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INFORMATION SCIENCES

CONVERSION OF LARGE-SCALE IS&R SYSTEMS FOR GENERAL-PURPOSE OPERATION

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SUMMARY

When an existing mechanized information base is encountered (i.e., a government information system), and the data therein is needed by a user or user group at Convair, the question arises, "Should this existing data base be retained in its established form and nonstandard software be designed at Convair to translate it and extract data as needed, or should this existing data base be translated or converted in its entirety to a form that will allow its continual use in a standard general-purpose information storage and retrieval system?".

Convair has answered this question on two major occasions by taking the existing, mechanized information base, converting it in its entirety and currently performing search and inquiry processing via the Convair General-Purpose Information Storage and Retrieval (IS&R) System. The first occasion was in 1963 when the 9-PAC system containing over 400,000 Failure and Consumption Data Records (FACD) was converted. The most recent occasion was the conversion of the NASA Linear Tape System, containing bibliographic citation data of over 300,000 records contained on approximately 40 magnetic tapes.

Because of the success achieved in the task accomplishment, the experience gained, the increased capability of servicing the user, and the inherent ability to now merge and synchronize this data base with other allied, existing systems, at least three other major systems are planned for similar treatment in 1970. They are, Defense Documentation Center (DDC) tapes, PANDEX (a New York bibliographic system covering periodicals and other reports not in DDC and NASA), and various DM Navy tapes on approved parts list (APL) and discrepancy report data to support the Integrated Logistics Support activity of VFX, VFX and DX programs for General Dynamics.

SECTION 1

INTRODUCTION

1.1 EXISTING CONVAIR GENERAL-PURPOSE INFORMATION SYSTEM (I&R)

Convair's Technical Data Systems Group, Department 591-C, has constructed a computer-based, general-information storage and retrieval system (I&R) that has been in operation for several years over a variety of data bases. The general technique employs a repertory of generalized programs that are specification controlled. This feature allows a selection to be made from a library of programs allowing individual customizing of a total system handling a particular data base. The success and flexibility of this approach becomes evident when one looks over the list of current, major applications since 1961.

The programs are designed to make the software system as independent as possible of the contents and formats of the particular customer or application data base. Details of this system design is given in other publications and will not be unduly elaborated for this report, except to point out some salient characteristics. Our intent in this report will be to describe the philosophy of obtaining an existing mechanized data base and transferring or converting it to a format which will enable its being placed in the I&R environment and then to subsequently employ the available flexibilities of this generalized system and total data base analysis.

1.2 THE NEW I&R SYSTEM ENVIRONMENT

Last year there were increased advances in the semantic classification of

"System Criteria for a Technical Information Computer Software System", by E. F. MacDonald, GDC-BKH-63-[illegible], Convair Division of General Dynamics, San Diego, November 1963

information-handling technology. Definite progress is evident in several practical, general-purpose information systems. Most computer hardware manufacturers have designed a general-purpose software package that is available to those lacking the facilities of designing their own information systems. It is becoming a matter of course for large governmental agencies and industrial complexes to turn their attention to the design of information systems, running the gamut from totally integrated management information systems to straightforward, serial-search-oriented magnetic tape systems for document search and recovery. As the trend continues, there is an increased understanding and an awareness that the basic principles employed owe their heritage to the library science and linguistics branches as opposed to the bookkeeper's or auditor's transaction-accounting and ledger-oriented activity.

Beyond the mere mechanization process, and usually upstream of this process, there exists an embarrassment of problems to be discerned and solved, upon which the success of the mechanization will depend. In the jargon of computer programming this is succinctly expressed as "GIGO" (garbage in, garbage out). Data-acquisition forms must be designed that are palatable for the data collector; usually these fall into disuse when their sole purpose is to collect data for a mechanization scheme without regard to the possibility of use as a daily-employed data vehicle by the acquiring function. There are the variety of acceptable terminology constraints and desires for a given data base; these standardizations, associated notation such as roles and links, thesauri, accepted coding and similar unique peculiarities give significance to the particular data base for the user. These are the traditions and practicies understood by the particular data-base user and represent the way he handles and talks about his data regardless of the existence or nonexistence of some computerized mechanization system. There are the file structures peculiar to each data base such as hierarchy (hardware association as in configuration management), classification schemes (Dewey Decimal and Library of Congress), not to mention the variety of administrative file organizations by department or time or associative dependency of the records (i.e.; 15 days after a test is completed certain other records should come into existence).

In the case of picking up an already mechanized data base such as the NASA Linear Tape System, and converting this as input to a general-information system, the file structures, record formats, and various other conventions are all established and not much can be done to change them. We will examine these record format considerations later on in this report. True, different file organizations can eventually be achieved and should be examined. This would be particularly true if conversion involves random-access hardware and the increased efficiencies and flexibilities they would provide over a linear-search system.

The purpose of the mechanization system is to accommodate the foregoing considerations and particularly to be flexible enough to later accommodate some additional peculiarity that was not understood or accommodated during initial data-base acquisition. Convair has kept abreast of the state of the art in the field of information storage and retrieval for several years. Finding a variety of shortcomings in the computer-manufacturer-supplied software packages, industrial systems generally specific-application oriented, and the inability to get a true figure of economic merit in many of the heavily subsidized governmental agency systems, we have pursued a research program over the years resulting in a systems criteria and design which has to date proven quite successful for a variety of data bases. Such an approach is not to be lightly undertaken. It takes considerable resource, especially the development of a personnel subsystem, and must have long-range goals of handling a considerable diversity of data bases. Currently, we are examining integration of allied data bases and the ability to synchronize and cross talk among these in larger superstructures of management information systems, while still preserving the service and intimacy with his data for a particular user and his data base as a daily service.

For example, having converted the NASA Linear Tape System, we are now engaged in examining conversion of the DDC tape system and PANDEX (an existing library tape system of reports covering periodicals and other sources not specifically covered in the government systems). Establishing a thesaurus or subthesauri of identifying terms to be employed, would enable inquiry across the entire collection as an integrated entity. There

is even the possibility of achieving increased indexing depth for some records above what any individual system now offers. For example, reports that are common to DDC and NASA systems are indexed twice, once by a DDC indexer with a reference framework of defense utilization and once by a NASA indexer with a reference of aerospace utilization. Mechanically locating these duplicate records and merging them would increase the number of different but valid terms employed beyond the depth afforded from either system individually.

1.3 CONVAIR'S FLEXIBLE DATA FORMAT

Convair's IS&R approach, and its ability to handle complex technical data, becomes a little clearer to comprehend by comparison with some traditional data handling employed in the auditing or business-data environment. With most business-oriented computer languages such as COBOL, an 80-column International Business Machine (IBM) card is employed to input the data. This is keypunched, using a coding sheet as the input medium and establishing certain groupings of columns (fields) for the various data categories, i.e., date, name, dollar amount, part number, etc. This is a direct outgrowth of a standard ledger with column headings. Such notation can usually be concise and lends itself well to rapid tally of similar items by merely searching and accounting in the proper columns. Knowing what column or columns are assigned, one merely locates that physical area to obtain the data therein and then moves right or left the proper distance to pick up associated data that might be desired. This fixed-field record technique implies that space is employed to account for the field whether data is there or not. In storage on magnetic tape or other storage media, the same geographic compartmentalization philosophy is employed. If it is necessary to add data or expand a given field, it is normally a major revision to the existing data base or the system programming or both.

In the case with the Convair IS&R System concept, each data field is preceded by a unique identifying tag. Although the data-acquisition form, which also serves as keypunch instruction sheet, might have a lot of preprinted, English-language instruction or data-field identification, it will usually carry an additional inconspicuous code, i.e.; K1, K2, etc., adjacent

to each data field. The keypuncher does not place the data field in particular, assigned colums of the IBM card because its identification is established by the keypunched K1, K2, etc., code rather than by relative physical location. This also removes constraints on field size. The field can be one alpha character or a full paragraph of open text. This can vary from one record to the next. Empty data fields need not have space or associated code stored, with a resulting economy that offsets the addition of the code to identify data fields. Increased ease of keypunching allows acceptance of far longer and more complex input records without hindering normal keypunch efficiency criteria such as quantity of cards input and verified per hour. Tests have indicated that the average storage room per data base on magnetic tape is the same as fixed-field methods because blank space is not employed.*

The code preceding each data field can be variable in length and accommodate the aforementioned peculiarities of file structure and terminology control desired by the user. Fig. 1-1 illustrates the Convair IS&R approach to accommodate this "customer overhead" as well as "system overhead" within a particular record.

Searchable Record (SR)

Each SR in a file is a unit record (or surrogate) containing the various variable-length customer data fields. Each of these data fields is preceded by a tag (or flag) that identifies the associated data field and also contains the dual information of (1) customer overhead data, and (2) system overhead data. In addition, there is a major SR flag preceding the total SR. The SR can be constructed as shown in Figure 1-1.

System Overhead

These data are the system identification of that associated data field or total SR. Such things as record-length indicators, which the system must know to efficiently manipulate the data, are contained in this area. Because the system can be quite specific on what it needs, there is a rigid, fixed

*During the conversion of the NASA Linear Tape System, a lot of system overhead necessary to operate in the NASA manner was dropped. Flag coding was added to accommodate the Convair IS&R System. This resulted in equivalent storage required.

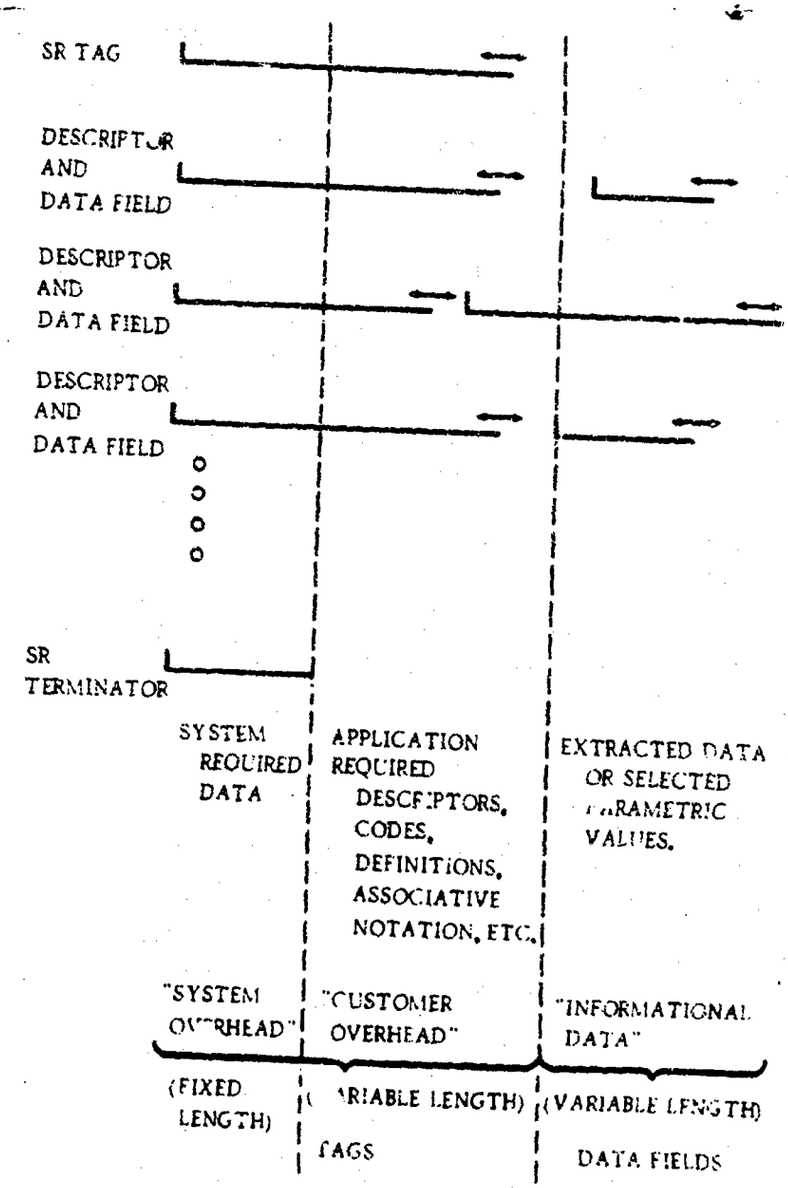


FIGURE 1-1. CONSTRUCTION OF SEARCHABLE RECORD.

area allotted to system overhead. Of course, none of this requirement of system overhead data embedment is ever visible to the customer on either inputting or outputting of his data. The customer's view of the data is in his language, with his specified identifiers and overhead data.

Customer Overhead Data

The same tag preceding the customer variable-length data field contains the area for customer overhead data. These data are the customer's identification of that associated data field or total SR. The customer can specify a narrative name in mnemonic (e.g., FIPART), a code (e.g., K12, K27), or any other identification that is normal in his discipline. He can specify relative weighting of importance or hierarchical relationship or role of the data field such as product, process, etc. All the peculiarities related to the particular customer data such as thesaurus or terminology control and file structure devices can be accommodated and subsequently changed as he wishes. The area for the customer's overhead data , preceding the associated data field is capable of accepting variable length. The customer is not constrained to any fixed field or form.

The IS&R Software Repertory

The Convair IS&R System consists of a library of programs, each of which performs a specific information-handling function, i.e., STORE, UPDATE, SEARCH, MERGE, SORT, etc. These are selected by the system operator/analyst along with the data being used, and the proper linkages are generated for the series of logical actions to take place. The output received is then formatted according to the instructions of the data recipient and produced on microfilm via the Stromberg-Carlson 4020. This modularization approach allows handling the diversity of customer information-handling tasks by customizing the total job as each total task dictates without need for a continual programming effort. The system is now evolving a higher-order language that the operator/analyst employs to call up and use the various subprograms. This is called SIMPL (Systematic Information Modular Programming Language).

SECTION 2

TYPES OF INPUT AND OUTPUT FOR THE CONVAIR IS&R SYSTEM

2.1 A GENERAL OVERVIEW

In the general case, an Information Storage and Retrieval (IS&R) System has the primary function of accepting and organizing a given data base and performing retrospective search and selective retrieval from that data base. Conversely, also in the general case, a system which accepts and reorganizes a data base of records and then displays all or a major part of all records, is usually called a report generator. Convair's IS&R System is designed for the purpose of the first case, the mechanization of a customer's data base to enable its storage via computer techniques and subsequent inquiry processing for selective retrieval. These retrievals fall into two general types, scheduled and demand. The scheduled are a special kind of report generation of a selective nature and are usually scheduled quite far in advance. This enables batching and scheduling the input in anticipation of the output, often just before output. On the other hand, demand inquiries are unknown until made upon the system. Where a system is subject to demand inquiry it is usually most economical and efficient to maintain the system in a ready state by short time updating (i.e.; on a daily basis of input received). Such updating really depends on a variety of things. For example, in the NASA Linear Tape System, the update or added material is delivered to the Convair Library, which in turn delivers it to the Convair IS&R System once a month via magnetic tape. This is usually converted and added to the existing file in a day or so to be in an update condition to answer inquiries.

In the case of total data-base organization and report generation, systems with this function as a primary goal normally find it difficult to accommodate selective retrieval. However, systems with selective retrieval as a primary function easily accommodate total data base report generation and

frequently can produce highly innovative output reports for the data user. Four such cases were selected from several available and documented in an IS&R report.[2]

Because of the many problems existing upstream of the mechanization scheme, as mentioned in Section 1 of this report, the Convair IS&R System's personnel devote a major part of this total design effort to the premechanization portion of the overall task. As an example of this emphasis, the personnel subsystem of Convair's IS&R is apportioned at a ratio of three system-design analysts for every programmer involved in the mechanization of a system. This is even more realistic in light of the fact that programming is not specifically application oriented in the Convair IS&R System and therefore provides a cumulative repertory of programs for the design analysts to use. The point to be made is that the Convair IS&R System is a combination man/machine system and is therefore not constrained to accepting one kind of input such as punched cards or magnetic tape. For example, inquiry processing often takes the form of a telephone conversation from the user in plain English with the man portion of the Convair IS&R System responsible for translating this request into code, constructing the Boolean logic, going through several processing functions, formatting and translating the output, offering consultation assistance to the user and finally acting as evaluator for the adequacy of a system design. In the specific case of the NASA Linear Tape System, inquiry is received from the requestor in person by the Convair Library. Trained library personnel translate this request into a logical Boolean expression, often with consultation from Convair IS&R personnel. In addition to nonscheduled inquiry processing, which, incidentally, are usually in the form of several inquiry batches at a time, a selective dissemination of information (SDI) is performed for the Convair Library. This consists of running a series of idealized profiles against only the most recent update information before it is merged into the total file. In this way, select personnel or groups, having their profile of

[2] W. F. MacDonald, Information Storage and Retrieval (IS&R) Used as an Analysis Tool, GDC-ERR-AA-1137, Convair division of General Dynamics, San Diego, Calif., December 1967

interest established, are automatically made aware of recent acquisitions. Of course, profiles can be changed or updated at any time to reflect current interest.

During 1963, a reliability information data base (9-PAC) was operating under a generalized package supplied by a computer manufacturer. This system was then converted by Convair IS&R personnel to run under a set of in-house programs designed to handle a generalized data base. The data base contained almost half a million reliability records.[2] This approach to converting an existing mechanized data base using generalized programming concepts, proved to be extremely reliable and efficient. While the original package had become very difficult to operate due to lack of program knowledge and flexibility, the converted system could be made to function smoothly since there was intimate knowledge of programming construction available. This also allowed a considerable expansion of this reliability data base and increased the number of users who could now employ it.

A similar situation developed with the NASA linear search file supplied by Documentation, Inc. The "canned" programs supplied, running in emulation mode on an IBM-1410 system, proved to be very troublesome. It was discovered that they had not been completely debugged before delivery. The system was inactive at Convair during most of 1967 due to the inherent problems of program-data incompatability and lack of knowledge about the programs. This was a difficulty not only at Convair, but also at Ft. Worth and other places such as Douglas.

It was decided to convert this file also to the Convair IS&R internal format to supply a much needed literature searching capability to the Convair Library. The conversion would allow the full power of the flexible IS&R System to be applied to the NASA data base.

To accomplish the conversion, a special program was developed to use the NASA Tapes as input and generate a type of IS&R record.

[2] R. A. Benson, Reliability Information Storage and Retrieval - A Systems Analysis, GDC-ERR-AN-[illegible], Convair division of General Dynamics, San Diego, Calif., August 196[illegible].

In view of the experience and success of these two major conversions of existing mechanized data bases, the Convair IS&R personnel have adopted a general approach to all similar mechanized data bases where it is desirable to have them searchable and usable by Convair.

The following section is a detailed writeup of the NASA Linear Tape System conversion to illustrate the philosophies involved and the search and output capabilities that are available. In addition to the tape systems (DDC and PANDEX) mentioned in Section 1 to be integrated into this Convair Library System, the IS&R personnel are currently examining several other conversion tasks, particularly Navy 3M data and its integration with an existing Convair IS&R-designed system of Maintenance Engineering Analysis (MEA) data to support such complex Navy programs as VSX, VFX at Convair, and DX at the Quincy Division.

SECTION 3

THE NASA TAPE CONVERSION

3.1 DATA FORMAT REVIEW

There is a quantity of detailed documentation available on the NASA Linear Tape System.[1] It will be sufficient, at this point, to perform only a cursory examination of the data format confronting IS&R personnel before going into individual detail. However, whenever such a task is attempted, programmer personnel desperately need very detailed and explicit documentation. The total documentation that was available for this NASA Linear Tape System was somewhat less than could be hoped for and, as a result, caused considerable programming anguish at times.

One of the major specifications for the programming was to retain the traditional and customary activity external to the mechanization system. In other words, the user should not have to adapt to the mechanization scheme, the mechanization scheme should adapt to the user. For example, the NASA format contains two classes of index terms labeled, "I" and "X". "I" terms are published terms, i.e., from an abstract, and "X" terms are nonpublished terms that tend to be precoordinated, or synonymous terms. Because this differentiation is available to a user, it was retained so a user would not discern the difference between interrogating the Convair IS&R NASA System, or the Standard NASA System.

Figure 3-1 is a printout of one record in the NASA Linear Tape System. The code used is BCD. The first two lines shown contain a variety of

[1] "Guide of Machine Searching and Retrieval of Information for the NASA Linear File, W. T. Brandhorst and P. F. Eckert, December 1964.

Guide to the Processing, Storage and Retrieval of Bibliographic Information at the NASA Scientific and Technical Information Facility, W. T. Brandhorst and P. F. Eckert, NASA CR-[illegible], June 1964.

information in physical-field orientation. Word marks (@) are employed to separate fields. The first two lines contain such items as (1) total record length, (2) issue, (3) year and type of accession, (4) accession number, (5) document security, (6) subject category, and (7) a relative indicator showing the number of characters or spaces from the front of the record to the beginning of the respective field. Line two, near the right, shows a "$" symbol which bounds the beginning of the title, "Progress Report of the Aerodynamische Versuchsanstalt Goettingen for the Year 1966". Following this, one can pick out the other information down to the $ symbol in the center of line 6, at which point individual terms by which this document has been indexed begin. The individual terms are fixed-field oriented with a given amount of spaces or characters allowed per term. Following the index terms is a series of concise coding which represents these same index terms. It is upon these highly stylized codes that initial search is performed to locate records that are potential candidates to answer an inquiry. (Reference cited NASA documentation for detailed coding and field identification.)

Figure 3-2 is again a record printout, only this is the same record as Figure 3-1 converted to the achieved Convair IS&R format. All the data represented within the original NASA record is accounted for and, in addition, items or fields available in the NASA record but not utilized for search, are now searchable because of the Convair IS&R technique. Line 1 starts with SS, which is an indication of the start of a record. Following that, for a total of 16 characters in the example, is bookkeeping information including a searchable record (SR) number that is treated in more detail later. Line 1, 17th character "OKTL0-2)", is a term locator. The OK is a normal flag in Convair's IS&R System and OKTL, means it is the term locator. This gives the location of the start and ending of the individual terms relative to the start of the record. Following that, on line 1, is "OKACCESS3C68A1003C01". The "OK" again indicates a normal flag and "ACCESS" tells us it is the accession number. The "3C" is a connective followed by six characters, "68A100", and an additional connvective,"3C", followed by 01. In the Convair IS&R System, because of use of a 12-bit machine at the present time, characters are handled 6 at a time with a

@137F@01@68A@10001@064011 @113@ 2 211 0000675 3212205 51
0038 @0045@ @ @ @0204@ @ @ @ @0337@0509$PROGRESS REP
ORT OF THE AERODYNAMISCH@E VERSUCHSANSTALT GOETTINGEN FOR THE YEAR 196@6/ AER
ODYNAMISCHE VERSUCHSANSTALT GOETTINGEN@, TAETIGKEITSBERICHT 1966/@.$20005@040P
UBL- AERODYNAMISCHE VERSUCHSANSTALT@,41PLAC- GOETTINGEN, WEST GERMANY, DATE- 19
67@.42COLL- 38 P. LANG- IN GERMAN@.$@3AERODYNAMICS @3AEROELASTICITY
@3ASTRODYNAMICS @1COMPUTATION @1COMPUTERS @1GAS DYNAMICS
@1GERMANY @1HYPERSONIC FLOW @3TEST FACILITIES $@3@)IMY2@1@-T EU@
3@(XY A@1@(6IM @3@D2Y2 @1@ 8J @@3@J & @@1@S PMA@1@5XG B$

FIGURE 3-1. ONE RECORD IN NASA LINEAR TAPE SYSTEM.

