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SACRD—A Data Base for Fast Reactor Safety Computer Codes—Operational Procedures

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MASTER

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**SACRD - A DATA BASE FOR FAST REACTOR SAFETY
COMPUTER CODES - OPERATIONAL PROCEDURES**

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TABLE OF CONTENTS

ABSTRACT	1
I. INTRODUCTION	1
II. THE JOSHUA SYSTEM DATA MANAGER	7
III. RECORD STRUCTURES IN SACRD AND FREE-FORM INPUT PROCEDURES . . .	15
IV. UNITS CONVERSION SUBROUTINES	59
V. BATCH DATA EDITING PROGRAM - SCROLL	69
VI. INTERACTIVE DATA EDITING PROGRAM - COMMUNE	77
VII. SACRD PLOTTING PROGRAM - SACRDEYE	91
VIII. AUTOMATIC DATA CHECKING MODULE - CHECKER	97
IX. DATA BASE USAGE STATISTICS	105
X. FILE SECURITY IN THE SACRD DATA BASE	107
XI. MAGNETIC TAPE DATA DISTRIBUTION	109
REFERENCES	113

LIST OF FIGURES

Figure 1. Data Flow in SACRD	2
Figure 2. Diagram of JOSHUA Pointer Chains	10
Figure 3. Typical Presentation Form for Property Data	16
Figure 4. ABSTRACT Record Free-Form Input	46
Figure 5. CONTENTS Record Free-Form Input	49
Figure 6. TAPULAR Record Free-Form Input	53
Figure 7. PROGRAM Record Free-Form Input	55
Figure 8. ERROR Record Free-Form Input	57
Figure 9. Demonstration of Data "Smoothness" Checks in CHECKER	99

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ABSTRACT

SACRD (Safety Analysis Computerized Reactor Data) is a data base of nondesign-related information used in computer codes for fast reactor safety analyses. This document reports the procedures used in SACRD to help assure a reasonable level of integrity of the material contained in the data base. It also serves to document much of the computer software used with the data base.

I. INTRODUCTION

A detailed description of SACRD and its contents is available in ORNL-5477/V1 and V2 (1,2). The present document describes the procedures used for entering, reviewing, and correcting SACRD data. It also describes several computer programs and features of the JOSHUA system (3) that are used to construct and maintain the data base. Several salient characteristics of the JOSHUA system, as related to SACRD, are presented in Chapter II.

Figure 1 is a flow chart of data entry and correction procedures.

When data are received, they are first examined to determine whether they are new or whether they are updates or corrections to data already in

Figure 1. Data Flow in SACRD.

the data base. With data not obtained directly from one of the officially sanctioned SACRD data evaluation groups, the appropriate committee chairman is contacted. If his committee indicates that the material is within the scope of the data base, the data are prepared for input.

SACRD provides for five different forms of data entry. These five forms come under the headings: ABSTRACT, CONTENTS, TABULAR, PROGRAM, and ERROR records. Therefore, when entering corrections and/or new data, a decision must be made as to which one of the five forms should be used.

An ABSTRACT record contains background and reference information supplied with the data and identifies evaluators, evaluation procedures, ranges of data validity, etc. A CONTENTS record provides a table of contents for the TABULAR records used to represent data and contains values for fixed variables that are associated with curvilinear tabulations of data. A TABULAR record contains information describing a curve using "x-y" value pairs. The PROGRAM record presents data in a parameterized form using FORTRAN function subprograms. A fifth kind of information is ERROR or uncertainty data which contains information about experimental and evaluation error estimates associated with data. (Detailed information on the contents of each of these kinds of SACRD records is given in Chapter III.)

New data are first written into a temporary file, not directly accessible to the external user community; this data will not be written into the standard SACRD file until checks and reviews for accuracy have been completed. The programs which enter data into this file contain several simple data qualification checks to help screen out improper data. As an example, data are checked to ensure that SI (Système International d'Unités) units are used.

An integral part of the "data entry" process is an internal review by SACRD staff members. After they are input, data are displayed in report and/or graphical formats, which are examined for "typos", transcription and cataloging errors. (A discussion of SACRD editing and plotting programs is provided in Chapters V, VI, and VII.)

Another part of the internal review is to pass the data through a CHECKER program which examines the data for several specific errors and/or omissions. This code checks for consistency in all cataloged entries, for unreasonable data values in tabular records and to be sure all needed forms of data are provided. A complete list of error checks is given in Chapter VIII along with a description of the CHECKER program.

After the internal review, displays of the data are passed to the appropriate evaluation group chairman who distributes them to members of his committee for a detailed quality review. The data displays are then returned to the committee chairman and finally to ORNL where any suggested corrections and modifications are made. Corrected data displays are then sent back to the committee to be sure all intended changes were made. After successfully iterating through these internal and external reviews, the data are ready to be copied into the standard SACRD file where they are accessible to the external user community. (Periodic updates of the SACRD data catalog (2) are made listing current contents of the data base.)

Versions and MODS in SACRD

A version is defined as the latest collection of sanctified (i.e., committee-approved) SACRD data which exists at the time of an official release. For the latest version, properties which are not specifically

included but which exist in a previous version are automatically members of the latest version. For example, consider the following hypothetical "history" of the evaluations for sodium (Na) thermal conductivity (K).

Material	Property	Version	Date Contributed
Na	K	1	1976
Na	K	5	1980
Na	K	6	1981
Na	K	9	1997

Then Versions 2, 3, and 4 Na thermal conductivity are identical with Version 1, Version 5 is unique, Versions 7 and 8 are equivalent to 6, and 9 is new. In the data base, only one copy of each evaluation is stored. This allows the data base to be as compact as possible, so that all versions can be retained on-line indefinitely.

In the unlikely event that two independent evaluations are submitted prior to the release of a new version, the appropriate working group will decide which, if either, of the new sets will become the next official version. Both sets can be retained, if need be, but one set will be placed in a special file and distributed only by specific request.

Prior to the official release of a version, new data may be obtained on request, but all software (interactive and batch) will mark data edits or displays as "interim data," so as to notify the user that the data are not officially released.

When errors are found in the data for a property related to the value of the property (e.g., a transcription error, an error in sign, a

misrepresentation of the units, an exponent error, etc.), the data base is corrected and the date and nature of the error is recorded at the front of the abstract for the property in a MOD (modification) statement. These "mods" will become a permanent part of the abstract, so as to document all changes to a set of data as a function of time. Minor corrections not affecting actual data values (e.g., typos in the abstract) may be made without the MOD designation.

II. THE JOSHUA SYSTEM DATA MANAGER

The JOSHUA System

The Data Base Management System (DBMS) chosen for the SACRD data base is a system named JOSHUA, which was developed at Savannah River Laboratories, Aiken, South Carolina (3). This system has many of the sophisticated features incorporated in the full-scale DBMS's available on today's market, including an efficient hierarchical data manager with record level security, a terminal monitor for time-sharing applications, and a precompiler for FORTRAN applications.

Data Manager

The JOSHUA data manager supports a hierarchical tree structure which allows each data record to have a unique, descriptive name. This name is composed of up to 16 fields or qualifiers separated from one another by periods. Each qualifier specifies a level in the hierarchical framework of the data base and allows a particular attribute of the data record to be named. In order to illustrate its application, an example from our SACRD data bank will be used.

The "physical" data base diagram for SACRD is shown below:

FILE
PROPERTY
MATERIAL
VERSION
DATA TYPE

Each of these levels, or segments, is a general classification of an attribute which a data record possesses. A "FILE" segment would specify one of several logical groups of properties such as thermodynamics, heat transfer, or chemical properties. The "PROPERTY" segment would specify the exact property, as would the "MATERIAL" segment, the exact material. The "VERSION" segment is included because, for many of the materials and properties, new and more accurate values are continually being found through new experiments and evaluations. Finally, the "DATA TYPE" segment specifies one of several formats in which different parts of the data are stored.

Each qualifier in the data record name specifies a specific member of one of the above segment types in sequential order. Thus the first qualifier would specify a particular entry for the first level of the hierarchical structure or the "FILE" type; the second qualifier, the second level (PROPERTY), and so forth. For example, the record named:

TH.DENSITY.SS304.1.ABSTRACT

contains abstractual information for the first version of a property, in this case, density, in the thermodynamics file for the stainless steel alloy 304. This type of "human readable" record name makes it relatively easy for a person to find a record that interests him with only casual knowledge of how the data manager works.

All records in the data base are cataloged in a general binary tree by using 16-byte nodes of the following form:

The "qualifier name" is one of the 8-byte alphanumeric qualifiers used in a record name. The 4-byte "next brother" field is a link to the next node at the same level in the tree structure. The 4-byte "first son" field is a pointer to the first node subordinate to it in the next level. See Fig. 2 for an example diagram of the pointers. In this diagram, all of the horizontal arrows represent the "brother" links and the vertical arrows represent the "son" links. The only exception to this is for the last level of the tree structure the son field will point to the proper data record. Within this field is a one-bit flag indicating whether the link is to another tree level or a data record, as in the last row.

To find a given record, say A1.B2.D2.J3 in the above tree, level 1 is first searched via the list of brother links until the first qualifier "A1" is found. The son pointer for this node gives the location of the first node of the linked list to be searched for the second qualifier "B2", etc. Thus the nodes visited in the search for this record name are A1, B1, B2, D1, D2, J1, J2, J3. This sequence of nodes is termed the "path" traveled to find the record.

In the JOSHUA system, several methods are used to minimize the number of disk reads necessary to locate a given record. First of all, the tree nodes are physically stored separately from the actual data records. For a given block size, a greater number of tree nodes can be moved into main

Figure 2. Diagram of JOSHUA Pointer Chains.

memory per disk read than if data were to accompany them, producing a higher probability that this same block will contain the next needed tree node. Secondly, several of these "pages" or blocks of tree nodes are retained in main memory at any one time. Before a read for another group of nodes is made, all in-core pages are checked to see if the needed node is contained within them. Lastly, several node "paths", like the one illustrated above, are kept in main memory. These are very useful when the order of record retrieval is approximately sequential. If the first record retrieved in the tree in Fig. 2 were A1.B2.D2.J1, then the path would contain the nodes A1, B1, B2, D1, D2, J1. Assuming the next record name were A1.B2.D3.K1, this path would be traced as far as possible, through node D2, and the search for the remaining nodes would begin their updating of the path as it goes. All in all, the search algorithm for a record name does the following: 1) trace in-core paths as far as possible, 2) check all tree node blocks in main memory for the presence of the next node, 3) if not found there, read the correct page from disk into the least recently used page in memory, 4) update the path for this node, and 5) repeat until all qualifiers have been found.

The actual data records are read and written to disk by FORTRAN direct access I/O statements, with the proper record number being found by the data manager. Data structure at the record level is handled by the use of "templates" (see Chapter III) which take care of defining the list structures, variable types, etc. However, the use of FORTRAN I/O facilities requires that all programs which read and write to the data base know the exact I/O list structures.

Other Aspects

The data manager is accessed in programs via subroutine calls under control of the JOSHUA Operating Systems. JOS is the backbone of the JOSHUA system and is run as a continuous job under IBM 360 OS/MVT. It consists of a reentrant control program, a terminal and a batch monitor, various other reentrant and serially reusable resident modules (such as the data manager), and several control blocks for maintaining system integrity. The terminal monitor was developed for hard-wired IBM 2260 terminals which are full-page, buffered devices. An abundant selection of terminal commands provide all necessary functions for data maintenance, manipulation, editing, batch job submission, and module execution. The batch monitor allows for execution of modules which require longer turnaround time than generally executed at a terminal. It also has the capability of simulating terminal sessions to a limited extent.

One of the most useful services the JOSHUA system has for the applications programmer is a precompiler for FORTRAN. In most other cases where software is accessed through FORTRAN, the access is with CALL statements. A package, such as the JOSHUA system, that provides a wide range of useful options, sometimes tends to have very long, cumbersome parameter lists. For this reason, a preprocessor was written that would transform a "JOSHUA FORTRAN" statement into standard FORTRAN calls with the proper arguments. For instance, if the programmer wanted to read the record from the data base containing the density of stainless steel alloy 304, he could use:

```
100 READ('TH','DENSITY','SS304','1','TABULAR',ERR=999)
X      LENGTH,NVALUE,(TEMP(I),DENS(I),I=1,NVALUE)
```

This statement would be commented out by the precompiler and replaced by the FORTRAN calls that were needed to perform the desired function. Thus, all the programmer needs to read this record is the record name and the I/O list structure. If the programmer was required to do such a read with standard FORTRAN, he would experience considerable difficulty in preparing a suitable argument list for his CALL statement to the generalized I/O routines which would be required. Other JOSHUA FORTRAN statements include a WRITE statement to write records to the data base, RENAME to rename a record, DELETE to delete a record, and EXECUTE which fetches a load module from disk and dynamically executes it.

III. RECORD STRUCTURES IN SACRD AND FREE-FORM INPUT PROCEDURES

As discussed in Chapter II, SACRD records are generally cataloged with five qualifiers:

FILE
PROPERTY
MATERIAL
VERSION
DATA TYPE

These qualifiers form a hierarchy which can be expressed as the ordered combination:

FILE.PROPERTY.MATERIAL.VERSION.TYPE

A list with this structure is used to "name" all SACRD records.

With JOSHUA, the structure of a record is arbitrary; it can be any FORTRAN IO-list one wishes to catalog. However, to keep software simple, it is very desirable to use as few structures as possible.

SACRD provides five record types. The first type, ABSTRACT, is used to store textual information which describes a data evaluation. The second record type, PROGRAM, stores a FORTRAN function subprogram which gives a parameterized fit to a property in the case where data evaluators have specified it.

The remaining three types of records are CONTENTS, TABULAR, and ERROR. They are best described by considering Fig. 3. In this case, we are considering a property $y(x)$ which is given for three fixed values of a parameter, z . Three independent "curves" of tabular data are specified.

Figure 3. Typical Presentation Form for Property Data.

This form of data presentation is very common and is often used to specify two-, three-, n-dimensional matrices required to represent a function or property. For simplicity, SACRD requires each curve be placed in a separate "TABULAR" record as a set of x-y value pairs, along with specifications for a reasonable interpolation procedure to use in determining intermediate values.

A "CONTENTS" record is provided that catalogs all the "TABULAR" records needed. In this case, the "CONTENTS" record would specify three curves, designate that each of these curves is a function of one fixed variable --z-- and specify the values and units for z.

Error or uncertainty data are accommodated in "ERROR" records that are in free-field text format and specify the information in whatever format the data evaluators provide; e.g., one sigma, standard error estimate, min/max, etc.

The following pages are edits graciously supplied to us by H. C. Honeck, which he produced using a Savannah River Laboratories documentation program. These edits describe the details of the record structures used in SACRD in a symbolic (close to FORTRAN) manner which is reasonably self-explanatory. It will be noted that records consist of one or more segments, a segment being a group of data of the same kind and/or dimension, with the segments written one-after-the-other within a record.

