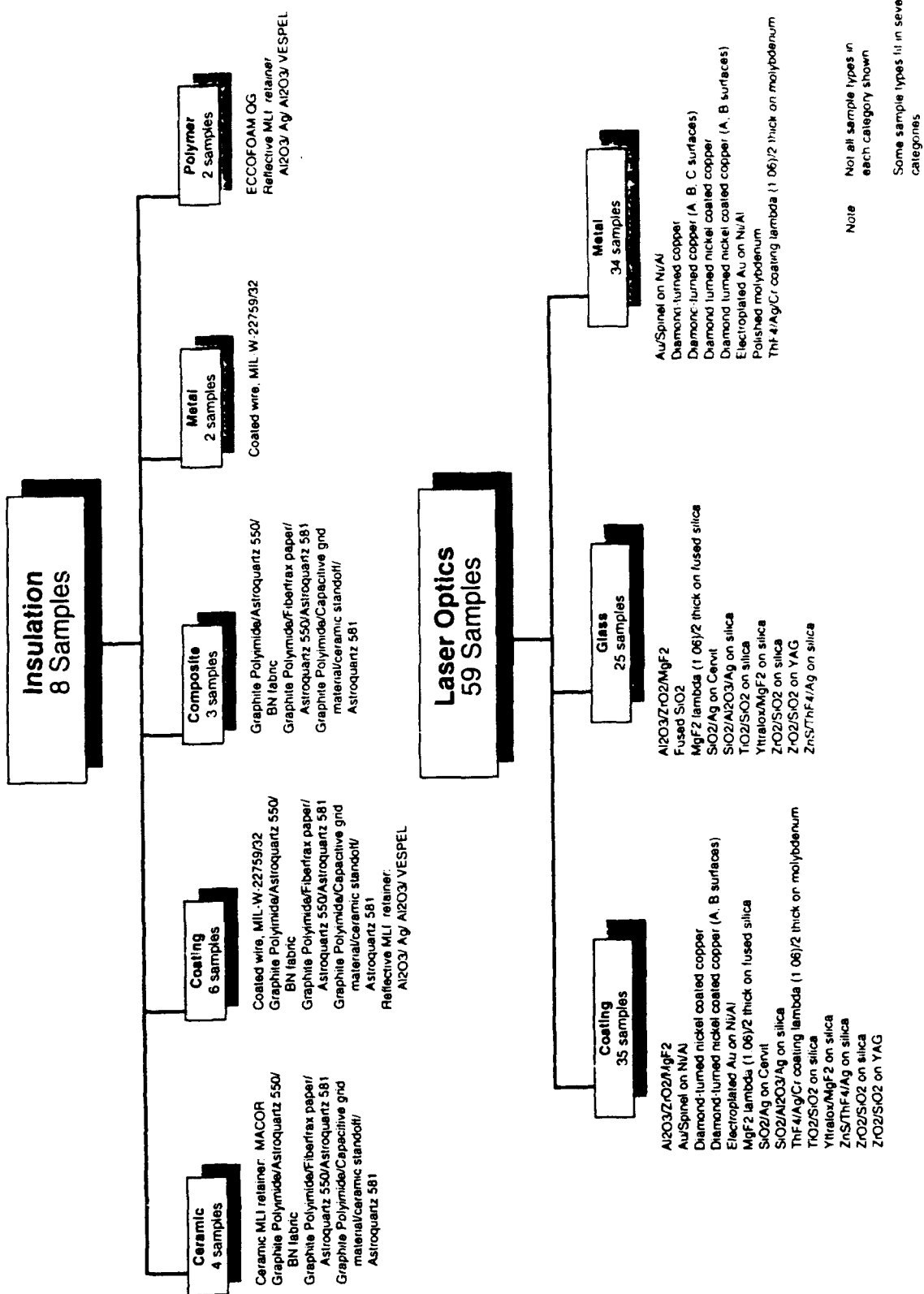
Note Not all sample types in each category shown

Some sample types fit in several categories



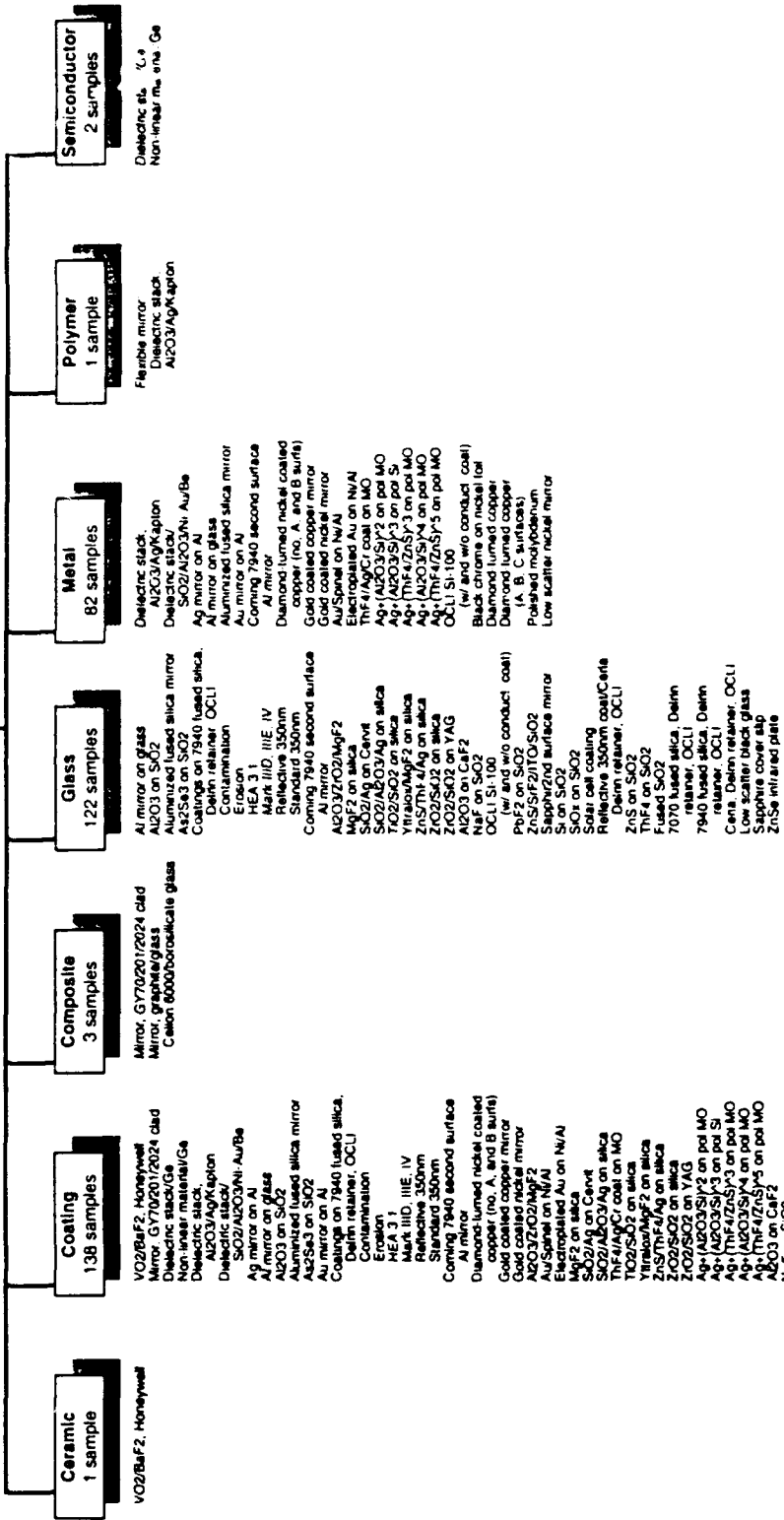


Note Not all sample types in each category shown  
Some sample types fit in several categories