SS6H@NOOUA339999@KTLO-2)@KACCESS3C68A1003C01 @KDATEINCC6803063KAERODY3CAERODY
3CNAMICS3KAEROEL3CAEROEL3CASTICI3CTY 3KASTROD3CASTROD3CYNAMIC3CS 1KCOMPUT
3CCOMPUT3CATION 1KCOMPUT3CCOMPUT3CERS 1KGAS DY3CGAS DY3CNAMICS1KGERMAN3CGERMAN
3CY 1KHYPERS3CHYPERS3CONIC F3CLOW 3KTEST F3CTEST F3CACILIT3CIES @KTITLE
3CPROGRE3CSS RE3CPORT O3CF THE 3C AEROD3CYNAMIS3CCHE V3CERSUCH3CSANSTA3CLT GO
3CETTING3CEN FOR3C THE 3CYEAR 13C966 / 3CAERODY3CNAMISC2CHE VE3CRSUCHS3CANSTAL
3CT GOE3CTTINGE3CN, TA3CETIGKT3CITSBER3CICHT 13C966/. @KDESC203C0050 @KIMPRO1
3CPUBL- 3CAERODY3CNAMISC3CHE VER3CSUCHSA3CNSTALT3C, PLAC3C- GOET3CTINGEN3C, WEST
3C GERMA3CNY, D3CATE- 13C967. C3COLL- 33C8 P. 3CLANG- 3CIN GER3CMAN. @KXA0111
@KXB 113@KXC 2 2@KXD115 @KXE3212@KXF205 @KXG 51 @KXH @KXI0038@KXJ @KDATPUB
0C6700000KZZ

FIGURE 3-2. RECORD PRINTOUT CONVERTED TO CONVAIR IS&R FORMAT.

preceding connective 3C making it 8 characters and signifying a continuation of the data field. Although the CDC 160G computer is a 12-bit machine, it is operated in essentially a 48-bit mode. The original concept of the format was to be applied to a 48-bit machine.

Following the accession number on line 1, "0KDATE1N0C680306", date of conversion, appears. The 3K following signifies the beginning of an index-term flag, "3KAERODY". Note the 3Cs used as connectives for groups of 6 characters. Note that the 3K flag embodies the first 6 characters of the index term. This "3K" or "1K" flag and the six-character mnemonic key allows for distinction from other keys in the Searchable Record and provides a rapid mechanism for determining a possible mismatch as rapidly as possible while searching the record for those terms specified in the search program input. The latter part of this record is a series of flags and associated data carrying date of publication, etc. In the original NASA record this information appeared, in compacted form, at the front of the record. The Convair IS&R method permits searches by these items of data as well. Differentiation between various types of flags is made by 1K, 3K, 0K, etc.; this enables rapid search on only a particular key type when desired.

3.2 CONVERSION PROGRAM USER INFORMATION

The NASA Conversion Program has certain options available which permit a certain amount of variation in the IS&R output record. The following list describes the types of parameter cards allowed which enable exercising these options. All the types of identifiers must start in column 1.

Type	Description
I,	Identification card, optional.
D,	Date card, optional. This causes the next eight characters on the card to be placed in the output record. The first two characters should be 0K. The computer halts at P = 0462 for the month entry and at P = 0470 for the day entry (see table in Para. 3.2. 2.e)
A,	Starting Searchable Record number, required. This causes the number punched in columns 3 through 8 to be used in the first Searchable Record (SR). Each succeeding output SR will contain a sequentially descending number.

Type	Description
L,	Last data, optional. Each set of eight characters punched in the card will be included at the end of each output SR. The eight character groupings must be in IS&R format. Multiple cards may be used.
E,	End card, required. This card signals that processing is to start.

1. Program Run Instructions

   a. Tape Setup

      TM-1: A tape of NASA Linear Search Data designed for the 1401 system.

      TM-2: A scratch tape (with write ring) to accept the output file.

      TM-3: A scratch tape (with write ring) to accept the exception file.

   b. Deck Setup

      Program deck consisting of:

      (1) Bootstrap

      (2) Program loader

      (3) Program and change cards

      (4) End card

      Spec Deck:

      A deck of cards consisting of the required elements of the types of identifiers listed above.

2. Operating Instructions

   a. Place desired tapes on the proper units, and ready at load point.

   b. Clear Bank controls and Master Clear.

   c. Press load, start, processing begins.

   d. Halt at P = 0151 A = 0000
      to continue with the next tape of the input set, set A = 0001, start, halt P = 0164, mount new tape on TM-1, start.

      If last of input set is finished, set A = 0002, start, halt P = 0220.

   e. Options:

      If near the end of TM-2 output reel:
      Set SLJ-1 on, halt P = 3603 A = 0000, mount new output reel (ring), set SLJ-1 off, start.

If a D, card is used, a halt will occur for the month entry. Halt at P = 0462 A = 0000. Set A to the month from the following table:

Jan 0001	Apr 0004	Jul 0007	Oct 0100
Feb 0002	May 0005	Aug 0010	Nov 0101
Mar 0003	Jun 0006	Sep 0011	Dec 0102

Start, Halt at P = 0470 A = 0000. Set A to the day from the following table:

0	0000	11	0101	27	0201
1	0001	12	0102	28	0210
2	0002	etc.	etc.	29	0211
3	0003	17	0107	30	0300
etc.	etc.	18	0110		
7	0007	19	0111		
8	0010	20	0200		
9	0011	21	0201		
10	0100	etc.	etc.		

A run may continue from Halt P = 0220 using the specs as previously read, but with the SR number continuing sequentially descending. NASA activity tapes have header records that are by-passed by the program. To accept the first record, if it is not a header record. change cells 0137, 0140, 0141, to 0001 (No-op.).

3. Error Halts

P = 0202 A = 0000 TM-1 not at load point. Ready TM-1 start.

P = 0323 A = 0100 Read comparison error. Start job over.

P = 1311 A = 0004 Parity error on read, set A = 0000. Start to accept with possible error.

P = 1364 A = 0000 No A, card, fix spec, start job over.

P = 1339 A = **** Incorrect tape status, nonrecoverable.

P = 2553 A = NEG Incorrect term FWA, nonrecoverable.

P = 2645 A = 0000 Incorrect number of characters stored while making a key from a term, nonrecoverable.

P = 2724 A = **** Same as P = 2553.

P = 2732 A = NEG Incorrect term LWA+1, nonrecoverable.

P = 3447 A = Non Zero. The built-up SR is not an eight-character multiple, nonrecoverable.

P = 3621 A = 0000 TM-2 not at load point, ready, start.

P = 5450 Should not get here.

4. Handling of Error Conditions During Conversion to IS&R Format

a. Errors encountered in the original NASA records are handled in one of the following two ways during the conversion (to IS&R format) process:

(1) Production of "dummy" records that are not searchable.

(2) Production of searchable records without the incorrect fields.

b. Dummy Output Records.

(1) A dummy record is generated whenever a character other than a $ is found at the start of a NASA data field. The dummy contains the number of the SR that would have been on the output tape. The output record that was generated up to the occurrence of the error is written on the tape of exceptions, TM-3. A printer message occurs.

(2) A dummy record is generated whenever the output record exceeds 2400 characters. It is written in its entirety on TM-3. A message is printed.

(3) The following is a list of codes that are printed specifying the area in which the dollar sign ($) was not found in the NASA record:

Code	
1	Title area no $
2	Author area no $
3	Term area no $
4	Term area incorrect code not a 1 or 3
5	Report number area no $
6	Contract number area no $
7	Corporation area no $
8	Historical notation area no $
9	Title notation area no $
10	Descriptive notation area no $

c. Valid Output Records

Whenever the NASA-supplied imprint area contains codes that are not ascending, or the codes contain illegal (non-numeric) fields, the program will not include the imprint data in the searchable record. The SR number, accession number and the faulty imprint area are combined to form a record which is placed on the exception tape. The rest of the NASA data is written as a searchable record on the output tape.

3.3 CONVERSION PROGRAMMER INFORMATION

1. NASA Data Format.

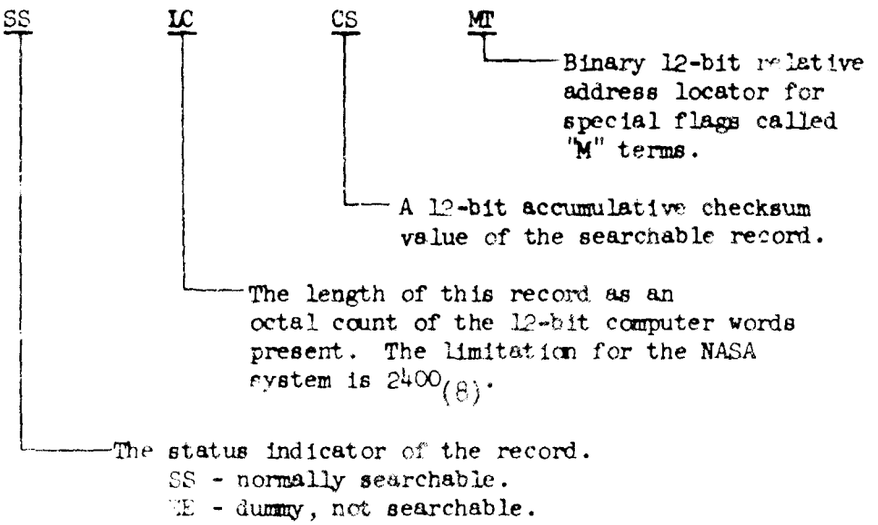
   Description of the NASA data format can be found in previously cited NASA documentation.

2. IS&R Internal Format.

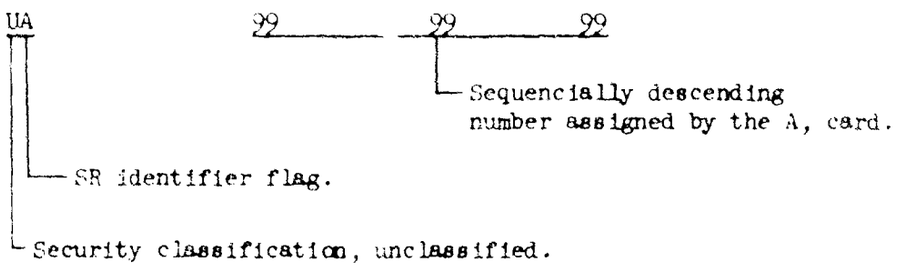
   The philosophies of the Convair IS&R System can be found in previously referenced Convair reports.

3. A brief discussion of the conversion to the IS&R System follows. It will be presented in a sequence of fields or areas normally found in the IS&R record.

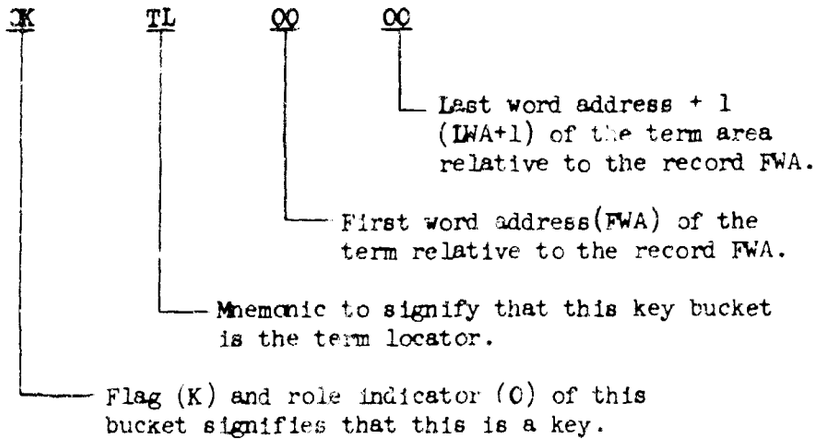
   a. Status flag field and associated "buckets". Each IS&R record begins with an eight-character grouping (bucket) as follows:



   The second bucket is the searchable record (SR) identifier.



The third bucket is a relative-position locator for the terms.



b. Accession Number Field.

A key (ØKACCESS) is generated and placed in the output record followed by two continuation data buckets to contain the NASA accession number. This is found in characters 3 through 10 of each logical NASA record.

Example:

ØKACCESS3C63N1233C45ßßßß

c. Datein Field.

If the D, card is used, each output record will contain the key as specified on the card followed by a numeric field of the date as entered from the console as year, month, day:

ØKDATEINØC680110

d. Term Field.

The term field in the NASA data record is located by a relative address field in positions 118 through 119. Each term is preceded by a Type 1 or 3. This type is placed in the role indicator of the IS&R key to aid in searching speed and to distinguish the term from other keys that have the same spelling (e.g.; IKACCESC - term and ØKACCESS - key). The first six characters of each term are placed in the key and as many continuation buckets as are required are used to contain the term:

IKTERMPER3CTEMPER3CATURE

This processing is repeated for all terms in the NASA record.

e. Title Field.

The title is located by a relative address field in positions 80 through 83 of each NASA data record. A key is generated and as many 3C data buckets are used as are needed. If the relative area is blank, this field is ignored.

Example:

0KTITLE03CCONVEC3CTIVE0H3CEATØTR3CANSFER....

f. Title Notation Field.

The title notation field is located by a relative address field in positions 84 through 87 and is formatted similar to the title field (e).

0KTITLN03CEINFLU3CSS0VON3C0ABSORP3CTIONSK....

g. Historical Notation Field.

This historical notation field is located by a relative address field in positions 92 through 95. It is formatted similar to the title field (e).

0KH1STN03C. .

h. Descriptive Notation Field.

Located by a relative address in positions 96 through 99, the field is separated by word marks into subfields, each with a code number type designator. These are examined for ascending order before further processing. If these subfield codes are not in order, the exception records specified in Paragraph 3.2.2, subpar. 4.. occur.

The following is a list of the subfield types and the data field generated:

00	0KDE3C003C....	not formatted.
01-0[illegible]	0KDE3C01-0[illegible]3C....	not defined.
07	0KCATDAT3C....	date of cataloging.
08-11	0KCORPSU3C.. .	corporate source supplementary.
12-18	0KAUTHAF3C....	personal authors corporation affiliation.
19-39	0KDE3C19-393C....	
	19	temporary number.
	20	not defined.
	21	old number - Langley research.
	22-39	not defined.

i. Author Field

Located by a relative address in positions 100 through 103. This field contains a single or multiple authors' names separated by word marks. Enough keys are generated for each author.

OKAUTHOR3CSMITHb3C....

OKAUTHOR3CJONES,?CbA.bB.

j. Corporation Field.

This field is located by a relative address in positions 104 through 107. The first eight characters are a code for the corporation and is listed in the corporation thesaurus. In the IS&R record, an additional blank is inserted between the code and the English-language equivalent.

OKCORPOR3CR[illegible]3C000bRUT3C....

k. Report Number Field.

There can be many report numbers in each NASA record. The start of the field is located by the relative address in positions 108 through 111. Each report number is placed in its own key.

OKRPTNUM3CNYC-[illegible]

OKRPTNUM3CTR-10[illegible]

l. Contract Number Field.

This field is similar to the report number field (K) and is located by positions 112 through 11[illegible].

OKCNTNUM3CAT[illegible]

m. Fixed-Field Data.

Certain information is contained in the fixed-field portion of the NASA record. Elements of this field are stored in keys of a pattern OKXl**** where l is a letter, A through J uniquely identifying the key and its data content. The **** is a four-character data field containing information from the NASA record. In this manner, the fixed-field area is conveniently searchable. Table 3-1 shows the keys and their corresponding fields, and the positions where they were located. Certain codes are used by Documentation, Inc., and a meaning of these codes can be found in previously referenced NASA documentation.

KEY	KEY POSITIONS	MEANING	FILLD POSITION
OKXA3456	3,4	Journal Issue Number	1,2
	5	Documentation Classification	19
	6	Title Classification	16
OKXB3456	3	Declassification Group	17
	4,5	Announc. Subject Category (01-34)	18,19
	6	NASA Supported	20
OKXC3456	3	NOFORN	21
	4	CONF. or SYMP Proceedings	22
	5	Corp. Source Supplementary	23
	6	Authors' Corp. Affil.	24
OKXD3456	3	Foreign Document	25
	4	Receipt Type	26
	5	Abstract	44
	6	Abstract Language	45
OKXE3456	3,4	Document Language	46,47
	5	Reproducible Code	48
	6	Copyright Code	49
OKXF3456	3	Microfiche to be Made	50
	4,5	Document Type	51,52
	6	Microfiche Code Prefix	7
OKXG3456	3	Microfiche Code Suffix	53
	4	Document Class.	54
	5	Handling	55
	6	"Et Al" following the Author	56
OKXH3456	3,4	Source - NASA Country Code	57,58
	5,6	Foreign Origin	59,60
OKXI3456	3,4,5,6	Number of Pages	61-64
OKXJ3456	3,4,5,6	CCRATI Subject Category	65-68
OKLXXXXX	3 Chr's	Last Analytic Accession Number	69-75

TABLE 3-1. FIXED-FIELD DATA CONVERSION TABLE

n. Date of Receipt.

The date of receipt is contained in characters 31 through 36 of the fixed field and, if present, is placed in a key:

OKRECPTbOC....

o. Date of Publication.

The date of publication is contained in characters 37 through 42 of the fixed field and, if present, is placed in a key:

OKDATPUbOC....

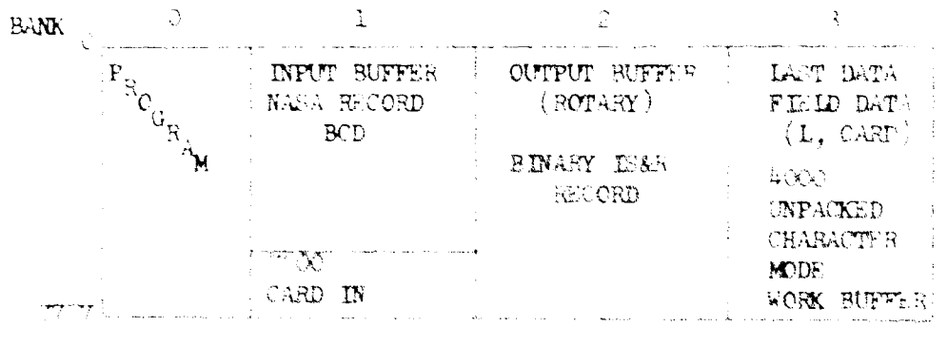
p. Last Data Field.

If an L, card is used, that data on the card is placed at the end of the abstrac

OKLZbbbb

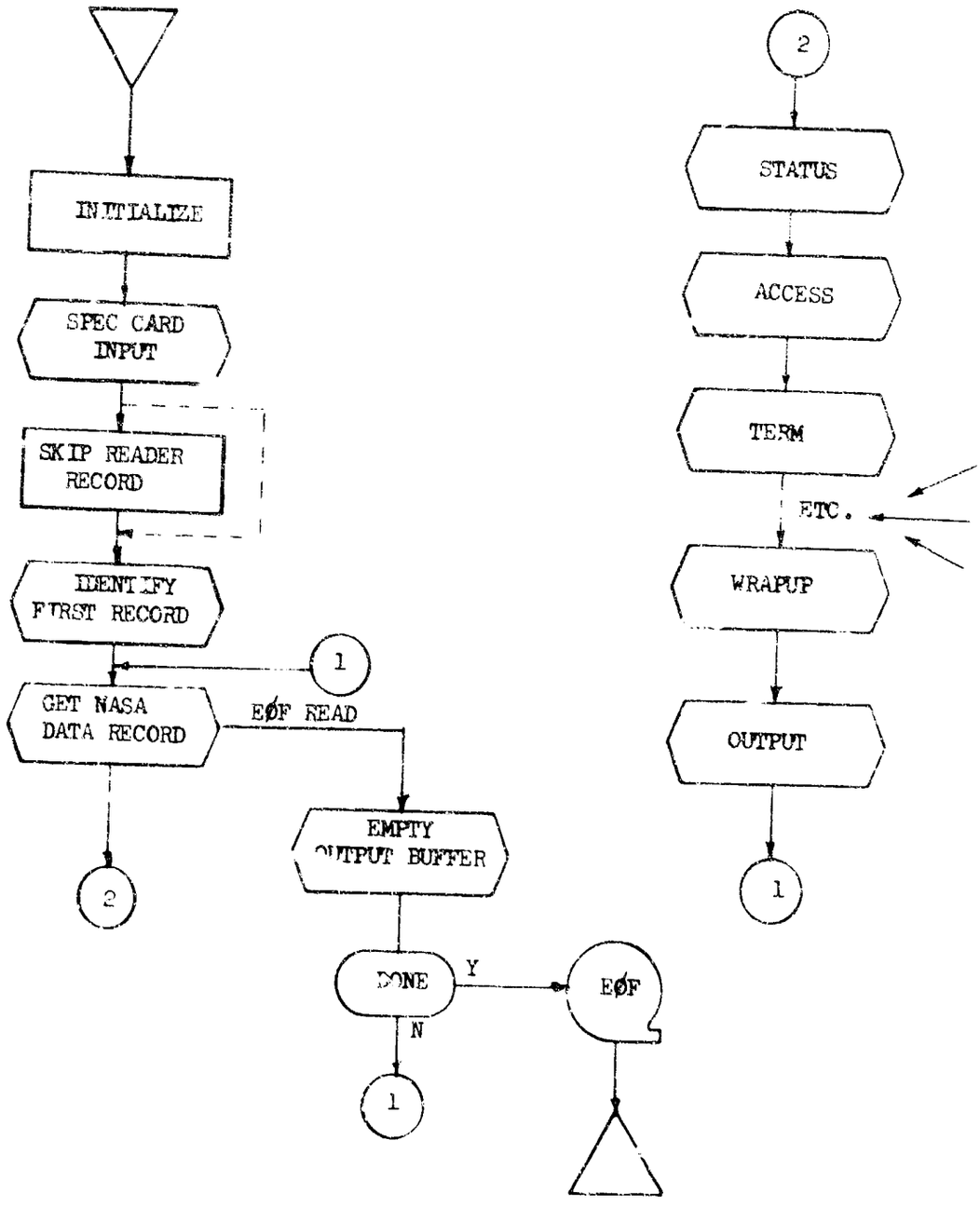
. Core Layout

The following diagram is a layout of core during program execution:



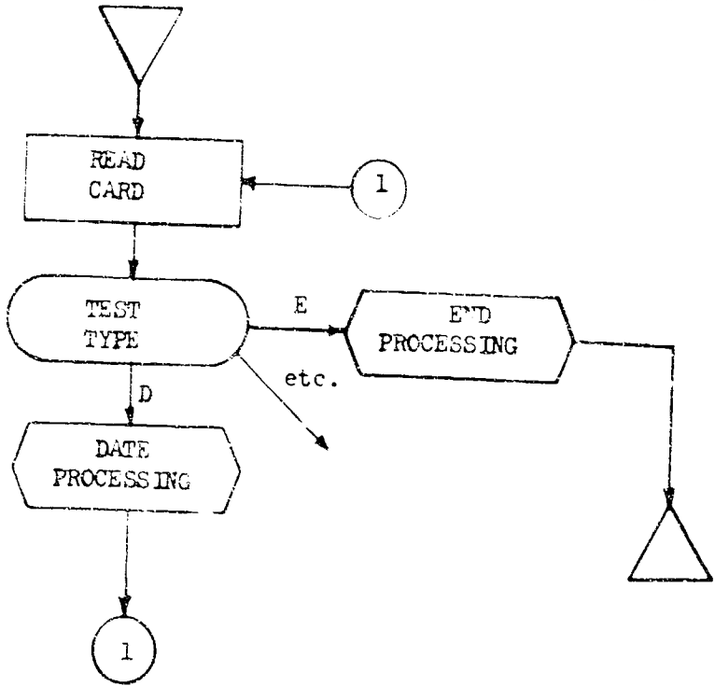
. Flow Charts.