DATA SET SACRD

SYMBOL	TYPE	DESCRIPTION	DATE
ABST	C56	ABSTRACT LINES (56 CHARACTER)	10/07/75
CDATE	C8	CREATE DATE (MM/DD/YY)	10/07/75
CRAP	R4	SPECIAL CONSTANTS NEEDED IN ADDITION TO TABULATION	10/07/75
FILE	C8	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
FURT	C56	FORTRAN CARD (56 CHARACTER)	10/07/75
INT	I4	INTERPOLATION CODE FOR RANGE	10/07/75
KEYWDS	C8	LIST OF ABSTRACT KEYWORDS	10/07/75
LEVINT	I4	INTERPOLATION CODE BETWEEN LEVELS	10/07/75
MATNAM	C8	MATERIAL NAME	10/07/75
MTDESC	C56	MATERIAL DESCRIPTION LINE	10/07/75
NA	I4	INDEX TO ABSTRACT LINES	10/07/75
NABST	I4	NUMBER OF ABSTRACT LINES	10/07/75
NBT	I4	BREAK POINT TABLE (LAST N1 IN RANGE NR)	10/07/75
NC	I4	INDEX TO SPECIAL CONSTANTS	10/07/75
NCRAP	I4	NUMBER OF SPECIAL CONSTANTS	10/07/75
NE	I4	INDEX TO ENTRIES	10/07/75
NENTRY	I4	NUMBER OF ENTRIES OF TABULAR DATA	10/07/75
NF	I4	INDEX TO FORTRAN CARDS	10/07/75
NFURT	I4	NUMBER OF FORTRAN CARDS IN PROGRAM	10/07/75
NI	I4	INDEX TO INDEPENDENT VARIABLES	10/07/75
NINDEP	I4	NUMBER OF INDEPENDENT VARIABLES	10/07/75
NL	I4	INDEX TO LEVELS	10/07/75
NLEVEL	I4	NUMBER OF LEVELS (NLEVEL=NINDEP-1)	10/07/75
NMATDL	I4	INDEX TO MATERIAL DESCRIPTION LINES	10/07/75
NP	I4	NUMBER OF MATERIAL DESCRIPTION LINES	10/07/75
NPUN	I4	INDEX TO PROPERTY UNITS	10/07/75
NR	I4	NUMBER OF UNITS FOR THIS PROPERTY	10/07/75
NRA	I4	INDEX TO INTERPOLATION RANGES	10/07/75
NRA	I4	NUMBER OF INTERPOLATION RANGES	10/07/75
NSP1	I4	SPARE 1	10/07/75
NSP2	I4	SPARE 2	10/07/75
NT	I4	INDEX TO TABULAR DATA	10/07/75
NTABLE	I4	NUMBER OF TABLE ENTRIES	10/07/75
NV	I4	INDEX TO VARIABLE UNITS	10/07/75
NVUN	I4	NUMBER OF UNITS FOR THIS VARIABLE	10/07/75
PRODESC	C56	PROPERTY DESCRIPTION	10/07/75
PROPTY	C8	PROPERTY NAME	10/07/75
VERSN	C8	VERSION NAME	10/07/75
VRDESC	C56	VARIABLE DESCRIPTION	10/07/75
XNAME	C8	NAME OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
XUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
XVALUE	R4	VALUE OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
YNAME	C8	NAME OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
YUNITS	C8	UNITS OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
YVALUE	R4	VALUE OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
ZNAME	C8	NAME OF THE INDEPENDENT VARIABLE	10/07/75
ZUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE	10/07/75
ZVALUE	R4	VALUE OF THE INDEPENDENT VARIABLE	10/07/75

GLOSSARY

DATA SET SACRO

NAME TREE

DATE 10/09/75

LEGEND KEY WORDS AND ABSTRACT

NAME	SACRO	.?FILE	.DATA	.?PROPTY	.?MAT	.?VERSN	.ABSTRACT
------	-------	--------	-------	----------	-------	---------	-----------

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	CB	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
	PROPTY	CB	PROPERTY NAME	10/07/75
	VERSN	CB	VERSION NAME	10/07/75

SEGMENT SUMMARY	SEGMENT	LEGEND
	KEYWORDS	LIST OF UP TO 10 KEY WORDS
	ABSTRACT	ABSTRACT INFORMATION

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD ABSTRACT

SEGMENT KEYWORDS SEQUENCE 1 DATE 10/09/75

LEGEND LIST OF UP TO 10 KEY WORDS

LIST (KEYWDS,NK=1,10)

SYMBOL	TYPE	DESCRIPTION	DATE
KEYWDS	Cd	LIST OF ABSTRACT KEYWORDS	10/07/75

TEMPLATE

J726.TEMPLATE.SACRD.CATA.?FILE.?PKCPTY.?MAT.?VERSN.ABSTRAC
KEYWORDS
:AAAAAAAA :AAAAAAAA :AAAAAAAA :AAAAAAAA :AAAAAAAA
:AAAAAAAA :AAAAAAAA :AAAAAAAA :AAAAAAAA :AAAAAAAA

DATA SET SACRD

RECORD ABSTRACT

SEGMENT ABSTRACT SEQUENCE 2 DATE 10/09/75

LEGEND ABSTRACT INFORMATION

LIST | NABST, (ABST, NA=1, NABST) |

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	NABST	14	NUMBER OF ABSTRACT LINES	10/07/75
	ABST	C56	ABSTRACT LINES (56 CHARACTER)	10/07/75
	NA	14	INDEX TO ABSTRACT LINES	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.ABSTRAC
3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.ABSTRAC
: III LINES OF ABSTRACT DATA GIVEN
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
: AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
```

DATA SET SACRD

RECORD CONTENTS

DATE 10/09/75

LEGEND LISTING OF TABULAR RECORDS FOR THIS MATERIAL PROPERTY

NAME		SACRD		.?FILE		.DATA		.?PROPTY		.?MAT		.?VERSN		.CONTENTS	
------	--	-------	--	--------	--	-------	--	----------	--	-------	--	---------	--	-----------	--

QUALIFIERS		SYMBOL		TYPE		DESCRIPTION		DATE	
		FILE		C8		FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES		10/07/75	
		PROPTY		C8		PROPERTY NAME		10/07/75	
		VERSN		C8		VERSION NAME		10/07/75	

SEGMENT SUMMARY		SEGMENT		LEGEND	
		XYDESC		DESCRIPTION OF THE X AND Y VARIABLES	
		LEVELS		VARIABLE NAMES, UNITS, AND INTERP CODE BY LEVEL	
		FIXEDZ		VALUES OF FIXED VARIABLES BY LEVEL AND ENTRY	
		SPECIAL		SPECIAL CONSTANTS	

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD CONTENTS

SEGMENT XYDESC SEQUENCE 1 DATE 10/09/75

LEGEND DESCRIPTION OF THE X AND Y VARIABLES

LIST YNAME,YUNITS,XNAME,XUNITS,NENTRY,CDATE,NSP1,NSP2

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	YNAME	C8	NAME OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
	YUNITS	C8	UNITS OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
	XNAME	C8	NAME OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
	XUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
	NENTRY	I4	NUMBER OF ENTRIES OF TABULAR DATA	10/07/75
	CDATE	C8	CREATE DATE (MM/DD/YY)	10/07/75
	NSP1	I4	SPARE 1	10/07/75
	NSP2	I4	SPARE 2	10/07/75

TEMPLATE

3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.CONTENT
DATA IS GIVEN AS Y(X,Z1,Z2,...,ZNLEVEL) = Y(X,NENTRY)
Y IS :AAAAAAAA IN :AAAAAAAA
X IS :AAAAAAAA IN :AAAAAAAA
THE Z1,...,ZNLEVEL ARE DESCRIBED ON THE FOLLOWING PAGE
:IIII COMBINATIONS (ENTRIES) ARE GIVEN
:AAAAAAAA IS THE CREATION DATE
:IIII (RESERVED FOR LATER USE)
:IIII (")

DATA SET SACRD

RECORD CONTENTS

SEGMENT LEVELS SEQUENCE 2 DATE 10/09/75

LEGEND VARIABLE NAMES, UNITS, AND INTERP CCDE BY LEVEL

LIST | NLEVEL,(ZNAME,ZUNITS,LEVINT,NL=1,NLEVEL) |

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	NLEVEL	14	NUMBER OF LEVELS (NLEVEL=NINDEP-1)	10/07/75
	ZNAME	C8	NAME OF THE INDEPENDENT VARIABLE	10/07/75
	ZUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE	10/07/75
	LEVINT	14	INTERPOLATION CODE BETWEEN LEVELS	10/07/75
	NL	14	INDEX TO LEVELS	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.CONTENT
:III LEVELS
LEVEL      VARIABLE NAME      VARIABLE UNITS      INTERP
          :                :                :                :
:22      :AAAAAAAA      :AAAAAAAA      :II
:22      :AAAAAAAA      :AAAAAAAA      :II
:22      :AAAAAAAA      :AAAAAAAA      :II
:22      :AAAAAAAA      :AAAAAAAA      :II
:22      :AAAAAAAA      :AAAAAAAA      :II
:22      :AAAAAAAA      :AAAAAAAA      :II
```

DATA SET SACRD

RECORD CONTENTS

SEGMENT FIXED2 SEQUENCE 3 DATE 10/09/75

LEGEND VALUES OF FIXED VARIABLES BY LEVEL AND ENTRY

LIST | ((ZVALUE,NL=1,NLEVEL),NE=1,NENTRY) |

ELEMENTS

SYMBOL	TYPE	DESCRIPTION	DATE
ZVALUE	K4	VALUE OF THE INDEPENDENT VARIABLE	10/07/75
NL	14	INDEX TO LEVELS	10/07/75
NLEVEL	14	NUMBER OF LEVELS (NLEVEL=NINCEP-1)	10/07/75
NE	14	INDEX TO ENTRIES	10/07/75
NENTRY	14	NUMBER OF ENTRIES OF TABULAR DATA	10/07/75

TEMPLATE

3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.CONTENT	
FIXED VARIABLES FOR ENTRY :IIII	
LEVEL	VALUE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE
:222	:EE.EEEEEEEEE

DATA SET

RECORD

SEGMENT

LEGEND

L I S T

ELEMENTS

TEMPLATE

DATA SET SACRD

RECORD TABULAR

DATE 10/09/75

LEGEND DATA GIVEN IN A TABULAR FORM

NAME | SACRD .?FILE .DATA .?PROPTY .?MAT .?VERSN .TABULAR .?NE |

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	C8	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
	PROPTY	C8	PROPERTY NAME	10/07/75
	VERSN	C8	VERSION NAME	10/07/75
	NE	I4	INDEX TO ENTRIES	10/07/75

SEGMENT SUMMARY	SEGMENT	LEGEND
	VARIABLE	VARIABLE NAMES, UNITS, AND VALUES OF FIXED VARIABLES
	INTERP	INTERPOLATION CODES BY RANGE OF X SPACE
	TABLE	TABLE OF VALUES OF X AND Y

STRUCTURE SEQUENTIAL

DATA SET SACRO

RECORD TABULAR

SEGMENT VARIABLE SEQUENCE 1 DATE 10/09/75

LEGEND VARIABLE NAMES, UNITS, AND VALUES OF FIXED VARIABLES

LIST
NLEVEL, YNAME, YUNITS, XNAME, XUNITS,
(ZNAME, ZVALUE, ZUNITS, NL=1, NLEVEL)

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	NLEVEL	I4	NUMBER OF LEVELS (NLEVEL=NINDEP-1)	10/07/75
	YNAME	C8	NAME OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
	YUNITS	C8	UNITS OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
	XNAME	C8	NAME OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
	XUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
	ZNAME	C8	NAME OF THE INDEPENDENT VARIABLE	10/07/75
	ZVALUE	R4	VALUE OF THE INDEPENDENT VARIABLE	10/07/75
	ZUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE	10/07/75
	NL	I4	INDEX TO LEVELS	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRO.DATA.?FILE.?PRCPTY.?MAT.?VERSN.TABULAR
:II FIXED INDEPENDENT VARIABLES
VARIABLE      VALUE      UNITS      TYPE OF VARIABLE
:AAAAAAAA      (TABULATION) :AAAAAAAA  DEPENDENT VARIABLE (Y)
:AAAAAAAA      (TABULATION) :AAAAAAAA  INDEPENDENT VARIABLE (X)
:AAAAAAAA:EE.EEEEEEEEE :AAAAAAAA  FIXED INDEPENDENT VARIABLE
:AAAAAAAA:EE.EEEEEEEEE :AAAAAAAA  FIXED INDEPENDENT VARIABLE
:AAAAAAAA:EE.EEEEEEEEE :AAAAAAAA  FIXED INDEPENDENT VARIABLE
:AAAAAAAA:EE.EEEEEEEEE :AAAAAAAA  FIXED INDEPENDENT VARIABLE
:AAAAAAAA:EE.EEEEEEEEE :AAAAAAAA  FIXED INDEPENDENT VARIABLE
```

DATA SET SACRO

RECCRD TABULAR

SEGMENT INTERP SEQUENCE 2 DATE 10/09/75

LEGEND INTERPOLATION CODES BY RANGE OF X SPACE

LIST | NRANGE, (NBT, INT, NR=1, NRANGE) |

ELEMENTS

SYMBOL	TYPE	DESCRIPTION	DATE
NRANGE	14	NUMBER OF INTERPOLATION RANGES	10/07/75
NBT	14	BREAK PCINT TABLE (LAST NT IN RANGE NR)	10/07/75
INT	14	INTERPOLATION CODE FOR RANGE	10/07/75
NR	14	INDEX TO INTERPOLATION RANGES	10/07/75

TEMPLATE

3726... MPLATE.SACRO.DATA.?FILE.?PRCPTY.?MAT.?VERSN.TABULAR		
:11 INTERPOLAT ON RANGES		
RANGE	BREAK PCINT	INTERP CODE
:222	:1111	:11
:222	:1111	:11
:222	:1111	:11
:222	:1111	:11
:222	:1111	:11
:222	:1111	:11

DATA SET SACRO

RECORD TABULAR

SEGMENT TABLE SEQUENCE 3 DATE 10/09/75

LEGEND TABLE OF VALUES OF X AND Y

LIST | NTABLE, (XVALUE, YVALUE, NT=1, NTABLE) |

<u>ELEMENTS</u>	SYMBOL	TYPE	DESCRIPTION	DATE
	NTABLE	I4	NUMBER OF TABLE ENTRIES	10/07/75
	XVALUE	R4	VALUE OF THE INDEPENDENT VARIABLE USED IN TABULATION	10/07/75
	YVALUE	R4	VALUE OF THE DEPENDENT VARIABLE	10/07/75
	NT	I4	INDEX TO TABULAR DATA	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRO.DATA.?FILE.?PRCPTY.?MAT.?VERSN.TABULAR
:III PCINTS GIVEN
PCINT      X      Y
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
:2222      :EE.EEEEEEEE :EE.EEEEEEEE
```

DATA SET SACRO

RECORD PROGRAM

DATE 10/09/75

LEGEND DATA GIVEN BY A FORTRAN SUBROUTINE

NAME | SACRO .?FILE .DATA .?PROPTY .?MAT .?VERSN .PROGRAM |

<u>QUALIFIERS</u>	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	C8	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
	PROPTY	C8	PROPERTY NAME	10/07/75
	VERSN	C8	VERSION NAME	10/07/75