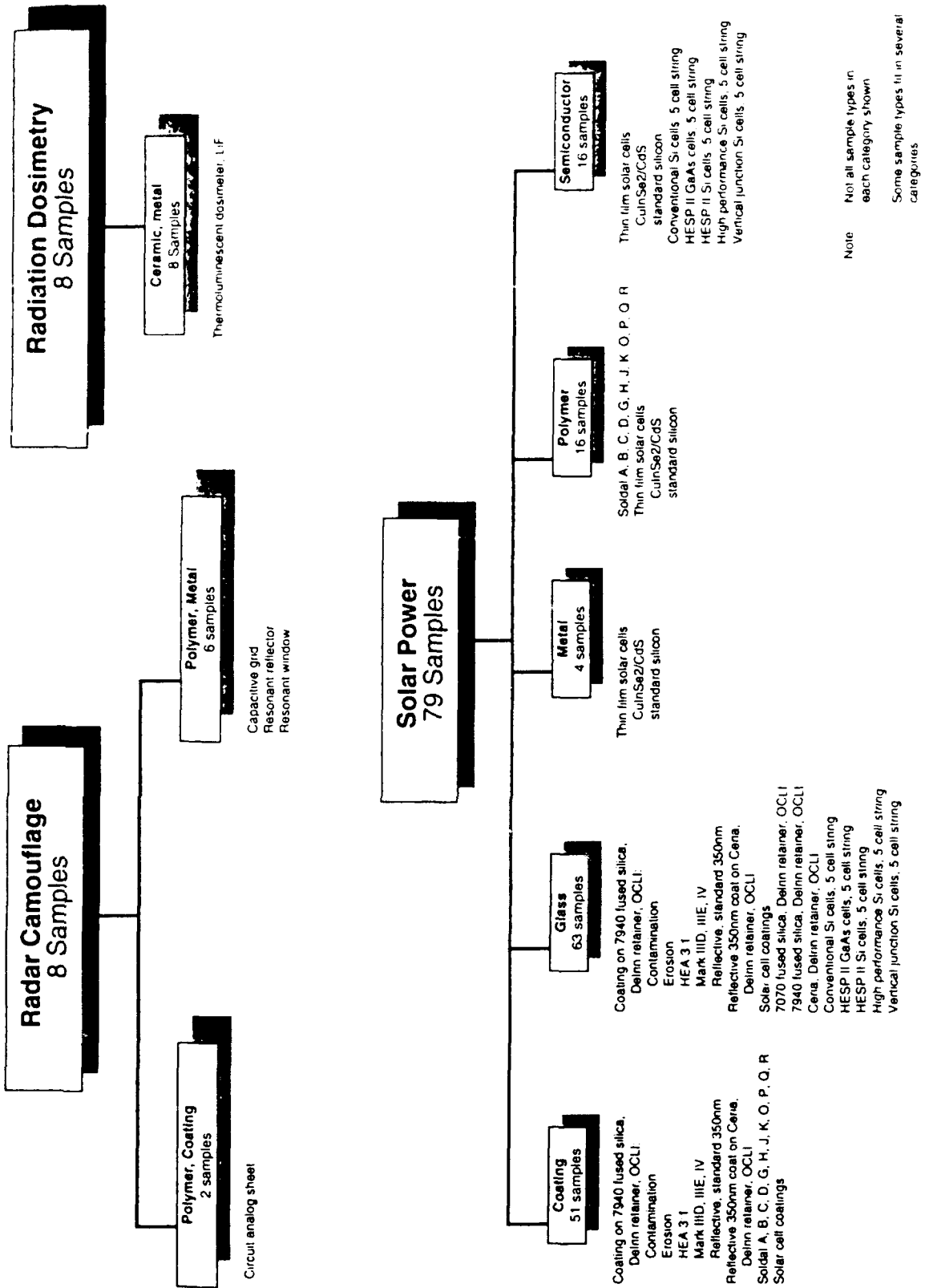


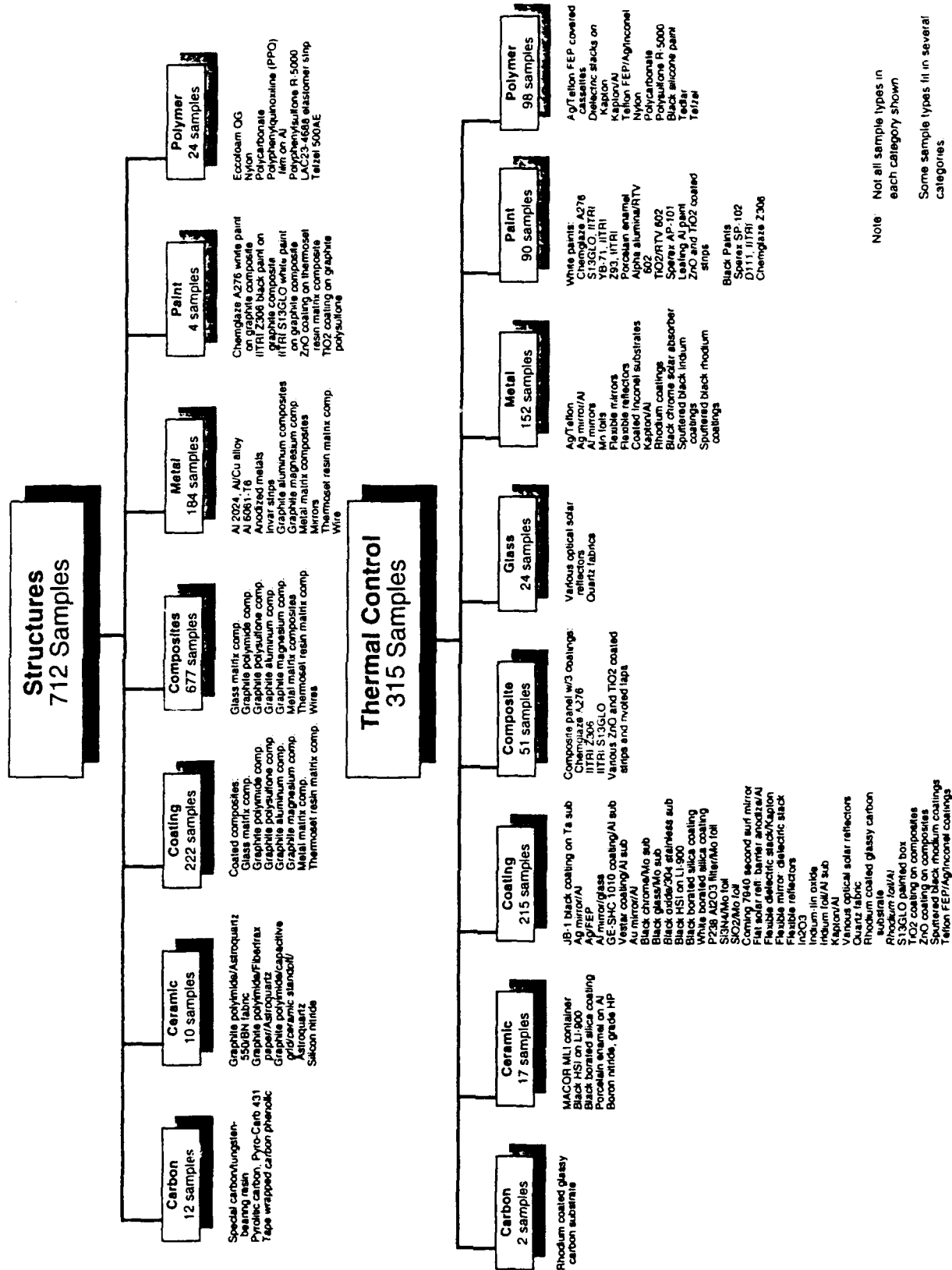
Note: Not all sample types in each category shown. Some sample types lie in several categories.

# Optics 188 Samples



**Note**  
Not all sample types in each category shown  
Some sample types fit in several categories





Note: Not all sample types in each category shown  
Some sample types fit in several categories.

## **LDEF EXPERIMENT M0003 SAMPLE OBSERVATION DATABASE (INSTRUCTIONS FOR PARADOX)**

### **ABOUT THE DATABASES**

In its original form, the LDEF database was a relational database, running in 4th Dimension on a Macintosh. Demand was sufficient to require creation of a PC version of the database, but unfortunately none of the PC database packages in common usage are fully relational. The database was, therefore, split into two parts: a large file of all the samples and the physical data pertaining to them, and a much smaller file, giving contact information for the experimenters involved in the project. Links were used to provide most of the features of the Macintosh product. Because of limitations inherent to Paradox, the contact information database had to be duplicated to allow full view of the information in it. Although both databases are identical, neither can be removed without changing the standard viewing form.

Information on the content of each individual field is found in Appendix A. Contact information for each subexperiment is summarized in Appendix B.

Another important thing to know about these databases is that most of the data is in text format. Even fields that you might expect to contain only numbers, such as width and phone number information, had to be entered as text for various reasons. Thus, the only fields that consist solely of numbers are the Experimenter ID field (in both databases) and the DB number field (in M0003). All other fields contain textual information, a distinction that becomes important when searching.

Finally, two of the fields are too large to fit into regular text fields and must, therefore, be placed in memo fields. These fields (Observations Aer in M0003 and Publications in POC and CONTACTS) are treated slightly differently by Paradox. We have attempted to note all the differences below.

### **INSTALLATION**

The data is contained in 3 databases in 22 files: one database of observation information (M0003.DB, .MB, .SET, .F, .R, .R1) and two (identical) databases of contact information (POC and CONTACTS, .DB, .MB, .SET, .PX, .F, .F1, .F2, .R). There are also 2 scripts in 4 files: QUERY.SC, .SC2; and EXAMPLE.SC, .SC2. Copy these files into your Paradox directory or some other suitable location. If the files are in a directory other than the Paradox directory, you will want to change the working directory, using the Tools|More|Directory command. You should also keep a copy of the files in a separate, safe location (such as floppy disks) as a backup.