The following flow charts are intended to give an overall perspective on the program logic.

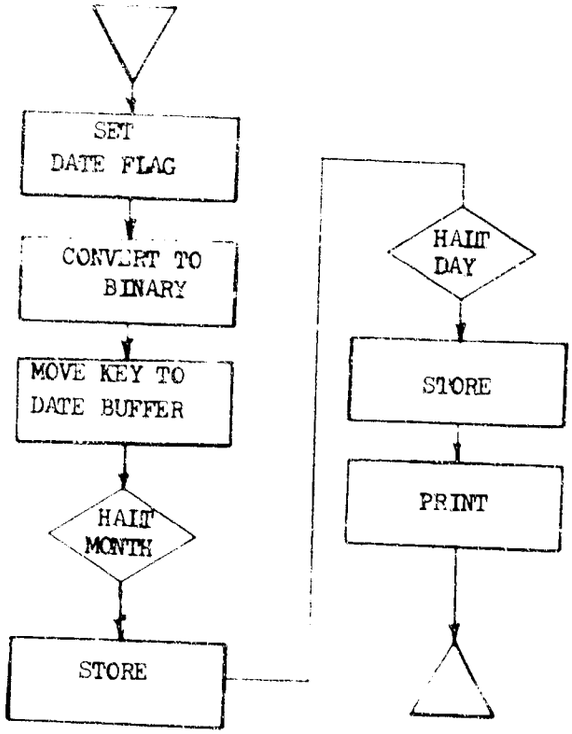


FLOW CHART 3-1. DRIVER. (CONVERSION)

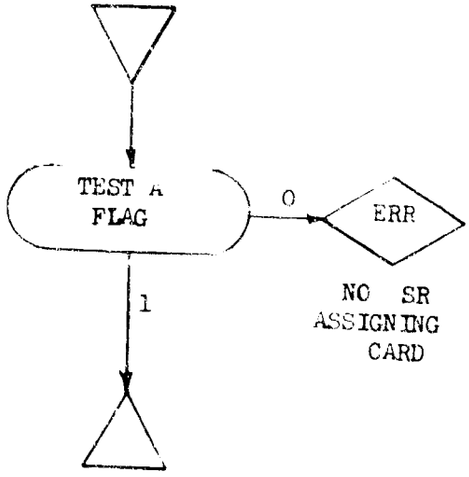
SPECIN PROCESSING



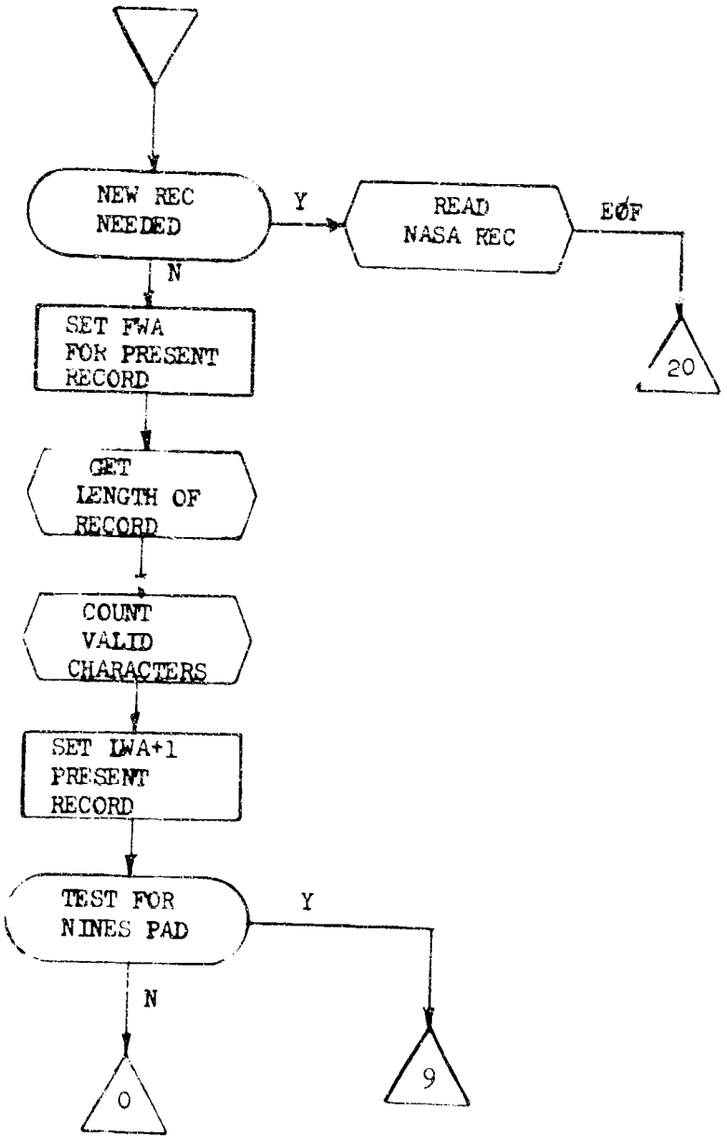
DATE PROCESSING



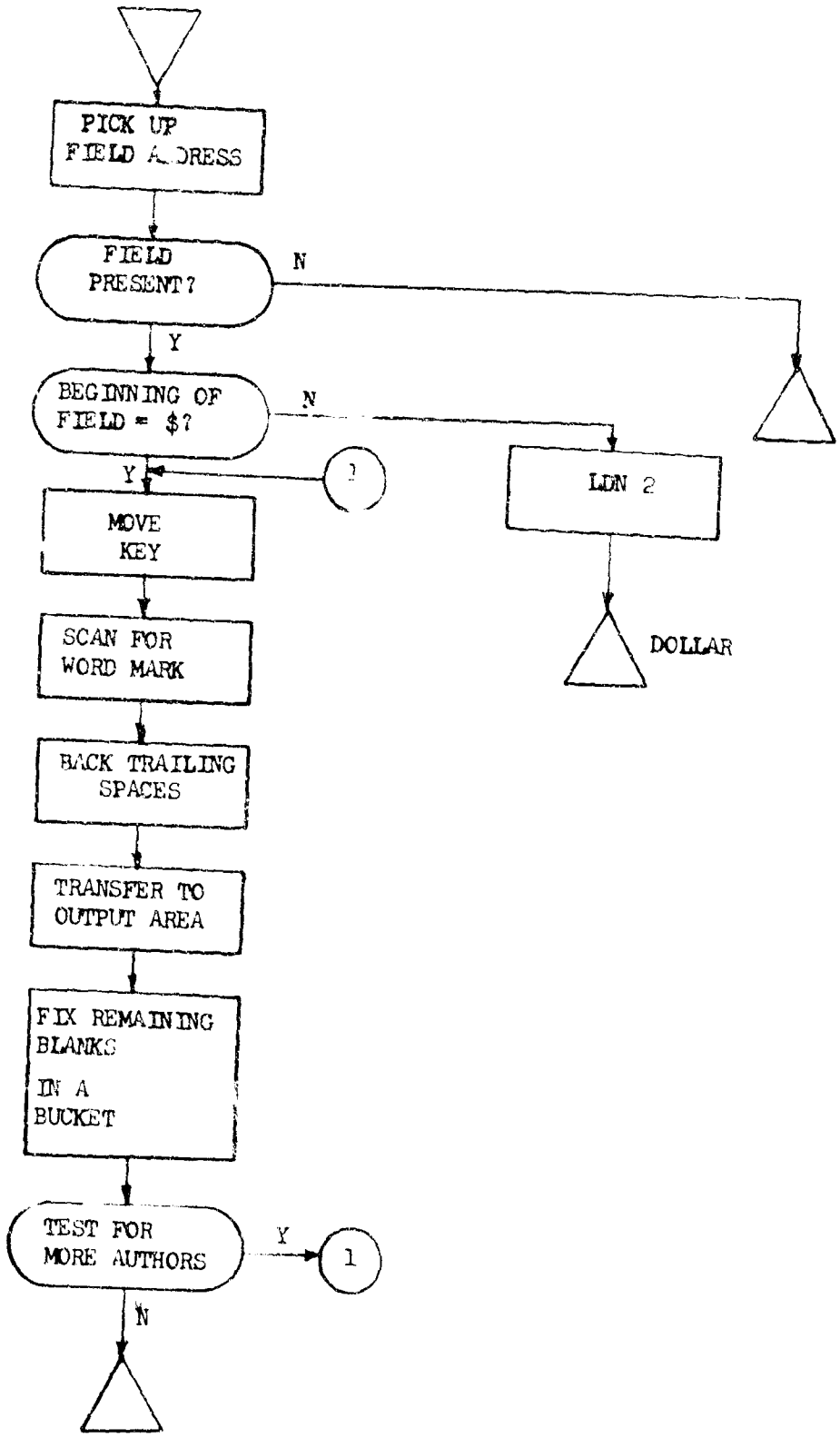
END PROCESSING



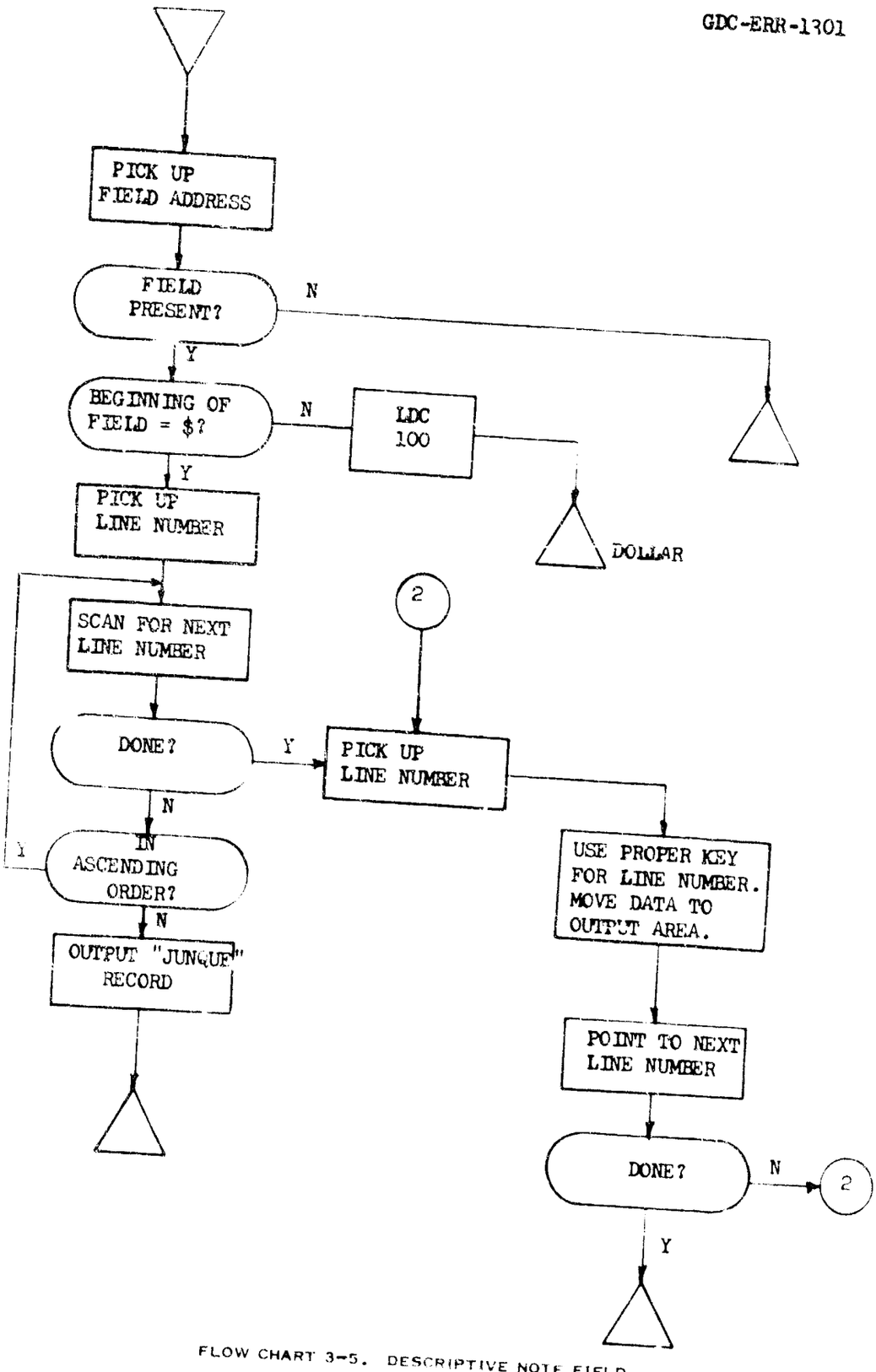
FLOW CHART 3-2. SPECIN (CONVERSION)



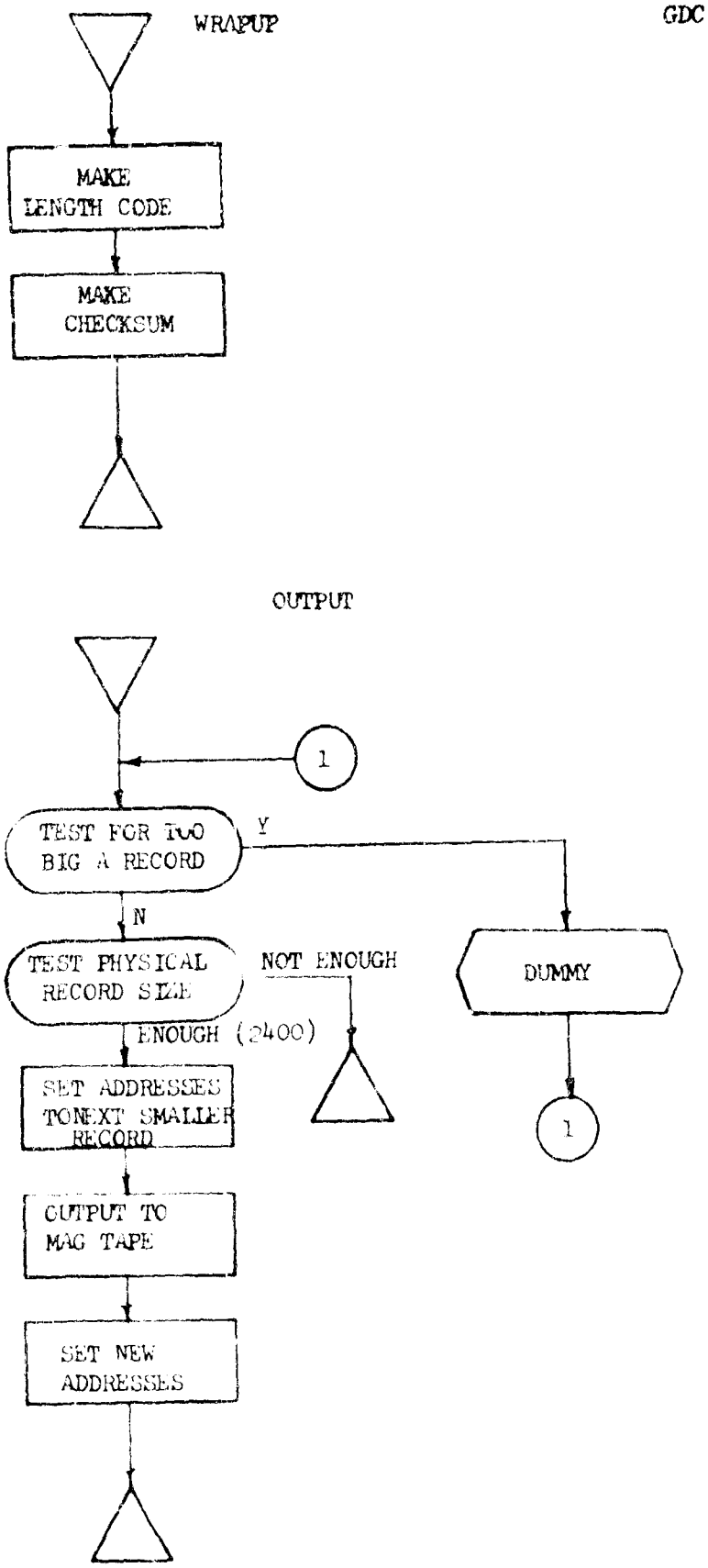
FLOW CHART 3-3. GETREC (CONVERSION)



FLOW CHART 3-4. AUTHOR
(CONVERSION)



FLOW CHART 3-5. DESCRIPTIVE NOTE FIELD (CONVERSION)



FLOW CHART 3-6. WRAPUP AND OUTPUT (CONVERSION)

3.4 NASA MERGE PROGRAM DOCUMENTATION (A Program Designed to Assist in Maintaining the NASA Linear Search Data Files)

Task Description

The additions or activities to the NASA file comes as a file consisting of 6 subfiles. These subfiles contain 2 ranges of accession numbers within each accession series (A, N, X). It is desirable to maintain the total file in alphanumeric order. Each subfile must be merged into the current master file in its proper location.

Certain existing IS&R programs will accomplish this merging but as they were written for a general-purpose application, it was felt that the added gain in efficiency of having a special program would compensate for the programming time required. Additional features were to be included in the program such as listing the beginning and ending of any sequential range of accession numbers.

3.5 NASA MERGE USER INFORMATION

1. General

A data tape of the NASA Linear Search file is used as input. The output (if any) is a blocked IS&R record of the NASA data file of $2400_{(8)}$ 12-bit words. Each searchable (SS) record must contain a key of OKACCESS and accession number data field of the form nn a nnnnn.

2. Control Card Format

Only one card type is permitted - the SR assigning card. This is called for by the program only if the resequencing option is specified (see paragraph 3.5, subparagraph 3, Options). The format is a six-digit number punched starting in card column 1.

cc 1
999999

3. Options

A table of the options is shown in paragraph 3.5, subparagraph 4, Run Instructions.

a. List

This option will scan the input tape and make a printer listing of the first and last accession numbers of any sequential range on the tape.

b. Copy

This option will cause the input tape to be copied and placed on the output reel.

c. Merge

This option will cause the activity file to be merged with the input master file and be placed on the output reel. Care must be taken to assure that the two tapes are in ascending order.

d. Resequence

This option will read the SR assigning card and will resequence the output file starting with the assigned number and will continue sequentially descending.

4. Run Instructions

a. Place the desired input tape (no ring) on unit one, ready.

b. Place the desired merge input tape (no ring), if required, on unit two, ready.

c. Place the desired scratch output tape (ring), if required, on unit three, ready.

d. Place the program deck and parameter card, if required, in the reader. Motor power on, ready.

e. Clear the bank controls and master clear.

f. Press load, start, processing begins.

g. The first halt occurs at P = 0122 A = 0000, enter the desired option parameters from the following list. A Y signifies that this parameter is wanted. Use the parameter number as specified. For example, to copy and resequence, set A = 0012.

RESEQUENCE	MERGE	COPY	LIST	PARAMETER NO. FOR A-REGISTER	COMMENTS
N	N	N	N	0000	Illegal.
N	N	N	Y	0001	
N	N	Y	N	0002	
N	N	Y	Y	0003	
N	Y	N	N	0004	
N	Y	N	Y	0005	
N	Y	Y	N	0006	Same as 0004.
N	Y	Y	Y	0007	Same as 0005.
Y	N	N	N	0010	Meaningless, causes error.
Y	N	N	Y	0011	Meaningless, causes error.
Y	N	Y	N	0012	
Y	N	Y	Y	0013	
Y	Y	N	N	0014	
Y	Y	N	Y	0015	
Y	Y	Y	N	0016	Same as 0011.
Y	Y	Y	Y	0017	Same as 0015.

h. After entering the option parameters, place the SR number card in the reader if the file is to be resequenced and press start, processing begins.

Normal Halts:

P = 0341, A = 0000. End of processing.

P = 1650, A = 0000. An EOF has been read on TM-1, if more tapes are to be read in this set, remove/replace tapes, start. If there are no more tapes, set A = 0001, start.

P = 1730, A = 0000. An EOF has been read on TM-2, for option, see P = 650.

Error Halts:

P = 0431, A = POS. Accession numbers are equal. Nonrecoverable.

P = 0525, A = POS. No OKACCESS found, nonrecoverable.

P = 0572, A = ****. Accession not A, N, or X. Nonrecoverable.

P = 0615, A = ****. No UA found, nonrecoverable.

P = 1206, A = ****. Same as P = 0615.

P = 1256, A = POS. Same as P = 0525.

P = 1335, A = POS. Should not get here.

P = 1661, A = 0004. Parity error TM-1, set A = 0000, start to accept.

P = 1741, A = 0004. Parity error TM-2, set A = 0000, start to accept.

P = 2011, A = 0100. Bad card read, fix card, place in reader, set A = 0000, start.

P = 2036, A = POS. SR card has alpha character, nonrecoverable.

i. End of Tape Options:

If nearing EOT on TM-3, set SLJ-1 on to write EOF on TM-3.

Halt P = 0211, A = 0000.

Remove/replace TM-3. Set SLJ-1 off, start.

Errors:

Halt P = 0211, A = 7777. SLJ-1 still on, turn off, start.

A = 0002, TM-3 busy, start.

A = 0000, TM-3 not at load point, ready at load point, start.

Caution: Do not let the EOT marker on TM-3 be sensed. The listing procedure will not give correct answers if this occurs.