<u>SEGMENT SUMMARY</u>	SEGMENT	LEGEND
	VARIABLE	LIST OF VARIABLE NAMES AND UNITS
	FORTRAN	SUBROUTINE SOURCE DECK LISTING

STRUCTURE SEQUENTIAL

DATA SET

SACRD

RECORD

PROGRAM

SEQUENCE

VARIABLE

SEQUENCE 1

DATE 10/09/75

LEGEND

LIST OF VARIABLE NAMES AND UNITS

LIST

NINDEP, NPORT, YNAME, YUNITS, (ZNAME, ZUNITS, NI=1, NINDEP)

ELEMENTS

SYMBOL TYPE DESCRIPTION

DATE

SYMBOL	TYPE	DESCRIPTION	DATE
PRAMP	C3	FUNCTION NAME	10/07/75
NINDEP	I4	NUMBER OF INDEPENDENT VARIABLES	10/07/75
NPORT	I4	NUMBER OF PORTMAN CARDS IN PROGRAM	10/07/75
YNAME	C8	NAME OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
YUNITS	C8	UNITS OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
ZNAME	C8	NAME OF THE INDEPENDENT VARIABLE	10/07/75
ZUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE	10/07/75
NI	I4	INDEX TO INDEPENDENT VARIABLES	10/07/75

TEMPLATE

3726.TEMPLATE.SACRD.DATA.?FILE.?PROPERTY.?MAT.?VERSM.PROGRAM

```

: II  INDEPENDENT VARIABLES
: III PORTMAN CARDS IN PROGRAM
Y IS :AAAAAAAA IN :AAAAAAAA
Z IS :AAAAAAAA IN :AAAAAAAA
Z 13 :AAAAAAAA IN :AAAAAAAA
Z IS :AAAAAAAA IN :AAAAAAAA
Z IS :AAAAAAAA IN :AAAAAAAA
Z 13 :AAAAAAAA IN :AAAAAAAA
Z IS :AAAAAAAA IN :AAAAAAAA
Z IS :AAAAAAAA IN :AAAAAAAA

```

DATA SET SACRD

RECORD PROGRAM

SEGMENT FORTRAN SEQUENCE 2 DATE 10/09/75

LEGEND SUBROUTINE SOURCE DECK LISTING

LIST | (FORT,NF=1,NFORT) |

<u>ELEMENTS</u>	SYMBOL	TYPE	DESCRIPTION	DATE
	FORT	L56	FORTRAN CARD (56 CHARACTER)	10/07/75
	NF	14	INDEX TO FORTRAN CARDS	10/07/75
	NFORT	14	NUMBER OF FORTRAN CARDS IN PROGRAM	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRD.DATA.?FILE.?PRCPTY.?MAT.?VERSN.PROGRAM
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
```

DATA SET SACRD

RECORD ERRCR

DATE 11/01/79

LEGEND ERRCR ESTIMATES FOR ASSOCIATED TABULAR RECORD

NAME	SACRD	.?FILE	.DATA	.?PROPTY	.?MAT	.?VERSN	.ERRCR	.?NE
------	-------	--------	-------	----------	-------	---------	--------	------

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	C8	FILE NAME, FILE REFERS TO A COLLECTIONS OF PROPERTIES	11/01/79
	PROPTY	C8	PROPERTY NAME	11/01/79
	MAT	C8	MATERIAL NAME	11/01/79
	VERSN	C8	VERSION NAME	11/01/79
	NE	I4	INDEX TO ENTRIES	11/01/79

SEGMENT SUMMARY	SEGMENT	LEGEND
	XYDESC	DESCRIPTION OF THE X AND Y VARIABLES
	RANGES	NO. OF ERROR RANGES
	TABLE	TABLE OF LIMITS AND ERROR FOR EACH RANGE

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD ERROR

SEQUENT HYDESC

SEQUENCE 1

DATE 11/01/79

LEGEND VARIABLE NAMES AND UNITS

LIST | YNAME,YUNITS,XNAME,XUNITS |

ELEMENTS

SYMBOL	TYPE	DESCRIPTION	DATE
YNAME	C8	NAME OF THE DEPENDENT (PROPERTY)	11/01/79
YUNITS	C8	UNITS OF THE DEPENDENT (PROPERTY)	11/01/79
XNAME	C8	NAME OF THE INDEPENDENT VARIABLE USED IN TABULATION	11/01/79
XUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE USED IN TABULATION	11/01/79

TEMPLATE

3276.TEMPLATE.SACRD.DATA.?FILE.?PROPERTY.?NAT.?VERSION.ERROR

VARIABLE	UNITS	TYPE OF VARIABLE
:AAAAAAAA	:AAAAAAAA	DEPENDENT VARIABLE (Y)
:AAAAAAAA	:AAAAAAAA	INDEPENDENT VARIABLE (X)

DATA SET SACRD

RECORD ERRCR

SEGMENT RANGES SEQUENCE 2 DATE 11/01/79

LEGEND NO. OF POINTS IN ERROR RANGES

LIST | NRANGE, (NET, NR=1, NRANGE) |

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	NRANGE	I4	NUMBER OF ERROR RANGES	11/01/79
	NET	I4	BREAK POINT (LAST NT IN RANGE NR)	11/01/79

TEMPLATE

```
3276.TEMPLATE.SACRD.DATA.?FILE.?PROPTY.?MAT.?VERSN.ERROR
:II ERRCR RANGES
      BREAK
      RANGE  POINT
      -----
      :222   :IIII
      :222   :IIII
      :222   :IIII
      :222   :IIII
```

DATA SET SACRD

RECORD ERRCR

SEGMENT TABLE SEQUENCE 3 DATE 11/01/79

LEGEND TABLE OF ERROR RANGES

LIST | (UPVAL,LOWVAL,ERROR,ITYPE,NR=1,NRANGE) |

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	UPVAL	R8	UPPER LIMIT FOR APPLICATION OF ERROR INFORMATION	11/01/79
	LOWVAL	R8	LOWER LIMIT OF APPLICATION OF ERROR INFORMATION	11/01/79
	ERROR	R8	ERROR IN PERCENT	11/01/79
	ITYPE	I4	TYPE OF ERROR	11/01/79

TEMPLATE

3276.TEMPLATE.SACRD.DATA.?FILE.?PROPTY.?NAT.?VERSN.ERROR			
UPVAL	LOWVAL	ERRCR	TYPE
:EE.FE888888	:EE.FE888888	:EE.FE888888	:IIII
:EE.FE888888	:EE.FE888888	:EE.FE888888	:IIII
:EE.FE888888	:EE.FE888888	:EE.FE888888	:IIII
:EE.FE888888	:EE.FE888888	:EE.FE888888	:IIII

DATA SET SACRD

RECORD MATERIAL

DATE 10/09/75

LEGEND	MATERIAL DESCRIPTION
1	100% COTTON
2	100% WOOL
3	100% SILK
4	100% LINEN
5	100% RAYON
6	100% NYLON
7	100% POLYESTER
8	100% COTTON/WOOL
9	100% COTTON/SILK
10	100% COTTON/LINEN
11	100% COTTON/RAYON
12	100% COTTON/NYLON
13	100% COTTON/POLYESTER
14	100% WOOL/SILK
15	100% WOOL/LINEN
16	100% WOOL/RAYON
17	100% WOOL/NYLON
18	100% WOOL/POLYESTER
19	100% SILK/LINEN
20	100% SILK/RAYON
21	100% SILK/NYLON
22	100% SILK/POLYESTER
23	100% LINEN/RAYON
24	100% LINEN/NYLON
25	100% LINEN/POLYESTER
26	100% RAYON/NYLON
27	100% RAYON/POLYESTER
28	100% NYLON/POLYESTER
29	100% COTTON/WOOL/SILK
30	100% COTTON/WOOL/LINEN
31	100% COTTON/WOOL/RAYON
32	100% COTTON/WOOL/NYLON
33	100% COTTON/WOOL/POLYESTER
34	100% COTTON/SILK/LINEN
35	100% COTTON/SILK/RAYON
36	100% COTTON/SILK/NYLON
37	100% COTTON/SILK/POLYESTER
38	100% COTTON/LINEN/RAYON
39	100% COTTON/LINEN/NYLON
40	100% COTTON/LINEN/POLYESTER
41	100% COTTON/RAYON/NYLON
42	100% COTTON/RAYON/POLYESTER
43	100% COTTON/NYLON/POLYESTER
44	100% WOOL/SILK/LINEN
45	100% WOOL/SILK/RAYON
46	100% WOOL/SILK/NYLON
47	100% WOOL/SILK/POLYESTER
48	100% WOOL/LINEN/RAYON
49	100% WOOL/LINEN/NYLON
50	100% WOOL/LINEN/POLYESTER
51	100% WOOL/RAYON/NYLON
52	100% WOOL/RAYON/POLYESTER
53	100% WOOL/NYLON/POLYESTER
54	100% SILK/LINEN/RAYON
55	100% SILK/LINEN/NYLON
56	100% SILK/LINEN/POLYESTER
57	100% SILK/RAYON/NYLON
58	100% SILK/RAYON/POLYESTER
59	100% SILK/NYLON/POLYESTER
60	100% LINEN/RAYON/NYLON
61	100% LINEN/RAYON/POLYESTER
62	100% LINEN/NYLON/POLYESTER
63	100% RAYON/NYLON/POLYESTER
64	100% COTTON/WOOL/SILK/LINEN
65	100% COTTON/WOOL/SILK/RAYON
66	100% COTTON/WOOL/SILK/NYLON
67	100% COTTON/WOOL/SILK/POLYESTER
68	100% COTTON/WOOL/LINEN/RAYON
69	100% COTTON/WOOL/LINEN/NYLON
70	100% COTTON/WOOL/LINEN/POLYESTER
71	100% COTTON/WOOL/RAYON/NYLON
72	100% COTTON/WOOL/RAYON/POLYESTER
73	100% COTTON/WOOL/NYLON/POLYESTER
74	100% COTTON/SILK/WOOL/LINEN
75	100% COTTON/SILK/WOOL/RAYON
76	100% COTTON/SILK/WOOL/NYLON
77	100% COTTON/SILK/WOOL/POLYESTER
78	100% COTTON/SILK/LINEN/RA
79	100% COTTON/SILK/LINEN/N
80	100% COTTON/SILK/LINEN/P
81	100% COTTON/SILK/RAYON/N
82	100% COTTON/SILK/RAYON/P
83	100% COTTON/SILK/NYLON/P
84	100% COTTON/LINEN/RA
85	100% COTTON/LINEN/N
86	100% COTTON/LINEN/P
87	100% COTTON/RAYON/N
88	100% COTTON/RAYON/P
89	100% COTTON/NYLON/P
90	100% WOOL/SILK/WOOL/LINEN
91	100% WOOL/SILK/WOOL/RAYON
92	100% WOOL/SILK/WOOL/NYLON
93	100% WOOL/SILK/WOOL/POLYESTER
94	100% WOOL/SILK/LINEN/RA
95	100% WOOL/SILK/LINEN/N
96	100% WOOL/SILK/LINEN/P
97	100% WOOL/SILK/RAYON/N
98	100% WOOL/SILK/RAYON/P
99	100% WOOL/SILK/NYLON/P
100	100% LINEN/RAYON/N
101	100% LINEN/RAYON/P
102	100% LINEN/NYLON/P
103	100% RAYON/NYLON/P
104	100% COTTON/WOOL/SILK/LINEN/RAYON
105	100% COTTON/WOOL/SILK/LINEN/NYLON
106	100% COTTON/WOOL/SILK/LINEN/POLYESTER
107	100% COTTON/WOOL/SILK/RAYON/NYLON
108	100% COTTON/WOOL/SILK/RAYON/POLYESTER
109	100% COTTON/WOOL/SILK/NYLON/POLYESTER
110	100% COTTON/SILK/WOOL/LINEN/RAYON
111	100% COTTON/SILK/WOOL/LINEN/NYLON
112	100% COTTON/SILK/WOOL/LINEN/POLYESTER
113	100% COTTON/SILK/WOOL/RAYON/NYLON
114	100% COTTON/SILK/WOOL/RAYON/POLYESTER
115	100% COTTON/SILK/WOOL/NYLON/POLYESTER
116	100% COTTON/SILK/LINEN/RA
117	100% COTTON/SILK/LINEN/N
118	100% COTTON/SILK/LINEN/P
119	100% COTTON/SILK/RAYON/N

NAME	SACRD	?FILE	.PARAM	.MATERIAL.?MAT
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
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99				
100				

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	CB	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75

SEGMENT SUMMARY	SEGMENT	LEGEND
	MATERIAL	DESCRIPTION OF A MATERIAL

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD PROPERTY

DATE 10/09/75

LEGEND DESCRIPTION OF A PROPERTY AND THE ALLOWED UNITS

NAME | SACRD .?FILE .PARAM .PROPERTY.?PROPTY |

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	CH	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
	PROPTY	CH	PROPERTY NAME	10/07/75

SEGMENT SUMMARY | SEGMENT | LEGEND |

 | PROPERTY | DESCRIPTION OF A PROPERTY AND THE ALLOWED UNITS |

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD PROPERTY

SEGMENT PROPERTY SEQUENCE 1 DATE 10/09/75

LEGEND DESCRIPTION OF A PROPERTY AND THE ALLOWED UNITS

LIST | PRDESC, NPUN, (YUNITS, NP=1, NPUN) |

ELEMENTS	SYMBOL	TYPE	DESCRIPTION	DATE
	PRDESC	C56	PROPERTY DESCRIPTION	10/07/75
	NPUN	I4	NUMBER OF UNITS FOR THIS PROPERTY	10/07/75
	YUNITS	C8	UNITS OF THE DEPENDENT VARIABLE (PROPERTY)	10/07/75
	NP	I4	INDEX TO PROPERTY UNITS	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRD.PARAM.?FILE.PRCPERTY.?PROPTY
DESCRIPTION OF A PROPERTY
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:III UNITS GIVEN FOR THIS PROPERTY
UNIT NO      UNITS
:22          :AAAAAAA
:22          :AAAAAAA
:22          :AAAAAAA
:22          :AAAAAAA
:22          :AAAAAAA
:22          :AAAAAAA
```

DATE 10/09/75

LEGEND	DESCRIPTION OF A VARIABLE AND ALLOWED UNITS
--------	---

NAME	SACRD	.?FILE	.PARAM	.VARIABLE.?NAME
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
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100				

QUALIFIERS	SYMBOL	TYPE	DESCRIPTION	DATE
	FILE	C8	FILE NAME. FILE REFERS TO A COLLECTION OF PROPERTIES	10/07/75
	ZNAME	C6	NAME OF THE INDEPENDENT VARIABLE	10/07/75

SEGMENT SUMMARY	SEGMENT	LEGEND
	VARIABLE	DESCRIPTION OF A VARIABLE AND ALLOWED UNITS

STRUCTURE SEQUENTIAL

DATA SET SACRD

RECORD VARIABLE

SEGMENT VARIABLE SEQUENCE 1 DATE 10/09/75

LEGEND DESCRIPTION OF A VARIABLE AND ALLOWED UNITS

LIST | VRDESC,NVUN,(ZUNITS,NV=1,NVUN) |

<u>ELEMENTS</u>	SYMBOL	TYPE	DESCRIPTION	DATE
	VRDESC	C56	VARIABLE DESCRIPTION	10/07/75
	NVUN	I4	NUMBER OF UNITS FOR THIS VARIABLE	10/07/75
	ZUNITS	C8	UNITS OF THE INDEPENDENT VARIABLE	10/07/75
	NV	I4	INDEX TO VARIABLE UNITS	10/07/75

TEMPLATE

```
3726.TEMPLATE.SACRD.PARAM.?FILE.VARIABLE.?ZNAME
DESCRIPTION OF AN INDEPENDENT VARIABLE
:AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
:III UNITS GIVEN FOR THIS VARIABLE
UNIT NO    UNITS
:222       :AAAAAAAA
:222       :AAAAAAAA
:222       :AAAAAAAA
:222       :AAAAAAAA
:222       :AAAAAAAA
:222       :AAAAAAAA
```

The above records, except material, property, and variable, are created by a free-form input program called INPUT. The input formats are described below:

ABSTRACT RECORD

Description:

The ABSTRACT record has two segments: a keyword section and the textual information which describes the evaluation.