You will need Paradox version 4.0 or later. Earlier versions may not be able to read the files properly.

These files should be protected by a password. Your password is ldef (all lower case), as in Long Duration Exposure Facility. This password does not allow editing of the data, but it does allow you to create whatever reports or formats you wish in order to best use the data. This prevents users from inadvertently introducing errors into their data (errors that might be propagated further when this person consults with coworkers, who then pass it along, etc...).

## BASIC PARADOX USAGE

This is only a quick overview to get you started. If you are already familiar with Paradox, you can probably skip over this, or skim it for shortcuts you may have forgotten. In any case, be sure to read the **About the databases** section above. Please consult the Paradox User's manual for information that demonstrates all of the available search options.

Some keys to remember:

Keystroke	Action
F1	On-line help for Paradox. Useful.
F2	"Do-It!": will complete the current action.
F3, F4	Previous and Next window: moves the active window through those windows that are currently open.
alt-F5	Shows the full amount of text in a field
F7	Toggles between table and standard form while viewing a table.
ctrl-F8	Cancel current action or close window, as appropriate
F10	Moves the cursor to and from the menu bar, allows use of the menus. Enter selects an item, and Esc moves you back.

Paradox 4.0 is menu-driven. The main menus are:

Menu	Action
≡	Resizes and moves windows, allows access to the text editor and other utilities
View	Shows the entire selected database. Detailed below.
Ask	Performs a query, or search, of selected database(s). Detailed below.
Report	Output of data and results to printer, screen, or text file. Detailed below.
Create	Creates a new database. Not relevant here.
Modify	Modifies an existing database. Not relevant here.
Image	Modifies how windows are shown. Detailed below.
Forms	Creating and changing forms for viewing of databases. Form design is not detailed here, as it is not necessary for the beginning user. Refer to User's Manual for details about this menu item.
Tools	Renaming, copying, exporting, importing, security, and other such considerations. Either self-explanatory or beyond the scope of this introduction.
Scripts	Creates macros or programs, either by directly writing code or simply by example. Detailed below.
End	Ends the session of Paradox.

(Menu choices will be abbreviated here as: Menu/Sub-Menu. This means you first choose Menu, which will allow you to choose Sub-Menu.)

When you chose a menu option, Paradox may ask you what table to use. Type in the name of the desired database: M0003 (those are zeroes, not O's) for the observations database; POC or CONTACTS (the two are identical) for the contact information. Case is not important here (or almost anywhere in Paradox). We attempted to configure the files such that you will usually want to choose M0003.

### View

The View menu will show you the entire requested database in a table form. To perform searches, see Ask below. To see the data by record, press F7. Use the Standard Form, unless you wish to create your own. The "by record" view of M0003 (the Standard Form) includes the contact information, so it will probably be more useful.

#### Navigating in table form:

Keystroke	Action
Arrows	Move the cursor between fields
tab	Moves one field right
shift-tab	Moves one field left
Page up	Shows the previous screen of records
Page down	Shows the next screen of records
Home/End	Moves to the first and last records, respectively (in the current field)
ctrl-Home	Moves to the first field of the current record
ctrl-End	Moves to the last field of the current record
alt-F5	Different effects, depending upon where the cursor is: <p style="margin-left: 40px;">If in a memo field, it will open a window showing the text of the field. Scroll through this using arrows, page up/down, and home/end. To exit, type ctrl-F8.</p> <p style="margin-left: 40px;">In other fields: you can now scroll through the field using the arrow keys. Press Enter to exit.</p>
F7	Change to Standard Form

#### Navigating in Standard Form:

Keystroke	Action
Arrows, tabs	As above
Page up/down	Moves up or down a page of the form.
ctrl-page up/down	Moves up or down 3 pages of the form (or the length of one record)
F3 or F4	Moves between observation and contact fields (not important in most cases)
alt-F5	As in table form, but shouldn't be needed in this form
F7	Change to table form

Each record of M0003 is divided into 3 pages in the Standard Form to allow all the data to be shown. This is why alt-F5 should be less useful.



## Ask (searching)

The Ask menu will allow you to search one or more databases using a large range of search criteria. A database need not be viewed to be searched, although it can be.

### Ask commands:

Keystroke	Action
F2	"Do-It!": starts the search
F5	Creates a link between files. Detailed below.
alt-F5	As before, this allows you to move around within a field. Useful when editing since it allows you to edit anywhere in a line without erasing the whole thing.
F6	Checks or unchecks an item for display in the Answers table. Only those fields that are checked will appear, therefore, at least one field must be checked for the search to proceed. To check or uncheck all the fields in a table, press F6 under the table name.
cntl-F8	Cancels the search and closes the query window.

When you request a query, a table of all the fields in the requested database appears. Tab, shift-tab, and the arrows will move you between fields. To search for something, simply type an example in the appropriate column. For example, to find all samples belonging to experimenter 13, type 13 in the Experimenter ID field. Text should be enclosed in quotes. You must also remember to check items for display in the answer table. (Searched fields need not be checked, and checked fields need not be searched.) So, if, for example, you wanted to know the sample IDs and database numbers of all samples belonging to Experimenter 13, the search window would look something like this:

```
=[ ]===== Query M0003 =====  
M0003  /   Sample ID  /   DB Number  /   Experimenter ID  /  
      |√             |√             |   13             |  
      |             |             |             |  
===== 1 of 1 =====< >--
```

(Italics indicate highlighted text. If you try this search, you should come up with 26 hits.)

Paradox will automatically remove any duplicate entries from the answer table, based on the checked fields. Sample ID and DB Number were checked above, and they are unique for each record. If you had checked Experimenter ID (and only Experimenter ID) instead, you would be given an answer table with only 1 entry. Although there are 26 records with Experimenter ID = 13, the information you have requested from each record is exactly the same. So, Paradox will only print it once. This is useful for finding different entries (say, finding all the Categories available), and if you want to get around it, you can always check Sample ID or DB Number (both of which are unique to each record).

There is only one query window per database; so, if you will be making multiple searches, keep this in mind. You may have to print out your results (see Reports below) before running another search if the results are ones you wish to save. Also, searches will not be performed if two unlinked queries are open. So, if you are going to stop searching one database and begin searching another, you must

either close the query window of the first database or link the two databases together. The second choice allows searches of both databases, but if you are really only going to be searching and checking items in one, it may increase the amount of time taken to search.

Remember that almost all of the fields contain text information, and will be searched in text order. This order is rather like a dictionary: spaces before punctuation, before numbers, before capital letters, before lower case letters, from left to right. In Paradox you don't need to surround text to be searched with in quotes (although it is encouraged), so it is very easy to forget that you are searching on text rather than numbers in some cases. Still, searches on text for the most part yield the expected answers. For example: width <= 3 will yield all fields with width  $\leq 3$ , and all blank fields (as will width <= "3 "). It will, however, pass over records with width 3.xxx because the space after the 3 is lower than the period character in 3.xxx.

Some of the fields are further limited to certain permitted words. The Category, Subcategory, Application, and Damage fields are all permitted to contain only certain key words, although they may contain more than one of these. The Tray, Module Number, and Experimenter ID fields are all limited to a single entry from a small list of choices. These choices, and the key words for the previous fields, are listed in Appendix C.

Some search options:

Operator	Meaning	Explanation and Examples	Search Finds
and	Logical and	<p>Within a field: use a comma</p> <pre>  DB Number   Experimenter ID                 &gt;3, &lt;= 14       </pre> <p>In separate fields, use the same line:</p> <pre>  DB Number   Experimenter ID     &gt; 147      &lt; 14             </pre>	<p>All records with Experimenter ID between 4 and 14 (inclusive)</p> <p>All records with DB number above 147 and Experimenter ID below 14</p>
or	Logical or	<p>Within a field: type or</p> <pre>  DB Number   Experimenter ID                 12 or 13         </pre> <p>In separate fields, use separate lines:</p> <pre>  DB Number   Experimenter ID     &gt; 189                                      13               </pre>	<p>All records with Experimenter ID of 12 or 13</p> <p>All records with DB Number above 189, or with Experimenter ID 13.</p>
..	wildcard	<p>Finds a piece of text within the field. The searches are not case-sensitive, and this command won't look specifically for a word. To find all occurrences of the string paint:</p> <pre>.."paint"..</pre> <p>If you want the word to appear alone, try putting spaces before and after your word:</p> <pre>.." paint "..</pre> <p>Unfortunately, putting spaces around your word will lose all occurrences of the word near punctuation, as we have seen here. If you think you have extra entries, make sure to check (F6) the search field and check your answer table by hand.</p>	<p>Finds phrases like:</p> <p>"The paint was peeling"</p> <p>"Paint, purple"</p> <p>"unpainted"</p> <p>Of the above, finds only:</p> <p>"The paint was peeling"</p>

F5 is used to create links between the "sample observations" database and the "points of contact" database. This allows you to search for all paints sent up by experimenters in California, for example, or can allow you to find the sample IDs of someone's work when you don't want to look up their

experimenter ID. To create a link, open queries for all of the desired files. For each link you want to create, go to the linking fields, press F5, and type a word (We suggest *link*, to keep the meaning clear, but any short word will do). For the LDEF M0003 databases, there are only two files, linked by the experimenter ID field. So you would press F5 and type *link* in each of the Experimenter ID fields. The linking word should appear in highlights. If it does not, something is wrong. Delete the entry and try again.