3.6 NASA MERGE PROGRAMMER INFORMATION

1. General Description

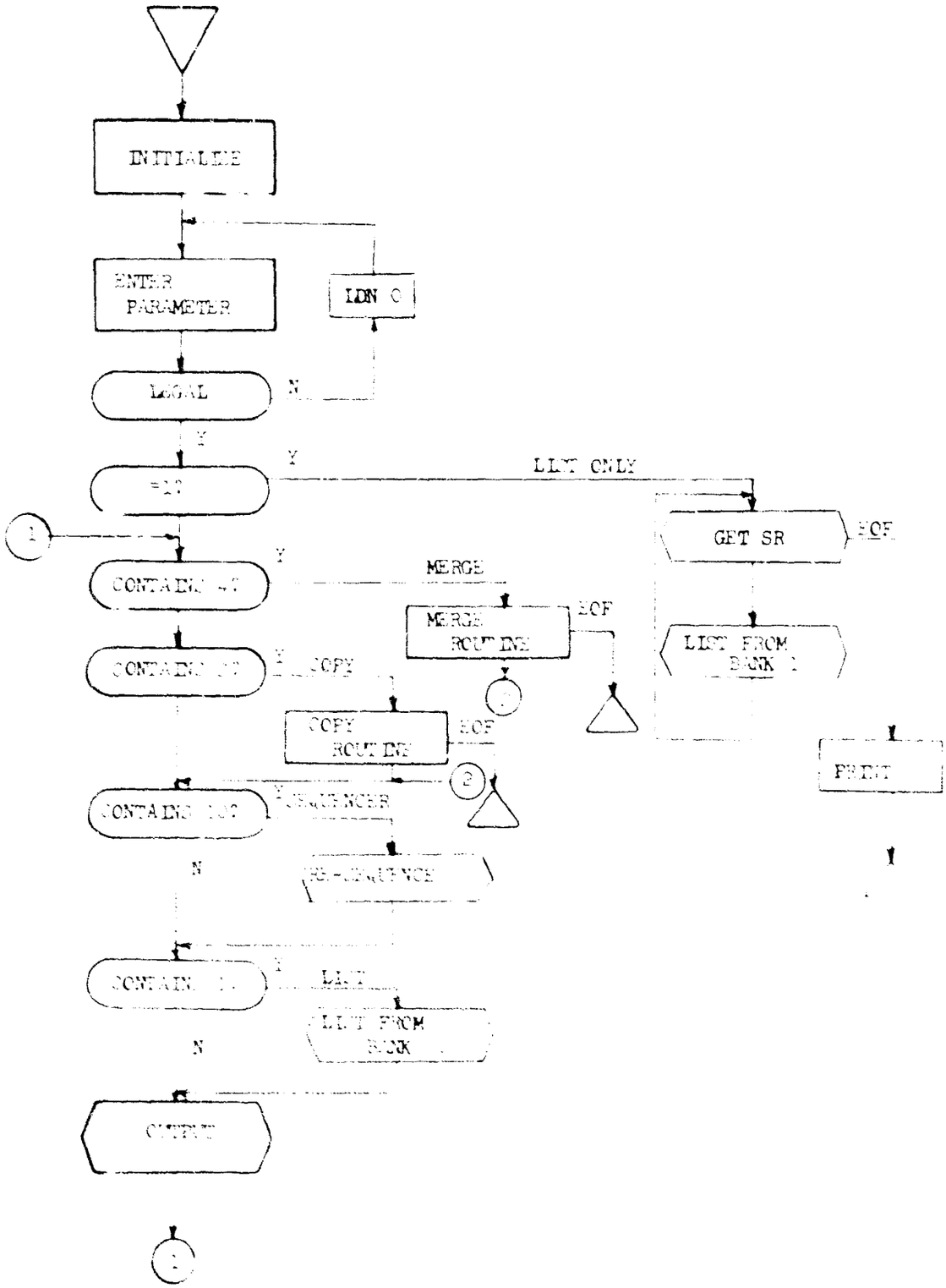
This program is a parameter driven, fixed program executing different routines on the basis of the parameter entered at run time. It is designed to run with IS&R-formatted data. In addition, each record must contain a CKACCESS key and attendant C field. The program merges and lists on the basis of this key; the logic that looks for this key is fixed internally to the program, and the size of the field is also fixed.

2. Core Layout

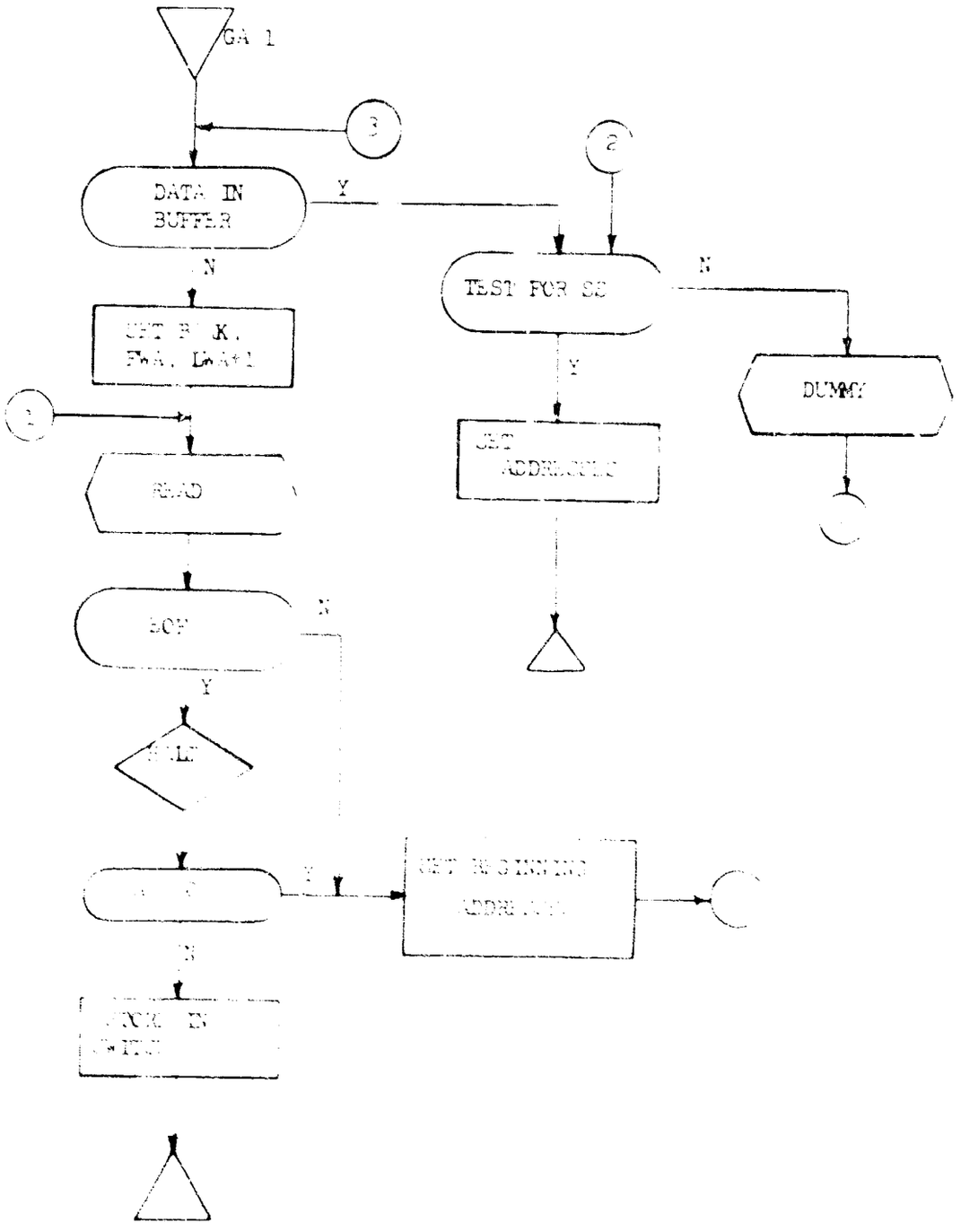
The following is a picture of core during execution:

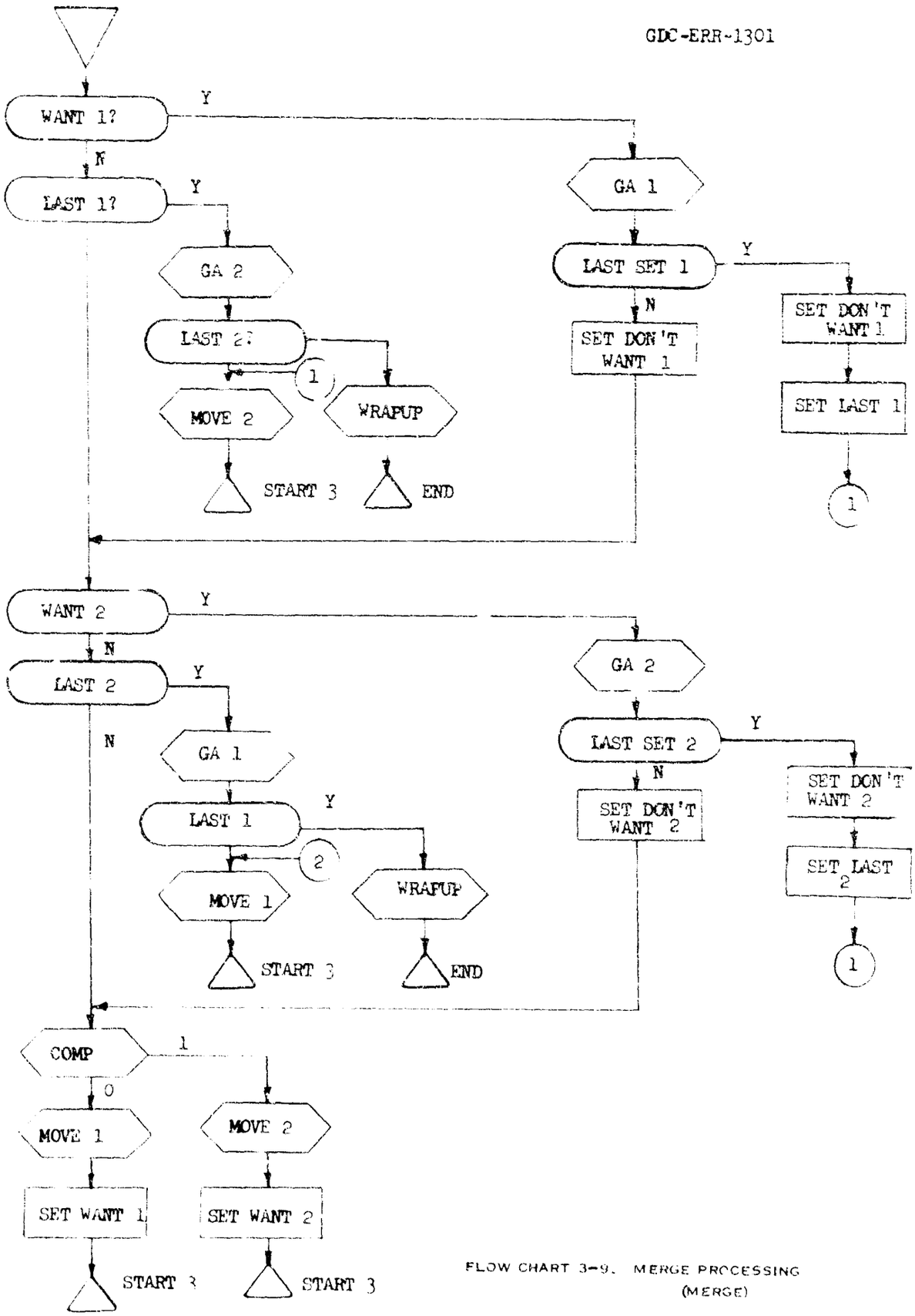
BANK

0	1	2	3
PROGRAM	INPUT AREA TM-1	INPUT AREA TM-2	ROTARY OUTPUT BUFFER
7100 SAVE AREA 1	3000 COMPARE AREA	3000 COMPARE AREA	
7500 SAVE AREA 2			
7700 PRINT BUFFER			

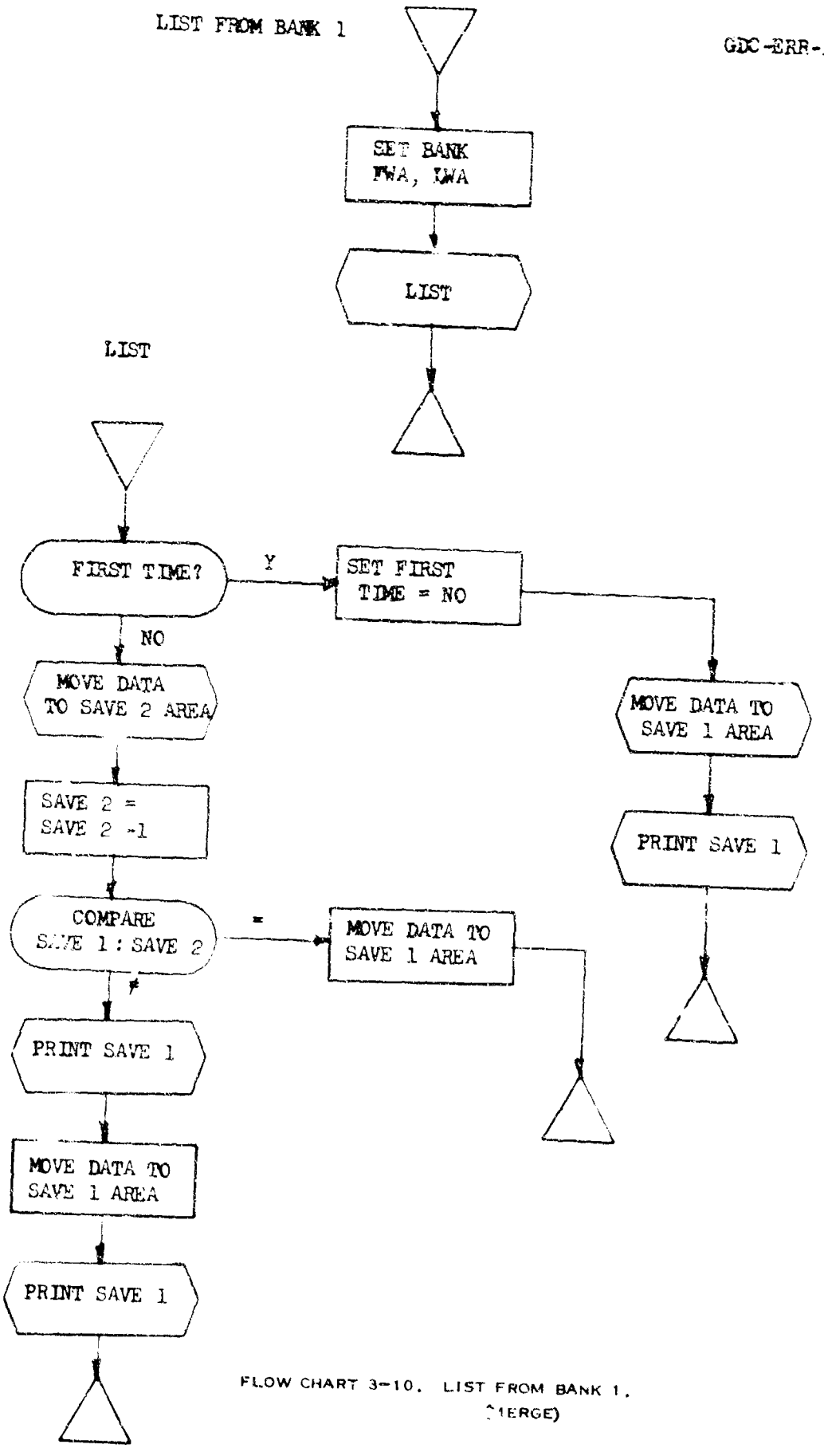


FLOW CHART SET, SORT/MERGE


GA 1
3
2
DATA IN BUFFER
Y
N
TEST FOR SE
N
Y
DUMMY
1
READ
EOF
N
Y
Y
N



FLOW CHART 3-9. MERGE PROCESSING (MERGE)



FLOW CHART 3-10. LIST FROM BANK 1, (MERGE)

3.7 NASA SEARCH PROGRAM DOCUMENTATION
(A Specialized Search Program Tailored for Rapid Searching of the NASA Data Files as Converted to IS&R Internal Format)

Task Description

It was decided that the current search program would prove too slow in searching this file when weighed against the total number of inquiries. There were some 300,000 citations on magnetic tape (each containing upwards of 15 key-word terms or phrases and 20 other fields used for display or searching). The nature of the data (random topics, etc.) and the method of retrieval (key words only in most cases) precluded subfiling as a means of increasing search speed.

The program is a multilist processor, where each separate search inquiry generates a small list or table containing the various terms to be searched for in each citation or searchable record. Up to 12 of these separate and distinct lists can be submitted at one time. The program collects those citations that are determined to be hits from one tape, flags them as to the inquiry or inquiries that are satisfied and writes them out on a second tape to be displayed by other IS&R output programs.

3.8 NASA SEARCH USER INFORMATION

The program parameter cards were patterned after the cards listed for the NASA Linear File - IBM 1401 System Supplement (previously referenced NASA Documentation). This was done to free present 1401 system users from having to learn another card format system.

1. Card Formats

The following is a brief description of all currently available card types and the action they perform in the IS&R NASA Search Program. All rules stated here override those specified in the previously cited NASA Documentation.

a. System Cards

Each spec must be bounded front and rear by cards defining the set as a logical search question. In addition, the last card in the deck specifies that all questions have been input and processing is to start.

(1) Search Card

Format:

ccl	3
$	SEARCH NN

The letters SE in cc 3 and 4 signify the card type. The number of the spec, punched as 01 through 12, is picked up as the first characters after a blank following the SE flag. Unique numbers should be used for those inquiries submitted at one time. If two or more identifiers are used, the answers will be indistinguishable for those inquiries upon output.

(2) End Card

Format:

cc 1	3
$	END OF SEARCH NN

Only the underlined characters EN are active. This card signifies that the complete inquiry is present and that the particular list being generated is to be terminated.

(3) End of Job Card

Format:

cc 1	3
$	EØJ

Only the underlined characters EØ are active. This card signifies that all inquiries have been read and that searching is to be performed.

b. Limit Cards

These cards describe the citations to be extracted from the master file. These can be coded directly on the 1401 worksheet. The limit codes must be in ascending order, except in those cases where multiple codes are legal.

(1) Limit Code 00 - Output Option

Format:

cc 7	13
00	ACC, CIT, TER

No action is taken upon reading this card. It is used for documentation control by IS&R personnel. The IS&R NASA Retrieval System is not limited to the output options specified in the previously cited NASA Documentation.

(2) Limit Code 01 Accession Number Range
(Positive Specifications)

Format:

cc 7	13
01	67N10001-67N12345, 67A10001-67A11111

If this type is used, only those citations that fall within any specified range or ranges (inclusive) will be accepted for further processing by that inquiry. Only two ranges may be placed on one card; multiple cards may be used. The letter series must match in the low and high limits of the range. The range must be specified as low to high. A dash (-) must be between the low and high ranges and a comma (,) must be placed between the two ranges on one card, if used. No blank characters are permitted. A range may not be split between cards. No trailing commas are permitted.

(3) Limit Code 02 Accession Number Range (Negative specification)

Format:

cc 7	13
02	66X12345-66X23456

This type specifies those ranges to be excluded from further processing by a given inquiry. If any citation falls within any range specified, the rest of that inquiry will not be processed against that citation. The general usage rules are the same as Limit Code 01.

(4) Limit Code 03 Accession Series.

Format:

cc 7	13
03	A,N,X

If this type card is used, only those citations that contain the specified accession series will be accepted for further processing. No blanks are permitted and the letters must be separated by a comma. No trailing commas are permitted. Care must be taken to ensure that card types 01 and 03 do not cancel each other.

(5) Limit Code 04 Searchable Record Range

Format:

cc 7	13
04	981234-991234

This card type allows only those citations that have a unique IS&R identification number that falls within the specified range or ranges to be subject to further processing by that inquiry. A dash (-) must be between the low and high limits, a comma (,) must be between the ranges, the ranges must not be split between cards, three ranges only permitted on a card, the low limit must be specified first. Multiple cards are permitted.

(6) Limit Code 05 Field Search

Format:

cc 7	13
05	+bQKXA11**,.-QKXB***5

This type allows the fixed-field information described in paragraph 3.5, subparagraph 3, to be searched. Each entry has the form:

1st char.	+	logical or operator
	.	logical and operator
2nd char.	-	logical not (negation)
	b	use without complimentation
3rd - 10th char.		key to be searched for, super-digits (all inclusive characters) are legal
11th char.	,	comma separator between terms.

No terms may be split between cards, multiple cards are legal. For example, to accept only those citations that have an SR prepared by the facility or the author in English and have an English-language document, the coding would be:

05 +bQKXD**11,+bQKXD**21,.bQKXE01**

(7) Limit Code 08 Corporation Search

Format:

cc7	13
08	R933(,00,ØA789470

If this type is used, those citations that do not contain a matching corporate source code are rejected for further processing by that inquiry. The codes are found in the Documentation, Inc., Corporate source listing. As many as five codes can be placed on one card; codes must be separated by commas and cannot be split between cards; multiple cards are permitted.

(8) Limit Code 09 Contract Number

Format:

cc 7	13
09	NAS7-100$
09	NAS7-

If this type is used, only those citations that contain a contract number as specified is considered for further processing by that inquiry. If a dollar sign follows the contract number, an exact match must occur for the citation to be considered a partial hit and processed further by that inquiry. A contract number not followed by a dollar sign is considered a root or truncated term and the citation is further processed if a match occurs through all of the characters specified. A further discussion is contained in the NASA Documentation previously cited. Only one contract number may be specified on a card; multiple cards are permitted.

(9) Limit Code 10 Report Number

Format:

cc 7	13
10	GDC-1234-56$
10	GDC-1234

This type is the same as (h) Limit 09, above, but searches for a given report number instead of contract number. This capability is not available in the 1401 system.

(10) Limit Code 11 Author

Format:

cc 7	13
11	SMITH
11	SMITH, G. H.

If this code is used, only those citations that have any one of the specified authors will be subject to processing by the rest of the inquiry. Only one author may be specified on a card, and must not be split between cards. The term must be written exactly as it appears in the Personal Author Authority List or in the STAR/IAA indices. In the example, all Smiths would be obtained by the first entry, while a SMITH, G. H. E., as well as SMITH, G. H., would be obtained by the second entry. The match occurs only on those characters specified and, if they match the entry in the citation, a possible hit occurs and the rest of that inquiry is processed.

(11) Limit Code 15 Sort Output

Format:

cc 7	13
15	ACC

No action is taken upon reading this card, however, it can be used by IS&R personnel for documentation control. The IS&R NASA Retrieval System is not limited to the sort options specified in the NASA Documentation (cited previously).

(12) Limit Code 16 - Hit Limit

Format:

cc 7	13
16	0025

This card will limit the total hits on the inquiry to the number specified. The maximum that can be specified is 9999. A message is printed at the end of the run signifying that the inquiry process was terminated due to reaching the hit limit

(13) Limit Code 40 - Terms

Format:

cc 7	9	11	13
40	bA	ts	HYDROGEN

The subject terms to be searched for in the citation are punched one per card in a type 40 card. They need not be in any order. If the given term will be referenced in the equation, an alphabetic identification must be placed in cc 9 and 10. A given combination of letters must not be double used in an inquiry.