Input:

?FILE.DATA.?PROPTY.?MAT.?VERSN.ABSTRACT

NABST = number of 56-character lines required for abstract

KEYWORD = keyword #1

.
.
.

KEYWORD = last keyword (10 keyword maximum)

\$END

SEG2

ABSTRACT (NABST cards are required)

\$TEST

An example of a set of ABSTRACT cards is shown in Fig. 4. Note that no keywords are included.

TR.DATA.TD.SS304.PLSA.ABSTRACT

NABST=21

\$END

SEG2

THERMAL DIFFUSIVITY STAINLESS STEEL(TYPE 304)

PROPERTY CODE 3110

DATA SOURCE

THERMAL DIFFUSIVITY VALUES WERE CALCULATED FROM THE
THERMAL CONDUCTIVITY, DENSITY, AND SPECIFIC HEAT DATA.

DATA ANALYSIS

NONE

DISCUSSION

THERMAL DIFFUSIVITY WAS CALCULATED BY ITS DEFINITION:
THERMAL DIFFUSIVITY= THERMAL CONDUCTIVITY/(DENSITY
*SPECIFIC HEAT)

REFERENCES

NONE
\$TEST

Figure 4. ABSTRACT Record Free-Form Input.

CONTENTS RECORD

Description:

The CONTENTS record has four segments. The first segment contains information such as the property and independent variable names (Y and X), the units of the data as supplied, the SI units in which the data will be stored in SACRD, the number of associated tabular records and the number of additional independent variables associated with this record. The second segment defines the additional independent variables and their units associated with the curve(s) that describe the property. The third segment specifies values of the independent variables. The fourth segment stores textual information which may be required to describe the tabular data.

Input:

?FILE.DATA.?PROPTY.?MAT.?VERSN.CONTENTS

YNAME = property name

YUNITS = property units

YSIUNITS = SI units in which the property value will be stored in the
SACRD record

XNAME = independent variable name

XUNITS = independent variable units

XSIUNITS = SI units in which the independent variable will be stored
in the SACRD record

NENTRY = number of entries in CONTENTS record
(number of associated TABULAR records to be entered)

CDATE = creation date (mo/da/yr)

NLEVEL = number of levels specified in CONTENTS

NCRAP = number of 8-byte words of general description or qualifying information

\$END

SEG2

[ZNAME(I),ZUNITS(I),ZSIUNITS(I),LEVINT(I),I=1,NLEVEL]

ZNAME(I) is the name of an independent variable associated with the data contained in the following TABULAR record(s)

ZUNITS(I) is the SACRD abbreviation for the units given with the parameter

ZSIUNITS(I) is the SACRD abbreviation for the SI units in which the SACRD record will store the parameter value

LEVINT(I) is a type of interpolation between various entries of the parameter ZNAME. The allowable values of LEVINT are:

1. flat
2. linear-linear
3. log-linear
4. linear-log
5. log-log

SEG3

[(ZVALUE(I,J),I=1,NLEVEL),J=1,NENTRY]

ZVALUE(I,J) is the value of the ZNAME parameter for each of the following TABULAR record(s)

SEG4

[CRAP(I),I=1,NCRAP]---textual information (use 7A8 format)

An example of a set of CONTENTS cards is shown in Fig. 5.

TR.DATA.K.RE.1.CONTENTS

YNAME=K

YUNITS=W/M-K

YSIUNITS=W/M-K

XNAME=TEMP

XUNITS=K

XSIUNITS=K

NENTRY=1

NLEVEL=1

NSP1=0

NSP2=0

CDATE=03/28/78

NCRAP=18

\$END

SEG2

STATE NONE NONE 1

SEC3

3.0

SEG4

THE TABULATED ENTRIES FOR THE ABOVE RECORDS WERE
GENERATED USING A CORRELATION TAKEN FROM GENERAL
ATOMIC DOCUMENT # GA-A13400

Figure 5. CONTENTS Record Free-Form Input.

TABULAR RECORD

Description:

Tabular records contain four segments. The first segment contains information such as the property and independent variable names, the units of the data as supplied and the SI units in which the data will be stored in SACRD. The second segment describes fixed independent variables associated with each TABULAR record or curve. The third segment specifies the number of interpolation ranges, the number of points in each range, and the type of interpolation associated with the range. The fourth segment contains the tabulated data. Each tabular record contains data for one curve.

Input:

?FILE.DATA.?PROPTY.?MAT.?VERSN.TABULAR

YNAME = property name

YUNITS = property units

YSIUNITS = SI units in which the property values will be stored

XNAME = independent variable name

XUNITS = independent variable units

XSIUNITS = SI units in which the independent variable will be stored

\$END

The following sections will be repeated NENTRY times, one for each curve.

SEG 1

[ZNAME(I),ZVALUE(I),ZUNITS(I),ZSIUNITS(I),I=1,NLEVEL]

ZNAME(I) is the name of a fixed independent variable associated with the data

ZVALUE(I) is the value of the fixed variable

ZUNITS(I) is the SACRD abbreviation for the units of the independent variable

ZSIUNITS(I) is the SACRD abbreviation for the SI units of the independent variable

SEG2

NRANGE,[NBT(I),INT(I),I=1,NRANGE]

NRANGE is the number of interpolation ranges associated with the data

NBT(I) is the number of points included in the ith interpolation range

INT(I) is the type of interpolation between various entries in the ith interpolation range. The allowable values of INT are:

1. flat
2. linear-linear
3. log-linear
4. linear-log
5. log-log

SEG3

NTABLE,[XVALUE(I),YVALUE(I),I=1,NTABLE]

NTABLE is the number of x and y values to be entered

XVALUE(I) is the independent variable value

YVALUE(I) is the property value

or

if XNAME = NONE

NTABLE,[YVALUE(I),I=1,NTABLE]

NOTE: To enter the above TABULAR record(s), the corresponding CONTENTS record must be entered in the same run just preceding the TABULAR entry. An example of the input for a TABULAR record is shown in Fig. 6.

```

TR.DATA.K.HE.1.TABULAR
YNAME=K
YUNITS=W/M-K
YSIUNITS=W/M-K
XNAME=TEMP
XUNITS=K
XSIUNITS=K
$END
**SEG1
STATE 3.0 NONE NONE
**SEG2
1 37 1
**SEG3
37
0.2500000E 03 0.1330644E 00
0.2750000E 03 0.1422586E 00
0.3000000E 03 0.1512057E 00
0.3250000E 03 0.1599323E 00
0.3500000E 03 0.1684603E 00
0.3750000E 03 0.1768081E 00
0.4000000E 03 0.1849908E 00
0.4250000E 03 0.1930221E 00
0.4500000E 03 0.2009129E 00
0.4750000E 03 0.2086741E 00
0.5000000E 03 0.2163137E 00
0.5250000E 03 0.2238399E 00
0.5500000E 03 0.2312599E 00
0.5750000E 03 0.2385795E 00
0.6000000E 03 0.2458047E 00
0.6250000E 03 0.2529402E 00
0.6500000E 03 0.2599912E 00
0.6750000E 03 0.2669610E 00
0.7000000E 03 0.2738546E 00
0.7250000E 03 0.2806747E 00
0.7500000E 03 0.2874247E 00
0.7750000E 03 0.2941079E 00
0.8000000E 03 0.3007268E 00
0.8250000E 03 0.3072844E 00
0.8500000E 03 0.3137825E 00
0.8750000E 03 0.3202240E 00
0.9000000E 03 0.3266106E 00
0.9250000E 03 0.3329442E 00
0.9500000E 03 0.3392270E 00
0.9750000E 03 0.3454604E 00
0.1000000E 03 0.3516467E 00
0.1025000E 03 0.3577864E 00
0.1050000E 03 0.3638816E 00
0.1075000E 03 0.3699331E 00
0.1100000E 03 0.3759133E 00
0.1125000E 03 0.3819128E 00
0.1150000E 03 0.3878427E 00

```

**Segments that are repeated NENTRY
 (the number of separate TABULAR
 entries) times.

Figure 6. TABULAR Record Free-Form Input.

PROGRAM RECORD

Description:

The PROGRAM record contains a function that presents the property in parameterized form.

Input:

?FILE.DATA.?PROPTY.?MAT.?VERSN.PROGRAM

YNAME = property name

YUNITS = property units

NINDEP = number of independent variables

FNAME = function name

NFORT = number of FORTRAN lines in this function

\$END

SEG1

XNAME, XUNITS

XNAME is the independent variable

XUNITS is the independent variable units

SEG2

PROGRAM

\$TEST

An example of the input for a PROGRAM record is shown in Fig. 7.

```

TR.DATA.K.HE.1.PROGRAM
YNAME=K
YUNITS=W/M-K
NINDEP=1
FNAME=HECON
NFORT=22
$END
SEG1
    TEMP      K
SEG2
    FUNCTION HECON(T,IUNIT)
C THIS EQUATION IS ONLY VALID IN THE TEMPERATURE RANGE
C 270 TO 1500 K AND PRESSURE RANGE 10**5 TO 10**7 PASCALS
C *** THIS PROGRAM WAS SUPPLIED BY GENERAL ATOMIC CO. -
C *** DOCUMENT # GA-A13400
C
C    COMPUTE THE THERMAL CONDUCTIVITY OF HELIUM (HECON)
C    AS A FUNCTION OF TEMPERATURE (T) . . .
C
C    IUNIT=1 TEMPERATURE IN DEGREES KELVIN
C    CONDUCTIVITY IN WATTS PER METER DEGREES KELVIN
C
    TT=T
    IF (IUNIT.EQ.2) TT=T*5.0/9.0
    HECON=2.774E-3*TT**0.701
    IF (IUNIT.EQ.2) HECON=HECON/1.7307413
    RETURN
    END
$TEST

```

Figure 7. PROGRAM Record Free-Form Input.

ERROR RECORD**Description:**

The ERROR record has one segment and this is a free-form text field.

Input:

?FILE.DATA.?PROPTY.?MAT.?VERSN.ERROR

NERR = number of 56-character lines required for error record

\$END

SEG2

ERROR (NERR cards are required)

\$TEST

An example of a set of ERROR cards is shown in Fig. 8.

TH.DATA.LTE.A286.1.ERROR
 NERR=23
 \$END
 SEG2
 ERROR ESTIMATE AS OF 1/31/80 FROM NSMH

THE UNCERTAINTY OF TABULATED VALUES IS ESTIMATED TO
 BE WITHIN (+/-) 5% BELOW 600F and (+/-) 10% ABOVE.

THE EQUATIONS AND TABLES WERE GENERATED BY LEAST
 SQUARES POLYNOMIAL FITS OF THE DATA FOR THE
 INSTANTANEOUS COEFFICIENT. THE STANDARD DEVIATIONS
 OF THE FITS WERE AS FOLLOWS:

CURVE -----	STANDARD DEVIATION -----
LINEAR EXPANSION	0.0006538
INSTANTANEOUS COEFFICIENT	0.005712
MEAN COEFFICIENT	0.006670

THE DATA WERE CALCULATED FROM THE FOLLOWING EQUATION:

$$\text{DELTA L/L} = -0.3102884 + 0.01454260 * T + 5.342218E-6 * T^2 - 2.245398E-9 * T^3$$

where

DELTA L/L = THERMAL LINEAR EXPANSION, MM/M AND
 T = TEMPERATURE, DEGREES C.

\$TEST

Figure 8. ERROR Record Free-Form Input.

58

IV. UNITS CONVERSION SUBROUTINES

All data entered into the SACRD data base are stored in SI units. However, a user can display or edit in a large variety of units in most cases. The conversion is performed by a subroutine SIUNIT(ANUM,SI,EN,IT,ARES,IST,IFIN) where

ANUM Array of input values to be converted
SI SACRD abbreviation for SI unit
EN SACRD abbreviation for engineering units
IT -1, conversion is to SI units
IT 0, conversion is from SI units
ARES Array of converted values
IST First number of the array to be converted
IFIN Last number of the array to be converted

The subroutine SIUNIT in turn calls a subroutine named CONV(SI,EN,IT,AJ). SI, EN, and IT are as defined above. AJ is the conversion factor returned after searching the SACRD file cataloged by 'SACRD'. 'UNITS'.SI. The majority of the conversion factors available were taken from References 4 and 5.

Available conversion factors are listed on the following pages.

EQUIVALENCE FACTORS

CURRENTLY IN USE IN SACRD

TO CONVERT TO *** K KELVIN ***

	FROM ----	USE ----
CELSIUS	C	(X+273.15)
FAHRENHEIT	F	((X+459.67)*.55555556)
RANKINE	R	(X*.55555556)

TO CONVERT TO *** 1E-6/K 1.E-6 PER KELVIN:

	FROM ----	MULTIPLY BY -----
1.E-6 PER DEGREE C	1E-6/C	1.0000 00

TO CONVERT TO *** SEC SECOND:

	FROM ----	MULTIPLY BY -----
MINUTE(MEAN SOLAR)	MIN	6.0000 01
HOURL(MEAN SOLAR)	HR	3.6000 03
DAY(MEAN SOLAR)	DAY	8.6400 04

TO CONVERT TO *** KG KILLOGRAM:

	FROM ----	MULTIPLY BY -----
ATOMIC MASS UNIT	AMU	1.6600-21
DYNE	DYNE	1.0200-03
GRAM	G	1.0000-03
GRAIN	GRAIN	6.4800-05
MICROGRAM	MCG	1.0000-09
MILLIGRAM	MG	1.0000-06
POUNDAL	PDL	1.4100-02
POUND MASS	LBM	4.5360-01
TON(LONG)	TONLG	1.0160 03
TON(SHORT, 2000 LB)	TON	9.0720 02

TO CONVERT TO **** KG/M3 KILOGRAM/METER CUBED:

	FROM	MULTIPLY BY
	----	-----
GRAM/CUBIC CENTIMETER	G/CM3	1.0000 03
POUND/CUBIC FOOT	LB/FT3	1.6020 01
POUND/CUBIC INCH	LB/IN3	2.7680 04
POUND/MIL FOOT	LB/MIL-FT	2.9370 09
MEGAGRAM PER METER CUBED	MEGGM/M3	1.0000 03

TO CONVERT TO **** M METER:

	FROM	MULTIPLY BY
	----	-----
ANGSTROM	ANGSTROM	1.0000-10
CENTIMETER	CM	1.0000-02
FATHOM	FATHOM	1.8290 00
FOOT	FT	3.0480-01
FURLONG	FURLONG	2.0120 02
INCH	IN	2.5400-02
KILOMETER	KM	1.0000 03
MICRON	MICRON	1.0000-06
MIL	MIL	2.5400-05
MILE	MILE	1.6090 03
MILLIMETER	MM	1.0000-03
ROD	ROD	5.0290 00
YARD	YD	9.1440-01
TERAMETER	TM	1.0000 12
GIGAMETER	GM	1.0000 09
MEGAMETER	MGH	1.0000 06
HECTOMETER	HM	1.0000 02
DEKAMETER	DKM	1.0000 01
DECIMETER	DCM	1.0000-01
MICROMETER	MCM	1.0000-06
NANOMETER	NM	1.0000-09
PICOMETER	PM	1.0000-12
FENTOMETER	FM	1.0000-15
ATTOMETER	AM	1.0000-18

TO CONVERT TO **** M2 METERS SQUARED:

	FROM	MULTIPLY BY
	----	-----
ACRE	ACRE	4.0470 03
ARE	ARE	1.0000 02
BARN	BARN	1.0000-28
CIRCULAR MIL	CMIL	5.0670-10
FEET SQUARED	FT2	9.2900-02
HECTARE	HECTARE	1.0000 04
MILES SQUARED	MILE2	2.5900 06
SECTION	SECTION	2.5900 06
TOWNSHIP	TOWNSHIP	9.3240 07

YARDS SQUARED	YD2	8.3610-01
TERAMETERS SQUARED	TM2	1.0000 24
GIGAMETERS SQUARED	GM2	1.0000 18
MEGAMETERS SQUARED	MGM2	1.0000 12
KILOMETERS SQUARED	KM2	1.0000 06
HECTOMETERS SQUARED	HM2	1.0000 04
DEKAMETERS SQUARED	DKM2	1.0000 02
DECIMETERS SQUARED	DCM2	1.0000-02
CENTIMETERS SQUARED	CM2	1.0000-04
MILLIMETERS SQUARED	MM2	1.0000-06
MICROMETERS SQUARED	MCM2	1.0000-12
NANOMETERS SQUARED	NM2	1.0000-18
PICOMETERS SQUARED	PM2	1.0000-24
FEMTOMETERS SQUARED	FM2	1.0000-30
ATTOMETERS SQUARED	AM2	1.0000-36

TO CONVERT TO **** M3

METERS CUBED:

	FROM	MULTIPLY BY
ACRE FOOT	ACRE-FT	1.2330 03
BARREL (PETROLEUM 42 GAL)	BARREL	1.5900-01
BOARD FOOT	BOARD-FT	2.3600-03
BUSHEL (U.S.)	BUSHEL	3.5240-02
CORD	CORD	3.6250 00
CUP	CUP	2.3660-04
DRAM (U.S. FLUID)	DRAM	3.6970-06
FLUID OUNCE (U.S.)	OZ	2.9570-05
FOOT CUBED	FT3	2.8320-02
GALLON (U.K. LIQUID)	GALUKL	4.5460-03
GALLON (U.S. DRY)	GALUSD	4.4050-03
GALLON (U.S. LIQUID)	GALLON	3.7850-03
GILL (U.K.)	GILLUK	1.4210-04
GILL (U.S.)	GILL	1.1830-04
HOGSHEAD (U.S.)	HOGSHEAD	2.3850-01
INCHES CUBED	IN3	1.6390-05
LITER	LITER	1.0000-03
PECK (U.S.)	PECK	8.8100-03
PINT (U.S. DRY)	DRYPINT	5.5060-04
PINT (U.S. LIQUID)	PINT	4.7320-04
QUART (U.S. DRY)	DRYQUART	1.1010-03
QUART (U.S. LIQUID)	QUART	9.4640-04
STERE	STERE	1.0000 00
TABLESPOON	TBSP	1.4790-05
TEASPOON	TSPN	4.9290-06
TON (REGISTER)	TONREG	2.8320 00
YARDS CUBED	YD3	7.6460-01
TERAMETERS CUBED	TM3	1.0000 36
GIGAMETERS CUBED	GM3	1.0000 27
MEGAMETERS CUBED	MGM3	1.0000 18
KILOMETERS CUBED	KM3	1.0000 09
HECTOMETERS CUBED	HM3	1.0000 06
DEKAMETERS CUBED	DKM3	1.0000 03
DECIMETERS CUBED	DCM3	1.0000-03
CENTIMETERS CUBED	CM3	1.0000-06
MILLIMETERS CUBED	MM3	1.0000-09
MICROMETERS CUBED	MCM3	1.0000-18
NANOMETERS CUBED	NM3	1.0000-27
PICOMETERS CUBED	PM3	1.0000-36
FEMTOMETERS CUBED	FM3	1.0000-45
ATTOMETERS CUBED	AM3	1.0000-54

TO CONVERT TO **** N

NEWTON:

	FROM -----	MULTIPLY BY -----
DYNE	DYNE	1.0000-05
KILOGRAM FORCE (KGF)	KGF	9.8070 00
KILOPOND FORCE	KPF	9.8070 00
KIP	KIP	4.4480 03
POUND FORCE (A VOIR D'POIS)	LBF	4.4480 00
OUNCE FORCE (A VOIR D'POIS)	OZF	2.7890-01
POUNDAL	PDL	1.3830-01

TO CONVERT TO **** N/M

NEWTONS/METER:

	FROM -----	MULTIPLY BY -----
POUNDS/FOOT	LB/FT	0.8520-01
DYNES/CENTIMETER	DYNE/CM	1.0000 03

TO CONVERT TO **** FA

PASCAL:

	FROM -----	MULTIPLY BY -----
NEWTONS/METER SQUARED	N/M2	1.0000 00
ATMOSPHERE	ATM	1.0130 05
BAR	BAR	1.0000 05
BARYE	BARYE	1.0000-01
CM OF MERCURY 0C	HGCM	1.3330 03
CM OF WATER 4C	H2O CM	9.8060 01
DYNES/CENTIMETER SQUARED	DYN/CM2	1.0000-01
FOOT OF WATER (39.2 F)	H2O FT	2.9890 03
INCH OF MERCURY (32 F)	HG IN 32	3.3860 03
INCH OF MERCURY (60 F)	HG IN 60	3.3770 03
INCH OF WATER (39.2 F)	H2O IN 39	2.4910 02
INCH OF WATER (60 F)	H2O IN 60	2.4880 02
KGF/CENTIMETER SQUARED	KGF/CM2	9.8070 04
KGF/METER SQUARED	KGF/M2	9.8070 00
LBF/FOOT SQUARED	LBF/FT2	4.7880 01
LBF/INCH SQUARED	PSI	6.8950 03
MILLIBAR	MBAR	1.0000 02
MM OF MERCURY (0 DEG C)	HG MM	1.3330 02
TORR (0 DEG C)	TORR	1.3330 02
KILOPOUNDS/SQUARE INCH	KSI	6.8950 06
MEGAPASCAL	MPA	1.0000 06
GIGAPASCAL	GPA	1.0000 09
LBF/INCH SQUARED	PSIA	6.8950 03

TO CONVERT TO **** PA-SEC PASCAL-SECOND:

	FROM ----	MULTIPLY BY -----
LBM/FOOT SECOND	LBM/FT-S	1.4880 00
LBM/FOOT HOUR	LBM/FTHR	4.1340-04
LBF SECOND/FOOT SQUARED	LBF S/FT2	4.7880 01
POISE	POISE	1.0000-01
CENTIPOISE	CPOISE	1.0000-03
MICROPOISE	UPOISE	1.0000-07
POUNDAL SECOND/FOOT**2	PD-S/FT2	1.4880 00
SLUG/FOOT SECOND	SL/FT-S	4.7880 01

TO CONVERT TO **** M2/SEC METERS SQUARED PER SECOND:

	FROM ----	MULTIPLY BY -----
MICROMETERS SQUARED/SECC	UM2/SEC	1.0000-12
CENTISTOKE	CSTOKE	1.0000-06
STOKE	STOKE	1.0000-04
FEET SQUARED/SECOND	FT2/SEC	9.2900-02
CENTIMETERS SQUARED/SEC	CM2/SEC	1.0000-04
METERS SQUARED PER HOUR	M2/HR	1.6670-02

TO CONVERT TO **** W/M-K WATTS PER METER-KELVIN:

	FROM ----	MULTIPLY BY -----
WATTS/CM-KELVIN	W/CM-K	1.0000 02
BTU/HOUR FOOT DEG F	BTU/HFTF	1.7300 00
BTU/HOUR FOOT DEG R	BTU/HFTR	1.7300 00
WATTS/METER-DEGREE C	W/M-C	1.0000 00

TO CONVERT TO **** W/M2 WATTS/METER SQUARED:

	FROM ----	MULTIPLY BY -----
BTU(THERMOCHEM)/FT**2SEC	BTU/FT2S	1.1350 04
BTU(THERMOCHEM)/FT**2MIN	BTU/FT2M	1.8910 02
BTU(THERMOCHEM)/FT**2HR	BTU/FT2H	3.1520 00
BTU(THERMOCHEM)/IN**2SEC	BTU/IN2S	1.6340 06
CALORIE(TH)/CM**2 MIN	CAL/CM2M	6.9730 02
ERG/CM**2 SECOND	ERG/CM2S	1.0000-03
WATTS/CENTIMETER SQUARED	W/CM2	1.0000 04

TO CONVERT TO **** UOHM/M MICRUGHMS PER METER:

	FROM ----	MULTIPLY BY -----
MICRUGHMS PER INCH	UOHM/IN	3.9370 01
MICRUGHMS/CENTIMETER	UOHM/CM	1.0000 02

TO CONVERT TO **** M/SEC METERS/SECOND:

	FROM ----	MULTIPLY BY -----
FEET/HOUR	FT/HR	8.4670-05
FEET/MINUTE	FT/MIN	5.0800-03
FEET/SECOND	FT/SEC	3.0480-01
INCHES/SECOND	IN/SEC	2.5400-02
KNOT	KNOT	5.1440-01
KILOMETERS/HOUR	KM/HR	2.7780-01
KILOMETERS/MINUTE	KM/MIN	1.6670 01
KILOMETERS/SECOND	KM/SEC	1.0000 03
MILES/HOUR	MILE/HR	4.4700-01
MILES/MINUTE	MILE/MIN	2.6820 01
MILES/SECOND	MILE/SEC	1.6090 03
CENTIMETERS/CALENDAR YR.	CM/YR	3.1710-10

TO CONVERT TO **** M/SEC² METERS/SECOND SQUARED:

	FROM ----	MULTIPLY BY -----
FEET/SECOND SQUARED	FT/SEC ²	3.0480-01
FREE FALL, STANDARD	FREE FALL	9.8070 00
GAL(GALILEO)	GALILEO	1.0000-02
INCHES/SECOND SQUARED	IN/SEC ²	2.5400-02

TO CONVERT TO **** J JCULE:

	FROM ----	MULTIPLY BY -----
ATOMIC MASS UNIT	AMU	1.4910-10
ERG	ERG	1.0000-07
FOOT POUND	FT-LB	1.3560 00
KILOGRAM METER	KG-M	9.8040 00
WATT HOUR	W-HR	3.6000 03
KILOWATT HOUR	KW-HR	3.6000 06
ELECTRON VOLT	EV	1.6020-19
MEGAELECTRON VOLT	MEV	1.6020-13
BRITISH THERMAL UNIT 1ST	BTU1ST	1.0550 03
BRIT. THERMAL UNIT(MEAN)	BTUM	1.0560 03
BTU(THERMOCHEMICAL)	BTU	1.0540 03
BTU(39F)	BTU39F	1.0600 03
BTU(60F)	BTU60F	1.0550 03

CALORIE(IST)	CALIST	4.1870 00
CALORIE(MEAN)	CALM	4.1870 00
CALORIE(THERMOCHEMICAL)	CAL	4.1840 00
CALORIE(15C)	CAL15C	4.1860 00
CALORIE(20C)	CAL20C	4.1820 00
KILOGRAM CALORIE (IST)	KG-CALIS	4.1870 03
KILOGRAM CALORIE (MEAN)	KG-CALM	4.1900 03
KGCAL-THERMOCHEMICAL	KG-CALH	4.1840 03
FOOT POUNDAL	FT-PDL	4.2140-02
KILOCALORIE(IST)	KCALIST	4.1870 03
KILOCALORIE(MEAN)	KCALM	4.1900 03
KILOCALORIE(THERMOCHEM)	KCAL	4.1840 03
TUN(NUCLEAR EQ. OF TNT)	TON	4.2000 09

TO CONVERT TO **** J/KG JOULES/KILOGRAM:

	FROM	MULTIPLY BY
	----	-----
KILOJOULES/KILOGRAM	KJ/KG	1.0000 03
BTU/POUND MASS	BTU/LB	2.3260 03

TO CONVERT TO **** J/MOL JOULES/MOL:

	FROM	MULTIPLY BY
	----	-----
CALORIES/MOL	CAL/MOL	4.1840 00
KILOCALORIES/MOL	KCAL/MOL	4.1840 03
KILOJOULES/MOL	KJ/MOL	1.0000 03

TO CONVERT TO **** J/MOL-K JOULES/MOL-K:

	FROM	MULTIPLY BY
	----	-----
CALORIES-THERMOCHEM/MOL-K	C/MOL-K	4.1840 00

TO CONVERT TO **** J/KG-K JOULES/KILOGRAM-DEG. K:

	FROM	MULTIPLY BY
	----	-----
CALORIES/GRAM-DEG C	C/G-C	4.1840 03
CALORIES/GRAM-KELVIN	C/G-K	4.1840 03
CALORIES/KILOGRAM-KELVIN	C/KG-K	4.1840 00
BTU/POUND-DEG F	BTU/LB-F	4.1860 03
BTU/POUND-DEG RANKINE	BTU/LB-R	4.1860 03
JOULES/KILOGRAM-DEG C	J/KG-C	1.0000 00

TO CONVERT TO **** J/M3 JOULES/METER CUBED:

	FROM ----	MULTIPLY BY -----
FOOT-POUND/CUBIC FOOT	FTLB/FT3	4.7880 01

TO CONVERT TO **** MPA MEGAPASCAL:

	FROM ----	MULTIPLY BY -----
NEWTONS/METER SQUARED	N/M2	1.0000-06
ATMOSPHERE	ATM	1.0130-01
BAR	BAR	1.0000-01
BARYE	BARYE	1.0000-07
CM OF MERCURY 0C	HGCM	1.3330-03
CM OF WATER 4C	H20CM	9.8060-05
DYNES/CENTIMETER SQUARED	DYNPCM2	1.0000-06
FOOT OF WATER(39.2 F)	H20FT	2.9890-03
INCH OF MERCURY(32F)	HGIN32	3.3860-03
INCH OF MERCURY(60F)	HGIN60	3.3770-03
INCH OF WATER(39.2F)	H20IN39	2.4910-04
INCH OF WATER(60F)	H20IN60	2.4880-04
KGF/CENTIMETER SQUARED	KGF/CM2	9.8070-02
KGF/METER SQUARED	KGF/M2	9.8070-09
LBF/FOOT SQUARED	LBF/FT2	4.7880-05
LBF/INCH SQUARED	PSI	6.8950-03
MILLIBAR	MBAR	1.0000-04
MM OF MERCURY(0 DEG C)	HGMH	1.3330-04
TORR(0 DEG C)	TORR	1.3330-04
KILOPOUNDS/SQUARE INCH	KSI	6.8950 00
PASCAL	PA	1.0000-06
GIGAPASCAL	GPA	1.0000 03