An example of how to use a link follows. Suppose you wanted to know the exposure time for all of Michael Meshishnek's paints that were discolored after the experiment. You don't know his experimenter ID, but you might want to obtain it for future reference, and you also want his phone number in case there are questions not answered by the database. Finally, you want to get sample IDs and database numbers in case you need to get observation information about the samples later.

The information you want to search on is: Description contains paint *and* Damage contains discolored *and* Person contains Meshishnek. Because the Person and the other fields are in different databases (Person is contact information, while description and damage both correspond to individual samples), a link must also be used. Finally, you want to check the Sample ID, DB Number, and Exposure fields in Query M0003 and the Experimenter ID and Phone fields in Query Poc. The final product should look something like this:

```

=[ ]===== Query M0003 =====[ ]==
M0003 / Sample ID / DB Number / Experimenter ID / Description / Damage
      |√          |√          | link          | .."paint".. |.."discolored"..
      |          |          |          |          |          |
===== 1 of 1 =====< >-----

=[ ]===== Query M0003 =====
Subcategory / Application / Exposure / Width
          |          |√          |          |
          |          |          |          |
===== 1 of 1 =====<

=[ ]===== Query Poc =====/ /===== [ ]==
POC / Experimenter ID / Person / Or/ / / Phone / FAX
    |√ link          | .."meshishnek".. | / / / |√ |
    |          |          |          | / / / | |
===== 1 of 1 =====< / / >-----

```

(Once again, italics indicate highlighted text. The M0003 query was too big to fit on one screen, so we showed two parts of the query. To see these two parts, you would use the arrows or tab/shift-tab to move around the window. The Poc query was also too big to fit onto a screen, but there was enough room to do a "split screen". This won't appear on your computer; you will have to use the arrows just as for M0003 to see all the data.)

This example yields an answer table something like this:

```

=[ ]===== Answer =====[ ]=====
ANSWER | Sample ID | DB Number | Exposure | Experimenter ID | Phone
  1 | D4-SCU Cover | 2000 | 69 months | 20 | 3103368760
  2 | D4-Sunshield | 2001 | 69 months | 20 | 3103368760
  3 | D8-SCU Cover | 2002 | 69 months | 20 | 3103368760
  4 | L3IV-18-17-1 | 179 | 69 months | 18 | 3103368760
  5 | L3IV-18-18-2 | 180 | 69 months | 18 | 3103368760
  6 | T3IV-18-17 | 743 | 69 months | 18 | 3103368760
  7 | T3IV-18-18 | 744 | 69 months | 18 | 3103368760
  | | | | | |
===== 2 of 7 =====< >-----

```

(Note that Michael Meshishnek has two experimenter IDs. This means that he is the point of contact for two different subexperiments. It is not an error in the database.)

Paradox allows you to save your queries as well. The command is `Scripts|QuerySave`, followed by the name you wish to give your search. This allows you to save search templates or even complete searches that you use often. To bring up the search, choose `Scripts|Play` and choose the script's name. Any queries of the LDEF databases that you are currently running will be erased, so take care not to lose any complex searches in this way.

Two sample scripts are included with the LDEF data. The first, called `QUERY`, simply calls up both databases and links them together. It is for use as a template. You must choose which fields to check, and you will probably want to enter some search conditions as well. The second, called `EXAMPLE`, simply sets up the example query above. It may be useful if you are having trouble getting a search to run and want to check your syntax against a working search.

Scripts are useful for more than just saving searches; they are useful in making any task you repeat often take a little less time. They are very similar to macros if you are more familiar with that term. Creating scripts is pretty intuitive, but is a little beyond the scope of this document. Scripts can be created by example, using the `Scripts` menu and `BeginRecord` and `End-Record` commands, or by using the Paradox script language and creating a text file with the proper commands. For further information on these options, consult your User Manual or the on-line help menus.

#### Reports (printing):

The `Report` menu will print a report of the desired data to printer, screen, or a text file by choosing `Report|Output`. You will then be prompted for the name of the table you wish to print and the report format to use. The full report for M0003 will print data from both databases together, allowing you to see the observations as well as the contact information for a particular sample. Examples of the full report follow on pages 20 – 22. Note that some records will take up more than one page if they contain a great deal of information. Also, be aware that this menu option prints the entire table; to print a subset of the table you must choose `Report|RangeOutput` command detailed below. M0003 is well over 1500 pages long, and you probably won't want to print all of it.

Please note that some PC printers have different ASCII tables than the standard. This will only affect extended characters, e.g., °, ±. Printing a report containing extended characters may result in some

confusion because they will be changed to different symbols. If this occurs, check with your copy of the database to see the correct characters.

We have been unable to discover how to print individual records. The `RangeOutput` menu item will allow you to specify pages to begin and end printing, but some records will take up more than one page. This leaves you to guess the proper range of pages to print. It may be wise to print to the screen for the wilder guesses, to conserve paper, until you narrow it down a little. Another option may be to print the entire M0003 database to a text file, then copy the records you want onto a separate file for printing. This is a bit of a kludge, of course, and will get tedious for large lists.

If your printing range starts late in the file, printing may not start for some time because the computer must figure out all of the page breaks previous to your range.

If you wish to print the results of a search, you can do so by choosing to print a report of the ANSWER table. Simply choose `Report | Output` and use ANSWER as the table name. This will print the answers to the latest query in table form, much as it appeared on the screen. You can also modify the standard report form if you wish, eliminating (but not adding) field information and changing field sizes. You may wish to do this if you have long text fields in your answer table because you either won't be able to read all of the data or Paradox will print it out spread across several pages in a barely readable format. Also, fields will occasionally be too small to show all the data (for example, the DB number field isn't wide enough to show decimal information) and will need to be widened. To create a by-record report, you must create a new report format for ANSWERS by choosing the `Report | Design` or `Report | Change` commands. Choose the free-form rather than tabular format and design the report as you wish.

Creation and modification of reports, while allowed by your password, are beyond the scope of this tutorial. Consult the User's Manual or the on-line help for instructions here.

### **Other Menus**

The `Image` menu will allow you to change the format of the table you are viewing, go to a given record, and resize windows — all the useful tricks for getting around and seeing what you want to see. If you use a certain image a great deal, you can save the settings with the `KeepSet` command from this menu. This will save all the settings that you have changed in this menu so they will always be in effect when you first open a file.

The `≡` menu will allow you to move and resize windows and gives you access to the text file editor that comes with Paradox.

The `Tools` menu allows you to change the current working directory with the `Tools | More | Directory` command.

Sample ID: L3I-1-1-C  
Database #: 1.000

Experimenter ID: 1  
Tray: D9 Module: I

Description: Resonant reflector

Width: 7.875 Exposure: 69 months  
Length: 8.625  
Thickness: <0.005  
Damage: Eroded (+), cratered  
Application: Radar camouflage  
Category: Polymer, metal  
Subcategory: Metallized polymer

Observations at Kennedy:

KAPTON ERODED, ONLY A REMNANT REMAINS. PLATE BEHIND FOIL HAS RESIDUE OF IMPACTS THAT HAVE PENETRATED THE FOIL

Observations at Aerospace: Date: Thursday, May 31, 1990 Time: 13:14:55

The sample is a Kapton sheet imprinted with a staggered pattern of metallic foil tripoles. The Kapton sheet has eroded and most of the sample is missing; only a flap of the central section and material near the edges remain. The remaining Kapton is thin, especially near the eroded periphery of the material. Blister-like features are apparent on the metallic tripoles and the edges of many appear eroded; however, the surrounding Kapton has eroded to a greater extent, releasing many of the tripoles. Some of these tripoles were found in the shuttle payload bay after LDEF retrieval. Impacting debris and micrometeoroids hitting the intact sample produced sprays of residue on the underlying hardware. Several perforations are apparent on the sample remnants (on the D10 side). The thermistor, originally attached to the foil surface, survived without change.

