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THE HDL AUTOMATED INFORMATION SYSTEM

by

Berthold Altmann

August 1970

U.S. ARMY MATERIEL COMMAND
HARRY DIAMOND LABORATORIES
WASHINGTON, D.C. 20438

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with supplements by

THE BUSINESS APPLICATION SECTION,
COMPUTER SCIENCES DIVISION
OF THE NATIONAL BUREAU OF STANDARDS
AND BY Ralph G. Moore, HDL

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ABSTRACT

This report reviews the purpose and development of the ABC system and presents the computer programs that were written and tested for the automatic construction and standardization of syntactical descriptors. Reasons of economy have overridden consideration of quality and have forced the installation to accept the analytical products of national and professional information centers rather than reprocess the items using the ABC system. This report contains a description of how the magnetic tapes distributed by national information centers are processed to provide the (under given conditions) best possible bibliographic (including SDI) services for HDL personnel; and presents also an outline of a prototype test which is to estimate the inherent limitations of a proposed system and thus prevent further investments in a system if it has less potential capability than required by the application.

CONTENTS

		Page
ABSTRACT		3
1.	INTRODUCTION	7
2.	HDL APPROACH	8
3.	SUMMARY OF INFORMATION RESEARCH ACTIVITIES IN HDL	9
4.	PARALLEL DEVELOPMENT OUTSIDE HDL—The Thesaurus Approach	10
5.	STANDARDIZATION OF SYNTACTICAL DESCRIPTORS	11
6.	A PERSPECTIVE VIEW OF STANDARDIZATION	18
7.	UTILIZATION OF CENTRALLY GENERATED ANALYSIS	19
8.	A PROTOTYPE TEST FOR DETERMINING THE LIMIT OF A GIVEN RETRIEVAL SYSTEM	20
9.	SUMMARY	25
10.	ACKNOWLEDGEMENTS	26
11.	REFERENCES	26
Exhibit A:	Comparison of 59 HDL Subject Groups with Corresponding COSATI Fields Used by DDC	28
Exhibit B:	COSATI Groups Consecutively Numbered	29
Exhibit C:	NBS Letter from M. Shaver to Dr. B. Altmann, Dated 19 January 1970	30
Exhibit D:	Worksheet for Analyst	33
Exhibit E:	Flowchart for Automatic Standardization of Syntagmas (ABC Descriptors)	34
Exhibit F:	Thesaurus Automatically Derived from Input	35
Exhibit G:	The HDL-SDI System (Phase I) by Ralph G. Moore	36
	Exhibit G - Chart a: Selective Dissemination Information Flowchart	38
	Exhibit G - Chart b: Capability of the SDI Program	39
Exhibit H:	The Nine Titles Selected for the Test	40
Exhibit I:	The 21 Syntactical Descriptors Reconstructed for Each of the Nine Documents Rated by a 0-9 Scale	41
Exhibit J:	Average Test Results with Standard Deviations	50
Exhibit K:	Preparations of First Set of Models for Measuring Test Results	51

Page

Exhibit L: Models and Values Used for Measuring Test Results 56

Exhibit M: Deficiencies Caused by Indexing 57

Exhibit N: Deficiencies (Average Test Results) Measured with the Second Set of Models 58

SUPPLEMENT A: Manual Retrieval System 59

SUPPLEMENT B: Automated Retrieval System 61

SUPPLEMENT C: The Programs for the Production of Structured Abstracts 62

Attachments 1 - 9 67

Listings 1 - 4 77

1. INTRODUCTION

An information office must be operated for the support of the scientific and engineering personnel it serves. Minimally, it must assemble and maintain an appropriate collection of bibliographic tools and of individual treatises pertinent to the installations's work.

Such minimal conventional library service, however, no longer suffices. The most recent advances in scientific and technical exploration and methodology are presented to the professional community in collections of symposia, proceedings of conferences, and in a steadily growing number of specialized journal and magazine literature, as well as in progress, interim and final technical reports. Hence, these must also be made readily available.

Access to information on commercially available hardware (components, devices, and subsystems) and to data concerning hardware characteristics has been adequately provided (especially by the IDEP system) because these data are amenable to integration into a well-defined structure and therefore also to mechanized (EAM or computer) storage and retrieval operations (and this system is used). A similarly adequate solution has not yet been found for analytical, experimental or developmental studies. One reason for this deficiency is that the broader range of subject content of the latter studies can, potentially, deal with any combination of subjects selected from the entire spectrum of human knowledge. They can rarely be fitted into any one classification scheme. The inherent complexity of many of the outstanding papers and different approaches by which various prospective users of the data will choose to acquire information constitute the challenge to the documentalist not only with respect to the multidimensional structure of the appropriate storage facility, but also with respect to the linguistic and algorithmic vehicles human beings require in their exchange of information.

A modern information service in a research and engineering installation must pursue the following objectives.

1. The introduction of a practicable process to select from the large stream of complex technical literature only that which its particular teams will accept as useful for the accomplishment of their current ever changing objectives.
2. The continuing acquisition and accumulation of the data on mission and task-related literature used for the dissemination and circulation of current information, compilation of bibliographies, and for facile retrieval by the investigators.
3. The frequent automatic dissemination of the information about recent relevant titles to groups in concise bulletins.
4. The transmittal of the papers which are selected from these lists without delay.

5. The maintenance of a continuing dialogue between the information-requiring teams and the developers of the system to facilitate up-to-date adjustments and improvements in the acquisition and filtering systems used to generate the services.

Because economy has always been an important consideration in the development of the HDL information service, this organization has always utilized available central and funded documentation efforts where appropriate. HDL ranks among the most extensive Army users of DDC services and has frequently taken advantage of the bibliographic services of NASA.

However, central services do not fully fill the requirements of an installation if:

1. The compilation of bibliographies takes too long too often,
2. The bibliographies are not responsive to the requester's specific requirement (as for an item that is not well-defined)
3. The subject groups of the announcement bulletins are either too broad or too restricted (Exhibits A and B) for the mission-related fields (as when screening of these accession bulletins requires about eight working hours or more of a professional staff familiar with all requirements of the laboratories), and
4. All the cataloging data centrally prepared (as those by DDC) cannot be automatically transferred into the library catalogs (because about 60 percent of all reports received in the installation are sent directly from the originating agencies and therefore lack the Center's own identification numbers).

The NASA bibliographies have proved to be of a relatively high quality but the titles are drawn from the holdings of a collection selected and assembled for one specific mission. Many of the reports generated by or for military establishments are therefore missing.

2. HDL APPROACH

In order to be timely and to automate such other operations as acquiring, cataloging, organizing, disseminating and circulating publications for use by HDL, and to adjust the selection in conformity with the changing profiles of the teams, a separate installational operation appeared to be more expeditious and also more economical (especially if, as is our goal, all available, relevant, centrally generated bibliographic services and analytical products are to be fully utilized). This plan appears to be beneficial also, because the HDL operation is being prepared to process the pertinent periodical literature which DDC (while it duplicates the IDEP literature) disregards and which NASA does not cover fully.

Specialists in programming were consulted, and they pointed out that the adjustment of existing similar programs[1*] to our computer operations and to our requirements would be more cumbersome and more expensive than the preparation of a new program (Exhibit C). They suggested the development of a system tailored to the peculiar needs of our laboratories not only as a more effective, but also a more economical procedure.

In this context it is necessary to list the major capabilities of the already automated HDL library system.

1. All reports we acquire and select are integrated into the system within 10 days; and operational computer program produce:

a. complete sets of all cards for different card catalogs (no adjustments by typewriter are necessary);

b. the accession bulletins (delays are caused only by an inadequate printing capability);

c. book catalogs, for example, one for all HDL publications, and one for all reports in the HDL library; and

d. KWICed title listings (consistently accumulated) which serve as a cheap, very useful, up-to-date retrieval tool.

2. The HDL computerized periodical system generates:

a. bid and purchase order lists for renewal of subscriptions;

b. records (in punched-card format) for all individual issues of magazines to which the installation subscribes. (These cards fulfill multiple purposes as control tools for issues received, as circulation records, and as masters from which lists of issues that were not received are tabulated);

3. The computerization of the administrative activities listed under 1 and 2 above has saved at least 3 personnel spaces in the library; without machine-assist the current operations and services could no longer be accomplished today.

3. SUMMARY OF INFORMATION RESEARCH ACTIVITIES IN HDL

Earlier, we tested syntactical descriptors in a manual retrieval system[2] (described in Supplement A), subsequently in a fully automated retrieval system[3] (described in Supplement B). The third phase developed methods and procedures to encode mechanically and standardize syntactical relations, update a syntactical thesaurus, create and dynamically maintain an HDL classification scheme, and to lay the ground for the operation of several different retrieval operations. Most of these operations were designed for on-line retrieval and include a question-answering service and the tracing of tree-structured information.[4]

* References appear on page 26

As in every information office or library, the analysis and organization of a body of information adequate for effective and efficient retrieval by subject, has been a more difficult and time-consuming task in our program. A brief report of our recent studies and efforts to develop syntactical and self-explanatory descriptors which can be standardized and assigned by progressively computerized operations will, therefore, be presented after the following short outline of the most general trends in indexing.

4. PARALLEL DEVELOPMENTS OUTSIDE HDL—The Thesaurus Approach

Subject descriptors have been collected into a thesaurus.[5] They have been in accordance with pre-established rules, and the resulting voluminous list enhanced by the addition of cross-references to wider, narrower, and related expressions and by cross-references from rejected synonyms and near synonyms to the accepted terminology. Furthermore, permuted and hierarchical indexes of the descriptors as well as an index arranged by subject categories were compiled to assist indexers and retrieval operators in their respective tasks. Despite the investment of time and thought, and despite general usefulness of this publication, important problems were not solved, of which we mention only a few:

1. how to maintain a steady automatic growth of the thesaurus as required by the continuing evolution of the numerous disciplines and specialties;
2. how to avoid the assignment of different descriptors to documents with identical content at different times; and
3. how to assign subject categories (COSATI) consistently.

It must be understood that the availability of a comprehensive thesaurus with a sophisticated reference and index system does not assure a satisfactory consistency in the assignment of subject descriptors. Furthermore, if one wants to give preference to phrases, the use of the thesaurus approach becomes less feasible because of cost and because of the still greater technical difficulties that are involved in establishing and maintaining a thesaurus covering semantic as well as syntactic elements.

A trend of introducing phrases or syntactical combinations into indexing of scientific and technical literature appears to be gaining ground as exemplified by the following.

1. DDC has abandoned its originally rigorous rule of coordinated indexing and has started to assign one or two descriptor combinations to each document for the identification of the salient subject content. Whether and how these (parenthetic) combinations are being controlled for consistency has — to our knowledge — not yet been announced.