If weighting factors are to be employed, they are punched in cc 11-12 (right or left justified). The term is punched starting in cc 13 as found in the Subject Terms Index. If it is desired to look only for published terms (those tending toward "precoordination"), a P must be punched in cc 61. As the terms are found in a given citation, a flag is set to a hit condition for that term. The weight, if specified, is added to the accumulated weight of the citation for that inquiry. The maximum generated weight should not exceed 4095. Hit flags are tested by the equation to determine if the citation is a hit. The accumulated weight is tested to see if it exceeds the minimum acceptable weight (type 49 cards). If terms are used, the weight limit card (49) or the equation (50-59) must be specified to interrogate the hit flags of the terms.

(14) Limit Code 49 - Weight

Format:

cc 7	13
49	2[illegible]

The minimum acceptable weight is tested against the accumulated weight of the citation collected by the [illegible]rm hits to determine if the citation should be processed further. It is punched as a one or two-digit number in cc 13-14. If the weight does not satisfy the minimum, no further processing of that citation occurs for the inquiry.

(15) Limit Code 50- 9

Format:

cc 7	13
50	A · (B + C)$

The equation is started on a type 50 card and is continued as necessary on cards 51-59. The following rules and restrictions apply to the equation:

1. Use + to indicate logical "or".
2. Use . (period) to indicate logical "and".
3. Use - to indicate logical "and-not".
4. Use parenthesis () to avoid ambiguity.
5. Use A if the equation has only one term; do not use +A as the start of any equation or parenthetical expression.
6. Use $ to terminate the equation.
7. Do not punch the equation in columns 80 or 81.

The equation is checked for validity when read. Illegal combinations of operators and terms cause diagnostics to be printed. The following must not occur in an equation:

1. No blank characters are permitted.
2. Two successive operators are not permitted.
3. The equation must end with a letter (signified by A) or right-hand parenthesis ")".
4.) and (must be separated by an operator.
5. A and (must be separated by an operator.
6.) and A must be separated by an operator.
7. Parenthesis must match, a (must precede any).

The equation is evaluated according to certain rules using the hit flags collected by the type 40 cards. In this program, hits are represented by ones and nonhits by zeros. The equation is scanned for the innermost set of matching parentheses; all terms within this set are evaluated by use of the follow-

ing tables:

+	A 0	A 1
B 0	0	1
1	1	1

(A + B)

.	A 0	A 1
B 0	0	0
1	0	1

(A · B)

-	A 0	A 1
B 0	0	1
1	0	0

(A - B)

If there is no initial operator, a work value of one is assumed and the first operand is applied to the work value with the logical AND function. Each operand is applied to the current work value by its preceding operator. When the expression is done, the work hit value (zero or one) is saved and the equation is examined for other nonevaluated expressions. The saved value of the expression is applied to the work value by the preceding operator during the processing of nested expressions. When all parenthetical expressions have been evaluated, the total equation is evaluated by the above rules, and the work value (0 or 1) is saved to determine the presence of a hit.

2. Program Run Instructions

a. Tape Setup

TM-1: A tape of NASA linear file converted data. This must be in IS&R Internal Format.

TM-3: A scratch tape (with write ring)

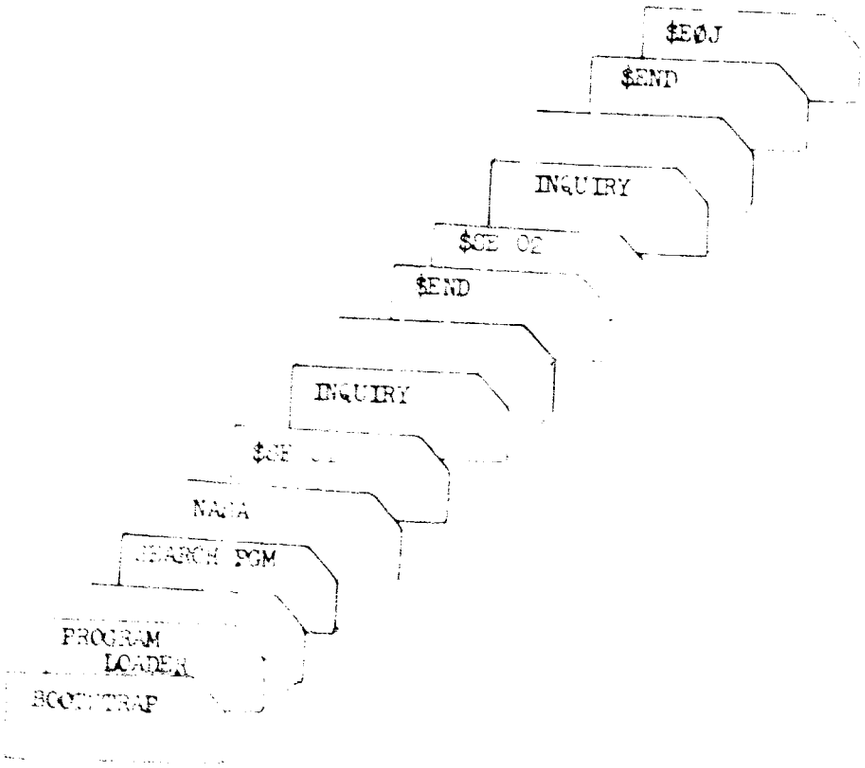
b. Deck Setup

Program deck consisting of:

(1) Bootstrap
(2) Program Loader
(3) Program and Change Cards
(4) End Card

Spec Deck

This deck must follow the program deck and is set up as shown in Exhibit 3-1.


$EØJ
$END
INQUIRY
$CE 02
$END
INQUIRY
$CE
DATA
SEARCH PGM
PROGRAM
LOADER
BOOTSTRAP

c. Operating Instructions

(1) Place desired tapes on the proper units, and ready at load point.

(2) Clear bank controls and master clear.

(3) Press load, start, processing begins.
Modification: Halt P = 6592 to enter specs, start.

(4) The first normal halt occurs at P = 0171, A = 0000.

If there are more tapes to be searched, set A = 0001, start, halt at P = 0205, A = 0000.

Remove/replace with next tape on Unit 1, ready, start, searching continues.

If all tapes have been searched, set A = 0002, start to conclude run. Printer records number of hits against each search.

d. Options

If TM-3 nears end of reel, set SLJ-1 on, halt P = 3470, A = 0000. Remove. Replace TM-3 with new scratch tape (ring). Set SLJ-1 off, start to continue.

e. Error Halts

(1) Errors during card spec processing. Card format errors are printed using a code.

0000 Read comp error.
0001 Illegal card type (spec).
0002 Numeric or nonmatching accession series.
0003 No - sign between lower upper limit.
0004 No, separator.
0005 Improper length accession range.
0006 No. separator.
0007 Improper length of corporate-source entry.
0010 Illegal spec card.
0011 Spec number exceeds 10.
0012 Cards out of order.
0013 Illegal boolean operator.
0014 No weight specified.
0015 Mismatched parenthesis in equation.
0016 Blank character in equation.
0017 Missing operator between) and (.
0020 Three or more letters as an operand.
0021 Equation does not end with letter or).
0022 Two operators in line or no letter between operator and).
0023 No letter between (and).
0024 Illegal character after).
0025 Letter in equation is not specified by the card.

c. Operating Instructions

(1) Place desired tapes on the proper units, and ready at load point.

(2) Clear bank controls and master clear.

(3) Press load, start, processing begins.
Modification: Halt P = 0552 to enter specs, start.

(4) The first normal halt occurs at P = 0171, A = 0000.

If there are more tapes to be searched, set A = 0001, start, halt at P = 0205, A = 0000.

Remove, replace with next tape on Unit 1, ready, start, searching continues.

If all tapes have been searched, set A = 0002, start to conclude run. Printer records number of hits against each search.

d. Options

If TM-3 nears end of reel, set SLJ-1 on, halt P = 0170, A = 0000. Remove. Replace TM-3 with new scratch tape (ring). Set SLJ-1 off, start to continue.

e. Error Halts

(1) Errors during card spec processing. Card format errors are printed using a code.

0000	Read comp error.
0001	Illegal card type (spec).
0002	Numeric or nonmatching accession series.
0003	No - sign between lower upper limit.
0004	No. separator.
0005	Improper length accession range.
0006	No. separator.
0007	Improper length of corporate-source entry.
0011	Illegal spec card.
0012	Spec number exceeds 10.
0013	Cards out of order.
0021	Illegal boolean operator.
0022	No weight specified.
0023	Mismatched parenthesis in equation.
0024	Blank character in equation.
0025	Missing operator between) and (.
0026	Three or more letters as an operand.
0027	Equation does not end with letter or).
0030	Two letters in line or no letter between operator and).
0031	No letter between (and).
0032	Illegal character after).
0033	Letter in equation is not specified by [illegible] cards.

Any errors occurring during spec processing cause the message, "Problem not accepted", to be printed and that spec will be ignored.

Modification: A halt will occur at P = 6557, A = number of errors.

(2) Errors during tape process phase:

P = 0272, A = ****. Spec number is set to zero, run is good, and has EOF TM-3.

P = 0303, A = 0000. Spec number is set to zero, run is good, and has EOF TM-3.

P = 3427, A = 0004. Parity error after 16 tries to read. Set A = 0000, run to accept with error.

P = 3570, A = 7777. SLJ-1 is on, Set SLJ-1 off, start, to continue.

A = 0200. TM-3 is busy, wait until TM-3 is ready, start.

A = 0002. TM-3 is not ready, correct and start.

A = 0000. TM-3 is not at load point, correct and start.

A = ****. A-register set to non-zero at P = 3570. Start to continue.

P = 3672, A = ****. No ID found after lookup for a key. Nonrecoverable.

P = 3732, A = 0000. Incorrect temporary address of first key of multiple set. Nonrecoverable.

P = 4010, A = 0000. Incorrect number of parenthesis found during skip processing. Nonrecoverable.

P = 4013, A = 0000. Same as P = 4010.

P = 4020, A = ****. Same as P = 4010.

P = 4074, A = ****. Incorrect code encountered during equation evaluation. Nonrecoverable.

P = 4117, A = ****. Trying to evaluate a code of 0 or 1. Nonrecoverable.

P = 4120, A = ****. Same as P = 4117.

P = 4207, A = 8888. Trying to process an invalid code, A shows code, nonrecoverable. Start to display table address at P = 4211.

P = 4211. See P = 4207.

P = 4302, A = 0000. No OKACCESS key found in the Searchable Record. Start to bypass this spec for this SR.

P = 4442, A = 0000. Same as P = 4302.

P = 4566, A = 0000. Same as P = 4302.

P = 5562, A = ****. Incorrect evaluation of expression. Nonrecoverable.

P = 5602, A = 000. Run past end of data during equation, evaluation. Nonre overable.

P = 5622, A = ****. Same as P = 5565.

P = 5701, A = ****. Pointer lost during type 15 process, table wrap-up, did not reference a 0001 table code. Nonrecoverable.

P = 5342, A = ****. Invalid boolean operator code referenced. Nonrecoverable.

(3) Special features, editing consideration.

The NASA Linear File was converted to standard IS&R format, but incorporated special features to provide faster processing. The standard 8-character modules (buckets) are used incorporating the 2-flag characters and 6-key or data characters. The 3rd bucket contains a key that points to the first and last entries of the term field. Its form is OKTLFFLL where OK is the flag, TL is the mnemonic, FF is the location relative to the first of the logical record in binary representation, LL is the location of the end of the field relative positions of the terms or the value of the key OKTLFFLL. The first six letters of a term are coded in each key to prevent having to obtain a complete match on a key and then determining if the data field examined is the term wanted. For example, the term "aerospace" normally coded:

OKKEYWRD 3CAERØSP 3CACEbbb ,

is coded:

1KAERØSP 3CAERØSP 3CACEbbb .

The 1K (or 3K, if a published term) avoids any ambiguity with other keys (having only OK flags).

The fixed-field data from the start of the NASA record is placed in keys only as shown in the table on the following page.

KEY	KEY CHARACTER POSITION	DATA FIELD
QKXA3456	3,4	Journal Issue Number
	5	Document Classification
	6	Title Classification
QKXB3456	3	Declassification Group
	4,5	Announcement Subject Category (01-34)
	6	NASA Supported
QKXC3456	3	Noform (No Foreign Release)
	4	Conference or Symposium Proceedings
	5	Corporate Source Supplementary
	6	Author's Corporate Affiliation
QKXD3456	3	Foreign Document
	4	Receipt Type
	5	Searchable Record
	6	SR Language
QKXE3456	3,4	Document Language
	5	Reproducible Code
	6	Copyright Code
QKXF3456	3	Microfiche to be made
	4,5	Document Type
	6	Microfiche Code Prefix
QKXG3456	3	Microfiche Code Suffix
	4	Document Classification
	5	Handling
	6	"Et Al" following the Author
QKXH3456	3,4	Source - NASA/Country Code
	5,6	Foreign Origin
QKXI3456	3,4,5,6	Number of Pages
QKXJ3456	3,4,5,6	COSATI Subject Category

Although not normally needed, editing with the standard IS&R programs can be accomplished if the above limitations are observed.

TABLE 3-2. FIXED-FIELD DATA CONVERSION TABLE.

(4) Output Considerations

Any given record that is a hit receives a code representing the inquiry that is satisfied. This code is a bit that is turned on in the seventh and eighth characters (12 bits total) of the first "bucket" in the record. During output formatting, any bit or combination of bits can be tested to split the output file into its parts as determined by the spec inquiry number.

If weights are collected, they are placed in the output record in the format:

OWHFNNNN,

where OW is the flag. HF is the hit flag in bit configuration as above, NNNN is a four-character decimal weight value.

Because of the special keys, flags, and size, the IS&R processing language program (SIMPL) must be used for output formatting instead of the normal Formatter program.

(5) Spec Examples

Certain spec examples, along with an explanation of equation evaluation, can be found in Exhibit 1.

3.9 NASA SEARCH PROGRAMMER INFORMATION

1. General Description

The NASA Search Program is a list, or table processor. Each card type generates certain entries in a list, and when processing occurs, each entry in the list is processed according to its type. The various functions being performed have the "responsibility" of keeping track of the length of its table entry and leaving the list pointer at the proper place. Each spec entered into the total table starts with an information area set up by the $ SE NN card. The entries in this area keep track of the number of the spec, the count of hits, weight, addresses to be used if certain conditions occur, etc.

2. Table Formats

The following are the table formats set up by the cards outlined in paragraph 3.8, subparagraphs 1 and 2. The formats are listed in the order they would normally occur in a spec.

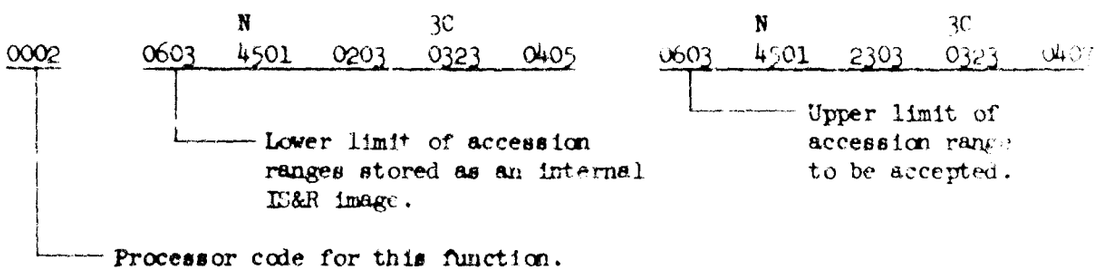
a. $ Search 04

The spec information area is set up according to the following list:

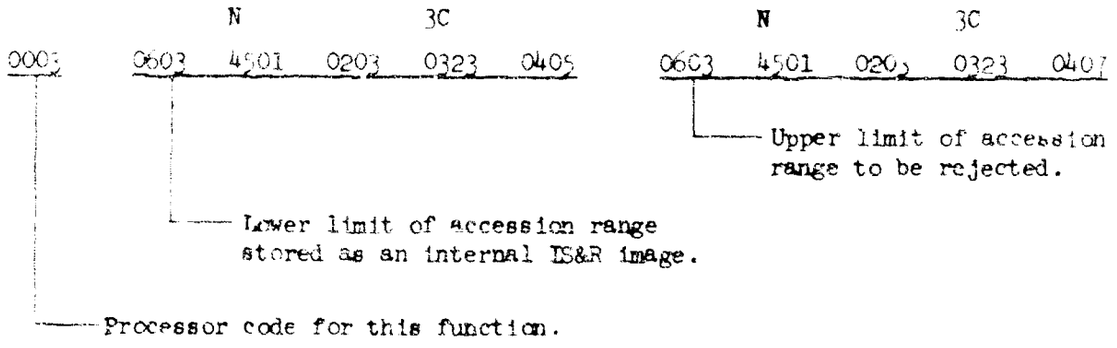
0001	Function Code.
0000	Hit this SR? 0 = No., 1 = Yes.
0010	Number of this spec (binary bit position 1-12).
	LWA+1 of this spec.
	Weight of this spec (in binary).
	Last positive accession range entry LWA+1.
	Last corporate source entry LWA+1.
	Last contract number entry LWA+1.
	Last author entry LWA+1.
	Hit counter in BCD characters.
	Hit counter.
	Hit counter.
	Hit limit reached, 0 = cont. 1 = bypass.
	Weight address, ≠ 0 if present.
	Last report number entry LWA+1.
	Last SR range entry LWA+1.
	Last field entry LWA+1.
0000	Spare cell for expansion.
0000	Spare cell for expansion.
0000	Spare cell for expansion.

b. Positive Accession Range

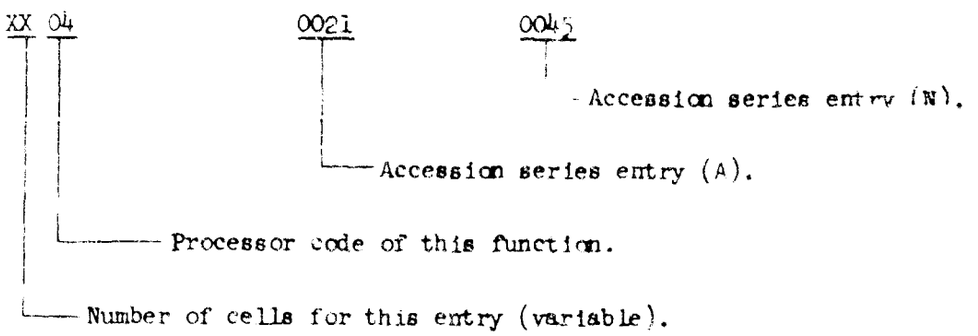
The following are the entries for this function. All others will be listed in this form.