Point of Contact:

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Dayton , OH 45469-0137  
5132553220 FAX: 5132588075

Publications:

The Aerospace Corporation

Sample ID: L3II-5-1-C1                      Experimenter ID: 5  
Database #: 9.000                              Tray: D9                      Module: II

Description: Teflon FEP/Ag/Inconel, 2 mil, Sheldahl

Width: 1.xxx                                      Exposure: 69 months

Length: 6.xxx

Thickness: 0.002

Damage:                      Embrittled, eroded, crazed, cratered

Application:                  Thermal control

Category:                      Coating, polymer, metal

Subcategory:                  Coated polymer, film, metallized polymer

#### Observations at Kennedy:

MISSING, REMOVED DURING TRAY COVER REMOVAL

Observations at Aerospace:                  Date:                                      Time:

This strip broke where turned under on the earthward side of the mounting plate. It is not possible to determine when in the mission the failure occurred. The strip curled and became milky-white. The metallic layer on the reverse surface is crazed and the Teflon surface front surface appears scratched and scuffed so that it is no longer transparent. The strip was pinched and pulled from its mounting location by a tray cover while at Kennedy Space Center. One end of the curled strip is more reflective than the other. A dark smudge is apparent on one end of the strip. Many impacting particles of varying sizes have perforated the strip. There is a contamination stain on the earthward end of the mounting hardware where the strip was positioned. There may be a contamination deposit on the strip as well.

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#### Publications:

1. C. J. Hurley and W. L. Lehn, "LDEF M0003-5 Thermal Control Coating: on DoD Experiment," LDEF Materials Workshop 91, NASA Langley, VA, Nov. 19-22, 1991
2. C. J. Hurley and Michele Jones, "LDEF M0003-5: Recent Results on Polymeric Films," LDEF Materials Workshop 91, NASA Langley, VA, Nov. 12, 1991
3. W. L. Lehn and C. J. Hurley, "Skylab D024 Thermal Control Coatings and Polymeric Films Experiment," LDEF Materials Workshop 91, NASA

The Aerospace Corporation



Langley, VA, Nov. 19-22, 1991

4. C. J. Hurley, "Thermal Control Materials," Proceedings of the First Post-Retrieval Symposium, Kissimmee, FL, June 2-8, 1991, NASA Conference Publication 3134, Part 2

The Aerospace Corporation

## **LDEF EXPERIMENT M0003 SAMPLE OBSERVATION DATABASE (INSTRUCTIONS FOR DBASE IV)**

### **ABOUT THE DATABASES**

The original LDEF observations database was a single relational database on 4th Dimension for the Macintosh. There was sufficient demand for a PC version of the data, but none of the database software in common usage is fully relational. We decided to split the database into two parts: a large database detailing each of the 1274 samples and a small database giving point of contact information for each of the experimenters. Most of the features of the Macintosh product were reproduced using links. One feature we were unable to duplicate was the printing of data from both databases on the same page. Printing a report will only yield data from one database (either contact information or observations). If you are going to be working with printouts a great deal and need to keep track of contact information, it may be helpful to simply print out all of the contact information (it is fairly compact). It will then be available for reference whenever you print out sample observation information. Alternatively, you may be able to use Appendix B, depending upon your needs.

Some of the field names in the databases may be a little unclear. dBase places a ten-character limit on field names, and the original field names were simply truncated to fit this limit. Most of the names are either complete or understandable (Publicatio = Publications, for example). Some names that may be unclear are "Experiment" and "Observatio." "Experiment" stands for Experimenter ID, a fine point, but one that may come up if you confer with users of the Paradox or Fourth Dimension versions of our database. "Observatio" contains the observations made at Aerospace (those made at Kennedy are in the Kennedy\_Ob field). For information on all of the fields, turn to Appendix A. Contact information for each subexperiment is found in Appendix B.

Most of the information in these databases is stored as text. Even fields that you would expect to contain only numerical data, such as width and phone information, are entered as text for various reasons. This will mostly show up when searching through the affected fields. Only the Experiment field (in both databases) and the DB\_Number field (in DBM0003) consist of purely numerical data. Further, the DB Number field is not a simple counter as you might expect, but contains up to two decimal places of data, denoting sub-entries.

In addition, two of the fields were too large to place in regular text fields: "Observatio" (in DBM0003) and "Publicatio" (in DBPOC). These fields are entered in memo fields rather than text fields and are treated differently by dBase IV. Most of the differences should be explained below.

Note that you should be able to edit the data in any of several views. We ask that you not edit the data because this may result in errors being propagated if you pass your copy along to your coworkers or others. Reports and forms may be created freely, but please don't modify the files that came with the database originally.

To keep inadvertent errors from creeping into your database (from typing the wrong command, or thinking you are in a different mode), it may be useful to compare periodically the files you work

with to the originals. If you have a security system already set up, we suggest that you add these files to that system, with read-only privileges to casual users.

## INSTALLATION

You should receive two files on your disk: LDEF.ZIP and PKUNZIP.EXE. The first is a compressed file containing all the dBase files that you requested. The second is the decompression program, written by PKWARE, Inc. To decompress your data, copy both files to your hard drive. Then enter the directory where you copied them and type at the system prompt (example prompt only, yours may be different): C:\DBASE\LDEF>pkunzip ldef.zip

This will cause your files to be inflated to their full, usable size. When all the files are unzipped, you should have a total of 20 dBase IV files. **Keep a copy of the original files.** dBase will not prevent you from editing the data, so you will need to have an untouched copy for comparison should you accidentally do so. Whether your backup copy is in the compressed or decompressed format is up to you, but it is important that some backup be kept. The names of the decompressed dBase files are as follows:

DBM0003 (database of observations; the 0's are zeroes, not o's.)

Ext: .TBK, .DBK, .DBF, .DBT

DBPOC (database of contact information)

Ext: .TBK, .DBK, .DBF, .DBT

STD\_LDEF (form for observation data)

Ext: .SCR, .FMT, .FMO

STD\_POC (form for contact data)

Ext: .SCR, .FMT, .FMO

CONTACTS (report, or print format, for contact information)

Ext: .FRM, .FRG, .FRO

RPT\_LDEF (report for observation information)

Ext: .FRM, .FRG, .FRO

When you first start dBase, you should be presented with a catalog of files that dBase will use. If you have not created any catalogs, this screen will only allow you to create new files, and will have no other entries. As files are best accessed through a catalog, you should add the LDEF files to one. This can be the current catalog, if you have one already prepared, or it may be a completely separate one.

To add the files to the current catalog, go to the `Catalog` menu (see basic navigation table below for instructions on menu use) and choose `Add file to catalog`. You will then be presented with listings of possible files to add, of the type whose column you were in when you chose the menu item. So, when you choose to add files from the `Data` column, you will be presented with choices of database information to add. If you are in the `Forms` column when you add, you will be shown available forms. This package includes data, forms, and reports, so be sure to add files from all three columns.

(From now on, we'll specify menu selections in `Menu/Sub-menu` form, so the above command would be written `Catalog|Add file to catalog`.)

When you add reports and forms, you will have a choice of two file types to add for each form/report. If you don't plan on making any modifications to a form or report, then add the `.FMO` (for forms) and `.FRO` (for reports) file. If you think you might be making some changes to a given form or report, then add the `.SCR` or `.FRM` files. If you do add the second type of file, be sure to modify and save the form/report before you use it. Even if you change your mind and decide not to modify the item, save some nonexistent changes or the file may not work properly. If you later decide to modify a file, remove the old `.FMO` or `.FRO` file from the catalog, add the `.SCR` or `.FRM` file, and modify away. While the `.FMO` and `.FRO` files are still needed (i.e., don't delete them from your directory), they do not need to be added to the catalog.

If you have added all of the files to a blank catalog, it should look something like this:

Data	Queries	Forms	Reports	Lab
<create>	<create>	<create>	<create>	<cre
DBM0003		STD_LDEF	Contacts	
DBPOC		STD_POC	RPT_LDEF	

If you wish to add the files to a different catalog, or create a new one, choosing `Catalog|Use a different catalog` gives you this option. Add the files to this catalog as above.

## USE

This is only a quick overview of the use of dBase IV to get you started. If you are already familiar with dBase IV, you may find this unnecessary. Still, a review of the routines pertinent to these databases may be useful. In any case, be sure to read the information above in **About the databases**. Please consult the dBase User's manual for information demonstrating all of the available search options. There is space for only a cursory coverage here.

## Basic navigation

Keystroke	Action
F1	Brings up dBase's on-line help. Use this if you get lost or need more information about options. It will attempt to start you off where you want to be, but you may need to search to find exactly the screen you are looking for.
F9	"Zoom"s into a memo field. (see below)
F10	Moves cursor to menu bar. The arrow keys will move you between and within menus, while the Enter or F10 keys will select an option. Esc will back you out of a menu option, if you make a mistake or change your mind.
alt-(letter)	Another way to enter the menu bar. Will go to the menu beginning with the typed letter. Similarly, you can select any menu item by pressing the first letter (without the alt, once you are in the menu bar).

More on memo fields: These fields will often appear as a short field with the word "memo" in it, just as a reminder that you must press F9 to see the full text. The memo note will also tell you if there is any information in the field — if it is printed all in caps (MEMO), there is something in the field; if all lowercase (memo), the field is blank. Press F9 when you are finished reading the memo field to return to where you were. (If this does not work, choose menu item `Exit|Abandon changes and exit.`)

## QUERIES (SEARCHES)

Queries are the search routines used by dBase IV. Many search options are supported, including searching through linked files like the LDEF databases. In addition, you can specify what information about each record found you wish to see, so you need only concern yourself with the data you want.