2. The subject indexes to the various sections of Science Abstracts have for some time been constructed from main headings each of which can be modified by a great number of very detailed compounded "subheadings" or phrases.

3. For the literature of physiology and medicine, Hans Selye and G. Ember[6] have introduced syntactical descriptors in which the terms represented by short mnemonic symbols follow in a standard order of precedence, while signs are used to denote combinations of subjects or the cause-effect, agent: target, part: entity and other dynamic (increase, decrease) or static relationships.

4. The Rand Corporation demonstrated the capability of a newly developed retrieval method with a "relational data file" in an experiment limited to the presentation rather than the subject matter of cybernetics research. In this instance[7] a relatively complex artificial language was created for describing subjects and relationships concerning authors, co-authors, their affiliations and background, the types or purposes of their publications, the citations of their writings in subsequent publications, and concerning other individuals also associated with these papers, e.g., as editors, reviewers, translators or sponsors, etc.

5. Members of the Z. S. Harris group investigated the "Feasibility of Automated Information Systems in the Users' Natural Language"[8] and advanced the opinion that when such a natural-language reporting and inquiry system "has been developed, it would render most of the existing information system technologically obsolete."

Whenever algorithms are applied for designating the syntactic elements in more complex descriptors, they appear to be an extension and at the same time a combination of role[9] and link-indicators.

5. STANDARDIZATION OF SYNTACTICAL DESCRIPTORS

The HDL objective of using and standardizing syntactical descriptors for storage and retrieval operations can, therefore, no longer be considered to be chimeric or utopian undertaking. When scientists and engineers retrieve their requirements directly from computer storage devices, the transmitted data must be represented in an understandable form and should include addresses of related information. We believe the question of whether abstracts such as the descriptors of the type we have developed in HDL should be applied or not has been answered in the affirmative, and confirmation has been given by all agencies who have invested considerable sums of money in the development of parallel software and applicable hardware.[10-12] Now the search is for the most economic and practical methods of implementing this application.

Descriptors are the basic elements of every information system, inasmuch as they are required to organize the contents of the collection. In HDL these elements were named ABC (Approach-by-Concept) descriptors, and were developed for SDI programs including the automatic selection

of reports and journal articles that pertain to the missions and task of the installation.

To achieve the basic objective of constructing unambiguous standardized ABC descriptors, we arrived at the following solution: We developed for our subject analysts a worksheet[13] in form of a questionnaire (Exhibit D) which, despite a long period of experimentation and a number of successive improvements may not yet have gained its final form. Whenever an analyst starts the analysis of a paper, he determines first the predominant subject of the paper and records it (line 5). Then he answers the questions listed on the form from lines 1 through 30 (Code A to AC), each of which must be directly related to the main subject (listed in line 5).

It has been our experience that when the analyst provides the answers to the questions in this form he will be constrained and guided to exhaust the entire content of the document as far as it relates to responsibilities of our installation, and to encode (by the very arrangement of the worksheet) the various aspects that the paper conveys.

It must be emphasized that all questions and answers must be directly connected with the main subject listed in line 5. Whenever a modifier recorded as an answer in the first column requires modifications of its own, this modifier is transferred to be the header of a separate column, and all the questions (Codes A-AC = lines 1-30) will be asked again with respect to this modifier. The process may be extended to other modifiers placed in the 5th line of any of the subsequent columns. After the answers of the analysts have been edited and inserted into a computer, the computer program will combine the main subjects of the various columns with the modifying terms and phrases by introducing the standard connectors which are provided for each category (1-30 = A-AC) and listed in front of the alphabetical codes on the worksheet.

The questionnaire was developed to meet the particular requirements of the Harry Diamond Laboratories. It is obvious that worksheets will differ from installation to installation according to the subject matter and tasks and the interests of the individual members of the staff.

The principles and methods we have applied to the development of standardized syntactical descriptors for a progressively automatable storage and retrieval system have also independently and simultaneously been investigated by the Bunker-Ramo Corporation[14] with a broader, more theoretical goal of classifying all the meaning-carrying elements available for the description of semantic relations, which the authors call "predication types". The task had been sponsored by the Air Force Office of Scientific Research of the Office of Aerospace Research. We emphasize that the Bunker-Ramo study was prepared for the purely theoretical purpose of defining and grouping syntactical relationships used in human communications. A practical application was apparently not envis-

aged by the contracting agency which would not provide the 1498 form of the project (but informed us that it had never been prepared). Also the authors did not refer to a utilization, for example, to automated storage and retrieval operations, in their final reports. We present a partial comparison of the codes and units HDL[15] and Bunker-Ramo have developed to denote typical relationships in concepts and linguistic structures. The comparison shows complete agreement or a considerable overlap in many instances.

Comparison of

Bunker-Ramo List of Predication Types and Primary Symbols			and	HDL Modification Codes	
(1)	PF:	description of performance (A is accomplished (achieved) by means of B)		E:	A is produced by B (tool or method)
	B:	indication of basic relationship (A is based on B)			
(2)	V:	indication of covariance (A varies with B)		F:	B is influenced by A
	Ef:	indication of effect (A affects (influences) B)			
(3)	Cn:	statement of concern (A concerns B)		G:	A is related to B
(4)	V:	indication of covariance		G:	A is related to B
(5)	E:	description of equipment (A is provided with (has) B)		H:	B is part of A
	L:	indication of location (A is found (encountered, occurs) in B)			
(6)	I:	indication of insertion (A is placed (entered, added) into B)		AB:	A is located in/at B
(7)	XE:	A is not provided with B		"X"	should be introduced to express the opposite or negative meaning of the subsequent concept.
(8)	Df:	A is defined as (called) B		K:	A is designated B
(9)	O:	indication of origin (B leads to A, A is derived from B, A stems from B)		U:	B results in A

(10)	C:	statement of causation (A is due to B B results in A)	U: Y:	B results in A A is because of B
(11)	Ef:	indication of effect (A effects B)	V: T:	A has influence on B B is vulnerable to A
	V:	convariance (A varies with B)		
(12)	T:	statement of passage (A passes through B)	AC:	write - in of preposition: Through
(13)	U:	description of use (A is used for (serves as) B)	W:	operating, performing, write-in of participle
(14)	P:	indication possibility (A allows for B)	R:	H serves purpose of B
(15)	Cp:	statement of comparability (A is comparable to (like) B)	Z:	A is like B

In certain cases where the Bunker-Ramo predication (or modification) codes represent broad units it was necessary to be more specific and adjust the scope of particular classes to the peculiar, more detailed interests of the installation and to an organization suitable for information retrieval that will meet the requirement of HDL more adequately. For instance, Bunker-Ramo's "D = descriptive statement (A has a property of B)" was divided in HDL into:

B: properties (adjective expression)
C: shape (adjective expression)
D: physical phase (adjective expression)

Similarly, the codes "E: description of equipment (A is provided with B)" and "A: statement of accompanying circumstances (A is accompanied by B)", a code that in the Bunker-Ramo system partly overlaps with "Rq: indication of requirements (A requires B)", correspond to the following equivalent modifiers in the HDL system:

1. N: provided with materials;
2. O: with components,
3. P: with devices; and
4. Q: with instruments.

Finally: "Dm: demonstration (A is shown by means of B)" combines the two more specific HDL types: "L: (A is simulated by B)" and "B: (A is modelled by B)".

For several "predication types" of the Bunker-Ramo system we have not yet found a requirement in HDL:

A:	statement of acquistion (A is acquired by B)
Cm:	statement of computation (A is computed for B)
Ex:	statement of explanation (A is accounted for by B)
M:	statement of measurement (A is measured by means of B)
Ma:	description of movement away (A moves away from B)
R:	statement of established result (A has been established as B)
Re:	indication of replacement (A is replaced by B)
Rm:	description of result of motion (A arrives at B)
Rq:	indication of requirement (A requires B)
Su:	indication of superiority (A exceeds B)
Va:	statement of value (A has the value of B)

It can, however, be anticipated that at a later time some of these modes of conceptual combinations will have to be entered into the HDL system. Because the encoding of phrases or of conceptual combinations will develop on the basis of papers that must be integrated into the HDL information collection, we are prepared to cover additional types of connectors, to take care of, "and" and "or" pairs, for example such as amplifiers and oscillators, or amplifiers or oscillators which will be introduced into the system as concepts of equal ranking within more complex descriptors.

In a memorandum[16] solicited from Dr. Robert Wall, Dr. Lew R. Micklesen, University of Washington in Seattle, pointed to various linguistic aspects which we in HDL (and the authors of the Bunker-Ramo report) had omitted to consider adequately. Dr. Micklesen stated: "Careful study of the structured descriptor technique has given strong indications that this promising information retrieval system can be considerably improved by the explicit and rigorous exploitation of strategic kinds of syntactic information." Therefore, among others he recommended the following three tasks.

1. A review of the prepositions we had selected as standard connectors, because certain nouns require an idiomatic selection of prepositions, for example: introduction to, love for, concern over, influence of; and may, therefore, not easily be fitted into any standard system of syntactic types or categories.
2. A similar review of prepositions in connection with gerundial forms because certain classes of verbs require the preposition "of" (e.g., processing of,) others "for" (e.g., searching, waiting); others the fourth case without any preposition (e.g., opposing an opinion; investigating surface waves).
3. A study of levels of "embedding", especially a determination when due to involved sentence structure intelligibility will begin to deteriorate drastically.

The operation of the HDL computer program can be illustrated by the example in Exhibit E, part IIB and III.* The computer reads the first

*The information that appears in the third, unnumbered line of columns 1/, 2/ and 3/ would corresponds to entries in line 5 of the final questionnaire (Exhibit D).

column - descriptor: "Mechanical detwinning produced by stress in a crystal". Because "Stress" and "Crystal", which modify "detwinning," require further modifications they are transferred to be the headers (placed in line 3) of columns two and three, but retain their original code (of column 1/) to permit the tracing of all dependencies. The second column is read out: "Modest stress at room temperature, "and third column as: (a) "Single Crystal produced by Czochalsky-process" and (b) "Consisting of La-Al-Oxide". The different strings are then interfiled always according to the alphabetical sequence of the codes.

The computer product (step 3) is the standardized ABC descriptor: "Description of mechanical detwinning produced by modest stress at room temperature, in single crystal produced by Czochalsky process of La-Al-Oxide". The comma placed after the word temperature indicate that the subsequent phrase is directly related to the main subject "detwinning", but its component elements (a: "produced by Czochalsky process" and b: "of La-Al-Oxide") refer to the header of this particular phrase which is "crystal". The operational, tested computer program developed for the standardization of syntactical (ABC) descriptors is appended as Supplement C.