TO CONVERT TO **** GPA GIGAPASCAL:

	FROM ----	MULTIPLY BY -----
NEWTONS/METER SQUARED	N/M2	1.0000-09
ATMOSPHERE	ATM	1.0130-04
BAR	BAR	1.0000-04
BARYE	BARYE	1.0000-10
CM OF MERCURY 0C	HGCM	1.3330-06
CM OF WATER 4C	H20CM	9.8060-08
DYNES/CENTIMETER SQUARED	DYNPCM2	1.0000-09
FOOT OF WATER(39.2 F)	H20FT	2.9890-06
INCH OF MERCURY(32F)	HGIN32	3.3860-06
INCH OF MERCURY(60F)	HGIN60	3.3770-06
INCH OF WATER(39.2F)	H20IN39	2.4910-07
INCH OF WATER(60F)	H20IN60	2.4880-07
KGF/CENTIMETER SQUARED	KGF/CM2	9.8070-05
KGF/METER SQUARED	KGF/M2	9.8070-06
LBF/FOOT SQUARED	LBF/FT2	4.7880-08
LBF/INCH SQUARED	PSI	6.8950-06
MILLIBAR	MBAR	1.0000-07
MM OF MERCURY(0 DEG C)	HGMH	1.3330-07
TORR(0 DEG C)	TORR	1.3330-07
KILOPOUNDS/SQUARE INCH	KSI	6.8950-03
PASCAL	PA	1.0000-09
MEGAPASCAL	MPA	1.0000-03

TO CONVERT TO **** CM²/SEC MICROMETERS SQUARED/SEC.:

	FROM ----	MULTIPLY BY -----
METERS/SEC	M ² /SEC	1.0000 12
CENTISTOKE	CSTOKE	1.0000 02
STOKE	STOKE	1.0000 04
FEET SQUARED/SECOND	FT ² /SEC	9.2900 06
CENTIMETERS SQUARED/SEC	CM ² /SEC	1.0000 08

TO CONVERT TO **** M³/KG METERS CUBED PER KILOGRAM:

	FROM ----	MULTIPLY BY -----
FEET CUBED/POUND MASS	FT ³ /LBM	6.2430-02

TO CONVERT TO **** M³/KG METERS CUBED PER KILOGRAM:

	FROM ----	MULTIPLY BY -----
FEET CUBED/POUND MASS	FT ³ /LBM	6.2430-02

V. BATCH DATA EDITING PROGRAM - SCROLL

The SCROLL program is a batch-type module which edits SACRD data records. It will display either all records associated with a property or particular records, such as TABULAR, at user option. The following example shows the results of a simple request for an ABSTRACT, CONTENTS, TABULAR, PROGRAM, and ERROR record.

TP FILE MATERIAL=HE PROPERTY=K
VERSION=1 ABSTRACT

IT CONTAINS
30 LINES IN THE ABSTRACT AND 0 KEYWORDS

A B S T R A C T

THE FOLLOWING INFORMATION WAS TAKEN FROM GENERAL ATOMIC
DOCUMENT # GA-113400

Tabular data were generated using the following
correlation:

$$\text{HECON} = 2.774\text{E-3} * \text{T}^{0.701}$$

where

T = temperature, K
HECON = K = thermal conductivity, W/m-K

The correlation is valid in the temperature range
273 to 1500 K and pressure range 10^{+5} to 10^{+7} Pa.

The coefficient in the above correlation was
determined by minimizing the sum of the squares of
the relative differences between the data and the
curves. Thus, the quantity

$$\text{SUM OVER I FROM 1 TO N OF } ((K_I - K)/K)^2$$

is what was minimized. The standard deviation was
calculated as

$$\text{SIGMAK} = \text{SQRT} ((\text{SUM OVER I FROM 1 TO N OF } ((K_I - K)/K)^2) / (N - 1)) = 2.4\%$$

TR FILE MATERIAL=HE PROPERTY=K
 VERSION=1 CONTENTS

YNAME K
 YUNITS W/M-K
 XNAME TEMP
 XUNITS K
 CDATE 03/28/78
 NENTRY 1
 NLEVEL 1

	INDEP VARIABLE	INDEP VARIABLE	INTERPOLATION BETWEEN
LEVEL	NAME	UNITS	LEVELS

1	STATE	NONE	PLAT

THE VALUES OF THE INDEPENDENT VARIABLE(S)
 ARE

ENTRY	STATE (NONE)

1	VAPOR

THE TABULATED ENTRIES FOR THE ABOVE RECORDS WERE
 GENERATED USING A CORRELATION TAKEN FROM GENERAL
 ATOMIC DOCUMENT # GA-A13400

TR FILE MATERIAL=HE PROPERTY=K
VERSION=1 TABULAP 1

YNAMP K
YUNITS W/M-K
XNAME TEMP
XUNITS K
NLEVEL 1

VARIABLE	VALUE	UNITS	TYPE OF VAP.
-----	-----	-----	-----
K	(TABULATED)	W/M-K	DEP. VARIABLE (Y)
TEMP	(TABULATED)	K	IND. VARIABLE (X)
STATE	VAPOR	NONE	FIXED IND. VAP.

1 INTERPOLATION RANGE(S)
ARE IN THIS RECORD

RANGE	PEAK POINT	INTERPOLATION BETWEEN LEVELS
-----	-----	-----
1	37	PLAT

37 POINT(S) ARE GIVEN

POINT	TEMP (K)	K (W/M-K)
1	2.5000D 02	1.3306D-01
2	2.7500D 02	1.4226D-01
3	3.0000D 02	1.5121D-01
4	3.2500D 02	1.5993D-01
5	3.5000D 02	1.6946D-01
6	3.7500D 02	1.7681D-01
7	4.0000D 02	1.8499D-01
8	4.2500D 02	1.9302D-01
9	4.5000D 02	2.0091D-01
10	4.7500D 02	2.0867D-01
11	5.0000D 02	2.1631D-01
12	5.2500D 02	2.2394D-01
13	5.5000D 02	2.3126D-01
14	5.7500D 02	2.3858D-01
15	6.0000D 02	2.4580D-01
16	6.2500D 02	2.5294D-01
17	6.5000D 02	2.5999D-01
18	6.7500D 02	2.6696D-01
19	7.0000D 02	2.7385D-01
20	7.2500D 02	2.8067D-01
21	7.5000D 02	2.8742D-01
22	7.7500D 02	2.9411D-01
23	8.0000D 02	3.0073D-01
24	8.2500D 02	3.0728D-01
25	8.5000D 02	3.1378D-01
26	8.7500D 02	3.2022D-01
27	9.0000D 02	3.2561D-01
28	9.2500D 02	3.3294D-01
29	9.5000D 02	3.3923D-01
30	9.7500D 02	3.4546D-01
31	1.0000D 03	3.5165D-01
32	1.0250D 03	3.5779D-01
33	1.0500D 03	3.6388D-01
34	1.0750D 03	3.6993D-01
35	1.1000D 03	3.7594D-01
36	1.1250D 03	3.8191D-01
37	1.1500D 03	3.8784D-01

TF FILE MATERIAL=HE PROPERTY=K
VERSION=1 PROGRAM

YNAM? K
YUNITS W/M-K
NINDEX 1
ENAM? HECON
NFCRT 22

THERE ARE 1 INDEPENDENT VARIABLE(S)
ASSOCIATED WITH THIS PROGRAM

VARIABLE	UNITS
-----	-----
1 TEMP	K

THE PROGRAM STORED IN THIS RECORD CONTAINS 22 LINES

THE PROGRAM BELOW IS FOR PROPERTY= K

```

      FUNCTION HECON(T,IUNIT)
      C THIS EQUATION IS ONLY VALID IN THE TEMPERATURE RANGE
      C 270 TO 1500K AND PRESSURE RANGE 10**5 TO 10**7 PASCALS
      C *** THIS PROGRAM WAS SUPPLIED BY GENERAL ATOMIC CO. -
      C *** DOCUMENT # GA-A13400
      C
      C      COMPUTE THE THERMAL CONDUCTIVITY OF HELIUM (HECON)
      C      AS A FUNCTION OF TEMPERATURE (T) . . .
      C      THE SELECTION OF UNITS IS CONTROLLED AS FOLLOWS ..
      C
      C      IUNIT=1 TEMPERATURE IN DEGREES KELVIN
      C      CONDUCTIVITY IN WATTS PER METER DEGREE KELVIN
      C
      C      IUNIT=2 TEMPERATURE IN DEGREES RANKINE
      C      CONDUCTIVITY IN BTU PER HOUR FOOT DEGREE RANKINE
      C
      TT=T
      IF (IUNIT.EQ.2) TT=T*5.0/9.0
      HPCON=2.774E-2*TT**0.701
      IF (IUNIT.EQ.2) HECON=HECON/1.7307413
      RETURN
      END

```

TM FILE MATERIAL=A286 PROPERTY=LTE
 VERSION=1 ERROR

IT CONTAINS 24 LINES

ERROR ESTIMATES

ERROR ESTIMATE AS OF 1/31/80 FROM NSMH

THE UNCERTAINTY OF TABULATED VALUES IS ESTIMATED TO
 BE WITHIN (+/-) 5% BELOW 600F AND (+/-) 10% ABOVE.

THE EQUATIONS AND TABLES WERE GENERATED BY LEAST
 SQUARES POLYNOMIAL FITS OF THE DATA FOR THE
 INSTANTANEOUS COEFFICIENT. THE STANDARD DEVIATIONS
 OF THE FITS WERE AS FOLLOWS:

CURVE -----	STANDARD DEVIATION -----
LINEAR EXPANSION	0.0006538
INSTANTANEOUS COEFFICIENT	0.005712
MEAN COEFFICIENT	0.006670

THE DATA WERE CALCULATED FROM THE FOLLOWING EQUATION:

$$\Delta L/L = -0.3102884 + 0.01454260 \cdot T + 5.342218E-6 \cdot T^2 - 2.245398E-9 \cdot T^3$$

WHERE

$\Delta L/L$ = THERMAL LINEAR EXPANSION, MM/M AND
 T = TEMPERATURE, DEGREES C.

76

VI. INTERACTIVE DATA EDITING PROGRAM - COMMUNE

COMMUNE is the interactive module which permits a user to access SACRD from a remote teletype terminal. This program employs the IBM Time Sharing Option (TSO) and requires very simple user responses.

The first step is to establish a communications link with the ORNL computers by calling

(615) 574-8717

FTS 624-8717

and informing us of your desire to use COMMUNE. At this point we will supply you with the necessary password to "logon" the system and will transfer your call to a special computer phone line, depending on whether your terminal transmits at 110 or 300 baud.

When you hear a constant tone in the handset, place it in the cradle of the modem attached to your terminal and enter

ATLOGON VMG/(password we give you)

Note that for reasons of security (see Chapter X), the SACRD passwords are changed monthly. For example, if the password is DATA, the user will enter

ATLOGON VMG/DATA

The system then responds with a few lines of self-explanatory information:

```
.  
. .  
. .  
. .  
READY
```

after which you would enter:

EXEC ALLOC LIST

This causes the system to allocate the various files needed for COMMUNE. When this is accomplished, eleven lines are printed in the form:

```
ALLOCATE FILE (.....  
. .  
. .  
. .  
. .  
END
```

after which the systems prints

READY

The user responds by entering:

EXEC SACRD 'COMMUNE' LIST

The system responds with two lines

```
STEPLIB .....  
CALL (JTMON) .....
```

Your response is

/*

This will activate COMMUNE which begins by requesting a user identifier:

USERID =

Enter the SACRD identifier
which you have been assigned.

From this point, the code will prompt you as to what information is expected. If the user does not know the PROPERTY or MATERIAL name, a HELP response will produce a listing of them.

PROPERTY =

Enter SACRD abbreviation for the desired property

MATERIAL =

Enter SACRD abbreviation for the desired material

DO YOU WISH TO SEE THE LATEST VERSION OF THIS DATA

Answer YES or NO

if NO

VERSION = Enter SACRD abbreviation for the desired version

then it will proceed as if you had answered YES

ENTER RECORD TYPE: Abstract, Contents, Tabular, Program, or Error

When TABULAR data are displayed, the module prompts the user to determine if data units are to be converted. If the user is not aware of available conversion factors, a HELP response produces a listing of them. Units available may include a selection of "English units," metric units or alternate SI units to those in which the data are stored.

To terminate the program, a response of:

END

exits the module.

To release the terminal line, the user should terminate a session by typing:

LOGOFF

On the following pages is an annotated sample of the output produced from a session with COMMUNE.

WELCOME TO THE SACRD DATA BASE

```

*****
*
*   SACRD DATA IS APPLIED TECHNOLOGY DATA.
*
*   PLEASE LIMIT THE DISTRIBUTION OF THE DATA TO
*   THOSE IN YOUR STAFF OR ORGANIZATION WHO ARE
*   INVOLVED IN FBR RESEARCH.
*
*   DO NOT DISTRIBUTE THE INFORMATION OUTSIDE
*   THE U.S. FBR COMMUNITY.
*
*****

```

ALL DATA ARE IN SI UNITS
OTHER UNITS MAY BE SPECIFIED
WHEN YOU ARE ABOUT TO VIEW THE DATA

TO END THIS SESSION TYPE END

PLEASE RESPOND WITH THE REQUESTED INFORMATION
IF YOU DO NOT HAVE A SACRD ID HIT RETURN
OTHERWISE ENTER YOUR SACRD ID

*This user has no standard
SACRD identifier or has
forgotten the one assigned.*

PLEASE ENTER YOUR NAME AND ADDRESS
TERMINATE THIS INFORMATION BY ENTERING \$\$\$

V. M. FURBERG BLDG. 2031
P. O. BOX X
JACK RIDGE, TENNESSEE 37630
\$\$\$

*This information is used
to keep a log of all SACRD
users.*

PROPERTY=

THERMAL CONDUCTIVITY

MATERIAL=

*Requesting HELP on a material name. Looking
for SACRD abbreviation for SODIUM. Prints all
materials whose abbreviation begins with S.*

SOME MATERIAL NAMES ARE :

ABB.	MATERIAL
SS	STAINLESS STEEL
S-CR	STEEL; 2.5CR - 1MC
SS304	STAINLESS STEEL 304
SS316	STAINLESS STEEL 316
SS316/20	STAINLESS STEEL 316 - 20% CW
SS316/30	STAINLESS STEEL 316 - 30% CW
SS321	STAINLESS STEEL 321

ENTER MATERIAL NAME OR TRY HELP AGAIN

*Requests the abbreviations beginning with N
since SODIUM was not listed in the S's.*

SOME MATERIAL NAMES ARE :

ADD.	MATERIAL
N	NITROGEN
NA	SODIUM
NA-CJN	SODIUM-CONCRETE
NAK	SODIUM-POTASSIUM

ENTER MATERIAL NAME OR TRY HELP AGAIN

SODIUM

DO YOU WISH TO SEE THE LATEST VERSION OF THIS DATA?

Response

VERSION=

Version 1

ENTER RECORD TYPE : ABSTRACT, CONTENTS, TABULAR OR PROGRAM

ABSTRACT

Display ABSTRACT record

IR FILE MATERIAL=NA PROPERTY=K
VERSION=1 ABSTRACT

IT CONTAINS

96 LINES IN THE ABSTRACT AND 0 KEYWORDS

DO YOU WISH TO VIEW THE ABSTRACT?