To create a search, choose `<create>` under **Queries**, and add the file (or files) that you will be searching by using the `Layout|Add file to query` command. If you have a data file in use already, it will automatically appear in the query design.

If you wish to link two files (such as DBPOC and DBM0003), simply type a word (any short word will do, but we suggest link to keep the meaning clear) in the linking fields of each file. For the LDEF databases, this is the `Experiment` field. So if you wish to search both databases, type link in the `Experiment` field of both files.

You should specify two things when making a search: the search conditions and the fields you wish to see in the answer table. Search conditions are specified by typing the condition under the field to which it applies. This is described further below. The fields to be in the answer table (the "view") are chosen using F5, as noted below. Remember that these fields need not be related; you do not need to search every field that you will display, nor do you have to display every search field.

## Query commands

Keystroke	Action
tab	Move one field forward
shift-tab	Move one field backward
F2	Run the current query
F3, F4	Move between skeletons (the field lists which appear on the query design screen)
F5	In the search skeleton (across the bottom of the screen): <ul style="list-style-type: none"> <li>• removes the current field from the view.</li> </ul> In a file skeleton: <ul style="list-style-type: none"> <li>• adds or removes the current field to the end of the view.</li> <li>• if under the file name, adds or removes all of the fields in the file from the view.</li> </ul>

Enter data of the type you are looking for in the appropriate field in the file skeletons. For example, to find all samples used by experimenter 13, type 13 in the Experiment column. (Remember to put this on a line separate from the word link if you are searching both files mentioned above. This only applies to the Experiment column since no other column has a link in it.) In order to add another line to your search, press the down arrow to move into the new line (it will be created as you move down). If you also want to know everything about the record, check all the fields (except the Experiment field, which appears in both files and really only needs to be displayed once). The screen should look something like this:

```

Dbm0003.dbf | ↓SAMPLE_ID | ↓EXPERIMENT | ↓WIDTH | ↓LENGTH
=====
|           |           | link       |         |
|           |           | 13        |         |
|           |           |           |         |

Dbpoc.dbf   | EXPERIMENT | ↓PERSON | ↓ORGANIZATI ...
=====
| link      |           |         |
|           |           |         |

```

(Note: the ↓ is a downward arrow. This means that the indicated field will be included in the answer view.)

Most fields in these databases are character fields. This means that you cannot compare them like numbers, but must search through them like text. Fortunately, this shouldn't affect your searches too much, as ASCII (the system used to compare strings) was created with this type of sorting in mind. You will have to remember to put quotes around your search parameters so that they will be recognized as text. So typing <= " 3 " in the width column, for example, will return all records with an

entry less than 3 in the width field. Because it is a text field, however, it will also return those records with blanks in the width field and won't return those with 3.xxx. Text comparisons are very much like looking a phrase up in the dictionary: spaces before punctuation, before numbers, before capital letters, before lower case letters. This sometimes leads to confusion, as seen above, but if you don't forget that you're dealing with text it shouldn't be too bad.

Some of the fields in DBM0003 are even further constrained. The Category, Subcategor, Applicatio and Damage fields are all restricted to containing one or more keywords from a list found in Appendix C. The Tray, Module\_Num, and Experiment fields are restricted to a single entry from a limited set of possibilities, also found in Appendix C.

Suppose you are looking for only partial text, perhaps all entries dealing with paint (one of the keywords found in Category). Type `$"paint "` in the appropriate field. `$` is the *contains* operator, and the above statement will catch all records with the word "paint" in the given field. It will also catch words like unpainted, which contain "paint". To avoid this, put spaces around the word, for example, `$" paint "`

Punctuation might complicate text searches as well. "paint, thermal", for example will not be found because there is no space after the word paint. You may want to try a few combinations to make sure you get all entries, or you can simply check your results by hand (for short lists).

Searches by string are case sensitive. The first example above would not find the record with "Paint, white", because the word paint is capitalized. To find all occurrences of paint, regardless of case, one must search for both by typing something like this:

```
$"paint "
```

```
$"Paint "
```

in the desired column. (Placing conditions on separate lines is equivalent to a logical *or*. So the above statement reads: field contains "paint" or field contains "Paint".)

The above logical *or* configuration holds between fields as well. If search data is placed in two different fields, on two different lines, the search conditions are connected by an *or*. If the entries appear on the same line, they are connected by an *and*. Within a field, an *and* is denoted with a comma:  `$"White", $"paint".`

A summary of query operators described above:

Operator	Means	Explanation and Examples	Search Finds
and	Logical and	<p>Within a field: use a comma</p> <pre>  DB_Number   Experiment   = =====               &gt; 3, &lt;= 14  </pre> <p>In separate fields, use the same line:</p> <pre>  DB_Number   Experiment   = =====   &gt; 147   &lt; 14  </pre>	<p>All records with Experimenter ID between 4 and 14 (inclusive)</p> <p>All records with DB number above 147 and Experimenter ID below 14</p>
or	Logical or	<p>Use separate lines:</p> <pre>  DB_Number   Experiment   = =====   &gt; 189                   13  </pre> <p>or</p> <pre>  DB_Number   Experiment   = =====               16                 13  </pre>	<p>All records with DB Number above 189, or with Experimenter ID equal to 13.</p> <p>All records with Experimenter ID of 16 or 13</p>
\$	Contains	<p>\$"paint"</p> <p>This is a case-sensitive command, and won't make sure the word appears alone (all as explained above).</p>	<p>All occurrences of paint. (But not Paint.)</p>

When you have made all of your selections from both databases (F3 and F4 will move you between the two), press F2 to show the results of the search. You may or may not want to save the query when you are done. Saving a query will allow you to run it again without going through all the trouble of setting it up again. A saved query, however, will also take up room on your hard disk and clutter your catalog. We suggest only saving those queries that you are likely to use often and deleting those that you find you no longer use.



When you have the results of your search, the selected records will be displayed in a table format. To toggle between this format and a listing, type F2. F9 zooms in on memo fields as before. To run another query, building from the current one, do Exit|Transfer to Query Design.

### Example

Here's an example search to show all of these commands together. Suppose you wish to know the exposure times of all paint samples belonging to Michael Meshishnek that were discolored in orbit. You also want the sample ID and database numbers in case you need more data later. Knowing the experimenter ID for Michael Meshishnek might also make future searches easier. Finally, you decide to get Meshishnek's phone number as well in case you need to talk to him about the samples.

This search contains three search conditions: the Descriptio field must contain "paint", the Damage field must contain "discolored",

and the Person field must contain "Meshishnek". We have also chosen to display five things: the sample ID, the DB number, the exposure time, the experimenter ID, and the experimenter's phone number. As we are searching on and displaying items from both databases, we will also need a link between the two files.

After typing all of these conditions into the search skeletons, they should look something like the following:

```
----- / /-----
|Dbm0003.dbf |↓SAMPLE_ID| EXPERIMENT | W/ /S | DESCRIPTIO |↓DB_NUMBER | OB
===== ===== ==/ /== =====
|           |link      | / / | $"paint"  |           |
|           | / / | / / | $"Paint"  |           |
|           | / / | / / | $"paint"  |           |
|           | / / | / / | $"Paint"  |           |
```

```
----- / /-----
|Dbm0003.dbf | CATEGORY | DAMAGE          | S/ /M | APPLICATIO |↓EXPOSURE |
===== <===== ==/ /== =====
|           | $"discolored" | / / |           |           |
|           | $"discolored" | / / |           |           |
|           | $"Discolored" | / / |           |           |
|           | $"Discolored" | / / |           |           |
```

```
----- / /-----
|Dbpoc.dbf   |↓EXPERIMENT | PERSON          | OR/ /ZIP |↓PHONE | FAX | PU
===== ===== ==/ /===== =====
|link       | $"Meshishnek" | / / |           |           |
```

(The ↓ is a downward arrow. This arrow indicates that the field will appear in the final view. The fields with ↓s should appear in the skeleton across the bottom of the screen in the order you added them.)

As seen in the "split screens" above, the entire search skeleton will not fit on a single screen. You will have to use tab and shift-tab to move between the fields of a skeleton to see the entire

thing. Also, we must repeat the search in DBM0003 four times to catch all possible capitalizations of the key words. We know that Meshishnek is capitalized, as it is a proper name. (Alternatively, it is fairly quick to check the capitalization of things in the DBPOC database by hand, as it is so small.)