A more sophisticated program could provide a smoother read-out; however, HDL scientists and engineers have assured us that they can understand the present somewhat awkward text.

With the described program, fully debugged and operational, unequivocal clauses and subclauses are automatically produced and the notions or concepts follow each other in unvarying sequence within the automatically generated descriptions.

In addition to the standardized format of the ABC descriptor, the computer program generates the following three by-products:

1. A dictionary (thesaurus) displaying (a) all the main subjects of the complete descriptors as well as (b) the headers of subsequent columns with (c) their modifiers and (d) through the respective code symbols the type of associations, furthermore, (e) the document symbol or shelf number of the source document (Exhibit F). In other words, a most comprehensive semantic and syntactic concordance of the descriptor texts is constructed.

2. The same dictionary is displayed in a different arrangement. In the first column the modifiers are alphabetized, followed by the terms they are modifying; and

3. A third possible arrangement is by categories A-AC and other codes that may be added whenever necessary. Under each category are found all the modified terms with their modifiers in alphabetical sequence. A most useful application of this format of the thesaurus will be described below.

This organization of data permits us (a) to reproduce the stored information in tree-structured format (Exhibit E, IIA and B) and (b) will permit us to trace all interdependencies of terms, phrases, and clauses on the screen of a terminal.

4. The same organization on tape or in other memory devices offers a new retrieval capability because a query or a user requirement can be expressed and processed by an intersection of encoded general groups or categories and the occurrence of particular terms or phrases assigned to these categories. For example, answers can be found about materials that meet the requirement of stated environments, or about production methods for particular components and materials, or about the performance of given systems or subsystems under specified conditions. The search program utilizes the third format of the thesaurus.

Concerning computerized language analysis for storage and retrieval systems and for question-answering services, Robert F. Simmons has given evidence in a comprehensive and quite critical review[17] that such systems and services cannot be operated without extensive preparations and large expenditures for building the structures, sets and subsets and algorithms, and for developing the rules and methods for keeping the operations updated. The various studies and practical developments have apparently resulted in a broader understanding of the principles that underlie the translation of natural language statement into standardized, formal and therefore, "computable structures." However, all existing systems remain experimental and "none uses more than a few hundred words of dictionary or a small grammar and semantic system. None can deal with more than a small subset of English strings." Therefore, the reviewer concludes, that for the real test of the "minimally adequate methods... developed for dealing with natural languages in small quantity"., one must "consider a research program that proposes to exploit and explore existing techniques...based on a 20 to 40 million word encyclopedia". He is not only aware of the implications of completing such gigantic dictionaries and comprehensive grammars for computer analysis but is also careful in predicting positive results when he adds the justly qualifying statement: "Perhaps only with such a program can we expect to discover whether what has been learned so far can be used for an eventual practical question-answering system." As much as one might agree with the outline of a final system and its techniques, we are convinced that for practical and economic reasons the expensive and sophisticated tools for computerized language operations must develop and grow as by-products of current services. Only when the yearly, relatively small investments pay immediate dividends and the contents, methods, and procedures can be steadily improved through the feedback of and the review by an intelligently cooperating clientele, can the necessary resources be accumulated which will slowly, but more soundly, facilitate the construction of the ideal, final system. In such a down-to-earth program, an approach as represented by the ABC system will turn out to be a major contributing factor.

6. A PERSPECTIVE VIEW OF STANDARDIZATION

The information exchange cycle can be compared with an ellipse having as its two focal points (a) the production of information in the form of publications and (b) the process of stating information requirements for the purpose of utilizing the information that has been accumulated in collections of publications, for studies and projects which in turn will lead to publications. Building the organization of published literature as well as establishing formal definitions of requirements to initiate retrieval action are both part of a communications problem, primarily a linguistic one, because the symbols used for the identification of document content must be meaningful and standardized to be applied to apt and effective translations of submitted user requirements and user profiles.

There is a general understanding (perhaps a consensus) about the future of modern storage and retrieval systems: Automation should make it possible (a) to standardize descriptors, that is, to assign linguistic elements consistently to documents as well as to information requests and (b) to facilitate unimpeded (direct) interactions between the inquirer and the organized collection for the purpose of fully satisfactory, retrieval results. However, no agreement has been reached about the methods that can organize and standardize descriptions. Because statistics has been a potent tool to classify and understand all physical data and observations that can be regenerated or repeated, it has been assumed—a symptom of our age in which technology is over-emphasized and human factors and values are neglected—that the same statistical methods can be applied easily also to language. Using correlations of terms or concepts based on frequency of occurrence and co-occurrence in the documents or particular segments of them, some have experimented with automatic grouping (clumping or classification), indexing, and production of extended dictionaries, frequently without taking into consideration the freedom of the human mind to express concepts and ideas in an endless variety of linguistic formulations; and they have been inclined to forget that words are symbols which gain meaning, i.e., definition, only within the context in which they occur and that for example, terms like "bridge", "circuits", and "detonate" will retrieve papers on such different subjects as "detonating-bridge circuits" as well as "circuits used for detonating a bridge".

Only with a clearer understanding of the linguistic elements in human communications and of the limited connection between language and communication theory can we gain the awareness that a definite ceiling is placed on the efficiency of automatic clumping, abstracting, indexing, probabilistic indexing, and of the applications of vector and varimax methods and the graph theory, and that merely similar subsequent operations, not the systems themselves, can be upgraded by a combination of feedback and statistical adjustment.

While such an improved understanding should not lead to an elimination of statistical methods from SDI operations, it should be instrumental in restricting applications to those that will assure consistent translation of free language into meaningful standardized expressions, phrases, and hopefully syntactical descriptions.

7. UTILIZATION OF CENTRALLY GENERATED ANALYSIS—General Considerations

The size of our installation, the limitation of our personnel spaces and the present financial restraints do not permit a separate analysis of HDL-mission-related literature. Such a new analysis is a prerequisite for the modern sophisticated reference system we have already designed and evaluated. Instead, however, we have been able to utilize only the magnetic tapes that are generated by well-funded information centers of the government and by large professional societies that prepare analytical data covering book and periodical literature.

Our in-house programming efforts exerted for the adaptation and utilization of available analytical reference service will facilitate:

1. the translation of different tapes into the format acceptable to the HDL computer system and the culling of irrelevant algorithms and non-mission-related or inappropriate information (e.g., IDEP reports included in TABs);
2. the printing of individualized bulletins containing titles and other descriptive information in response to profiles prepared with the various branches or teams of the labs; these profiles are to be modified continually on the basis of user notations identifying hits, misses, and subjects which should be dropped or added;
3. the mechanical up-dating of the thesaurus; and
4. the retrieval operations by utilizing

   (a) standard descriptor and subject-heading terminology and cross references,

   (b) the classification schemes the centers develop and apply, and

   (c) the free language used in titles as well as in identifiers and annotations.

The HDL profile for filtering-out and forming the overall mission-related collection can be defined as the union of all the individual profiles the teams and the individual scholars submit. It will slowly evolve while these individual profiles improve through continuing feedback until the entire selection process can cease to be a manual operation and be performed by automation with greater consistency. According to a preliminary agreement, it is planned to transfer successively the information of the reformatted tapes to a set of disks which will be the storage devices for an on-line retrieval service to be built and

tested with the help of the computer service and the terminal leased by one of our laboratories.

In these ways the many services generated at great cost at information centers will be modified and made useful for the particular requirements of HDL personnel.

The system under development can also facilitate

1. the preparation of requisition forms for the reports selected for acquisition,
2. the selective dissemination of titles that will meet with increasing accuracy the subscribers' requirements (for programming effort see Exhibit G),
3. the cumulation of an HDL-mission-related information bank, the basis for future on-line retrieval by laboratory personnel, and
4. the continuation of preliminary studies to

(a) develop a dynamic HDL classification scheme by statistical means (correlations, factorization of co-occuring terms), and
(b) automatically generate term and phrase dictionaries (our first edition, already on tape, is based on the Thesaurus of the Joint Engineering Council).[18]

Nevertheless, we must be realistic and consider the consequences of the above decisions.

We begin by using a Boolean approach in which the desirable documents are selected by the absence, presence or co-occurrence of individual concepts. These isolated concepts are represented by terms and sets of terms as substitute for phrases coined by subject-specialist in subjects that constitute HDL mission, tasks, and fields of interest. In other words, we retain from the more appropriate communication tool we have called the ABC system, all elements except the connectors within and between phrases and the accompanying standardization of phrases and syntax. For this reason we must anticipate that our present solution, a child of economic necessity, will lead to a deterioration of our original scheme. To some extent, the degree of deficiency will become evident when we estimate the capability of the system and later measure the response of our personnel to the services we have established. Some of the potential advantages unique to our ABC system may never have a chance to be proven and measured without fuller development and application at HDL.

8. A PROTOTYPE TEST FOR DETERMINING THE LIMITS OF A GIVEN RETRIEVAL SYSTEM

Those who test retrieval methods are generally aware of the unavoidable subjectivity involved. It is assumed that the use of a portion of an actual library collection and a set of queries obtained from the

existing reader population will provide a realistic basis for obtaining accurate estimates of the system's efficiency.

It is hardly possible, however, to determine how a change of the subject matter or the complexity of documents or an increase of detail and involvement of information requirements will affect the outcome of the test runs.

It is therefore desirable to produce a test model that will facilitate the elimination or evaluation of these subjective elements and thereby make it possible to rate a given storage and retrieval system and to predict its efficiency under well defined conditions.

It is desirable to establish the inherent limit of retrieval and relevance capabilities for each system because test results exceeding such a limit require critical analysis.

The method designed in HDL and described below seems to meet these criteria and could, when fully developed, be used to test any retrieval system.

For reasons of economy HDL abandoned its own promising analytical efforts and started to rely on the efforts of national and professional information centers which disseminate tape records at no or relatively low cost.

What we had designed was a relatively accurate method for measuring the deficiency (D) of individual retrieval operations which can also be applied to the evaluation of entire retrieval systems. This method requires, however, a large sample and therefore an extended period of operation and testing to achieve a reliable rating for a system at a high confidence level.

In the following chapter we suggest another testing method which permits the early determination of the limits of a given system. Timeliness is essential if the system's designer is to prevent futile efforts and expenditures trying to exceed the inherent limitations of the tested system. We illustrate the basic principles and procedures of this proposed method with a coordinate-indexing or Venn-diagram type retrieval model to evaluate Boolean search operations. See Exhibit G.

We have intentionally termed this a prototype test because of the small size of the sample used and because we do not offer at this time a final evaluation of the Boolean retrieval operation. Instead, we generate basic concepts, feasible procedures and such abstractions or ideal types, as are used for the construction of any practical measuring tool.