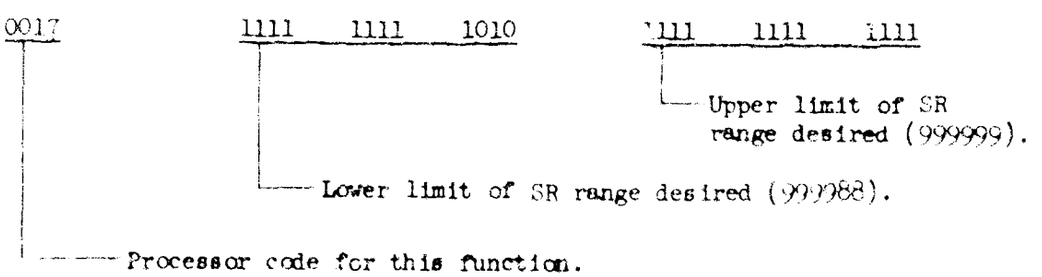
c. Negative Accession Range



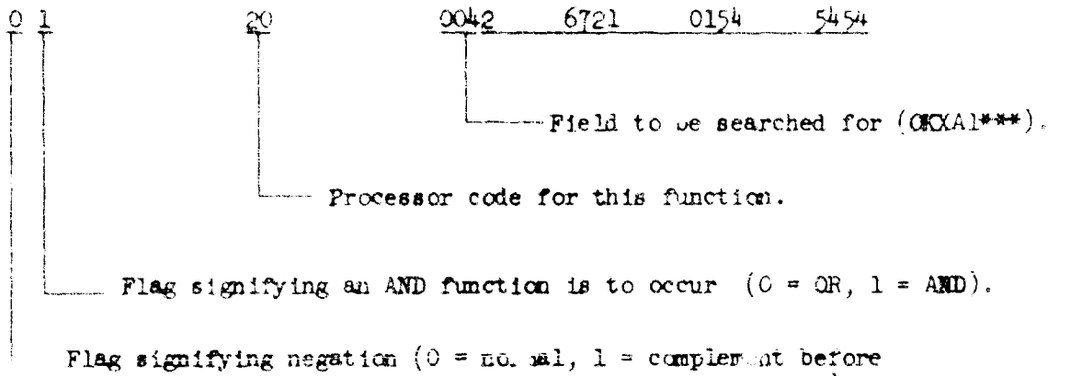
d. Accession Number Series



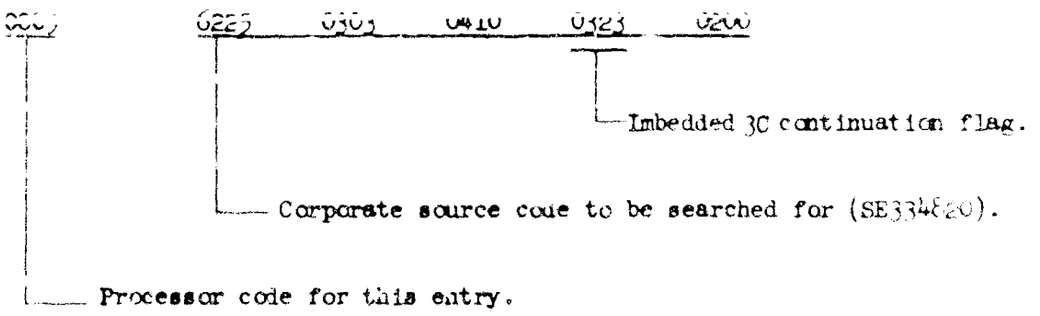
e. SR Range



f. Field Search

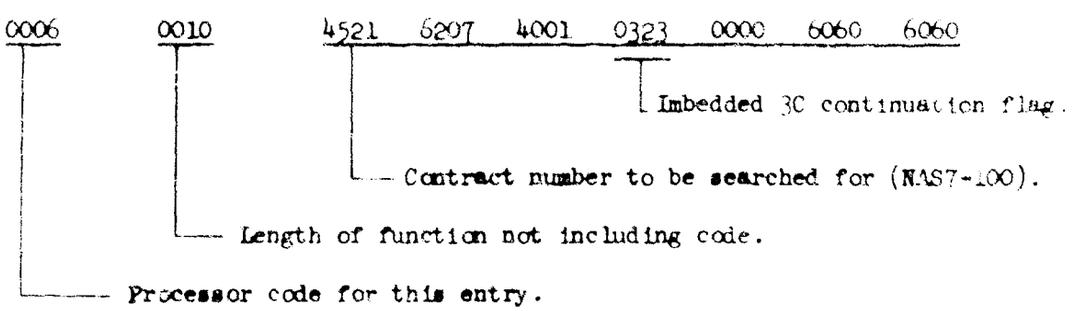


g. Corporate Source

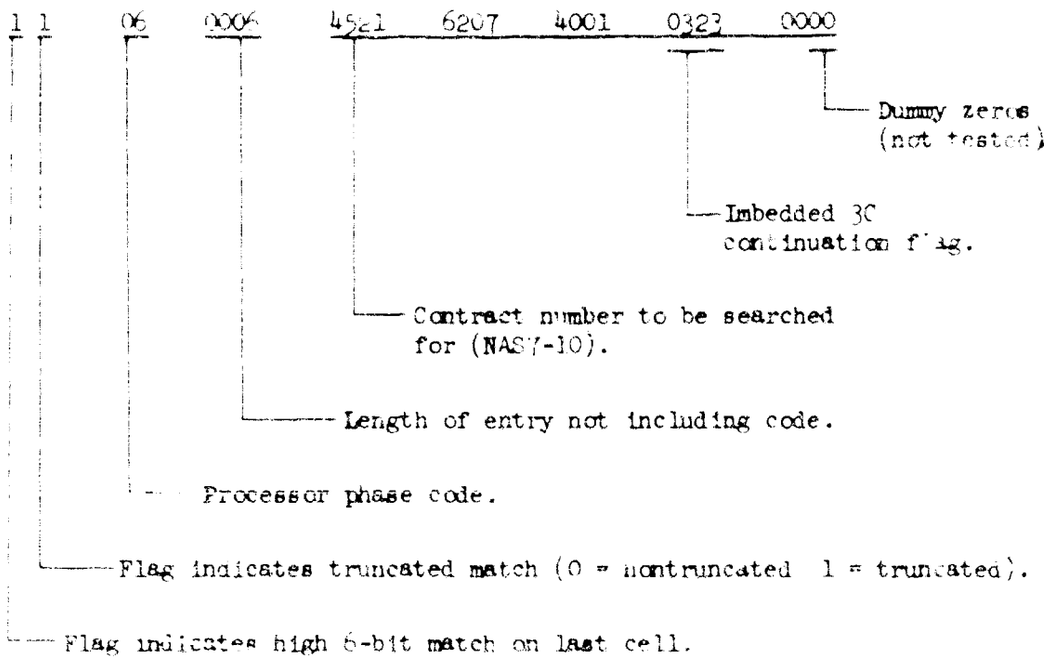


h. Contract Number

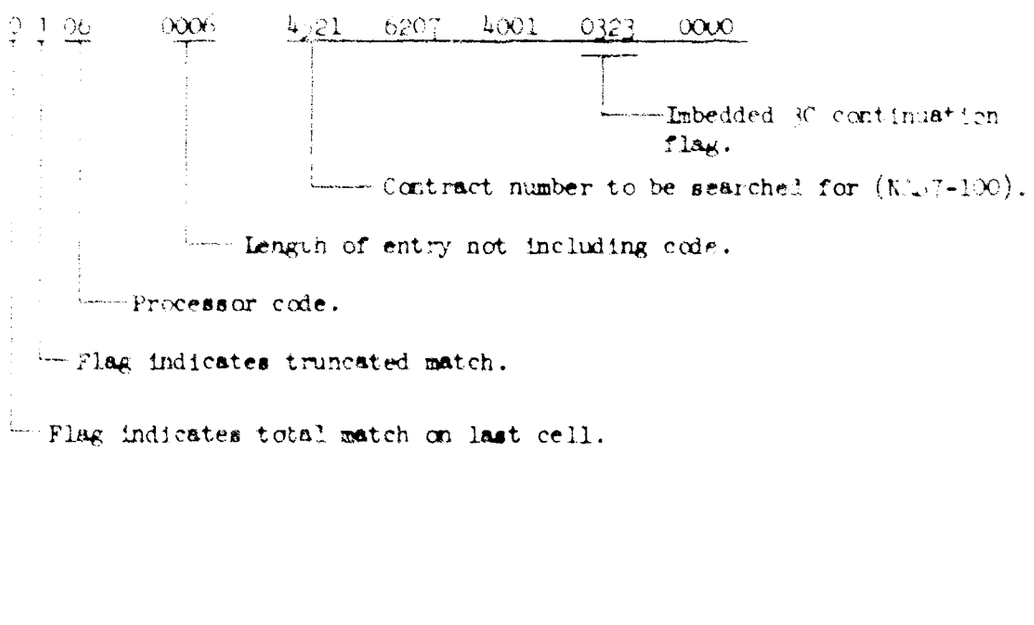
Exact match:



Truncated match (end with high 6-bit comparison)



Truncated match (end with full-cell comparison)



1. Report Number

0016 0010 2724 2340 2551 0323 5140 0102 0360

1116 0006 2724 2340 2551 0323 5100

0116 0003 2724 2340

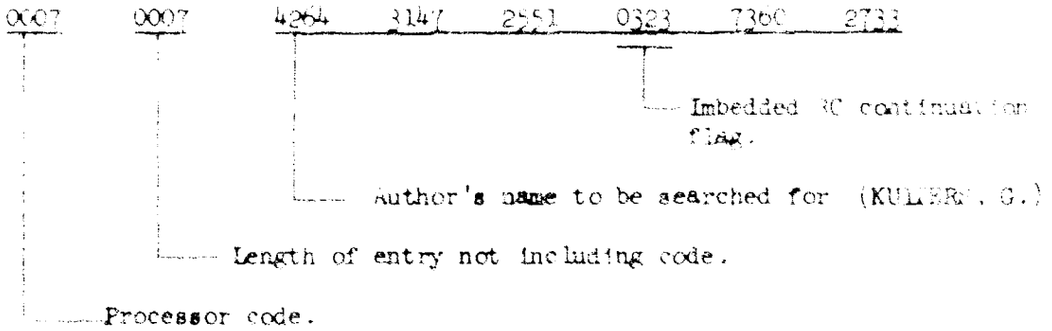
This type is similar to Contract Number (h.) above.

The data fields tested [illegible] are, in order of the above coding:

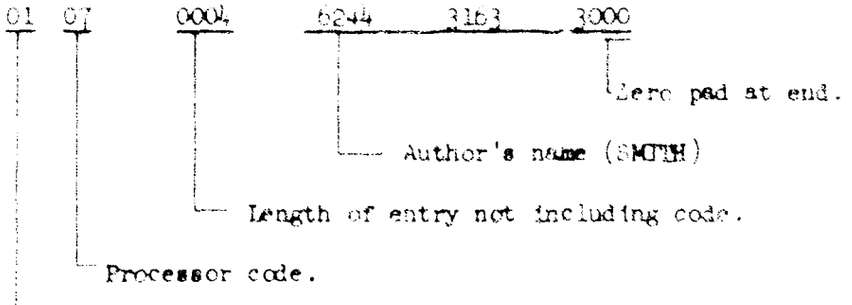
GDC-ERR-123
GDC-ERR
GDC

J. Author

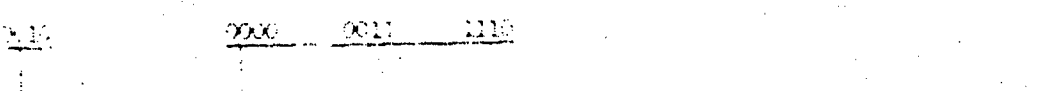
Full word comparison at end.



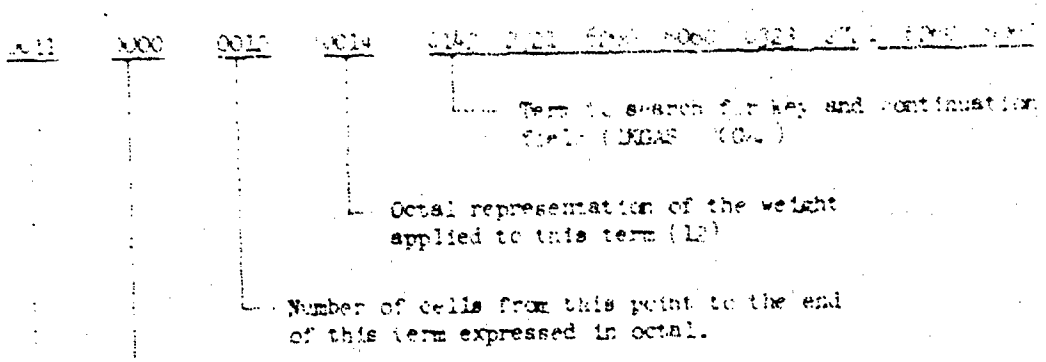
High 6-bit End Comparison.



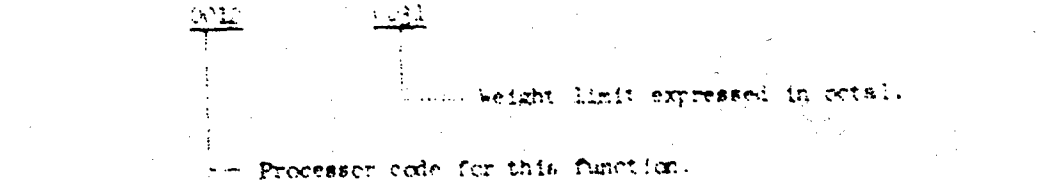
a. Hit Limit



b. Term



c. Weight



n. Equation

0013 0011 0102 0003 0005 0007 0212 0002 0024 0006

- 0013: Processor code for this entry.
- 0011: Length of entry not including code.
- 0102: Equation in internal (program) code as follows:

0000 - An evaluation of a parenthetical expression equal to a non-hit.

0001 - An evaluation of a parenthetical expression equal to a hit.

0002 - The logical or boolean operator.

0003 - The logical and boolean operator.

0004 - The logical not-and boolean operator.

0005 - A left-hand parenthesis.

0006 - A right-hand parenthesis.

0007 - A symbol specifying that an expression has not been evaluated, set to 0, or 1 when evaluated.

All others are the table address of the hit flag of the ter- referenced (see 1. above)

o. End of Spec

0014

- Code signifying end of this search problem.

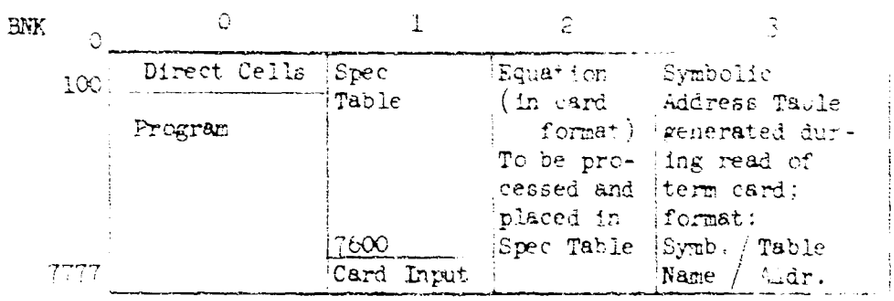
p. End of Table

0015

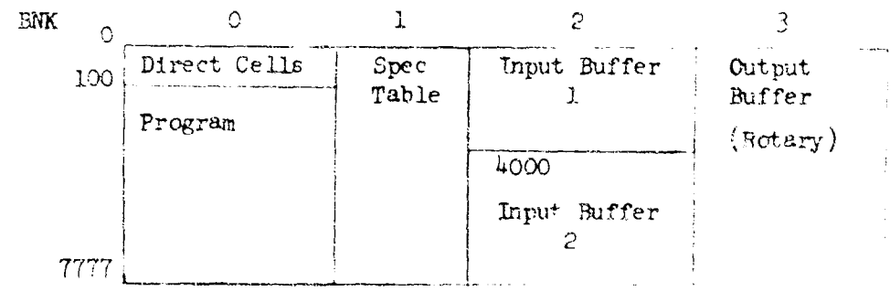
- Code signifying that all problems have been processed for a given citation.

3. Core Layouts

The following is a layout of core during the initial processing of the spec input cards:

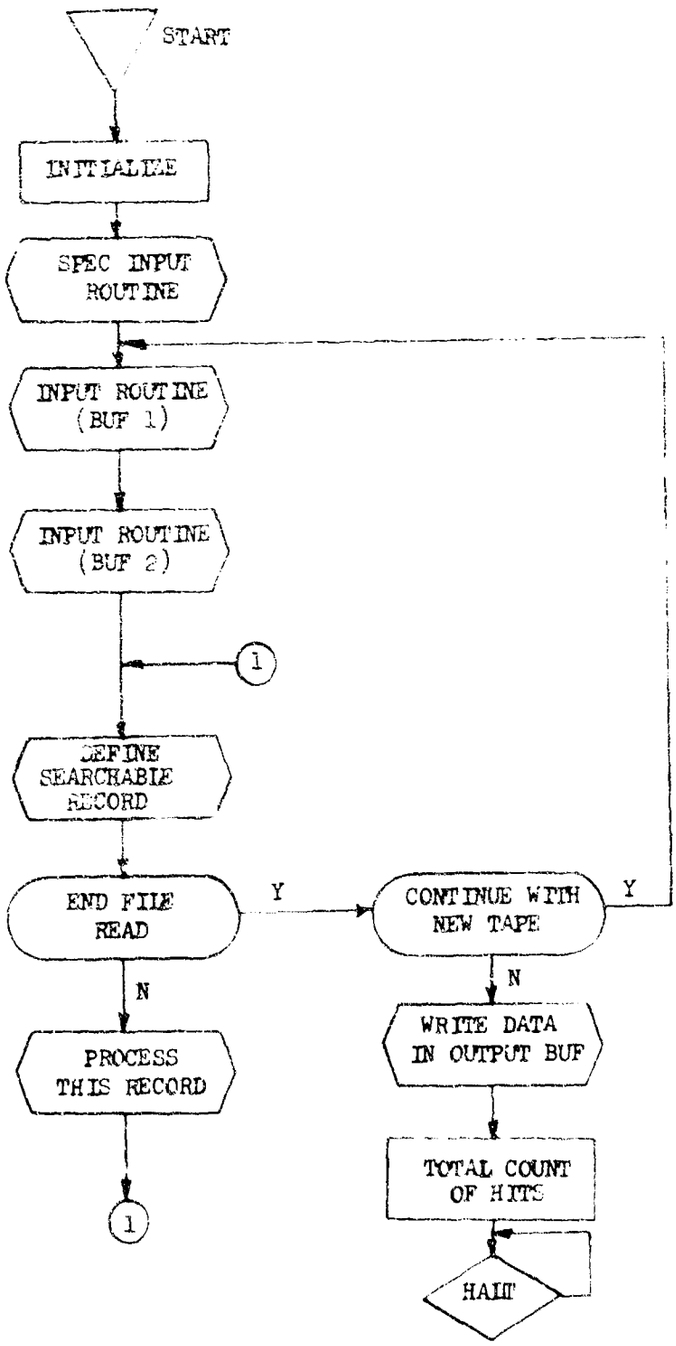


The following is a layout of core during the searching phase of the program:

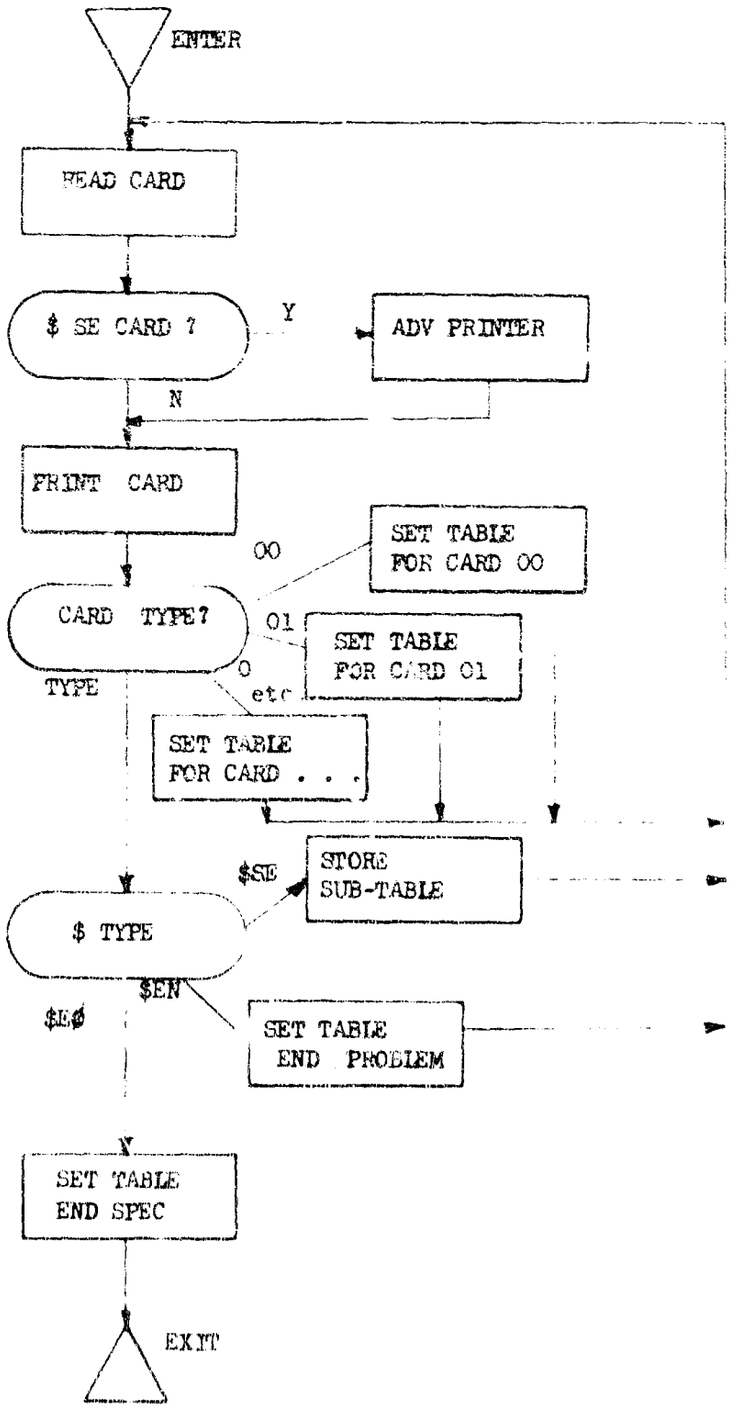


4. General Flow Charts

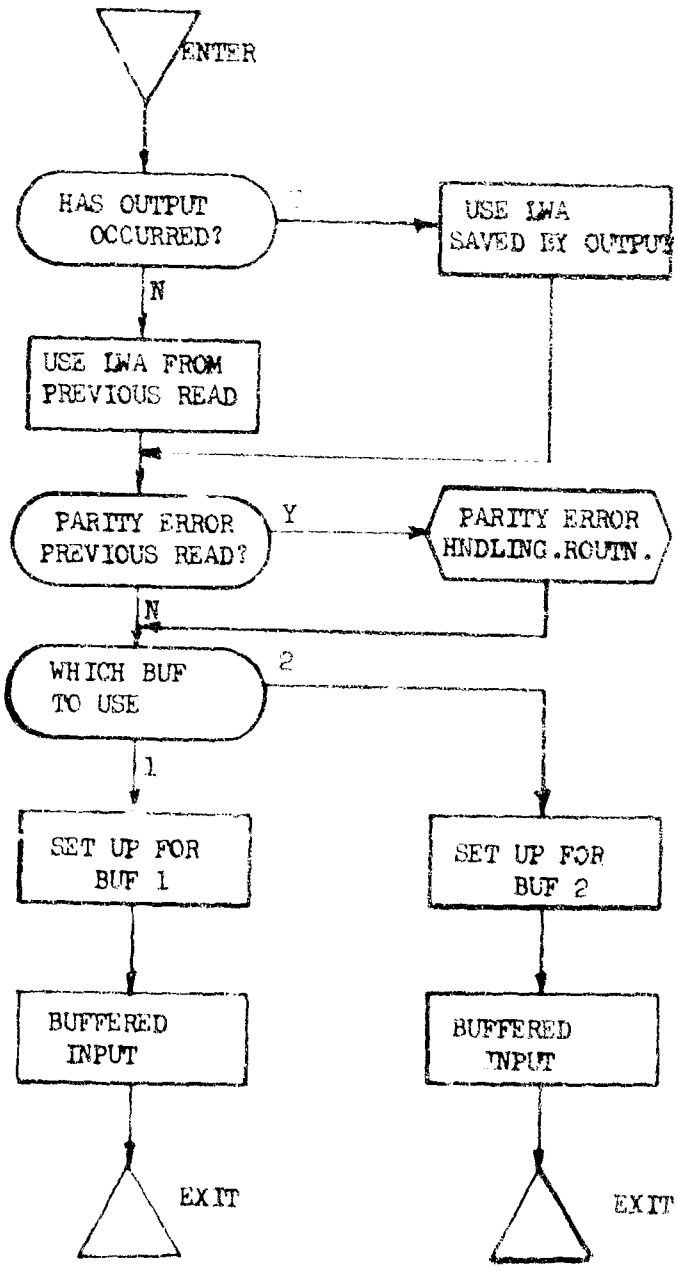
The following flow charts are intended to provide guidance in examining program logic. Certain charts are intended to show the more complex process functions.