Response

THE ABSTRACT FOR RECORD
TR.DATA.K.NA.1.ABSTRACT
IS

THIS PORTION OF THE ABSTRACT WAS TAKEN FROM THE
PROPERTIES FOR LMFBR SAFETY ANALYSIS, ANL-CEN-RSD-76-1
(MARCH 1976)

LIQUID THERMAL CONDUCTIVITY SODIUM PROPERTY CODE 3113

DATA SOURCE

THE VALUES OF THERMAL CONDUCTIVITY GIVEN FOR LIQUID
SODIUM ARE BASED ON THE WORK OF GOLDEN AND TOKAR(1) AND
GROSSE.(3)

DISCUSSION

GOLDEN AND TOKAR(1) DEVELOPED AN EQUATION FOR THE
THERMAL CONDUCTIVITY OF LIQUID SODIUM BASED ON THEIR
ANALYSIS OF THE EXPERIMENTAL DATA. THEIR EQUATION WAS
PROPOSED FOR THE LIQUID RANGE UP TO 1643K:

$$(K/CM K) = 0.930 - 0.581E-3 (T - 273) + 1.173E-7 (T - 273)^2$$

ABOVE THE BOILING POINT, FOUST(2) RECOMMENDS A
SEMI-EMPIRICAL METHOD DEVELOPED BY GROSSE(3) FOR
ESTIMATION OF THERMAL CONDUCTIVITIES. THE VALUES
PRESENTED IN THE PRECEDING TABLE WERE OBTAINED FROM THE
GOLDEN AND TOKAR(1) EQUATION UP TO 1300K; THE VALUES
FROM 1400K WERE OBTAINED BY GRAPHICAL INTERPOLATION OF
GROSSE'S(3) CALCULATED RESULTS. IT SHOULD BE BORNE IN
MIND THAT GROSSE'S METHOD DEPENDS STRONGLY ON THE CHOICE
OF CRITICAL TEMPERATURE; HE USED A VALUE OF 2800K,
SLIGHTLY GREATER THAN THE VALUE RECOMMENDED BY
MILLER.(4) IN ADDITION, GROSSE'S METHOD IS BASED ON THE
WIEDEMANN-FRANZ-LORENZ LAW. IN THE ABSENCE OF
EXPERIMENTAL DATA AT THE HIGHER TEMPERATURES, GROSSE'S
APPROACH SEEMS PREFERABLE TO SOME OF THE OTHER
EXTRAPOLATIVE METHODS (SEE FOUST(2)).

REFERENCES

1. G. H. GOLDEN AND J. V. TOKAR, "THERMOPHYSICAL
PROPERTIES OF SODIUM," ANL-7323 (1967).
2. J. J. FOUST, EDITOR, "SODIUM-NAK ENGINEERING
HANDBOOK, VOL. 1," GORDON AND BREACH, NEW YORK, 1972.
3. A. V. GROSSE, REV. HAUTES TEMP. ET REFRACT. 3, 115
(1960).
4. D. MILLER, A. B. COHEN, AND C. E. DICKERMAN,
"ESTIMATION OF VAPOR AND LIQUID DENSITY AND HEAT OF
VAPORIZATION OF THE ALKALI METALS TO THE CRITICAL
POINT," INTERNATIONAL CONFERENCE ON THE SAFETY OF FAST
BREEDER REACTORS, AIX-EN-PROVENCE, FRANCE, SEPTEMBER
19-22, 1967.

THIS PORTION OF THE ABSTRACT WAS TAKEN FROM THE
NUCLEAR SYSTEMS MATERIALS HANDBOOK, TID-26666

GENERAL

THE FOLLOWING IS AN EXCERPT FROM REFERENCE 1, FROM WHICH
THE HANDBOOK VALUES WERE OBTAINED:

"IT IS RECOGNIZED THAT MANY PROPERTIES ARE NOT WELL
KNOWN AND THAT THE SELECTION OF "BEST" VALUES
USUALLY INVOLVES SOME RISK. THE EXPRESSIONS AND
DATA WERE SELECTED FROM THE BEST INFORMATION
AVAILABLE. THEY HAVE NOT BEEN CHECKED FOR OVERALL
SELF-CONSISTENCY. NO CREDIT IS TAKEN HERE FOR
ORIGINAL WORK. THE EXPRESSIONS GIVEN ARE BASED ON
AND GENERALLY IN AGREEMENT WITH THE RECOMMENDATIONS
OF THE LIQUID METAL INFORMATION CENTER (REF. 2) AND
SUPPLEMENTED BY INFORMATION FROM THE DETAILED REVIEW
BY GOLDEN AND TOKAR (REF. 3)."

SPECIFIC

VALUES OF THERMAL CONDUCTIVITY FOR SOLID SODIUM FROM
ROOM TEMPERATURE TO 208.1F ARE FOUND IN REFERENCE 2.
WHEREAS VALUES FOR THE LIQUID MATERIAL ARE FOUND IN
REFERENCE 3.

REFERENCES

- 1 - YUNKER, W. H., "STANDARD FFTF VALUES FOR THE
PHYSICAL AND THERMOPHYSICAL PROPERTIES OF SODIUM,"
WHAN-2-3, JULY 6, 1970.
- 2 - LIQUID METAL INFORMATION CENTER, P.O. BOX 1449,
CAYUGA PARK, CA 91304.
- 3 - GOLDEN, G. H. AND TOKAR, J. G., "THERMOPHYSICAL
PROPERTIES OF SODIUM," ANL-7323, 1967.

PROPERTY=

☒ K

THERMAL CONDUCTIVITY

MATERIAL=

☒ NA

SODIUM

DO YOU WISH TO SEE THE LATEST VERSION OF THIS DATA?

☒ YES*Response*

ENTER RECORD TYPE: ABSTRACT, CONTENTS, TABULAR OR PROGRAM

☒ CONTENTS*Display CONTENTS record*

TR FILE MATERIAL=NA PROPERTY=K
VERSION=1 CONTENTS

DATE CREATED: 03/20/78

THERMAL CONDUCTIVITY/(K)
IS IN
WATTS PER METER-KELVIN/(W/M-K)TEMPERATURE/(TEMP)
IS IN
KELVIN/(K)DO YOU WISH TO SEE THE NAMES AND UNITS
OF THE INDEPENDENT VARIABLE(S)?☒ YES*Response*

FIXED INDEPENDENT VARIABLE AND ASSOCIATED CURVE TYPE

STATE(NONE) FLAT

DO YOU WISH TO SEE THE VALUES
OF THE INDEPENDENT VARIABLE(S)?☒ YES*Response*

FIXED INDEPENDENT VARIABLE VALUES BY TABULAR RECORD

NO.	STATE(NONE)
1	SOLID
2	LIQUID

PROPERTY=

☒

THERMAL CONDUCTIVITY

MATERIAL=

☒

SODIUM

DO YOU WISH TO SEE THE LATEST VERSION OF THIS DATA?

☒

Response

ENTER RECORD TYPE: ABSTRACT, CONTENTS, TABULAR OR PROGRAM

☒

Display TABULAR data

TO VIEW A PARTICULAR MEMBER OF THIS TABULAR RECORD
ENTER ITS NUMBER, OTHERWISE HIT RETURN☒

Tabular entry 1 (first curve)

TR FILE MATERIAL=NA PROPERTY=K
VERSION=1 TABULAR 1

THERMAL CONDUCTIVITY/(K)
IS IN
WATTS PER METER-KELVIN/(W/M-K)TEMPERATURE/(TEMP)
IS IN
KELVIN/(K)

THERE ARE 1 FIXED INDEPENDENT VARIABLE(S)

DO YOU WISH TO SEE THEM?

☒

Response

VALUES OF FIXED INDEPENDENT VARIABLE(S):

STATE(NONE)

SOLID

1 INTERPOLATION RANGE(S)
ARE IN THIS RECORD

DO YOU WISH TO VIEW THEM?

☒

Response

RANGE	BREAK POINT	INTERPOLATION BETWEEN LEVELS
-----	-----	-----
1	4	LINEAR-LINEAR

4 POINTS ARE GIVEN

DO YOU WISH TO SEE THEM?

YES

Response

TEMP IS IN K UNITS
C IS IN M/M-K UNITS
DO YOU WISH TO CHANGE UNITS?

YES

Response

TYPE THE NAME OF THE VARIABLE YOU WISH CHANGED
AND THE ABBREVIATION FOR THE UNITS IN WHICH
YOU WOULD LIKE THE DATA DISPLAYED
OR TYPE HELP AND THE UNIT YOU WISH CHANGED

HELP W/M-K

Display the conversion factors available
for watts per meter Kelvin

THERE ARE 4 EQUIVALENCE FACTORS
FOR THE SI UNIT W/M²-K WHICH IS EXPRESSED IN
WATTS PER METER-KELVIN

	A39.	DEFINITION	MULT. FACTOR
1	W/CM-°F	WATTS/CM-KELVIN	1.00000000000000 C J2
2	BTU/HFT F	BTL/MCLR FOOT DEG F	1.73000000000000 C 00
3	BTU/HFT R	BTL/MCLR FOOT DEG R	1.73000000000000 D 00
4	W/M-C	WATTS/METER-DEGREE C	1.00000000000000 D 00

ENTER THE NAME OF THE VARIABLE YOU WISH CHANGED
AND THE ABBREVIATION FOR THE UNITS
IN WHICH YOU WOULD LIKE THE DATA DISPLAYED

< W/CM-K

Thermal conductivity in watts/centimeter-Kelvin

THE CONVERSION FACTOR FOR CHANGING
W/M-K WATTS PER METER-KELVIN
TO

WATTS/CM-KELVIN IS 1.000000-02
DO YOU WISH TO CONVERT ANOTHER UNIT?

YES

Response

TYPE THE NAME OF THE VARIABLE YOU WISH CHANGED
AND THE ABBREVIATION FOR THE UNITS IN WHICH
YOU WOULD LIKE THE DATA DISPLAYED
OR TYPE HELP AND THE UNIT YOU WISH CHANGED

TEMP F

Display temperature in degrees F

DO YOU WISH TO CONVERT ANOTHER UNIT?

✓✓

Response

POINT	TEMP(F)	K (W/CM-K)
1	7.655560 01	1.324000 00
2	1.220000 02	1.283000 00
3	1.670000 02	1.241000 00
4	2.120000 02	1.199000 00

PROPERTY= THERMAL CONDUCTIVITY

☐ <

MATERIAL=

☐ HE

HELIUM

DO YOU WISH TO SEE THE LATEST VERSION OF THIS DATA?

☐ YES

Response

ENTER RECORD TYPE: ABSTRACT, CONTENTS, TABULAR OR PROGRAM

☐ PROGRAM

Display PROGRAM record

TR FILE MATERIAL=HE PROPERTY=K
VERSION=1 PROGRAM

THERMAL CONDUCTIVITY/(K)
IS IN
WATTS PER METER-KELVIN/(W/M-K)

THERE ARE 1 INDEPENDENT VARIABLE(S)
ASSOCIATED WITH THIS PROGRAM

DO YOU WISH TO SEE THEM?

☐ YES

Response

	VARIABLE	UNITS
	-----	-----
1	TEMP	K

THE PROGRAM STORED IN THIS RECORD CONTAINS 22 LINES
DO YOU WISH TO SEE IT?

☐ YES

Response

THE PROGRAM YOU ARE ABOUT TO VIEW IS NAMED HECON

```

FUNCTION HECON(T,UNIT)
C THIS EQUATION IS ONLY VALID IN THE TEMPERATURE RANGE
C 270 TO 1500K AND PRESSURE RANGE 10**5 TO 10**7 PASCALS
C *** THIS PROGRAM WAS SUPPLIED BY GENERAL ATOMIC CO. -
C *** DOCUMENT # GA-A13400
C
C COMPUTE THE THERMAL CONDUCTIVITY OF HELIUM (HECON)
C AS A FUNCTION OF TEMPERATURE (T) . . .
C THE SELECTION OF UNITS IS CONTROLLED AS FOLLOWS ..

```

C
C
C
C
C
C

```

IUNIT=1 TEMPERATURE IN DEGREES KELVIN
CONDUCTIVITY IN WATTS PER METER DEGREE KELVIN

IUNIT=2 TEMPERATURE IN DEGREES RANKINE
CONDUCTIVITY IN BTU PER HOUR FOOT DEGREE RANKINE

TT=T
IF (IUNIT.EQ.2) TT=T*5.0/9.0
HECON=2.774E-3*TT**0.701
IF (IUNIT.EQ.2) HECON=HECON/1.73J7413
RETURN
END

```

PROPERTY=

END

End session with interactive query program.

VII. SACRD PLOTTING PROGRAM - SACRDEYE

SACRDEYE is a module designed to produce plots of data stored in the SACRD data base. The plots are generated using DISSPLA (6), a graphics software package from Integrated Software Systems Corporation. In order to minimize core requirements and to allow graphical display on a remote terminal, a two-step procedure is used by SACRDEYE. The first step creates what is referred to as a DISSPLA compressed plot data set. This data set is plotted or displayed in the second step. Because most of the "work" is in the first step, the permanent retention of the compressed plot file is both desirable and economical. The compressed plot data set is device-independent. The plotter is selected by the user in the second step or at a later date.

The plotting code permits the user to exercise a large number of options when creating the compressed plot data set. Among these are:

- 1) The number of curves to be plotted on a graph can be varied. Each tabular record contains data for one curve. One may have all curves plotted or select only those desired.
- 2) Line specifications, such as none, solid, dotted, dashed, chain-dotted, and chain-dashed can be selected.
- 3) Interpolation schemes can be selected from:
 - a) linear
 - b) cubic spline
 - c) parametric cubic spline
 - d) third-order parametric polynomial for evenly spaced points
 - e) third-order parametric polynomial for unevenly spaced points

- f) fifth-order parametric polynomial for evenly spaced points
 - g) fifth-order parametric polynomial for unevenly spaced points
 - h) histogram
- 4) The frequency of plotting a data marker can be varied. For example, one can specify that every fifth point be marked.
 - 5) The type of graphing can be selected from the following coordinates:
 - a) linear x, linear y
 - b) log x, linear y
 - c) linear x, log y
 - d) log x, log y
 - 6) The size of the plot can be varied.
 - 7) The type of grid line can be selected.
 - 8) The number of grid lines and number of ticks per division on the x and y axis can be selected.
 - 9) Fixed independent values associated with each plot are noted.

On the following pages is a selection of plots produced by SACRDEYE.

SM.DATP.Y5.P285.1

SACRD DATA BASE

CHTR ENTERED: 12/19/78

SM.DATA.YS.AL-6061.1

SACRO DATA BASE

DATA ENTERED- 01/08/78

LEGEND
□ - TABULAR RECORD - 1

CURVE	STATE (NONE)	TEMPER (NONE)
1	SOLID	76

SM.DATA.YS.1718.1

SACRO DATA BASE

DATA ENTERED- 04/08/79

LEADER
 □ - TRIBULAR RECORD- 1
 ○ - TRIBULAR RECORD- 2

CURVE	STATE (NONE)	CURVE (NONE)
1	SOLID	MINIMUM
2	SOLID	TREND

96

VIII. AUTOMATIC DATA CHECKING MODULE - CHECKER

The CHECKER program, through which all SACRD data are processed, looks for a number of simple errors and produces messages when potential problems are sensed. The following conditions are examined and messages are written if they are not satisfied.