To explain our approach, it must also be mentioned that budgetary and manpower limitations are forcing the use of available data banks on most of our library and information activities, in particular (1) on the selection of reports and documents, (2) on cataloging and processing for dissemination and circulation, as well as (3) on rendering future bibliographic services (including on-line retrieval by our scientists and engineers).

A Boolean search can eliminate materials to which one or more unwanted search items have been assigned, and can retrieve items whenever the desired term or combination of terms is associated with an item.

The test consists of several steps.

1. Nine reports pertaining to HDL's fields of interest were randomly selected from an unclassified Technical Accession Bulletin.

2. The strings of descriptors assigned by the DDC indexers and the notations of the particular document number (1-9) were copied verbatim (Exhibit H), and handed to 21 junior and senior scientists selected by their Branch Chiefs to act as liaison officers between their laboratory teams and the Scientific and Technical Information Office. These officials were requested to examine the strings of assigned indexing terms and phrases and, to the best of their ability, to express the contents of each of the 9 documents in syntactical descriptors. In this test, the degree of the operation's difficulty was represented only by the totality of the different individual documents of which the collection was composed; while the coincidence of query and document content was to eliminate the subjective element of query formulation.

To rate the reconstruction efforts of our 21 professional test operators we first applied a psychometric method. Each of the descriptive phrases they had generated was rated by an average of 7 to 8 members of the same group using a scale of 0 (no agreement) to 9 (full coincidence between document and abstract information). As Exhibits I (1-9) indicate the range of ratings was extremely large extending in many instances from 0 through 8 and 9.

The large deviations of different evaluators may have been caused by two different approaches to the task.

Some evaluators may have compared the descriptors against the abstracts of the documents and thereby could have included the deficiencies of the DDC abstractors in their ratings, whereas others may have used the entire document for comparison and arrived at lower rates of deficiency.

The average results and their standard deviations, with confidence intervals at 0.95 percent, are tabulated in Exhibit J. It is quite obvious that the deficiency ratios[3] for semantics as well as syntax are as a rule closely related to the number of embedded phrases and the length of the documents.

Moreover, the results point to the subjectivity of the opinions reflected in psychometric measurements and to the large number of evaluators necessary if one wishes to arrive at reliable data. With the limitation of our funds and personnel spaces, this method could not be efficiently utilized in our own organization.

To measure, nevertheless, the quality of both the strings of the index terms and the 9 times 21 descriptive phrases generated by our information coordinators (or officers), we developed a standard measuring rod. First, we described the substance of the author's abstract by identifying in a three-column scheme (a) the type of publication, (b) the main subject or subjects treated in the paper (study, experiment or development), and (c) the significant modifiers related to these subjects (Exhibit K). Based on these important substantial elements of the document, a syntactical (ABC-type) descriptor was formulated for each of the nine documents by introducing appropriate and concise connectors (Exhibit L).

To complete the measuring rod, relative values were assigned by the conductor of the test to every linguisti component of a document. If as in this prototype the value of 100 is accepted as the optimum rating for each complete document, the component syntactical elements were assumed to be capable of reaching a maximum of about 40 to 50 (inserted with prefix) and its semantic elements, a maximum of about 50 to 60. (See superscribed numbers of Exhibit L.)

On the basis (see Exhibit K & L) of the entire ideal-type descriptor, the sub-distribution of the values to the linguistic components in the various columns in proportion to their significance brings the rating of each major subject term in Column II up to an average of "15", the rating of their modifiers in Column II to "5" and for the terms designating the type of publication in Column I to 5, while important connectors average a rating up to 20 each. For example, in the first document analyzed (Exhibit K and L) the type of publication (column I) "Math Models," and "Prediction" with a rating of 5 each, is represented by a total of 10; the main subject (column II): "Antenna" 15 and its modifiers: "Ferrite" and "Cylindric" with 5 each, a total of 25; the significant related subject: "Polarization Current" (column III) a total of 15; while the main connectors: "prediction of" and "antenna using" with 20 each, and the minor connection models "for" (within column I) total 50. If the document is complex (as documents III, V, VI, VIII, and IX are) the individual values have to be proportionately reduced without changing the overall ratings.

The deficiencies of this procedure are obvious.

1. The ideal type descriptors should have been developed not by one analyst, but by at least 40 to arrive at a composite formulation.

2. A valid evaluation of syntax and semantics should be the average of the evaluations of at least the same number of analysts.

3. A psychometric method should have been applied in which 40 or more analysts in a step-by-step reduction of the 100-percent value assigned to each document arrive at rating values for the individual elements which are successively eliminated from the complete formulations. Again the averages over the obtained ratings of a large group should then be used as a standard for comparison.

We must also call attention to the fact that we have not yet taken into consideration the allocation of superfluous descriptors. For example, the descriptors, "Cylindrical bodies" and "pipes", assigned to document #1 because of the shape of rod-or tube-antennas are bound to cause false drops in Boolean or coordinate indexing-type retrieval systems. Also the headings "Data Processing System", "Flow Charting", (in document #2) and "Nonlinear Systems" in document #9 (apparently added by the indexer because of the non linear operation of the beam-plasma amplifier) are too broad for the information described in the document that explains the computer implementation of the Fast-Fourier Transform as a tool for spectral analysis.

After acceptable standards of descriptor texts and values have been constructed, the deficiencies caused by the indexer can be calculated easily. One underscores all terms (Exhibit K & L) of the standard descriptors which have also been covered by the indexers, so that all values of the not-under-scored terms add up to the semantic deficiencies caused by processing. In this instance, the average score is 18 percent (Exhibit M), which is relatively low in comparison with the entire 43 percent assigned to syntactical deficiency because of the system's omission of syntactical codes.

The deficiencies introduced by our 21 scientists and engineers, (Exhibit J) who prepared their abstracts or syntactical descriptions from the strings of terms assigned by DDC indexers added 19 to the semantic deficiencies of the indexers, but raised (or improved) the syntactical one to 17 percent (due to the gift of the human brain for correct associations and due to the subject knowledge of our professional people). If all statistical data had been derived from a sufficiently large sample and under sufficiently effective controls, the semantic deficiency for this particular collection would have amounted to 37 percent* and the syntactical one to 17 percent.** (See footnote on p. 25)

*It is no more than a coincidence that in her evaluation of subject headings in a dictionary catalog, Patricia Knapp[19] found that, of the 336 terms under which student and professors searched, only 47 percent were correct; that, of 219 users, 59.3 percent had difficulties; and that, of the 150 students sampled, 69 or 46 percent were not successful.

It can be predicted that these percentages will gain precision (lower percentage) larger staff of trained testing personnel, and will rise with the complexity and decrease with the simplicity of the documents that constitute the text collection. However, as soon as the inherent limits have been established for Boolean and other retrieval systems, we will acquire a more realistic insight into their capabilities and their actual performance under different conditions.

9. SUMMARY

The key parameters in designing and operating automated library services are described and analyzed. The system operating at the HDL library is presented, and an original method (ABC) for standardizing the syntactical relationships among descriptors assigned to documents is reviewed. A comparison is made between the related studies at HDL and the Bunker-Ramo Corporation analyzing the relationships found in linguistic structures. The identification of an unambiguous and comprehensive list of such relationships is the key to the ultimate development of any practical automated storage and retrieval system which will apply the power and the convenience of linguistic syntax.

The method and programs are described by which HDL utilizes information files available from other agencies. Shortcomings of such files and their use are pointed out, and it is emphasized that there is a great potential loss to the scientists at the HDL laboratories and to the science information community if economic considerations abort further development of the ABC method.

A preliminary test is described in which a new parameter "deficiency" is measured for information retrieval systems. This new parameter has potential of great utility both in the earlier evaluation of proposed information systems and in providing a single quantitative value for the comparison of different systems. It still remains to study and apply the test on large sample so that firm values and conclusions can be drawn.

**Another set of ideal-type syntactical descriptors of the nine documents was constructed by a senior physicist, and then used to evaluate the approximately 21 times 9 formulations which our junior and senior analysts (representatives of the laboratory branches) had generated. The results showing the averages for the nine documents are listed in Exhibit N. The total average deficiency of the semantic elements turned out to be 22 percent and of the syntax 28 percent. The combination of indexer and analyst deficiencies for syntax was 28 percent. The results obtained by using the average over the two models raised the semantic deficiency to 21 percent, and the syntactical to 22 percent.

Detailed documentation is included illustrating the ABC method and its results, the HDL SDI computerized system listings of the programs, and the experimental data obtained in the test studies measuring "deficiency."

10. ACKNOWLEDGEMENTS

I express my gratitude to Dr. Michael Flynn, Northwestern University, who at the suggestion of Dr. F. J. Murray, Duke University, surveyed our computer requirements and submitted two reports forming the bases for the development of the SDI services and such other HDL library operations as were derived from the tape records of different information centers. Dr. Irving H. Sher, Director of Research and Development, Information Company of America, contributed flow charts for the construction of the computerized system, as well as valuable suggestions for streamlining this report of our research and developmental efforts covering a period in excess of two years. Credit for the efficiency and the favorable acceptance of the SDI service must be given to Mr. Martin R. Shaver, Chief, Business Application Section Computer Services Division, National Bureau of Standards and his intelligent co-workers, who are also the authors of the automated standardization program for the ABC system which are published above as Supplement C. The funds for this particular contractual effort were provided by the Army Research Office. Washington, through the Chief of Engineers, Department of the Army, as a project in Task Area 04 of the STINFO-ATLAS program.