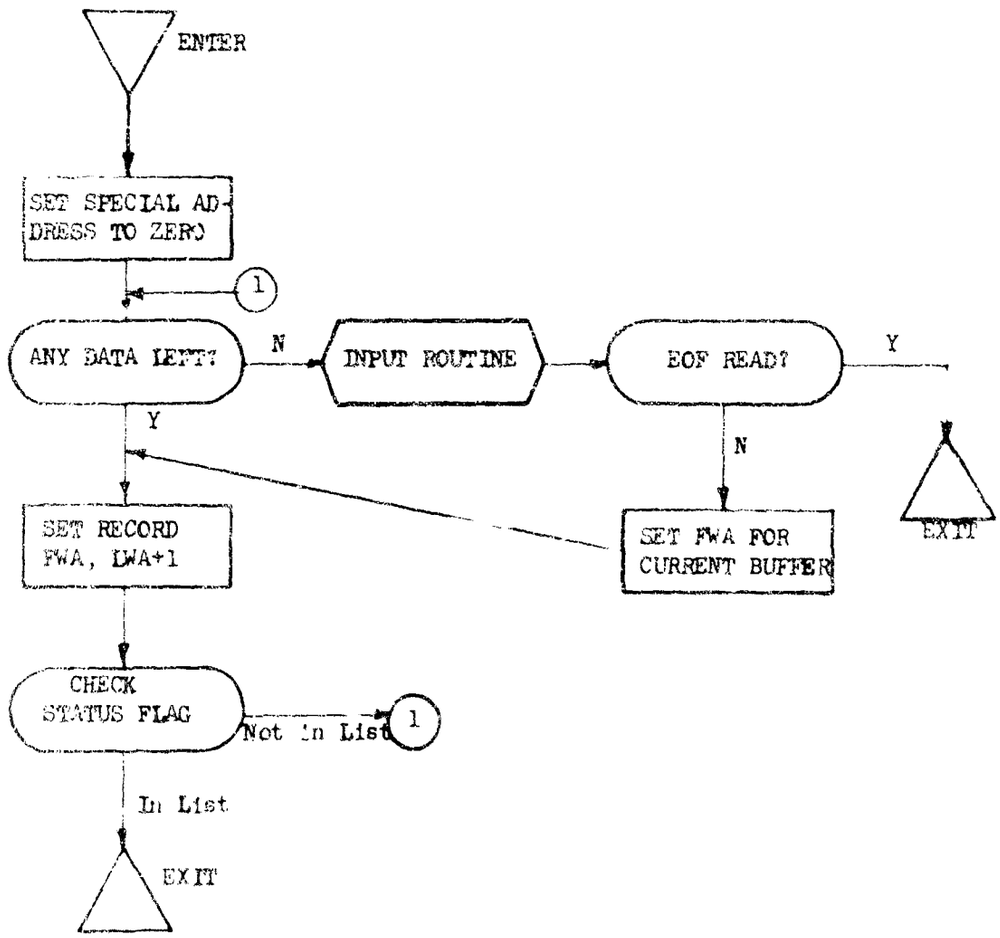
FLOW CHART 3-11. MAIN DRIVER. (SEARCH)



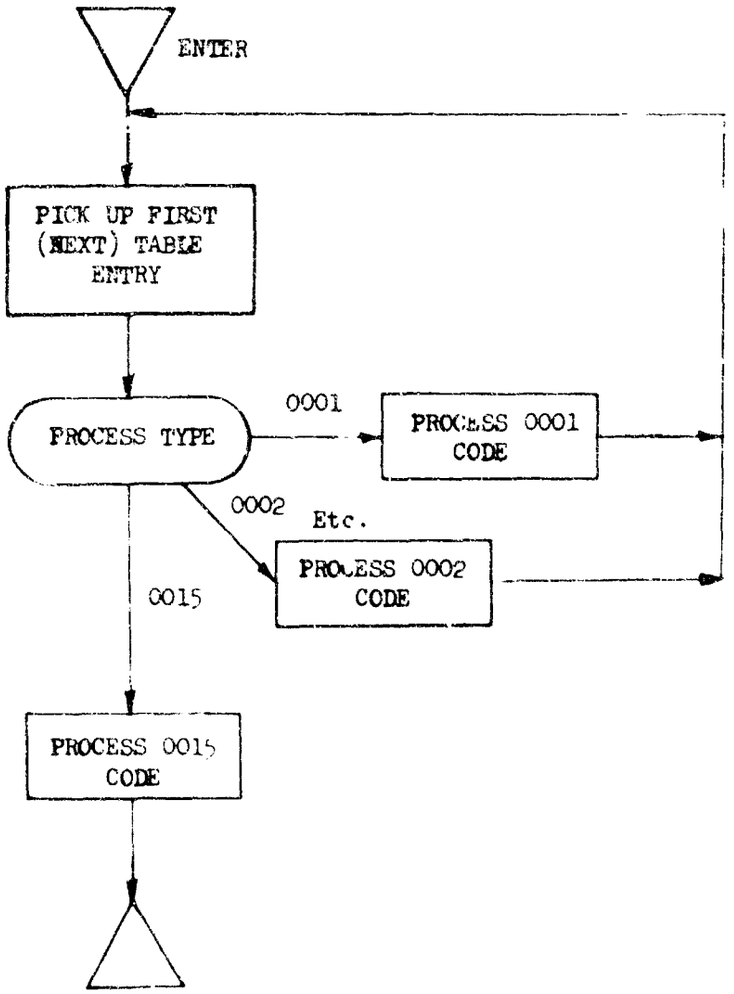
FLOW CHART 3-12. SPEC INPUT ROUTINE (SEARCH)



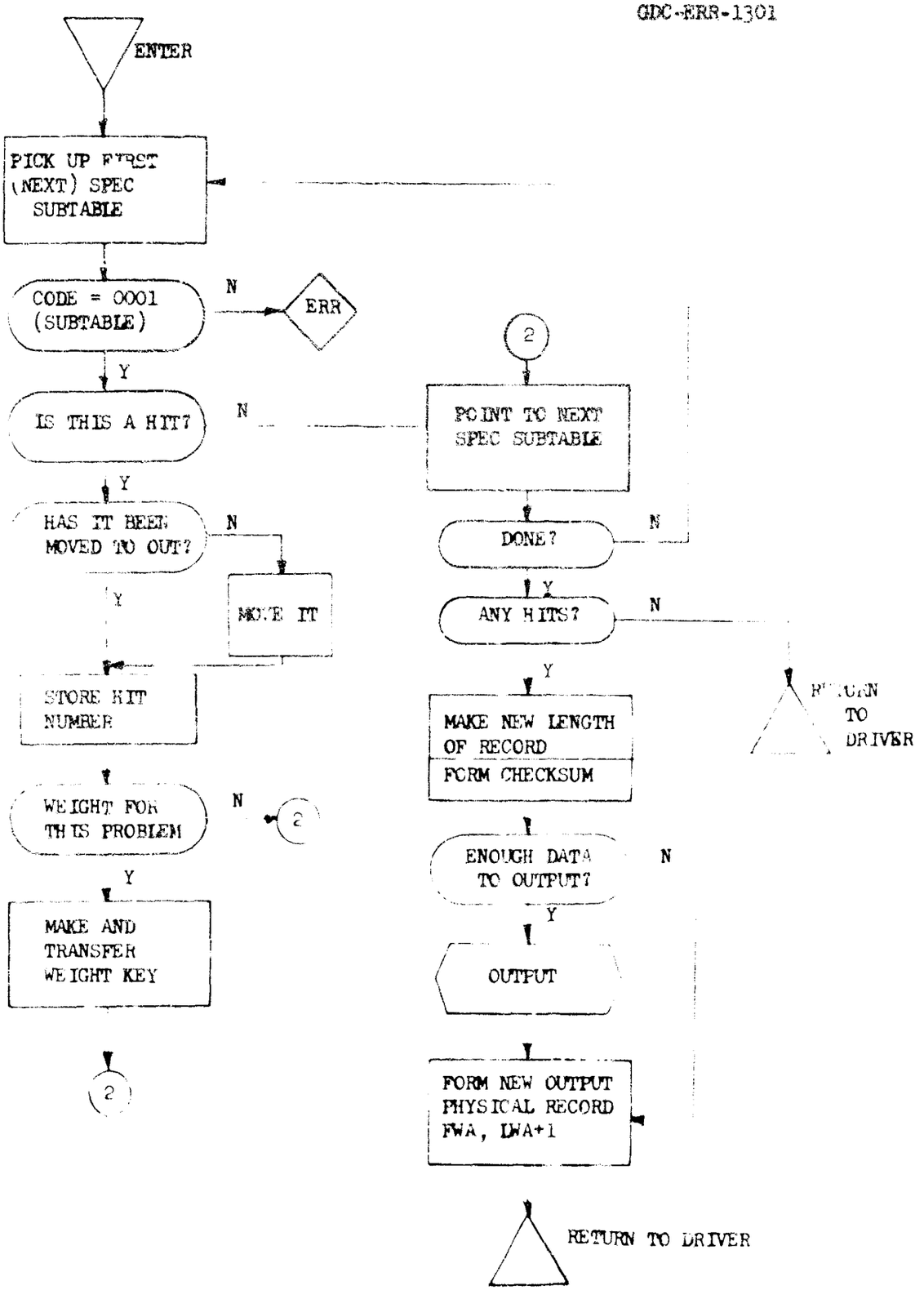
FLOW CHART 3-13. INPUT ROUTINE. (SEARCH)



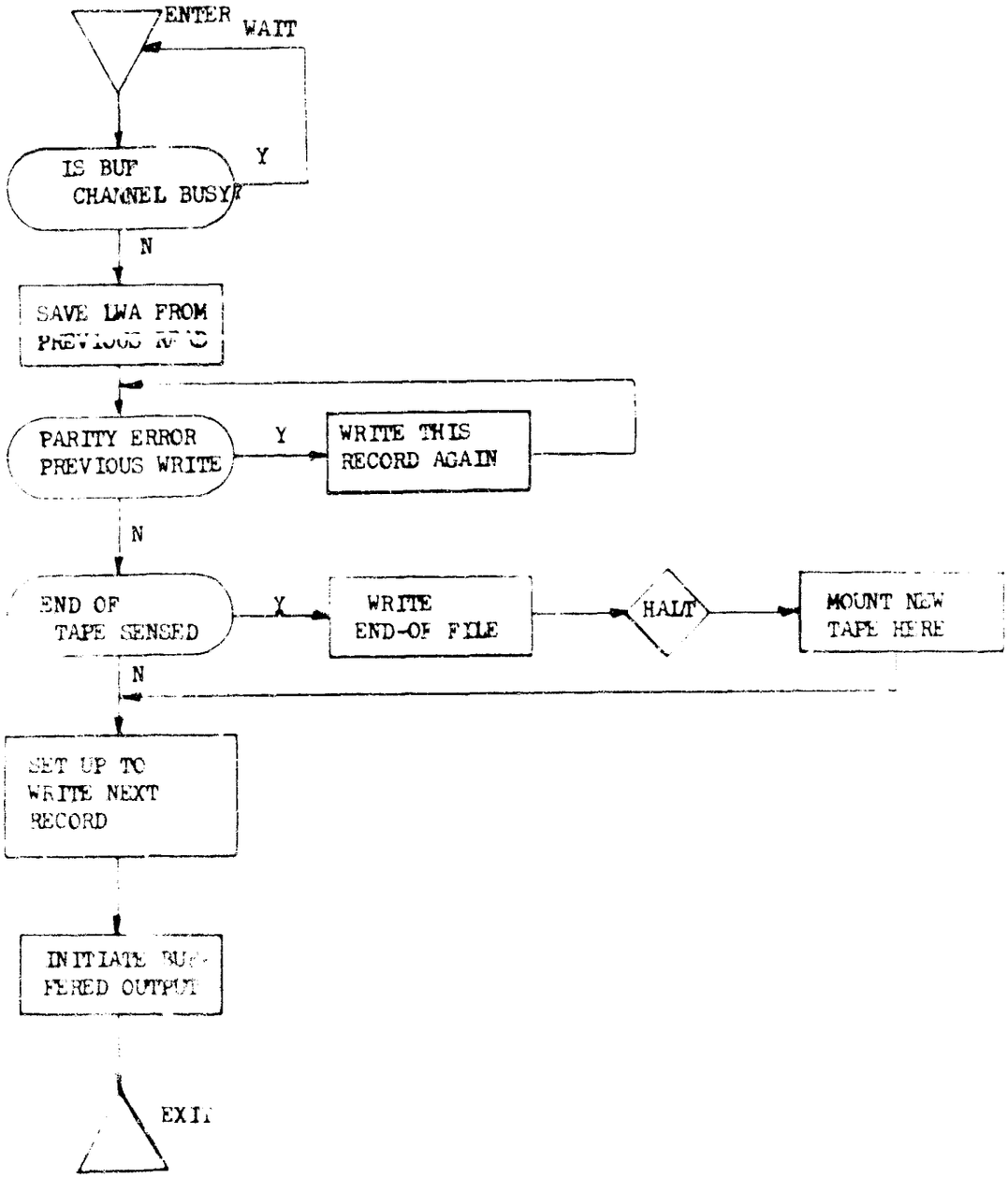
FLOW CHART 3-14. DEFINE SEARCHABLE RECORD, (SEARCH)



FLOW CHART 3-15. PROCESS ROUTINE. (SEARCH)



FLOW CHART 3-16. PROCESS 0015 CODE. (SEARCH)



FLOW CHART 3-17. OUTPUT ROUTINE. (SEARCH)

SECTION 4

CONCLUSIONS

4.1 WHY PERFORM CONVERSION?

1. Experience at Convair shows a daily advantage in having a system operating in a software environment that is familiar and controllable. The inevitable program difficulties constantly encountered are solvable quickly.

2. Innovations become available that would be difficult to achieve when dealing with a "canned" software package that is usually not easily disected and reorganized.

3. Ability to cross reference and blend between different data bases becomes natural because they share the same software environment.

4. The basic general-purpose IS&R System increases its capability by learning from the converted system and therefore implementing concepts that were inherent within the original nonconverted system. This makes these concepts available to other converted systems where they could not previously be employed.

5. Where duplicate material is employed in two different data bases (or sources for these data bases) there is the opportunity to merge these duplications and actually perform a depth indexing or enhancement of the data beyond what either system could offer.

4.2 WHAT ARE SOME STEPS PRECEDING CONVERSION?

1. A general-purpose system may be in existence and have reasonable previous operational experience. It is improbable to be able to design both a

conversion and a general-purpose system concurrently without unduly biasing one or both. The general-purpose system must exist as truly "general purpose" and not be solely data base or application oriented.

2. Adequate detailed documentation of the system to be converted is mandatory. This should include detailed understanding of the intents and philosophy of system objectives beyond mere coding.

3. Because there is little opportunity to change the established system upstream of the proposed converted mechanization, the converted system must be flexible enough to accept the supplied data base with no disturbance or requirement imposed upon the existing nonconverted system. Also, awareness of potential or planned change to the original data base and formats must be considered and accounted for with capability for input flexibility in the converted system.

4.3 WHAT ARE SOME CUSTOMER OR USER REQUIREMENTS?

1. The existing nonconverted system usually has a tradition of procedure in how it is used. The converted system must not change this procedure. Ideally, the personnel using the previous system should be unaware of any change of the data-base-mechanization environment other than increased capability that might become available.

2. All output reporting must be the same as the previous nonconverted system except for possible increase capability over what was originally available.

4.4 WHEN SHOULD CONVERSION BE CONSIDERED?

1. When a data base and system become difficult, inefficient or costly to use because of lack of intimacy with the software design and therefore ability to perform changes or modification to the software.

2. When increased flexibility of search and output is desired beyond that offered by the existing system.

3. When it is desired to track or correlate this data base with other data bases.

4.5 WHO PERFORMS A CONVERSION?

The work of converting is done by programmers. The specifications are designed by information specialists. At Convair we are fortunate that our programmers, working in the IS&R System, are information specialists and do not work divorced from the other 75% of the group.

4.6 SOME STATISTICS AND OPERATING CHARACTERISTICS ON THE ACCOMPLISHED CONVERTED NASA SYSTEM.

The conversion of the data base consumed approximately 4 man-months of labor over a 2-month period to go operational.

One tenth of 1% of the records encountered a problem during conversion. These were printed out and manually edited and keypunched for entry. Out of 300,000 records in the data base, 300 have some minor discrepancy but are nevertheless searchable and contain the essential data of title, descriptors, and document idnetification.

Data fields not previously searchable may now be employed.

Some typical output formats are included in the appendix to this report. New formats, or radical changes to these examples, can be made at a cost averaging 2 manhours for coding instructions. The new format will henceforth be available at no development cost.

The search program will handle 70 descriptor terms apportioned to a mix of 12 different inquiries run simultaneously. This is only an optimum ratio used as a rule of thumb. Actually, 200 terms could be employed, for example, but it would be desirable to have less than 12 inquiries batched, otherwise the total logic to compare would cause the system to be computer bound and therefore slow.

The master data base consists of 40 reels of tape and these are processed at an optimum rate of 7 minutes per tape.

The machine complex employed is a CDC 1604 and costs an average of $[illegible]/hour to operate.

It is possible to construct a complex, multiple inquiry which would result in being computation bound (not able to process at tape speed). To alleviate this, a rough cut is normally made using Boolean logic and terms that will assure capturing all candidate records from the selected data base subfile on a tape of hits while processing at input tape speed. The acquired one or two tapes of hits of candidate records obtained is then processed for satisfaction of the inquiries. On the average, this technique results in more than half overall total time savings on complex inquiries over the method of single-pass techniques.

SECTION 5

RECOMMENDATIONS

It is a little early to ascertain what the set of applicable general rules are for converting an existing mechanized data base to the Convair IS&R environment. This will be learned with more experience. Hopefully, the software employed can be modularized into a library of discrete routines that can be selected and linked together for a particular conversion. This would enable maximum salvage from previous work and the consequent conservation of time.

In 1969 it is planned to convert DDC, PANDEX, Navy APL and Navy 3M magnetic-tape data systems to the Convair IS&R System. This effort will provide invaluable experience toward the development of a general-purpose set of computer routines for handling all future conversion tasks.

APPENDIX

This appendix contains a selection of typical output reports for the purpose of illustrating the variety of formats and contents that can be provided by the system. Only one page of each report is used.

A data base such as the NASA Linear Tape System can be searched in response to almost any inquiry, regardless of complexity. The search process produces all the relevant records in their entirety. The system further permits the selection and display of specific data items from these records in innumerable formats based on individual user needs. The displays are generated by the S-C 4020 High-Speed Microfilm Recorder using a magnetic tape produced by the computer. This tape contains instructions for headings, drawing of lines, page numbering and selection of data. New formats can be designed in nominal time depending upon complexity. The S-C 4020 produces 16 mm/35 mm microfilm frames from which hard copy is produced in the quantities desired. The two black bars in the lower left-hand margin are cut marks for activating the paper cutter.

The following exhibits are examples of the individual outputs that can be produced by the system:

Exhibit A-1

This is one page of a typical output report. The original request was a search for literature specifically dealing with "Sandwich" construction.

Exhibit A-2

This is one page of an output report delivered to the General Dynamics Director of International Sales in Belgium. The request was to identify

available open literature on the Centaur upper stage electrical and electronic systems to assist on analysis and bidding in support of performing the design and fabrication of the electrical and electronic subsystems of ELDO's new upper-stage booster.

Exhibit A-3

This is one page of a report listing General Dynamics Research Reports. This data base has been organized and indexed with the same tesaurus and format as NASA's Linear Tape System. Being a companion piece of the converted NASA Linear Tape System, it can now be interrogated with the same inquiry at the same time. This is a good illustration of the possibility of integrating different data bases.

Exhibit A-4

This is one page of a report; a cross reference listing of report numbers versus NASA Linear Tape System accession number. Such devices are used by the Convair Library for rapid reference and they also give the Convair IS&R personnel insight into file structures that can expedite inquiry processing.

Exhibit A-5

This is one page of a report which has selected out only those General Dynamics reports contained within the converted NASA Linear Tape System.

TITLE- SANDWICH CONSTRUCTION
1962 THRU APRIL 1968
REQUESTER- E. SPIER DEPT. 587-0

GENERAL DYNAMICS CONVAIR DIVISION
NASA LINEAR TAPE SEARCH
NUMBER- 101A-02
NUMBER- 1010-02

LIBRARY AND INFORMATION SERVICES
DEPT 524-1 PHONE 277-8900 EXT 1073
DATE 26 APR 1968
** PUBLISHED ITEMS

&N17051
N67-17051 GRUMMAN AIRCRAFT ENGINEERING CORP., BETHPAGE, N.Y. ON THE DEFORMATION OF THICK, COMPOSITE, ORTHOTROPIC, CIRCULAR CYLINDRICAL SHELLS. PART I- ORTHOTROPIC, CIRCULAR CYLINDRICAL HOMOGENEOUS SHELLS. PART II- CIRCULAR CYLINDRICAL, SANDWICH SHELLS WITH ORTHOTROPIC CORES. TECHNICAL REPORT NO. 1 JACQUES CROUZET-PASCAL, JAMES B. MAHONEY, VITO L. SALERNO, AND ALLEN A. PIFKO SEPT. 1962 136 P 17 REFS CONTRACT NONR-3465/00/FBM. /RE-165/
CROUZET-PASCAL, J.
MAHONEY, J. B.
PIFKO, A. B.
SALERNO, V. L.

ACOUSTICS	APPROACH	CHARACTERISTICS
CIRCLE	COMPOSITE	CONSTRUCTION
CORE	CYLINDER	DYNAMICS
ELASTICITY	FLUID	HOMOGENEITY
INNER	LAYER	MEDIUM
MODE	ORTHOTROPISM	OUTER
REINFORCEMENT	RING	SANDWICH
SUBMERGED	THICKNESS	VIBRATION
*CYLINDRICAL SHELL	*DEFORMATION	*SANDWICH CONSTRUCTION
*SHELL		

&N14468
N63-14468 ILLINOIS INST. OF TECH., CHICAGO THE CARRYING CAPACITY OF CONICAL SHELLS UNDER CONCENTRATED AND DISTRIBUTED LOADS PHILIP G. HODGE, JR., AND JOHN A. DE RUNTZ, JR. FEB. 1963 43P /CONTRACT NONR-1406(04)/ /OCMIIT-1-22/
DE RUNTZ, J. A., JR.
HODGE, P. G., JR.

LOSS	CONE	LOAD
PERFECT	PLASTICITY	POINT
RIGIDITY	SANDWICH	SHELL
TRESCA FLOW	VERTEX	YIELD
*CONICAL SHELL	*LOADING	*SANDWICH CONSTRUCTION
*YIELD POINT		

&N20615
N65-20615 GRUMMAN AIRCRAFT ENGINEERING CORP., BETHPAGE, N.Y. THE FREE VIBRATIONS OF THICK, COMPOSITE, ORTHOTROPIC, CIRCULAR CYLINDRICAL SHELLS NYMAN GARNET AND FRANK NOLAN AUG. 1963 140P 13 REFS /CONTRACT NONR-3465/00/FBM// /RE-165/
GARNET, H.
NOLAN, F.

CIRCULAR	CONDITION	CORE
CYLINDER	EDGE	EQUATION
FORCE	FREE	MASS
ORTHOTROPISM	PLATE	SANDWICH
SHELL	SOLUTION	SUPPORT
THICKNESS	VIBRATION	
*CIRCULAR CYLINDER	*CYLINDRICAL SHELL	*FREE VIBRATION
*ORTHOTROPIC CYLINDER	*SANDWICH CONSTRUCTION	

&A41816
PLASTIC BUCKLING ANALYSIS OF RIB CORED CYLINDRICAL SANDWICH SHELLS SUBJECTED TO HYDROSTATIC PRESSURE TECHNICAL MEMORANDUM
24 MAR. 1964 176 P REFS
MILL, P. W.

BEHAVIOR	CONSTRUCTION	CORE
CYLINDER	LINEARITY	NONLINEAR
ORTHOTROPISM	RIB	SANDWICH
SHELL	STRESS	
*BUCKLING	*CYLINDRICAL	*ORTHOTROPIC SHELL
*SANDWICH CONSTRUCTION		

&A10480
DESIGN AND PERFORMANCE OF 60 FOOT C-BAND RIGID RADOME, CW-424/FPS-26.
IN- OHIO STATE U. AND USAF RESEARCH AND TECHNOLOGY DIV. /OSU-RTD/, SYMPOSIUM ON ELECTROMAGNETIC WINDOWS, 7TH, OHIO STATE U., COLUMBUS, OHIO, JUNE 2-4, 1964; PROCEEDINGS. VOLUME 2 COLUMBUS, OHIO STATE U., 1964. 27 P. 12 REFS.
DEAL, C. S.
DISCOLL, D.
GOLDEN, J. R.