Pressing F2 to proceed with the query should yield a view similar to the following (The order may be different, depending upon the order you pressed F5 in while designing the query.)

```

-----
|SAMPLE_ID      |DB_NUMBER |EXPOSURE      |EXPERIMENT|PHONE      |
-----
|L3IV-18-17-1  | 179.000 |69 months    |          |18|3103368760|
|L3IV-18-18-2  | 180.000 |69 months    |          |18|3103368760|
|T3IV-18-17    | 743.000 |69 months    |          |18|3103368760|
|T3IV-18-18    | 744.000 |69 months    |          |18|3103368760|
|D4-SCU Cover  | 2000.000|69 months    |          |20|3103368760|
|D4-Sunshield  | 2001.000|69 months    |          |20|3103368760|
|D8-SCU Cover  | 2002.000|69 months    |          |20|3103368760|
|              |          |              |          |   |              |
-----

```

```

Browse |C:\dbase\<<NEW>          |Rec 199/1274      |View |      |Ins

```

(Note that Michael Meshishnek has two Experimenter ID numbers. This means that he is the point of contact for two different sub-experiments. It is not an error in the database.)

**Forms.** These will display the data in an easier to read format, compared to simply selecting the database and displaying the data. Such a display will give you a table, but the large text fields found in these databases make a table format undesirable. For this reason, we created some more reasonable forms for the data. Using the forms STD\_LDEF (for observation data) and STD\_POC (for contact data) will show each record alone, with sufficient space allowed to show all of the text in each field. (You may have to step through a few fields to see the entire page, especially for long entries.) You must have the correct database in use (above the single line in the Data column) to use these forms. If you do not, dBase will remind you to do so.

**Reports.** these print out the data from their database. Again, you must have the proper database in use to print these reports. Unfortunately, they do not print out data from both sources at once. A menu will appear with various printing options. Select the ones you want (you may want to save common settings to a file) and print. Examples of the included reports appear on pages 33 – 35. The first two pages are example DBM0003 records, and the last is a page of DBPOC records.

If you wish to print the results of a query, you can select Layout|Write view as database file in the query modification screen to create a temporary database, which can then have a report created for it that can be printed. Note that you should probably only do this for common views or short results lists; you will end up wasting lots of memory otherwise. It is also useful to periodically delete all of the temporary databases you have created for this purpose to keep disk space available for working.

The range of pages to be printed is found under Output Options. Each record should take up a single page exactly. Note that the database number field is not a counter; the pages will correspond to

the location of the record in the database, and not the value in the database number field. Look for the Rec ##/1274 to see which page to print.

If pages are wrapping past the edge of your printer paper, or every other page is blank, the page length is probably not set correctly. This value is found under Page dimensions. The correct number is most easily found by counting the number of lines found on each page before it wraps, as long as there is text on each line.

Some printers have non-standard ASCII sets in the extended range. While this does not affect regular text, it will cause extended range characters such as ° and ± to be changed to different symbols. If this occurs, you may wish to check with the database to see which characters correspond to each symbol.

Page No. 1  
08/04/93

Sample ID: L3I-1-1-C  
DB Number: 1.000

Experimenter ID: 1  
Tray: D9 Module Number: I

Description: Resonant reflector

Width: 7.875  
Length: 8.625  
Thickness: <0.005

Exposure: 69 months

Damage: Eroded (+), cratered  
Application: Radar camouflage  
Category: Polymer, metal  
Subcategory: Metallized polymer

Observations at Kennedy:

KAPTON ERODED, ONLY A REMNANT REMAINS. PLATE BEHIND FOIL HAS RESIDUE OF IMPACTS THAT HAVE PENETRATED THE FOIL

Observations at Aerospace: Date: Thursday, May 31, 1990 Time: 13:14:55

The sample is a Kapton sheet imprinted with a staggered pattern of metallic foil tripoles. The Kapton sheet has eroded and most of the sample is missing; only a flap of the central section and material near the edges remain. The remaining Kapton is thin, especially near the eroded periphery of the material. Blister-like features are apparent on the metallic tripoles and the edges of many appear eroded; however, the surrounding Kapton has eroded to a greater extent, releasing many of the tripoles. Some of these tripoles were found in the shuttle payload bay after LDEF retrieval. Impacting debris and micrometeoroids hitting the intact sample produced sprays of residue on the underlying hardware. Several perforations are apparent on the sample remnants (on the D10 side). The thermistor, originally attached to the foil surface, survived without change.

The Aerospace Corporation

Page No. 2  
08/04/93

Sample ID: L3I-1-2-D  
DB Number: 2.000

Experimenter ID: 1  
Tray: D9 Module Number: I

Description: Circuit analog sheet

Width: 7.875 Exposure: 69 months  
Length: 8.625  
Thickness: <0.005  
Damage: Discolored (+), cratered  
Application: Radar camouflage  
Category: Polymer, coating  
Subcategory: Coated polymer

Observations at Kennedy:

WHITE PAINT DISCOLORED, SPOTTED. IMPACTS. THERMISTOR ADHESIVE IS  
DISCOLORED. 1 MICROMETEOROID PENETRATION

Observations at Aerospace: Date: Thursday, May 31, 1990 Time: 13:56:23

The sample is intact. The white paint overcoating is slightly discolored; reddish-brown discoloration occurs primarily around surface protrusions and in cracks in the rough, crazed coating. The vertical side surfaces of this sample are moderately discolored (yellow-brown), especially on the D10 side of the sample. Many small impact craters are apparent in the surface; most have penetrated the sample coating. The adhesive surrounding the thermistor has darkened. A smudge of extraneous particulate matter is apparent near the center of the sample.

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ExperimenterID: 1

Contact: Charles J. Hurley  
University of Dayton  
Aerospace Vehicle Coatings  
300 College Park  
Dayton, OH 45469-0137  
5132553220 FAX: 5132588075

Publications:

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ExperimenterID: 2

Contact: Linda DeHainaut  
Phillips Laboratory  
PL/LIDA  
Building 429  
Kirtland AFB, NM 87117-6008  
5058467034 FAX: 5058442040

Publications:

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ExperimenterID: 3

Contact: Charles Miglionario  
Phillips Laboratory  
PL/VTSI  
  
Kirtland AFB, NM 87117  
5058464798 FAX: 5058461926

Publications: 1. C. Miglionario, L. Murr, et al, "Effects of Space Environment on Structural materials, Parts 1 and 2," Poster Session, Proceedings of the First Post-Retrieval Symposium, Kissimmee, FL, June 2-8, 1991, NASA Conference Publication 3134

2. C. Miglionario, L. Murr, et al, " Observations of Surface Structures and Reaction Products for Materials Exposed in Space in Low Earth Orbit," Electron Microscope Society of America, June 1991

3. C. Miglionario, L. Murr, et al, "Effects of Space Environment on Structural materials: A Preliminary Study and Development of Materials Characterization Protocols," Journal of Materials Sciences, Oct. 1991

The Aerospace Corporation

## REFERENCE

- 1 S. R. Gyetvay, J. M. Coggi, and M. J. Meshishnek, "Long Duration Exposure Facility Experiment M0003 Deintegration Observation Database," SMC-TR-93-38 (17 February 1993).

## APPENDIX A — FIELD DESCRIPTIONS IN EACH RECORD OF THE M0003 SAMPLE DATABASE

**Sample ID** - Sample identification key. Each sample has a unique key value. The value itself provides useful information about the sample and should be used in preference to the DB# when possible. For example, the sample with ID equal to "L3II-7-65-10" was on the Leading Edge, in the 3-in.-deep tray (D9), on module II. It's from subexperiment 7 and was the 65th sample on that module. The experimenter's ID# was 10.

Note that the first character in the Sample ID is either an L (for leading edge) or T (for trailing edge). The number following the L or T is always a 3 or 6. The number refers to the tray depth in inches. The 3-in.-deep trays were D9 (LE) and D3 (TE). The 6-in. trays were D8 (LE) and D4 (TE).

**Experimenter ID** - A number corresponding to one of the 20 subexperiments on M0003. Each subexperiment had a Principal Investigator as listed in Appendix C.

**Width** - The width of the sample in inches.

**Length** - The length of the sample in inches.

**Thickness** - The thickness of the sample in inches. Thickness measurements were provided by the subexperimenter. Note that in some records, the thickness measurement does not agree with that provided in the Description field.

**Description** - A brief description of the original sample prior to LDEF launch. This information was provided by the subexperimenter.

**Database Number (DB Number)** - Each sample record has a unique DB#.

**ObservationsAer** - A detailed description of the sample upon arrival at Aerospace. All observations were made in a class 10,000 clean room using microscopic techniques where applicable.

**Date** - The date the sample was observed at The Aerospace Corporation.

**Time** - Time of day when Aerospace observations were made.

**Kennedy Obs** - A brief description of the sample made at SAEF II immediately after LDEF retrieval. Not every sample was observed.

**Category** - One of the 9 generic sample categories as listed in Appendix C.

**Damage** - A keyword associated with the damage seen on the sample after space exposure. Some entries contain a "+" or "-" to distinguish the magnitude of the damage mechanism. In samples whose holder has become damaged due to the low Earth orbit environment (10 samples), the term "(holder)" was added to the damage field entry. See Appendix C for a list of possible damage field entries.