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Exhibit A

COMPARISON OF 59 HDL SUBJECT GROUPS WITH CORRESPONDING COSATI FIELDS USED BY DDC*

1)	characteristics, parameters, data 101, 118
2)	theory, analysis 101, 118
3)	Design, development [illegible]
4)	electric, electromagnetic 76,78,79,120,146,180,183,191
5)	magnetic, ferrite 57, 93, 94, 143, 180
6)	acoustic, hypersonic, ultrasonic 146, 178, 181
7)	optical, light 120, 150, 183, 187
8)	photoelectric 94,120,180,183,185,187
9)	magnetomechanical, piezo 81,89,94,112,148,179,180
10)	thermal, temperature 111, 118, 120, 190
11)	tunneling (tunnel effect) 180, 185, 187, 189
12)	junction (space charge) 97, 108, 118, 180
13)	field effect 77, 79, 180, 189
14)	dielectric, ferroelectric 94, 111, 180
15)	parametric (varactors, ...) 77, 79, 81, 180
16)	linear devices and effects, (resistors, capacitors, ...) 77, 118
17)	diode, rectifier 77, 81
18)	transistor 77, 81
19)	non-linear devices and effects exc. nos. 17 and 18 77, 81, 101
20)	functional units 77, 81
21)	circuit 77, 81
22)	instruments, equipment, appliances (ready for use) 81, 118, 120
23)	systems 79, 81, 118
24)	noise 118, 178, 191
25)	interference, interaction 81, 118, 143, 191
26)	reliability, vulnerability, aging, failure 49,93,111,116,118,120,122
27)	isolation, shielding 81, 89,93,97,116,118
28)	generation of any kind 93, 111, 118
29)	conversion of any kind (energy, frequency, signal,...) transducer 77,81,89,94,118
30)	amplification, gain 77, 81, 191
31)	oscillation 77, 88, 191
32)	modulation, demodulation 118, 191
33)	transmission, communication 118, 143, 180
34)	detection 141,150,151,152,152A
35)	discrimination 77,118,142,143,152A
36)	synchronization, tuning, phase 81, 118, 120
37)	stabilization 79, 106, 118
38)	automatic control 118, 120, 191
39)	simulation, analog 78, 118, 120
40)	switching, logic 77,78,I01,I02,I20,130,143,193
41)	memory, storage 31, 78, 130
42)	computer 78
43)	radar, sonar 142, 146, 149, 151
44)	maser, laser 182
45)	space science 14, 206
46)	military, weapons 124, 127, 168
47)	manufacturing 24, 79, 111, 117
48)	miniaturization 77, 79, 118
49)	thin-film 77, 79, 189
50)	measuring, testing, observation 101, 118, 120
51)	improvement 118
52)	germanium, silicon, selenium 57, 89, 93, 94
53)	compound semiconductors 57, 94, 189
54)	non-semiconducting material 55,87,92,93,94,99
55)	power, energy 84,85,86,118,180
56)	pulse 118, 191
57)	frequency 118, 191
58)	radio waves 143, 144, 191
59)	microwaves, millimeter-waves 143, 151, 191

*The numbers under the headings refer to the group numbers of the COSATI scheme in Exhibit B following.

Exhibit B

COSATI GROUPS CONSECUTIVELY NUMBERED

1	01	**Aeronautics**	
2		01	Aerodynamics
3		02	Aeronautics
4		03	Aircraft
5		04	Aircraft flight instrumentation
6		05	Air facilities
7	02	**Agriculture**	
8		01	Agricultural chemistry
9		02	Agricultural economics
10		03	Agricultural engineering
11		04	Agronomy and horticulture
12		05	Animal husbandry
13		06	Forestry
14	03	**Astronomy and Astrophysics**	
15		01	Astronomy
16		02	Astrophysics
17		03	Celestial mechanics
18	04	**Atmospheric Sciences**	
19		01	Atmospheric physics
20		02	Meteorology
21	05	**Behavioral and Social Sciences**	
22		01	Administration and management
23		02	Documentation and information technology
24		03	Economics
25		04	History, law and political science
26		05	Human factors engineering
27		06	Humanities
28		07	Linguistics
29		08	Man-machine relations
30		09	Personnel selection, training and evaluation
31		10	Psychology *(Individual and group behavior)*
32		11	Sociology
33	06	**Biological and Medical Sciences**	
34		01	Biochemistry
35		02	Bioengineering
36		03	Biology
37		04	Bionics
38		05	Clinical medicine
39		06	Environmental biology
40		07	Escape, rescue and survival
41		08	Food
42		09	Hygiene and sanitation
43		10	Industrial *(Occupational)* medicine
44		11	Life support
45		12	Medical and hospital equipment
46		13	Microbiology
47		14	Personnel selection and maintenance *(Motion)*
48		15	Pharmacology
49		16	Physiology
50		17	Protective equipment
51		18	Radiobiology
52		19	Stress physiology
53		20	Toxicology
54		21	Weapons effects

55	07	**Chemistry**	
56		01	Chemical engineering
57		02	Inorganic chemistry
58		03	Organic chemistry
59		04	Physical chemistry
60		05	Radio and radiation chemistry
61	08	**Earth Sciences and Oceanography**	
62		01	Biological oceanography
63		02	Cartography
64		03	Dynamic oceanography
65		04	Geochemistry
66		05	Geodesy
67		06	Geography
68		07	Geology and mineralogy
69		08	Limnology
70		09	Mining engineering
71		10	Physical oceanography
72		11	Seismology
73		12	Snow, ice and permafrost
74		13	Soil mechanics
75		14	Terrestrial magnetism
76	09	**Electronics and Electrical Engineering**	
77		01	Components
78		02	Computers
79		03	Electronic and electrical engineering
80		04	Information theory
81		05	Subsystems
82		06	Telemetry
83	10	**Energy Conversion** *(Non-propulsive)*	
84		01	Conversion techniques
85		02	Power sources
86		03	Energy storage
87	11	**Materials**	
88		01	Adhesives and seals
89		02	Ceramics, refractories and glass
90		03	Coatings, colorants and finishes
91		04	Composite materials
92		05	Fibers and textiles
93		06	Metallurgy and metallography
94		07	Miscellaneous materials
95		08	Oils, lubricants, and hydraulic fluids
96		09	Plastics
97		10	Rubber
98		11	Solvents, cleaners and abrasives
99		12	Wood and paper products
100	12	**Mathematical Sciences**	
101		01	Mathematics and statistics
102		02	Operations research

103	13	**Mechanical, Industrial, Civil and Marine Engineering**	
104		01	Air conditioning, heating, lighting and ventilating
105		02	Civil engineering
106		03	Construction equipment, materials and supplies
107		04	Containers and packaging
108		05	Couplings, fittings, fasteners and joints
109		06	Ground transportation equipment
110		07	Hydraulic and pneumatic equipment
111		08	Industrial processes
112		09	Machinery and tools
113		10	Marine engineering
114		10.1	Submarine engineering
115		11	Pumps, filters, pipes, tubing and valves
116		12	Safety engineering
117		13	Structural engineering
118	14	**Methods and Equipment**	
119		01	Cost effectiveness
120		02	Laboratories, test facilities, and test equipment
121		03	Recording devices
122		04	Reliability
123		05	Reprography
124	15	**Military Sciences**	
125		01	Antisubmarine warfare
126		02	Chemical, biological, and radiological warfare
127		03	Defense
128		03.1	Antimissile defense
129		04	Intelligence
130		05	Logistics
131		06	Nuclear warfare
132		07	Operations, strategy, and tactics
133	16	**Missile Technology**	
134		01	Missile launching and ground support
135		02	Missile trajectories
136		03	Missile warheads and fuzes
137		04	Missiles
138		04.1	Air and space launched missiles
139		04.2	Surface launched missiles
140		04.3	Underwater launched missiles
141	17	**Navigation, Communications, Detection and Countermeasures**	
142		01	Acoustic detection
143		02	Communications
144		02.1	Radio communications
145		03	Direction finding
146		04	Electromagnetic and acoustic countermeasures
147		05	Infrared and ultraviolet detection
148		06	Magnetic detection
149		07	Navigation and guidance
150		08	Optical detection
151		09	Radar detection
152		10	Seismic detection

153	18	**Nuclear Science and Technology**	
154		01	Fusion devices *(Thermonuclear)*
155		02	Isotopes
156		03	Nuclear explosions
157		04	Nuclear instrumentation
158		05	Nuclear power plants
159		06	Radiation shielding and protection
160		07	Radioactive wastes and fission products
161		08	Radioactivity
162		09	Reactor engineering and operation
163		10	Reactor materials
164		11	Reactor physics
165		12	Reactors *(Power)*
166		13	Reactors *(Non-power)*
167		14	SNAP technology
168	19	**Ordnance**	
169		01	Ammunition, explosives and pyrotechnics
170		02	Bombs
171		03	Combat vehicles
172		04	Explosions, ballistics and armor
173		05	Fire control and bombing systems
174		06	Guns
175		07	Rockets
176		08	Underwater ordnance
177	20	**Physics**	
178		01	Acoustics
179		02	Crystallography
180		03	Electricity and magnetism
181		04	Fluid mechanics
182		05	Masers and lasers
183		06	Optics
184		07	Particle accelerators
185		08	Particle physics
186		09	Plasma physics
187		10	Quantum theory
188		11	Solid mechanics
189		12	Solid state physics
190		13	Thermodynamics
191		14	Wave propagation
192	21	**Propulsion and Fuels**	
193		01	Air breathing engines
194		02	Combustion and ignition
195		03	Electric propulsion
196		04	Fuels
197		05	Jet and gas turbine engines
198		06	Nuclear propulsion
199		07	Reciprocating engines
200		08	Rocket motors and engines
201		08.1	Liquid propellant motors
202		08.2	Solid propellant motors
203		09	Rocket propellants
204		09.1	Liquid propellants
205		09.2	Solid propellants
206	22	**Space Technology**	
207		01	Astronautics
208		02	Spacecraft
209		03	Spacecraft trajectories and reentry
210		04	Spacecraft launch vehicles and ground support

Exhibit C

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
Washington, D.C. 20234

January 19, 1970

Dr. B. Altmann
Harry Diamond Laboratories

Dear Dr. Altmann:

In accordance with your telephone request, I've reviewed the documentation for the NASA SDI system. The documentation proved to be enlightening in that it indicates that your experimental approach to SDI, conceived quickly in detail last month, is very similar to the methods of the expensive (no doubt) NASA system. Part of your request was for a judgment as to whether your efforts should be discontinued and the NASA system should be adopted to serve your SDI requirements. My recommendation is that you should not discontinue your current project. The rationale for that decision follows.

Adoption of the NASA system would delay implementation of the SDI service. You expect the programs for your current SDI system to be ready for initial use in two or three weeks. Even if you requested the NASA programs immediately, you would be lucky to get them in two weeks. Since they do not include a program to generate document profiles, it would be necessary to develop a program similar to the PURGE being written by Glen Moore to produce the document profiles from the DDC tapes. Glen's program could probably be modified to perform that function but the modifications would require a minimum of two weeks. Then, the NASA system would have to be tested on your computer. That testing might take a week or it might take several months. The variation would depend upon the similarity of your 7094 hardware and software to the 7094 system upon which the programs originally functioned. Another possible problem, completely out of your control, is the condition of the source programs provided by NASA. The documentation indicates that the original system was modified several times and is no longer in regular use by NASA. One can only speculate on the quality of maintenance for an unused system.

Adoption of the NASA system would definitely cost more than completion of your current system. Since your staff are still programming novices, you would have to depend upon outside support, such as that provided by my organization, if problems were encountered in implementation of the NASA system. In the simple system currently under development, your staff should be able to resolve most of their own problems.