ANTENNA	APERTURE	CONFERENCE
CONSTRUCTION	DESIGN	MAIN
MATERIAL	MODULE	PANEL
POWER	RADOME	RIGID
SANDWICH	SHELL	SKIN
SPHERICAL	STRUCTURAL	THICKNESS
TRANSMISSION		
*C-BAND	*RADOME MATERIAL	*RIGID STRUCTURE
*SANDWICH CONSTRUCTION	*SPHERICAL SHELL	*STRUCTURAL DESIGN

&A13436
STRUCTURAL OPTIMIZATION OF RIB- SANDWICH CYLINDERS SUBJECTED TO EXTERNAL PRESSURE.
AMERICAN SOCIETY OF MECHANICAL ENGINEERS, WINTER ANNUAL MEETING, NEW YORK, N.Y., NOV. 29- DEC. 4, 1964. PAPER 64 - WA/UNT-6. 9 P. 8 REFS.
MEMBERS, $0.50, NONMEMBERS, $1.00.
CHAO, H.
HOFFITZ, J. T.

BUCKLING	CONSTRUCTION	CROSS SECTION
CYLINDER	DIMENSIONAL	ELASTIC
EXTERNAL	OPTIMUM	PRESSURE
RIB	SANDWICH	SHELL
STABILITY	STRUCTURE	
*CYLINDRICAL SHELL	*ELASTIC BUCKLING	*SANDWICH CONSTRUCTION
*SHELL STABILITY		

&A17603
THERMAL STRESS AND INSTABILITY OF SANDWICH CYLINDERS ON RIGID SUPPORTS.
JOURNAL OF AIRCRAFT, VOL. 2, JAN.-FEB. 1965, P. 44-48, 9 REFS.
BIJLAARD, P. P.
GALLAGHER, R. H.
GERATY, R. A.

ANALYSIS	BUCKLING	CONSTRUCTION
CYLINDER	INSTABILITY	MATERIAL
RIGID	SANDWICH	SHELL
SPACECRAFT	STABILITY	STRESS
STRUCTURE	SUPPORT	THERMAL
*CYLINDRICAL SHELL	*SANDWICH CONSTRUCTION	*SHELL STABILITY
*SPACECRAFT CONSTRUCTION MATERIAL	*THERMAL STRESS	

&A29450
STRUCTURES EN CORRUGATED STAINLESS STEEL (STRUCTURES EN CLINQUANT D'ACIER INOXYDABLE).
ASSOCIATION FRANCAISE DES INGENIEURS ET TECHNICIENS DE L'AERONAUTIQUE ET DE L'ESPACE, CONGRES INTERNATIONAL AERONAUTIQUE, 7TH, PROBLEMES DE STRUCTURES D'AVIONS ET D'ENGINS, PARIS, FRANCE, JUNE 14-18, 1965, PAPER. 27 P. IN FRENCH.
LEQUEUX, P.

0001

EXHIBIT A-1, PAGE OF TYPICAL OUTPUT REPORT.

TITLE- CENTAUR PROJECT- OPEN LITERATURE 1962 THRU APRIL 1968
REQUESTER- GD DIRECTOR OF INTERNATIONAL SALES

GENERAL DYNAMICS CONVAIR DIVISION
NASA LINEAR TAPE SEARCH
NUMBER- 102A/6-01

LIBRARY AND INFORMATION SERVICES
DEPT 324-1 PHONE 277-8900 EXT 1073
DATE 24 APR 1968
AS PUBLISHED TERMS

63A10157
A63-10157 CENTAUR, SKYBOLT CONTROLS DETAILED. JOHN F. JUDGE. MISSILES AND ROCKETS, VOL. 11, NOV. 12, 1962, P. 26-28.
JUDGE, J. F.

CONTROL	CRYOGENICS	DEPENDENCE
FLIGHT	GAS	MOTOR
PROPELLANT	SERVO	TEMPERATURE
VALVE		
*CENTAUR PROJECT	*CRYOGENIC PROPELLANT	*FLIGHT CONTROL
*SERVOMOTOR	*SKYBOLT VEHICLE	

63A10186
A63-10186 DESTINATION MOON - THE DESIGN AND FABRICATION OF THE CENTAUR NOSE CONE. B. E. CHITWOOD /GENERAL DYNAMICS CORP., FORT WORTH DIV., FORT WORTH, TEXAS/. SOCIETY OF AUTOMOTIVE ENGINEERS, NATIONAL AEROSPACE ENGINEERING + MANUFACTURING MEETING, LOS ANGELES, CALIF., OCT. 8-12, 1962. PA ER 579A. 4 P.
CHITWOOD, B. E.

[illegible]	CONE	DESIGN
FABRICATION	HIGH TEMPERATURE	NOSE
RADAR	TRANSPARENCY	
*CENTAUR PROJECT	*NOSE CONE	

63A10264
A63-10264 AEROSPACE CONTROL POWER MACHINE DESIGN, VOL. 34, NOV. 22, 1962, P. 139-141.

BOOSTER	CONTROL	ELECTRIC
FLIGHT	HYDRAULICS	PNEUMATICS
ROCKET ENGINE	SATURN PROJECT	
*CENTAUR LAUNCH VEHICLE	*ELECTRIC CONTROL	*HYDRAULIC CONTROL
PNEUMATIC CONTROL	*ROCKET ENGINE CONTROL	*SATURN LAUNCH VEHICLE

63A10489
A63-10489 NASA LUNAR AND PLANETARY- MERCURY, JUPITER PROBES PLANNED IF FUNDS PERMIT. MISSILES AND ROCKETS, VOL. 11, NOV. 26, 1962, P. 122-125, 127-129.

EXPLORATION	MARINER B PROGRAM	MISSION
MOON	PLANETARY	PROBE
PROGRAM	RANGER PROJECT	SPACE
SURVEYOR PROJECT	VOYAGER PROJECT	
*ATLAS CENTAUR LAUNCH VEHICLE	*JUPITER PROJECT	*MERCURY PROJECT
*NASA PROGRAM	*PLANETARY EXPLORATION	*SPACE PROBE

63A14561
A63-14561 THE ROLE OF CHEMICALLY FUELED LAUNCH VEHICLES FOR ASTRONOMICAL RESEARCH. DAVID H. GARDLER /GENERAL DYNAMICS CORP., ASTRONAUTICS DIV., SAN DIEGO, CALIF./ /INTERNATIONAL ASTRONOMICAL UNION-DOUGLAS AIRCRAFT CO., INC., INTERNATIONAL SYMPOSIUM ON SPACE AGE ASTRONOMY, PASADENA, CALIF., AUG. 7-9, 1961./ IN- SPACE AGE ASTRONOMY. NEW YORK, ACADEMIC PRESS, INC., 1962, P. 278-287.
GARDLER, D. H.

ASTRONOMY	ATLAS CENTAUR LAUNCH VEHICLE	CHEMICAL
FUEL	LAUNCH	PROPULSION
RESEARCH	ROCKET	SPACECRAFT
VEHICLE		
*CHEMICAL PROPULSION	*LAUNCH VEHICLE	*SPACECRAFT PROPULSION

63A15209
A63-15209 HANDLING LIQUID HYDROGEN FOR CENTAUR. JOHN S. HARRISON /GENERAL DYNAMICS CORP., ASTRONAUTICS DIV., SAN DIEGO, CALIF./ AMERICAN INSTITUTE OF AERONAUTICS AND ASTRONAUTICS, SPACE FLIGHT TESTING CONFERENCE, COCOA BEACH, FLA., MAR. 18-20, 1963, PAPER 63090-63. 9 P.
HARRISON, J. S.

EXPERIENCE	FUEL	HANDLING
HYDROGEN	LIQUID	PROPELLANT
PROPERTY	STORAGE	TANK
*CENTAUR PROJECT	*HYDROGEN FUEL	*LIQUID HYDROGEN
*PROPELLANT STORABILITY		

63A17760
A63-17760 NASA PLANS FOR FUTURE MIS[illegible] THREE PROGRAMS. MISSILES AND ROCKETS, VOL. 12, MAY 20, 1963, P. A3-46, 50, 52, 70, 73.

APOLLO PROJECT	ATLAS CENTAUR LAUNCH VEHICLE	CHECKOUT
COMPUTER	DIGIT	FACILITY
GROUND	LAUNCH	PROGRAM
SATURN PROJECT	SPACE VEHICLE	SUPPORT
SURVEYOR PROJECT	SYSTEM	TITAN II ICBM
*FLIGHT TEST	*GROUND SUPPORT SYSTEM	*LAUNCHING FACILITY
*SPACE VEHICLE CHECKOUT PROGRAM		

63A19752
A63-19752 OPERATION *SODIUM CLOUD* /OPERACION NUBE DE SODIO*/. ROBERTO M. CAJAL. REVISTA NACIONAL AERONAUTICA Y ESPACIAL, VOL. 23, MAR. 1963, P. 18-22. IN SPANISH.
CAJAL, R. M.

ARGENTINA	ATMOSPHERE	AXIS
CLOUD	DENSITY	PHYSICS
ROCKET	SODIUM	SOUND
SOUNDING	TURBULENCE	WIND
*ATMOSPHERIC CIRCULATION	*CENTAUR LAUNCH VEHICLE	*CLOUD PHYSICS
*SOUNDING ROCKET		

63A23450
A63-23450 SURVEYOR PROJECT STATUS. W. E. GIBERSON /CALIFORNIA INSTITUTE OF TECHNOLOGY, JET PROPULSION LABORATORY, PASADENA, CALIF./. /AMERICAN ROCKET SOCIETY, LUNAR MISSIONS MEETING, CLEVELAND, OHIO, JULY 17-19, 1962./ IN- TECHNOLOGY OF LUNAR EXPLORATION. PROGRESS IN ASTRONAUTICS AND AERONAUTICS. VOL. 10. EDITED BY CLIFFORD I. CUMMINGS AND HAROLD R. LAWRENCE. NEW YORK AND LONDON, ACADEMIC PRESS, INC., 1963, P. 877-904. CONTRACT NO. NAS 7-100.
GIBERSON, W. E.

ATLAS CENTAUR LAUNCH VEHICLE	BOOSTER	DESIGN
LANDING	MOON	ORBIT
RECONNAISSANCE	SOFT	SPACECRAFT
*LUNAR LANDING	*SPACECRAFT DESIGN	*SURVEYOR PROJECT

63A25883
A63-25883 GROUND HANDLING SYSTEMS FOR LIQUID HYDROGEN. J. J. GILDEAU AND D. G. HUBER /GENERAL DYNAMICS CORP., ASTRONAUTICS DIV., SAN DIEGO, CALIF./ SOCIETY OF AUTOMOTIVE ENGINEERS, NATIONAL AERONAUTIC AND SPACE ENGINEERING AND MANUFACTURING MEETING, LOS ANGELES, CALIF., SEPT 23-27, 1963, PAPER 733C. 1 P. MEMBERS, $0.75, NONMEMBERS, $1.00.
GILDEAU, J. J.
HUBER, D. G.

DESIGN	FACILITY	GROUND
HANDLING	HYDROGEN	LIQUID
PRECAUTION	PROBLEM	SAFETY
SOLUTION	SYSTEM	

EXHIBIT A-2. PAGE OF OUTPUT REPORT DELIVERED TO BELGIUM.

GENERAL DYNAMICS CONVAIR DIVISION

GENERAL DYNAMICS IRAD
REPORTS RECEIVED IN CONVAIR
LIBRARIES 1960- 1968.

ENGINEERING ADMINISTRATIVE SERVICES
LIBRARY AND INFORMATION SERVICES
DEPT 32a-1 PHONE 817-6800 EXT 1073
DATE 31 MAY 1968

60/FT.WORTH
ERR-FW-310
WAVE DRAG OF MACH 3-5 CONFIGURATIONS.
31 DEC 1963 25P
DUCKNER, J.R.
A51447
DRAG MEASUREMENT SUPERSONIC FLOW WAVE DRAG
0763

60/FT.WORTH
ERR-FW-315
PROFILE OF SOLAR ADSORPTION LINES IN THE ZODIACAL LIGHT AND THE INTERPLANETARY ELECTRON DENSITY.
18 FEB 1964 14P
PETERSON, A.W.
A55723
SPECTROSCOPY ELECTRON DENSITY (CONCENTRATION) ASTRONOMY
WAVE SCATTERING ZODIACAL LIGHT
0764

60/FT.WORTH
ERR-FW-316
PRELIMINARY SOLID PROPELLANT ROCKET MOTOR SIZING (U).
28 FEB 1964 39P
DAILEY, R.O.
A55719
SOLID ROCKET ENGINE
PROPELLANT DESIGN
ROCKET ENGINES
0765

60/FT.WORTH
ERR-FW-317
INVESTIGATIONS OF INVISCID INCOMPRESSIBLE FLOWS. PT.1. POTENTIAL FLOW ABOUT THIN TWO-DIMENSIONAL BODIES USING THE GERMAIN TRANSFORMATION.
31 DEC 1963 84P
HASKELL, R.N.
A62421
INCOMPRESSIBLE FLUID DYNAMICS INVISCID FLOW
FLOW
0766

60/FT.WORTH
ERR-FW-305
RADIATION FROM THE CYANOGEN VIOLET BAND SYSTEM.
31 DEC 1964 69P
MASSINGILL, G.
A64702
SPECTROSCOPY THERMAL RADIATION CYANOGEN
ABSORPTION RADIATION
SPECTRA MEASURING INSTRUMENTS
0767

60/FT.WORTH
ERR-FW-306
RESEARCH PROGRAM IN PLANETARY ASTRONOMY AT THE UNIVERSITY OF TEXAS IN 1963.
31 DEC 1963 32P
DEVAUCOULEURS, G
A55721
RESEARCH ASTRONOMY INTERPLANETARY
PROJECTS SPACE
0768

60/FT.WORTH
ERR-FW-308
NATURAL TIME MEASUREMENTS IN A HARMONICALLY VIBRATING SYSTEM.
31 DEC 1963 36P
ROMAIN, J.E.
PEDEN, D.N.
A55722
ASTRONOMY RELATIVITY TIME
HARMONIC
ANALYSIS
0769

60/FT.WORTH
ERR-FW-309
ANALYSIS OF GASEOUS IMPURITIES IN METALS.
24 JAN 1964 14P
REYNOLDS, J.O.
A55818
METALS SPECTROMETERS SPECTROSCOPY
GASES
0770

60/FT.WORTH
ERR-FW-299
THEORETICAL ROCKET PERFORMANCE FOR BERYLLIUM-HYDROGEN-OXYGEN.
31 DEC 1963 38P
TURNER, R.A.
A55720
SOLID BERYLLIUM BERYLLIUM OXIDES
PROPELLANTS HYDRIDES
0771

60/FT.WORTH
ERR-FW-302
LUNI-SOLAR INTERVAL IN MARS AND THE SECULAR ACCELERATION OF PHOBOS.
6 FEB 1964 19P
FISH, F.F.
RICHMOND, J.C.
A55463
ASTROPHYSICS MARS (PLANET) PHOBOS
0772

60/FT.WORTH
ERR-FW-301
ADHESIVES, CORE, AND RESIN SCREENING.
30 JAN 1964 40P
SMITH, H.P.
THOMAS, J.E.
A63227
ADHESIVES RESINS THERMODYNAMIC PROPERTIES
0773

60/FT.WORTH
ERR-FW-304
HYDROTHERMAL MINERAL SYNTHESIS, 1963 SUMMARY REPORT.
1 JAN 1964 17P
EHLMANN, A.J.
A55462
HYDROTHERMAL SYNTHESIS THERMOCHEMISTRY
CRYSTAL GROWTH
MINERALS
0774

60/FT.WORTH
ERR-FW-295
HELIUM AS A PNEUMATIC MEDIUM.
31 DEC 1963 31P
KREGER, W.
A59180
HELIUM PNEUMATICS
0775

GENERAL DYNAMICS CONVAIR DIVISION REPORT NUMBER TO NASA ACCESSION NUMBER INDEX JAN-APR 68 SUPPL PAGE 0001

REPORT NUMBER	ACCESSION	REPORT NUMBER	ACCESSION	REPORT NUMBER	ACCESSION	REPORT NUMBER	ACCESSION
	68N[illegible]84	GDA-DDDE4-038	68N81439	GD/C-64-223	68X81478	NASA-CR-89151	68X[illegible]
	68N10090	GDA-ERR-AN544	68N81995	GD/C-64-233	68X81118	NASA-CR-89402	68X[illegible]
	68X1033[illegible]	GDA-ERR-AN-499	68N80767	GD/C-66-008	68X10022	NASA-CR-89451	68X122[illegible]
	68X10332	GDA-ERR-AN-551	68N81245	GD/C-69A5106	68X80628	NASA-CR-89942	68X[illegible]
	68X10773	GDC-62-170N	68X80351	GD/C-ANR-67-005	68X13489	NASA-CR-90100	68N[illegible]
	68X11858	GDC-BDJ-67-001	68X12179	GD/C-DDE 65-026	68N82035	NASA-CR-90131	68X[illegible]
AD-653769	68N80055	GDC-BDJ-67-002	68X12004	GD/C-DDE65-025	68N80055	NASA-CR-90479	68X[illegible]
AD-660566	68N81179	GDC-DAD67-002	68X10628	GD/C-DDE-67-022	68N18327	NASA-CR-90550	68X[illegible]
AD-660575	68N11966	GDC-DAB67-003, V. 10	68X10560	GD/C-DDB-66-030	68X10098	NASA-CR-90557	68X[illegible]
AD-660647	68N81[illegible]			GD/C-DDL67-009, V. 2	68X11439	NASA CR-90602	68X[illegible]
AD-661214	68N12814	GDC-DAB67-003, V. 2	68X10544			NASA-CR-90894	68X[illegible]
AD-807465	68X81197			GD/C-DCL67-009, V. 3	68X11425	NASA-CR-90953	68X[illegible]
AD-809633	68X80336	GDC-DAD67-003, V. 3	68X10557			NASA-CR-91119	68N[illegible]
AD-809634	68X80233	2, ADD. A		GD/C-DCL67-009, V. 4	68X11424	NASA-CR-91141	68N[illegible]
AD-810465L	68X80628	GDC-DAB67-003, V. 3	68X10555			NASA-CR-91205	68X[illegible]
AD-811947L	68X82133			GD/C-DDB67-003	68X1144[illegible]	NASA-CR-91221	68X[illegible]
AD-815779	68X81173	GDC-DAD67-003, V. 4	68X10741	GD/C-DDE-66-017	68N15457	NASA-CR-91222	68N[illegible]
AD-816201L	68X10098			GD/C-DDG-67-006, V. 1	68N12456	NASA-CR-91223	68N[illegible]
AD-816223	68X80016	GDC-DAD67-003, V. 5	68X10730			NASA-CR-91224	68N[illegible]
AD-816737L	68X82146			GD/C-DDG-67-006, V. 2	68N12371	NASA-CR-91268	68N[illegible]
AD-817053L	68X82178	GDC-DAB67-003, V. 6	68X10745			NASA-CR-91409	68X[illegible]
AD-817325L	68X81958			GD/C-DDG-67-006, V. 3	68N12503	NASA-CR-91559	68X[illegible]
AD-817328	68X80022	GDC-DAD67-003, V. 7	68X10402			NASA-CR-91560	68X[illegible]
AD-817331	68X81922			GD/C-DDG-67-006, V. 4	68N12237	NASA-CR-91561	68X[illegible]
AD-818715L	68X82201	GDC-DAB67-003, V. 8	68X10746			NASA-CR-91719	68X[illegible]
AD-818716L	68X80177			GD/C-DDG-67-006, V. 6	68N12372	NASA-CR-91760	68X[illegible]
AD-821523	68X80506	GDC-DAB67-003, V. 9	68X10469			NASA-CR-91770	68X[illegible]
AD-821630	68X80769			GD/C-ZZL-67-010	68N17090	NASA-CR-91828	68X[illegible]
AD-822502	68X11072	GDC-DAD67-300, V. 1	68X10401	HPS-2	68X80192	NASA-CR-92680	68N[illegible]
AD-823154	68X12179			HPS-2	68X81645	O-00139	68X[illegible]
AD-823155	68X12004	GDC-DDD67-004	68N17179	NPR-5	68X[illegible]86	O-75061	68X[illegible]
AD-823383L	68X82225	GDC-DDE66-017	68N11736	NASA-CR-61410	68X11447	O-75099	68X[illegible]
AD-823384L	68X82214	GDC-DDE67-005	68N12814	NASA-CR-61454	68N15457	REPT.-O-75017	68X[illegible]
AD-823385L	68X81690	GDC-DDE67-020	68X12502	NASA-CR-61540	68N16428	REPT.-O-75062	68X[illegible]
AD-823388L	68X81693	GDC-DDE-67-012	68N11966	NASA-CR-65769	68X[illegible]Z2	REPT.-O-75192	68X[illegible]
AD-823390L	68X82213	GDC-DDE-67-013	68N10954	NASA-CR-65822	68X[illegible]43	REPT.-O-79038	68X[illegible]
AC-824316	68X12502	GDC-DDG67-001	68N11935	NASA-CR-65823	68X10544	REPT.-16	68X[illegible]
AC-824978	68X13489	GDC-DDG67-002	68X12998	NASA-CR-65824	68X10557	REPT.-55A5393	68X[illegible]
AD-825264	68X[illegible]258	GDC-DDB-66-008, V. 1	68X12200	NASA-CR-65825	68X10555	REPT.-64-20203	68N[illegible]
AE60-0267	68N80268			NASA-CR-65826	68X10741	REPT.-69-A5216	68X[illegible]
AFML-TR-68-454	68X10098	GDC-DDD66-011	68N80103	NASA-CR-65827	68X10730	REPT.-O-7912[illegible]	68X[illegible]
AFML-TR-67-257	68X13258	GDC-DCL67-009, V. 1	68X10497	NASA-CR-65828	[illegible]	SPEC-O-79147	68X[illegible]
AFRPL-TR-67-258	68X11072			NASA-CR-65829	68X10402		
AFWL-TR-67-99	68X12502	GDC-DCL67-009, V. 2	68X10629	NASA-CR-65830	68X10746		
ARL-67-0151	68N11966			NASA-CR-65831	68X10499		
CRD-1	68X81644	GDC-DDG-67-005	68X82261	NASA-CR-65832	68X10360		
CT-68-5A-138	68X82133	GDC-DDG-67-006	68N12672	NASA-CR-65833	68X10628		
ERR-AN-038	68N80765	GDC-ERR-AN-1074	68N11759	NASA-CR-66171	68X[illegible]996		
ERR-AN-487	68N81466	GDC-ERR-AN-782	68X80590	NASA-CR-66336	68N[illegible]79		
FAA-CT-800-058	68X82178	GDC-ZZL67-017	68X13258	NASA-CR-66350	68N16327		
FDL-TDR-61-149	68X80769	GD/A-63-1137	68N81466	NASA-CR-66724	68X81118		
GDA-AE68-0807, PT.	68N81179	GD/A-DDE64-062	68N16428	NASA-CR-88013	68X80022		
		GD/A-ERR-AN-339	68N80018	NASA-CR-89049	68X82146		

EXHIBIT A-4. PAGE OF REPORT – CROSS REFERENCE LISTING OF REPORT NUMBERS VERSUS NASA LINEAR TAPE SYSTEM ACCESSION NUMBER.

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NASA-CR-90100 GDC-DBE-67-013	68N10954	BASE FLOW FIELD INVESTIGATION ON THE S-II STAGE DATE- MAR. 1967 COLL- 42 P REFS	DATTORRE, L. THOMMEN, H. U.
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