**Subcategory** - A more specific description of the sample type. See Appendix C.

**Tray** - One of the four sample trays. Trays D3 and D4 were on the LDEF trailing edge and trays D8 and D9 were on the leading edge.

**Module Number** - Each tray was subdivided into 6 modules labeled I-VI.

**Application** - Each sample was assigned one (or more) generic applications from a list of 14. See Appendix C.

**Exposure** - Amount of time the sample was exposed to the space environment. Exposure varies among samples since some were located in self-closing Environment Exposure Control Canisters (EECCs) on LDEF.

## **FIELD DESCRIPTIONS IN EACH RECORD OF THE POINTS OF CONTACT DATABASE**

**Person** - Name of the person responsible for that subexperiment.

**Organization** - The company or organization that person belongs to.

**Department** - The department in the organization.

**Address, City, State, Zip, Phone, FAX** - Address information for the Point Of Contact.

**Publications** - LDEF Symposium papers the Point Of Contact has written.

**APPENDIX B — EXPERIMENT M0003 POINTS OF CONTACT**

Subexpt Number	Scope	Subexperiment Point of Contact	Organization/ Address
-1	Radar camouflage materials and electro-optical signature coatings	Charles Hurley	Univ. of Dayton Research Inst. 300 College Park Dayton, OH 45469-0001
-2	Laser optics	Linda De Hainaut	Phillips Lab/LIDA Kirtland AFB, NM 87117-6008
-3	Structural materials	Charles Miglionico	Phillips Lab/PL/VTSI Kirtland AFB, NM 87117-6008
-4	Solar power components	Terry Trumble	Wright Labs/POOC Wright Patterson AFB, OH 45433-6533
-5	Thermal control materials	Charles Hurley	Univ. of Dayton Research Inst. 300 College Park Dayton, OH 45469-0001
-6	Laser communication components	Randall R. Hodgson	McDonnell Douglas Astronautics Corp. Mail Code 1067267 P. O. Box 516 St. Louis, MO 63166
-7	Laser mirror coatings	Terry M. Donovan	3481 Murdoch Dr., Palo Alto, CA 94306
-8	Composite materials, electronic piece parts, fiber optics	Gary Pippin	Boeing Aerospace Co. Materials Technology Dept., MS 2E-01 P. O. Box 3999 Seattle, WA 98124
-9	Thermal control materials, antenna materials, composite materials, and cold welding	Brian C. Petrie	Lockheed Missiles & Space Co. Dept. 62-92, Bldg. 564 P. O. Box J04 Sunnyvale, CA 94086
-10	Advanced composite materials	Gary L. Steckel	The Aerospace Corp. P. O. Box 92957, M2/242 Los Angeles, CA 90009
-11, -12	Contamination monitoring Radiation measurements	Eugene N. Borson F. Barry Sinsheimer	The Aerospace Corp. P. O. Box 92957, M2/270 Los Angeles, CA 90009
-13	Laser hardened materials	Randall R. Hodgson	McDonnell Douglas Astronautics Corp. Mail Code 1067267 P. O. Box 516 St. Louis, MO 63166

Subexpt Number	Scope	Subexperiment Point of Contact	Organization/ Address
-14	Quartz crystal microbalance	Donald A. Wallace	QCM Research 2825 Laguna Canyon Road P. O. Box 277 Laguna Beach, CA 92652
-15	Thermal control materials	Oscar Esquivel	The Aerospace Corp. P. O. Box 92957, M2/241 Los Angeles, CA 90009
-16	Advanced composites	Gary L. Steckel	The Aerospace Corp. P. O. Box 92957, M2/242 Los Angeles, CA 90009
-17	Radiation dosimetry	Sam S. Imamoto, J. Bernard Blake	The Aerospace Corp. P. O. Box 92957, M2/260 Los Angeles, CA 90009
-18	Thermal control paints	Michael J. Meshishnek	The Aerospace Corp. P. O. Box 92957, M2/250 Los Angeles, CA 90009
-19	Electronic Piece Parts	Seymour Feuerstein	The Aerospace Corp. P. O. Box 92957, M2/244 Los Angeles, CA 90009
-20	Tray Hardware	Michael J. Meshishnek	The Aerospace Corp. P. O. Box 92957, M2/250 Los Angeles, CA 90009

**APPENDIX C — LISTING OF ALL POSSIBLE TRAY, MODULE, SUBEXPERIMENT NUMBER, MATERIAL CATEGORY, MATERIAL SUBCATEGORY, APPLICATION AND DAMAGE ENTRIES (NOTE: MULTIPLE ENTRIES ARE PERMITTED IN THE LATTER FOUR).**

Tray*	Module #*	Subexpt #	Material Category	Material Subcategory	Application	Damage
D3	I	1 to 20	Carbon	Adhesive	Adhesive Bond	Bleached
D4	II		Ceramic	Alloy	Antennae	Blistered
D8	III		Coating	Anodized Metal	Contamination	Buckled
D9	IV		Composite	Black Paint	Monitor	Contaminated
	V		Glass	Clear Paint	Electronics	(particle)
	VI		Metal	Cloth	Electro-optic	Contaminated
			Paint	Coated Composite	Signature	(stain)
			Polymer	Cloth	Hardware	Contaminated
			Semiconductor	Coated Polymer	Insulation	(particle, stain)
				Coated Substrate	Laser Optics	Corroded
				Crystal	Optics	Cracked
				Detector	Radar Camouflage	Cratered
				Elastomer	Radiation Dosimetry	Crazed
				Film	Solar Power	Crystallized
				Glass Matrix Composite	Structures	Darkened
				Graphite Epoxy	Thermal Control	Debonded
				Graphite Polyimide		Delaminated
				Graphite Polysulfone		Discolored
				Graphite Aluminum		Distorted
				Graphite Magnesium		Dulled
				Laminate		Embrittled
				Mesh		Eroded
				Metal Matrix Composite		Flaked
				Metallized Polymer		Hazed
				Mirror		Microfractured
				Optical Solar Reflector		Missing
				Silicone/RTV		Outgassed
				Solar Cell Coverglass		Oxidized
				Solar Cell (string)		Roughened
				Substrate		Stained
				Thermoset Resin Matrix		Textured
				Composite		Unchanged
				White Paint		Whiskered
				Wire		Wrinkled

\* The records of some non-sample items, such as the Sunshield Panels, may not have entries in these discrete fields. Also note that the terms "Sub-experiment #" and "Experimenter ID" are synonymous.

## TECHNOLOGY OPERATIONS

The Aerospace Corporation functions as an "architect-engineer" for national security programs, specializing in advanced military space systems. The Corporation's Technology Operations supports the effective and timely development and operation of national security systems through scientific research and the application of advanced technology. Vital to the success of the Corporation is the technical staff's wide-ranging expertise and its ability to stay abreast of new technological developments and program support issues associated with rapidly evolving space systems. Contributing capabilities are provided by these individual Technology Centers:

**Electronics Technology Center:** Microelectronics, solid-state device physics, VLSI reliability, compound semiconductors, radiation hardening, data storage technologies, infrared detector devices and testing; electro-optics, quantum electronics, solid-state lasers, optical propagation and communications; cw and pulsed chemical laser development, optical resonators, beam control, atmospheric propagation, and laser effects and countermeasures; atomic frequency standards, applied laser spectroscopy, laser chemistry, laser optoelectronics, phase conjugation and coherent imaging, solar cell physics, battery electrochemistry, battery testing and evaluation.

**Mechanics and Materials Technology Center:** Evaluation and characterization of new materials: metals, alloys, ceramics, polymers and their composites, and new forms of carbon; development and analysis of thin films and deposition techniques; nondestructive evaluation, component failure analysis and reliability; fracture mechanics and stress corrosion; development and evaluation of hardened components; analysis and evaluation of materials at cryogenic and elevated temperatures; launch vehicle and reentry fluid mechanics, heat transfer and flight dynamics; chemical and electric propulsion; spacecraft structural mechanics, spacecraft survivability and vulnerability assessment; contamination, thermal and structural control; high temperature thermomechanics, gas kinetics and radiation; lubrication and surface phenomena.

**Space and Environment Technology Center:** Magnetospheric, auroral and cosmic ray physics, wave-particle interactions, magnetospheric plasma waves; atmospheric and ionospheric physics, density and composition of the upper atmosphere, remote sensing using atmospheric radiation; solar physics, infrared astronomy, infrared signature analysis; effects of solar activity, magnetic storms and nuclear explosions on the earth's atmosphere, ionosphere and magnetosphere; effects of electromagnetic and particulate radiations on space systems; space instrumentation; propellant chemistry, chemical dynamics, environmental chemistry, trace detection; atmospheric chemical reactions, atmospheric optics, light scattering, state-specific chemical reactions and radiative signatures of missile plumes, and sensor out-of-field-of-view rejection.