It's possible to make several comments on the relative merits of the two systems. There's no doubt that the NASA system provides more flexibility in representing user profiles. However, it may be that you do not need that flexibility. The NASA system also provides the means for developing statistics on the effectiveness of the SDI operation. Your fledgling system has no such capabiiity. However, it's possible, with your small group of users, that such statistics could easily be compiled manually. As far as efficiency of the computer programs is concerned, it's difficult to determine how the two systems will compare. However, I would suspect that the time required for your system will not exceed the sample times provided in the NASA documentation. In one regard your current system will provide more information than the NASA system. The actual computer portion of the NASA system produced only a reference to an accession number. Additional information concerning the document was provided by means of high quality pre-printed abstracts. NASA could afford the production of those abstracts since they served a large user group. Even if you could afford their production (which did not involve the computer), you couldn't possibly initiate it without a considerable amount of work involving your print shop and possible outside support. Thus, you would be stuck with a system which provided only accession number in response to a profile match. In this situation, your current system is superior since it will provide title, author and other bibliographic information.

To summarize, I think it best to start off with a simple system over which you have control. It should not take you long to determine its weaknesses. If it fails, all your work will not have been wasted since the data used by your system and produced by it can be converted for use with the NASA system.

If your system works, you'll have time to implement the more sophisticated NASA system, if desired, or to concentrate on improving service or saving money in other areas such as the direct preparation of bibliographic data for the catalog from the DDC tape file.

I'll be happy to go into further details of the NASA system with you at any time.

Martin R. Shaver

MARTIN R. SHAVER
Chief, Business Applications Section
Computer Services Division

EXHIBIT D

WORKSHEET FOR ANALYST

	DOCUMENT:			REFERENCE:
1	(type of publication)		,A/	
2	(properties - adj)		,B/	
3	(shape, form - adj)		,C/	
4	(physical phase - adj)		,D/	
5	(main subject) * * * *		./	
6	(tool,) (method)	PRODUCED BY	,E/	
7		INFLUENCED BY	,F/	
8		RELATED TO	,G/	
9		BEING PART OF	,H/	
10		LIMITED TO	,I/	
11		WITHOUT	,J/	
12		DESIGNATED	,K/	
13		SIMULATED BY	,L/	
14		MODELLED BY	,M/	
15	(materials)	WITH	,N/	
16	(components)	WITH	,O/	
17	(devices)	WITH	,P/	
18	(instruments)	WITH	,Q/	
19	(purpose)	FOR	,R/	
20		RESISTANT TO	,S/	
21		VULNERABLE TO	,T/	
22		RESULTING TO	,U/	
23	(influence on)	ON	,V/	
24	(operating, performing)		,W/	
25	(principle,energy)	USING	,X/	
26	(instrument)	BECAUSE OF	,Y/	
27		LIKE	,Z/	
28	(environment)	IN, AT	,AA/	
29	(where)	IN - AT	,AB/	
30	(when)	DURING	,AC/	

EXHIBIT E

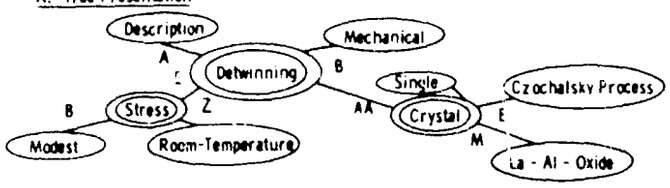
Flowchart for automatic standardization of syntagmas (ABC descriptors).

I. ORIGINAL ABSTRACT

Crystals produced by the Czochalsky process frequently show twin boundaries. An experiment was conducted by which twins in Lanthanium - Aluminum - Oxide were removed by the application of modest stress at room temperature. The paper describes the detwinning method

II. CONTENT ANALYSIS

A. Tree Presentation



B. Format of Computer-Stored Analysis (taken from worksheet)

1A Description	2B Modest	3C Single
1B Mechanical	2/1E* Stress	3/1AA* Crystal
1/* Detwinning	2Z Room Temperature	3E Czochalsky Process
1E Stress		3M La - Al - Oxide
1AA Crystal		

III. COMPUTER PROCESSING METHOD (transformation of II.B.)

Step 1 Introduction of Standard Connectors and Preliminary Arrangement:
Description of Mechanical Detwinning produced by

(1E) Stress

(2B 1E) Modest (2Z 1E) Room-Temperature

in

Crystal

(3C/1AA) Single (3E/1AA Produced by Czochalsky Process (3M/1AA) La Al - Oxide

Step 2 Intermediary Process Modifiers and their standard connectors are properly sequenced, those coded A-E in front of, all others behind the term that is modified.

Step 3 Standardized Computer Product Description of mechanical detwinning produced by modest stress at room temperature*, in single crystal produced by Czochalsky Process of La - Al Oxide"

* The comma indicates that the subsequent phrase is directly related to the main subject "detwinning" but its component elements refer to the main subject of this particular phase ("crystal").

Exhibit F

THESAURUS AUTOMATICALLY DERIVED FROM INPUT

A

Terms	Modified by	Associative Code	Document Symbol
Antenna	Design	A	CFA
	Fuze	H	CFA
	Gamma Radiation	S	CFA
	Parallel	C	CFA
	Spiral	C	CFA
Fuze	Anti-Missile Missile	H	CFA
	Chirp Radar	W	CFA
Gamma Radiation	Nuclear Blast	E	CFA
Missile	Nike-X	J	CFA

B

Terms	Used as modifiers of		
Anti-Missile Missile	Fuze	H	CFA
Chirp Radar	Fuze	W	CFA
Design	Antenna	A	CFA
Fuze	Antenna	H	CFA
Gamma Radiation	Antenna	S	CFA
Nike-X	Missile	J	CFA
Nuclear Blast	Gamma Radiation	E	CFA
Parallel	Antenna	C	CFA
Spiral	Antenna	C	CFA

EXHIBIT G

The HDL-SDI System

(Phase 1)
Ralph G. Moore

The system described (Chart a) is a user-oriented Selective Dissemination of Information service based on magnetic tape records furnished by the Defense Documentation Center. The computer programs are written in COBOL for the IBM-7094.

The DDC tapes are processed by a 'purge' program which removes documents found in certain COSATI fields and groups of no concern to the installation, periodical articles (covered comprehensively on tapes provided by such professional associations as IEEE), and IDEP test reports for which an excellent retrieval system already exists. The remaining documents are treated in the following manner.

1. The terms found in titles, DDC descriptors, and identifiers are prepared for comparison with the user profiles in the search program.
2. The titles, corporate authors, personal authors and other descriptive cataloging data are retained. These records are rewritten in fixed-length format on a tape titled DDC-TAB-EXTRACTS which is the input for the SDI search program.

The user profiles consist of one or more sets (Chart b) of terms with Boolean operators assigned to each set. The sets themselves are composed of one or more terms interrelated by Boolean operators.

The program first checks the terms within a set to determine if the document terms match. If so, the set operator is checked. If a set of profile terms returns a TRUE value for a document and the set operator is NOT , the document is rejected.

For a document to be selected in response to a profile:

A. A FALSE value must be found for all NOT sets
B. A TRUE value must be found for all AND sets
C. A TRUE value must be found for at least one of the OR sets.

In many instances a profile will consist of only one set and a TRUE value must be found for the set in order for the document to be selected.

Because the document terms used in the retrieval operation consist not only of controlled terms (index thesaurus terms) but also of free terms found in titles and of assigned identifiers, the vocabulary available for the automated withdrawal of documents is in a constant state of change. A list of such terminology is maintained and updated at regular intervals to serve as an aid in coding profiles.

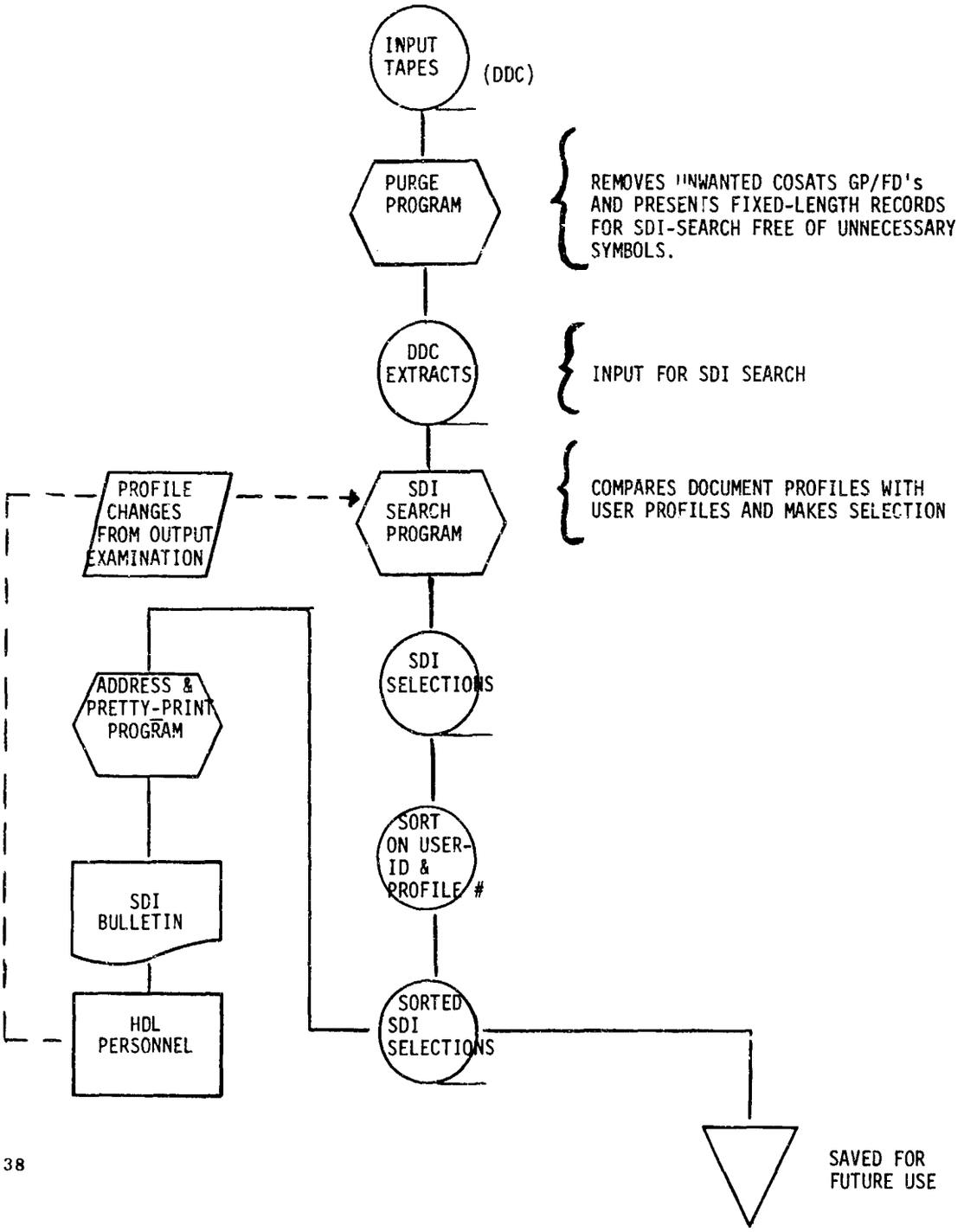
It should be noted that a user is free to request profile terms not found in the list to enable him to cover the latest topics with only recently introduced terminology. The profiles are encoded to reflect both standardized descriptors as well as brand-new technical expressions.