- 1) ABSTRACT, CONTENTS, TABULAR, PROGRAM, and ERROR records are present for each property. While this is not always true -- or even reasonable -- the check requires SACRD staff to ascertain whether or not all possible useful forms of data for a property have been included.
- 2) The FILE, PROPERTY, MATERIAL, and VERSION names cataloging a SACRD record are valid SACRD names.
- 3) The PROPERTY is written in the correct file.
- 4) The variable units in the CONTENTS record are valid SACRD units.
- 5) The interpolation specifications in the CONTENTS record are valid.
- 6) The independent variable values in the CONTENTS record are nonnegative.
- 7) In a TABULAR record, the number of points in an interpolation range is greater than zero and the interpolation specifications are valid.

- 8) There is a small degree of redundancy between the CONTENTS and TABULAR record structures. Checks are made to ensure that parameters in these two records which should agree, in fact, do agree.
- 9) The number of points in a TABULAR record does not exceed the maximum allowed in SACRD editing and plotting programs.
- 10) The independent variable values are nonnegative and are in ascending order in the TABULAR record.
- 11) The property values are nonnegative in the TABULAR record.
- 12) The fixed independent variable values are nonnegative in the TABULAR record.
- 13) The number of TABULAR records agrees with the number specified in the CONTENTS record.
- 14) The number of words in the textual field in the CONTENTS record does not exceed the size of the array allocated for the field.
- 15) Points are checked to see if they seem to fit with neighboring points within reasonable limits. Consider Fig. 9. In examining the i th point, if one determines point A by extrapolating from the two succeeding points, point B by extrapolating the two preceding, then point C can be determined by extrapolating the points on either side of i . Therefore, one would expect that the value $y(i)$ should lay between

$$\min(a,b,c) \text{ and } \max(a,b,c)$$

Figure 9. Demonstration of Data "Smoothness" Checks in CHECKER.

when the evaluator has done a reasonable job of describing the local curvature of his function. This check is especially useful for flagging "exponent" transcription errors.

It should be noted that all items flagged by CHECKER are not data errors. For example, it is conceivable that SACRD will be used to store a "property" which has negative values. The checks in CHECKER are meant to be simple and reasonable for the bulk of SACRD data.

Output from a sample CHECKER run follows. The latter pages are from runs on "dummy" records which have been deliberately constructed in an improper fashion.

ERROR SEARCH FOR ****TR ***** DATA ***** K ***** 1 *****

**** NO CCNTENTS RECCRD ****
 **** NO TABULAR RECCRD ****
 **** NO PROGRAM RECCRD ****
 **** NC ERROR RECORD ****

A completely specified property in SACRD would include all of these types of data. in the case of the thermal conductivity of krypton, only one point is specified, thereby making the inclusion of many of the data forms superfluous.

ERROR SEARCH FOR ****TR ***** DATA ***** K ***** 1 ***** TH *****

**** NO PROGRAM RECORD ****
 **** NC ERROR RECORD ****
 SUBROUTINE EYEBALL NCT RUN TOO FEW POINTS
 IN TABULAR RECORD 1

Parameterized fits for the thermal conductivity of thorium were unavailable for input. No uncertainty data are included.

Program CHECKER was unable to make checks on the reasonableness of data points in the tabular data.

ERROR SEARCH FOR ****TR ***** DATA ***** K ***** U ***** 1 *****

**** NO PROGRAM RECORD ****
 **** NC ERROR RECORD ****
 SUBROUTINE EYEBALL NCT RUN TOO FEW POINTS
 IN TABULAR RECORD 1

Comments same as for thorium thermal conductivity data.

2 /////////////// MORE TABULAR RECORDS THAN ENTRIES //

The Contents record for this property specified that fewer curves should have been written into the data base than actually were.

ERROR SEARCH FOR *****TR DATA NEWP NEWM 1 *****

**** NO ABSTRACT RECORD ****
 **** NO TABULAR RECORD ****
 **** NO PROGRAM RECORD ****
 **** NO ERROR RECORD ****

This output is the result of requesting a scan on a property named NEWP and a material named NEWM. In this case, no data were found.

1111 PROPERTY RECORD NEWP NOT FOUND 1111
 1111 MATERIAL RECORD NEWM NOT FOUND 1111
 2222 MATERIAL NEWM NOT IN HELP FILE 2222
 2222 PROPERTY NEWP NOT IN HELP FILE 2222
 **** NO PROPERTY FILE FOUND FOR NEWP ****

These comments indicate that a scan of the authority files containing valid SACRD abbreviations and qualifiers did not contain information for NEWP and NEWM.

ERROR SEARCH FOR *****TA DATA TC 55309 9 *****

**** NO CONTENTS RECORD ****
 **** NO TABULAR RECORD ****
 **** NO PROGRAM RECORD ****
 **** NO ERROR RECORD ****

1111 FILE RECORD TA NOT FOUND 1111
 1111 PROPERTY RECORD TC NOT FOUND 1111
 1111 MATERIAL RECORD 55309 NOT FOUND 1111
 1111 VERSION RECORD 9 NOT FOUND 1111
 2222 MATERIAL 55309 NOT IN HELP FILE 2222
 2222 PROPERTY TC NOT IN HELP FILE 2222
 **** NO PROPERTY FILE FOUND FOR TC ****

Version 9 is not a valid SACRD Version.

This output is the result of checking a specially constructed property--K for helium, version DUMMY. It has many suspicious characteristics, including negative values, nonordered ordinates, cataloging inconsistencies, etc.

```

FROM SEARCH FOR ***** DATA K HE DUMMY *****
*****

**** NO ABSTRACT RECCRO ****
**** NO PROGRAM RECORD ****
**** NO ERROR RECORD ****
**** VERSION RECORD DUMMY NOT FOUND ****
Y IN CONTENTS K W/(M-K) NO UNITS FILE
X IN CONTENTS TEMP MR NO UNITS FILE
LEVEL= 1 Z IN CONTENTS STATE NNE NO UNITS FILE
      1 6 ILLEGAL INTERPOLATION VALUE IN CONTENTS
ENTRY 2 LEVEL 1 NEGATIVE VALUE -0.200000 01
YNAME DOES NOT MATCH CONTENTS IN TABULAR 1
YUNITS DOES NOT MATCH CONTENTS IN TABULAR 1
XNAME DOES NOT MATCH CONTENTS IN TABULAR 1
XUNITS DOES NOT MATCH CONTENTS IN TABULAR 1
NEGATIVE X VALUE -0.200000 01 IN POSITION 1 IN TABULAR 1
NEGATIVE X VALUE -0.100000 01 IN POSITION 2 IN TABULAR 1
NEGATIVE Y VALUE -0.300000 01 IN POSITION 2 IN TABULAR 1
SUBROUTINE EYEBALL NOT RUN TOO FEW POINTS
IN TABULAR RECORD 1
BAD INTERPOLATION VALUE IN RANGE 1 IN TABULAR 1
IN TABULAR 1 LEVEL= 1 ZNAME STATE DOES NOT MATCH ZNAME IN CONT. STATE
IN TABULAR 1 LEVEL= 1 ZUNITS NONE DOES NOT MATCH ZUNITS IN CONT. NNE

```

DUMMY is not a valid Version.

The property units are suspect.

The units of the independent variable, TEMP, are suspect.

Illegal interpolation type.

Inconsistencies between CONTENTS and TABULAR entries.

Negative values are suspect.

YNAME DOES NOT MATCH CONTENTS IN TABULAR 2

YUNITS DOES NOT MATCH CONTENTS IN TABULAR 2

XNAME DOES NOT MATCH CONTENTS IN TABULAR 2

XUNITS DOES NOT MATCH CONTENTS IN TABULAR 2

0.900000 01 IN POSITION 2 IN TABULAR 2

0.800000 01 IN POSITION 3 IN TABULAR 2

0.700000 01 IN POSITION 4 IN TABULAR 2

0.600000 01 IN POSITION 5 IN TABULAR 2

0.500000 01 IN POSITION 6 IN TABULAR 2

0.400000 01 IN POSITION 7 IN TABULAR 2

0.300000 01 IN POSITION 8 IN TABULAR 2

0.200000 01 IN POSITION 9 IN TABULAR 2

0.100000 01 IN POSITION 10 IN TABULAR 2

0.300000 02 YVALUE HIGHER THAN PROJECTED
BAD INTERPOLATION VALUE IN RANGE 1 IN TABULAR 2

NEGATIVE ZVALUE IN TABULAR 2 LEVEL= 1

IN TABULAR 2 LEVEL= 1 ZUNITS NONE DOES NOT MATCH ZUNITS IN CONT. NNE

YNAME DOES NOT MATCH CONTENTS IN TABULAR 3

YUNITS DOES NOT MATCH CONTENTS IN TABULAR 3

XNAME DOES NOT MATCH CONTENTS IN TABULAR 3

XUNITS DOES NOT MATCH CONTENTS IN TABULAR 3

***** NO. OF POINTS GREATER THAN 75 ***** 80

IN TABULAR 3 LEVEL= 1 ZUNITS NONE DOES NOT MATCH ZUNITS IN CONT. NNE

LEVEL= 1 Z IN TABULAR 3 STATE NO UNITS FILE

INCORRECT TABULAR NAME 4

Inconsistencies.

*Suspicious ordering of
independent variable.*
IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

IS NOT IN ASCENDING ORDER

*This value is not in the same
range as surrounding points.*

DOES NOT MATCH ZUNITS IN CONT. NNE

DOES NOT MATCH ZUNITS IN CONT. NNE

*Contents record specified more
tabular records than were found.*

IX. DATA BASE USAGE STATISTICS

When a user requests data with SACRD interactive programs, a record is created which notes the user and the data requested. This information is stored in a special file which serves two purposes: first, it provides a profile of the data usage and users; second, and most important, it allows one to trace all users of a particular set of data so that notification can be made in the event significant errors are found in that set of data.

106

X. FILE SECURITY IN THE SACRD DATA BASE

SACRD is a collection of materials, properties and handbook information required for input into the approximately 100 safety-related computer codes used by the U.S. advanced reactor development effort. The scope of the data base is very broad and covers a wide range of data types including heat transfer, thermodynamic, structural mechanical, aerosol, meteorology, and dosimetry data. The bulk of these data were obtained from evaluation efforts sponsored by the Department of Energy and/or the Nuclear Regulatory Commission; therefore they have different security requirements. For example, any data developed under the auspices of the NRC are by law in the public domain and have no distribution restrictions. On the other hand, most of the data taken from DOE-funded research are applied technology with their distribution restricted to users directly involved in DOE-funded advanced reactor work. No "classified" data will ever be included in the data base.

A primary means of limiting access to the data base parallels what is done with most of the restricted handbooks that form part of SACRD, which is to maintain a controlled mailing list, wherein only individuals on the list can receive restricted data. In this case, the assumption is made that any data not sponsored by NRC falls in this category. Control is made easier by the fact that NRC-related data are presently not under the JOSHUA part of SACRD, but are maintained by a separate written set of software. In other words, our data base is controlled by two systems -- JOSHUA and non-JOSHUA, corresponding to restricted and nonrestricted data.

An obvious means of violating our security efforts would be through the remote access links to the data base. Unless very elaborate provisions were included, once a user is allowed to communicate with the data base, he is free to access essentially anything in it, assuming he possesses reasonable proficiency in the use of an interactive facility such as IBM TSO. These elaborate provisions (passwords, sequential responses, etc.) generally make it very awkward and inefficient to use a system. In any event, the state-of-the-art is such that the use of most interactive facilities (ours included) is less than ideal, due to slow transmission times and other delays.

For these reasons, our security measures on interactive facilities are similar to those on hard copy distribution. This is accomplished by changing the "logon" procedure to establish a communications link on a short-term (monthly) basis, such that a user desiring access must first call a member of the SACRD staff in order to determine the current scheme. (This does not require two calls to connect to the data base, since we can locally transfer the call to a computer link line.) This procedure allows us to check against our qualified users list before giving the necessary information to "logon".

Users desiring access to the nonrestricted files only can "logon" under a different procedure and are not screened.

While these schemes have obvious weaknesses that can be violated by a moderately sophisticated user, it is felt that they are well in tune with the security precautions used with the handbook sources, which certainly do not require lock-and-key storage.

XI. MAGNETIC TAPE DATA DISTRIBUTION

Version 1 of SACRD is available on a magnetic tape which can be selectively searched by the user with a program supplied on the tape. The tape is 7 track, unlabeled, and is written at a density of 556 bpi. Its contents are:

<u>File</u>	<u>Contents</u>	<u>RECFM</u>	<u>LRECL</u>	<u>BLKSIZE</u>
1	Version 1 data	FB	60	31980
2	Program to edit Version 1	F	133	80
3	EXREM-III data	FBA	133	1064
4	COMRADEX-III data	FBA	133	1064
5	INREM data	FBA	133	1064
6	Nuclear decay data for 219 selected radio- nuclides as calculated by MEDLIST	FBA	133	1064
7	AIRDOS-II data	FBA	133	1064
8	ADLIST code abstracts of computer codes applicable to the environmental assess- ment of radioactivity releases	FBA	133	1064
9	Reg. Guide 109 data	FBA	133	1064

Program to Selectively Dump Contents
of SACRD Data Tape

A simple program for dumping the SACRD data tape is on file 2 of the tape. It is written in 80-character card images in IBM FORTRAN. Versions for other computers, viz., CDC and UNIVAC, have not been written, but the IBM program should be easy to convert, as it uses no features unique to any machine.

While the program is very simple to use, it provides a reasonably general set of "selection" options for displaying data. Bear in mind, however, that it is based on sequential tape reading and will be inefficient for some kinds of searching.

Recall that SACRD data are cataloged by:

FILE
PROPERTY
MATERIAL
VERSION
DATA TYPE

This program allows a user to key on any one or all of these qualifiers in searching the data. As many searches as desired can be made in the same run, though each search will involve a complete scan of the whole data tape. The input format for the code is:

(A1, 1XA8)

where an F, P, M, V, or T corresponding to file, property, material, version, or type of data, respectively, is placed in column 1 with the 8-character name of the qualifier in columns 3-10. Groups of these 5 or

fewer cards are delimited by cards with any character (or blank) other than F, P, M, V, or T in column 1.

For example, to select all heat transfer data (HT), one would input

F = HT

blank card

This would cause all heat transfer data, for all versions, all materials and all types (abstract, contents, tabular) to be edited. To select only heat transfer data for stainless steel alloy 304, one would enter

M = SS304

F = HT

blank card,

or if one wants only the abstract for Version 1 specific heat data for sodium from the thermodynamics file, the entry would be

P = CP (Cp)

F = TH (Thermodynamics File)

M = NA (Sodium)

T = ABSTRACT

V = 1

blank

Note that the qualifiers can be specified in any order and that a single blank card will cause the entire contents of a tape to be dumped.

Multiple searches are specified by stacking groups of cards.

The following are the required logical assignments:

<u>Logical</u>	<u>Purpose</u>
1	SACRD Data File
5	Search Command Cards
6	Standard Output
60	Edit Input Commands (This can be removed or written onto Logical 6.)

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