The documents selected by the profiles are recorded together with the user's ID and profile numbers on the tape SORTED-SDI-SELECTIONS. The SDI bulletins are printed from this tape which is retained for future use such as on-line information retrieval.

The bulletins are sent to the subscribers in duplicate. The user is requested to return one of the copies with indication as to which documents should be acquired for the library collection, which should be sent to the user on loan, or which he considers irrelevant to the search request. This feedback is an important element in providing the user with the best possible product.

Exhibit G - Chart a

SELECTIVE DISSEMINATION OF INFORMATION
FLOWCHART



Capability of the SDI Program Exhibit G - Chart b

SET A (NOT)	SET B (AND)	SET C (OR)#1	SET D (OR)#2	SET Z (NOT,AND,OR)
TERM-1	TERM-7	TERM-15	TERM-18	.
and	and	or	and	.
TERM-2	TERM-8	TERM-16	TERM-19	.
and	and	or	and	.
TERM-3	TERM-9	TERM-17	TERM-20	.
or	or		and	.
TERM-4	TERM-10		TERM-21	.
not	or		or	.
TERM-5	TERM-11		TERM-22	.
not	or		or	.
TERM-6	TERM-12		TERM-23	.
	not		not	TERM-(N-1)
	TERM-13		TERM-24	operator
	not			TERM-(N)
	TERM-14			

DEFINITIONS: BOOLEAN OPERATOR- NOT,AND,OR.

SET - ONE OR SEVERAL TERMS COMBINED BY BOOLEAN OPERATORS.

PROFILE - ONE OR SEVERAL SETS OF TERMS. THE SETS ARE ALSO COMBINED BY BOOLEAN OPERATORS.

Exhibit H

The Nine Titles Selected for the Test*

1. AD - 849 707 Fld. 915
   ***(ANTENNAS* FERRITES), CYLINDRICAL-BODIES, PIPES, ANTENNA-PATTERNS, ANTENNA-APERTURES, MATHEMATICAL-MODELS, PREDICTIONS.=

2. AD - 849 961 Fld. 9/2, 12/1
   ***(SPECTRUM-ANALYZERS* INTEGRAL-TRANSFORMS), SIGNALS, DATA-PROCESSING-SYSTEMS, FREQUENCY, SAMPLING, FLOW-CHARTING.=

3. AD - 849 513 Fld. 9/2
   ***(THIN-FILM-STORAGE-DEVICES* MANUFACTURING-METHODS), VAPOR-PLATING, VACUUM-APPARATUS, INTEGRATED-CIRCUITS CIRCUIT-INTERCONNECTION, TEST-METHODS, MODULES-(ELECTRONICS).=

4. AD - 849 761L Fld. 9/5, 9/1, 18/8
   ***(RADIOFREQUENCY-AMPLIFIERS* INTEGRATED-CIRCUITS*), (SEMICONDUCTOR-DEVICES* RADIATION-DAMAGE), FEEDBACK-AMPLIFIERS, DICDES(SEMICONDUCTOR), FIELD-EFFECT-TRANSISTORS, SPACE-ENVIRONMENTAL-CONDITIONS, RADIOACTIVE-ISOTOPES, GAMMA-RAYS, COBALT.=

5. AD - 849 857 Fld. 9/5
   ***(INTEGRATED-CIRCUITS* CIRCUIT-INTERCONNECTIONS*), MANUFACTURING-METHODS, SHIFT-REGISTERS, PROBES, PLATING SEALS, TEMPERATURE, CERAMIC-MATERIALS, BONDING.=

6. AD - 849 932 Fld. 9/5
   ***(LIMITERS* VERY-HIGH-FREQUENCY), BAND-PASS-FILTERS, TUNED-CIRCUITS, COUPLING-CIRCUITS, FERRITES, MECHANICAL-WAVES, MAGNETIC-PROPERTIES, EXCITATION, BROADBAND, GARNET, IRON-COMPOUNDS, YTTRIUM-COMPOUNDS, GALLIUM, PUMPING(ELECTRONICS).=

7. AD - 684 236
   ***(SPACE-CHARGE* CONTROL-SYSTEM), MATHEMATICAL-MODELS, TRANSISTORS, ELECTRON-TUBES, ELECTRICAL-CONDUCTANCE.=

8. AD - 684 471
   ***(ELECTRICAL-CONNECTORS* RESISTANCE (ELECTRICAL) L, SURFACES, METAL-FILMS, PLATING, ZINK, CADMIUM CHROMIUM, ENCIRONEMENTAL-TESTS, ELECTRIC-CONTRACTS.=

9. AD - 684 478
   ***(ELECTRON-BEAMS* PLASMA-MEDIUM*) ELECTRON-TUBES INTERACTION, MICROWAVE-AMPLIFIERS, NONLINEAR-SYSTEMS, XENON, GAIN.=

*From Technical Abstract Bulletin 69-10, 15 May 69

Exhibit I

DOCUMENT 1

THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1	1		1	2	1	1		1	1	
2	1		1		2	2	1	1		
3	1			1	1		1	1	1	2
4	2	1	2			3				
5	1		1	2		1	1	2		
6							3	2		2
7						3	2		1	1
8				2	1		2	2		1
9	2		1	1	2			1		1
10	1	2	3		1		1			
11	1		1	2		2	2			
12	1		1			1	2	2	1	
13		1	2	1	1	2		1		
14						3	2	1	1	1
15				2	1	2	2	1		
16	1		1	1	2	1	2			
17			3	1		1	1		1	
18	1		1	1		2	1	1		1
19	1	1	2	1	2		1			
20	1		2	1		1	1		2	
21	1		1			1	1		2	1

Exhibit I

DOCUMENT 2

THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1	3	1	3	1						
2	5		1	1	1					
3	3	1	2					1		1
4	2	2	1	1	1					
5	3	1	1		3					
6	2		2	3			1			
7	3	1	3	1						
8	3		1	2	1			1		
9	3		2					1		1
10	4	3		1						
11	1	1	5							
12	2	1	3		1	1				
13	5		1	1	1					
14	3		1		1	1		1		1
15	2	1	3			1	1			
16	2		2	1	1		1		1	
17	3		1	1		1		1		
18	1	3	3			1				
19	2	1	3		1	1				
20	3		2	1			1	1		
21	2				1		2		1	1

Exhibit I

DOCUMENT 3 — THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1	1				2	1		4		
2			2	2	1		2	1		
3				2		1			3	2
4		2		1	1		4			
5	5		2	1						
6					1	1	1		2	3
7				1		2	1		3	1
8						1	1	3	1	2
9				1	1	1		3	1	1
10	5	1	1			1				
11			1	2	1			3	1	
12	1				1	1	2	2		1
13	1	1	1	2	1			1	1	
14				1		1	3	2	1	
15					1	2	1	3	1	
16	1	1			3	1	2			
17	3	1		3			1			
18		1	1		1	2	1	1	1	
19				2	1	2	2		1	
20				1			2	3	1	1
21					1	1		2	3	1

Exhibit I

DOCUMENT 4

THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1								2	2	2
2								2	3	1
3					2		1	1	1	1
4				1		2	2	1		
5										
6								2	4	
7							2	3	1	
8					1		1	2	2	
9				1		1	1	1	1	1
10										
11					1	1	1	1	1	1
12	1			1	1		1	2		
13	1			1	2		1	1		
14	1					1	1	2	1	
15							2	2	1	1
16	1		1	1			1			2
17	1			2			1	1		1
18	3		1		2					
19							2		2	2
20				1			1	1	2	1
21				1	2		1	1	2	

Exhibit I

DOCUMENT 5 | THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	LE 0	1	2	3	4	5	6	7	8	9
1			1	3	2					
2			1	1	1	1	1	2		
3			1	1			1	2		1
4		1	1	1	1	1		1		
5		1					1	2	3	
6				1				2	3	
7					2			3	2	
8				1	1	2	1	1	1	
9						1	3	2		
10										
11		2	2		1			1		
12		1	1	1	1	1		1		
13	1	4				1				
14			2		1		2	1		1
15		1						3	1	2
16	1	1	1	1		2				
17					1	1	1	2	1	
18			2	1	1	2				
19				2				4		1
20		1	1		1		1	3		
21		1				3	1	1	1	

Exhibit I

DOCUMENT 6 — THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1	4	1	1							
2		1	1			1	1	2		
3		1	1	3		2				
4	1	3	1						1	
5										
6			1		1		2		2	1
7				2	1	2	2			
8					2	1	3			1
9					3	1	1	1		1
10										
11			2	1	2				1	
12				2	1			1	1	1
13		1	3	2						1
14				3	2			1		
15				1	3		1			2
16	2			2				1		
17		2	1	1				1		
18		2	2	1					1	
19			1	2	1	1	1	1		
20			1	1	2		1	1		
21		1			1		2	1	1	1

Exhibit I

DOCUMENT 7 — THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1				1			2	1	2	
2		1			1		1	1	2	
3			1	1	1		2	1		1
4							1	1	2	1
5										
6						1	1	3	1	1
7		1		1		1			1	1
8	1	2	1	1			1			
9		1			1	1		2		2
10										
11		1	1	2	2				1	
12		2				2			3	
13	1	3	1		1					
14		3	1	1	1				1	
15						3		2	1	
16		1	1			1	1	1	1	
17			1			1	2	2		
18		1	1	2		1	1			
19		2			1		1	2		
20		1	1	1	1	1			1	
21				1		1	1	2	1	1

Exhibit I

DOCUMENT 8 — THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1			1		2			2	1	
2			1	1	1			1	3	
3		1	1	1	2		1			
4						1	2	1	3	
5	5	1								
6		1	1	1		1		2	1	
7	1	1	1			1	1	1	1	
8		1			1	2	1	1		1
9			1	3		1		1		
10										
11		1	3				1		1	
12					1	2	1	2	1	
13		1	2			1	2			
14		1			1	2	1	1	1	
15		1					3		3	
16			1	1	1		2	1		
17			1	1		2	1	1		
18		1		2	1	1	1			
19		1				1	2	1	1	
20	4	1			1					
21								2	3	2

Exhibit I

DOCUMENT 9

THE 21 SYNTACTICAL DESCRIPTORS RECONSTRUCTED FOR EACH OF THE NINE DOCUMENTS RATED BY A 0-9 SCALE

NUMBER OF RECONSTRUCTION	SCALE 0	1	2	3	4	5	6	7	8	9
1										
2		1				1		4		
3	2	1		1	1	2				
4					1			4	1	
5		1	1		2	2				
6		2		2	1		1	1		
7			2	2		1	1	1		
8			2	2	1		1			
9				2	1	2		2		
10										
11	1	1		2			1	1		
12					1			4	2	
13	1	1	1	1			2			
14				1	1	2	1	1		
15					1		2	4		
16			2	2		2				
17		1	1	1			3	1		
18					2	1	2	2		
19		2			1	1	1	1		
20	2	2		1		1				
21							1	2	3	1

Exhibit J

AVERAGE TEST RESULTS WITH STANDARD DEVIATIONS

DOCUMENT	TYPE RATING	AVERAGE	STANDARD DEVIATION	CONFIDENCE INTERVALS AT CONFIDENCE LEVEL OF 95% LOWER	UPPER
1.	Semantics	4.61	5.87	- 7.65	16.87
1.	Syntax	9.52	9.50	-10.33	29.37
2.	Semantics	42.79	11.4	19.01	66.57
2.	Syntax	27.55	10.86	4.10	50.20
3.	Semantics	14.78	8.60	- 3.19	32.75
3.	Syntax	21.26	9.08	2.29	40.23
4.	Semantics	22.73	17.46	-13.76	59.22
4.	Syntax	5.71	12.8	-20.91	32.33
5.	Semantics	5.44	11.6	-18.68	29.56
5.	Syntax	2.93	10.5	-18.91	24.77
6.	Semantics	17.26	14.7	-13.31	47.83
6.	Syntax	16.19	12.0	- 8.77	41.15
7.	Semantics	19.52	15.6	-12.91	51.96
7.	Syntax	35.00	9.22	15.83	54.17
8.	Semantics	20.14	17.0	-15.22	55.50
8.	Syntax	10.95	12.1	-14.21	36.11
9.	Semantics	24.25	16.0	- 9.03	57.53
9.	Syntax	24.32	10.6	2.28	46.36
AVERAGE	Semantics	19.05	11.3	- 7.05	45.15
AVERAGE	Syntax	17.04	10.8	- 7.70	41.78

Exhibit K

PREPARATION OF FIRST SET OF MODELS FOR MEASURING TEST RESULTS

	I	II	III
I	Math models Analysis Prediction (Method of Analysis)	Antenna IIa Ferrite material-rod Ferrite - rod Ferrite-loaded cylinder pipes Solid dielectric rod IIb RF amplification (Microwave) when electron beam converted to RF wave energy Coupling of RF energy to device: quasi-optical techniques (elliptic cavity coupler)	using: Electric + magnetic polarization current Illumination of an aperture represented by cross-section of feeding cavity)

	I	II	III
II	Software Computer programs	To be applied to: Fast Fourier transforms	for: (a) sampling, spectral analysis signal processing; exact frequency determination (coefficients), (b) Taylor weighting, cosine weighting (c) Output display

Exhibit K

I	II	III
III Manufacturing process Design Module fabrication Test results	For: Memory system, Thin mated Film Storage, Storage array, Compact, (Low-power). IIa And: Integrated circuit, ultrasonically bonded to evaporated vapor plating wiring	with: Copper - mylar tape interconnections, Vacuum deposition techniques, Circuit interconnection techniques, Encapsulation techniques, Copper - Kapton tape connection, Copper - mylar tape connections

I	II	III
IV Irradiation of Cobalt 60 (Gamma)	(a) ICOA (Integrated circuit) (b) Semiconductor components	

Exhibit K

	I	II	III	IV	
V	Production =	of:	by:	purpose:	high yield,
	Packaging and testing	Integrated circuits	beam-leaded ic's,		low cost,
		with:	beam crossovers,		high reliability,
		Multi-chip interconnection	under:		
			elimination of wirebands,		
			and of interconnection interfaces,		

	I	II	III	IV	
VI	Construction of	limiters,	using: subharmonic magnetoelastic modes	Objective	(a) low internal saturation magnetic field,
		limiter circuits,	IIIa		a low limiting threshold;
		tuned circuits,	in: ferrimagnetic materials,		(b)Selective limiting;
		IIa	YIG-doped gallium,		(c)Low intermodulation levels;
		(wide) broadband,	highly-doped garnet.		(d)Linear small signal phase response
		(Very high) Frequency-selective,			
		(band-pass).			

Exhibit K

I	II	III
VII (Math) Model Ia Non-linear, Controlled-conductance	Derived from: Electronic processes in charge-controlled active devices;	for: Synthesis of discrete state circuits

I	II	III
VIII Tests and measurements	Of: Contact resistance, electrical (reactance) low-voltage. dc - contact, as in: seams, + door closures of electromagnetically shielded rooms	Between metal surfaces, flat - overlap IIIa Plated electrolytically with zinc, cadminum, chronium. IIIb Environment: Salt-air (which produces surface film not to be penetrated by normal pressure); Sulfur-diode atmosphere (with negligible effects)

Exhibit K

	I	II	III
IX	Theory, caluclation	of	Objective
	experiments,	beam-plasma device (tube),	Gain,
	correlation of theoretical observed test results	beam-plasma interaction,	power output,
		cylindrical plasma (xenon),	efficiency,
	Ia	cylindrical column (medium),	Magnitude of higher harmonic components,
	Non-linear operations (system),	Slow electromagnetic wave conductor,	reduction of coupling losses
	Saturation Characteristics.	propagation	
		cylindrical (concentric) electrons,	
		Electron steam (beam),	

Exhibit L

MODELS AND VALUES USED FOR MEASURING TEST RESULTS

I Math models for analysis and prediction of Ferrite-loaded cylindric Antenna using polarization current

II Computer programs to utilize Fourier-Transforms for spectral analysis, signal processing and frequency determination output display.

III Module fabrication of and test results with a memory system consisting of a thin film storage array (ultrasonically) bonded to (apo)plated circuitry. (circuit interconnection)

IV Effects of Gamma (Cobalt 60) Irradiation on integrated circuits and semiconductor components

V Production of packaging methods interconnected integrated multi-chip circuit systems by beam crossover and test for high yield, high reliability, low cost

VI Construction of wide-band high-frequency selective tuned limiter circuit using (subharmonic) magneto-elastic modes in Yttrium-iron-Garnet doped with gallium to obtain low-limiting threshold.

VII Math model of conductance derived from (processes in) charge-controlled (active) devices (for circuit synthesis).

VIII Tests and measurements of the electrical contact resistance of flat, zinc-cadmium-, chrominum-plated metal surfaces in (salt-air, sulfur-dioxide atmosphere environments.

IX Efficiency, power-output and gain of a non-linear beam-plasma tube in which the electron beam is concentrically conducted around a xenon plasma column

Exhibit M

DEFICIENCIES CAUSED

BY INDEXING

	SEMANTICS		SYNTAX
1.	20.0	(100 total)	50.0
2.	9.06	(99.66 total)	36.24
3.	19.25	(99.02 total)	45.12
4.	5.0	(100 total)	40.0
5.	42.35	(99.02 total)	45.12
6.	25.0	(100 total)	50.0
7.	20.0	(100 total)	40.0
8.	10.0	(100 total)	40.0
9.	10.35	(100.09 total)	41.4
	161.01		387.68
	17.89		43.09

Exhibit N

DEFICIENCIES (AVERAGE TEST RESULTS) MEASURED WITH SECOND SET OF MODELS

D E F I C I E N C I E S

Item	Semantics	Syntax
I.	9.5	20
II.	34	37.5
III.	24.75	40
IV.	22.73	5.71
V.	22.09	38
VI.	29	40
VII.	15.5	16
VIII.	12.37	21.35
IX.	29.25	32
Average	22.13	27.84
Av . Prev.Test	19.05	17.04
Ave of both averages:	21	23

SUPPLEMENT A. MANUAL RETRIEVAL SYSTEM

For the test of the first-generation ABC system we used a collection of 3600 documents analyzed by professors and instructors of an engineering school. We can characterize their descriptors as logically (prepositionally) interconnected verbless phrases (nominalizations). The texts were transferred to punched cards and processed by a KWIC-type computer program which produced what we call the concept dictionary. The sample page (Chart a) shows the advantages of the process:

(1) It produces clusters of descriptors around key or clue words which serve as logical avenues to information.

(2) The process does not change the original sequence of words nor does it disturb the meaning of the individual descriptor phrases wherever they are repeated in the dictionary; in addition it alphabetizes all terms behind the window over a distance of 30 characters.

(3) In the process of generating the dictionary, the machine blocks insignificant words, such as articles and prepositions, from alphabetization. It also blocks other terms (identified by the analyst) from alphabetization if these terms would result in clustering unrelated and nonsubstantial abstracts or disrupt the homogeneous character of the cluster.

(4) The dictionary is completely cross-referenced because every significant term that occurs in one of the descriptors will form the axis of its own cluster. The inquirer will thus be guided by the co-occurring terms from cluster to cluster; for example, from one denoting a scientific principle to others related to applications, performance, or tests. The dictionary represents an organic system of abstracts where the significant terms can be found in situ; i.e., in clusters of abstracts to which they are materially or functionally related.

(5) The sample page also illustrates the results of using a new KWIC program which eliminates the customary throw-back. The text of each descriptor starting with*** and continuing line after line can be easily read.

(6) The program can process very long descriptions. The present usual limit of 102 character has been raised to 450 characters.

SUPPLEMENT A -- Chart a

Sample page of second-generation ABC dictionary.

	KEYWORD	CODE
...SCATTERING OF DIELECTRIC COATING =	ELECTROMAGNETIC-WAVE• FROM METAL BODY WITH THIN	B
...TRANSMISSION AND ABSORPTION OF SLAB =	ELECTROMAGNETIC-WAVE IN COLLISIONLESS PLASMA•	WYJ
...NONLINEAR PROPAGATION OF MAGNETOSTATIC FIELD =	ELECYROMAGNETIC-WAVE• IN IONIZED-GAS AND	SCN
... PRESENCE OF MAGNETIC-FIELD =	ELECTROMAGNETIC-WAVE IN POLAR SEMICONDUCTOR• IN	AASZ
...MODAL ANALYSIS AND SYNTHESIS OF RADIATION AND DIFFRACTION OF	ELECTROMAGNETIC-WAVE• IN SPHERICAL- REGION =	XAG
...PROPAGATION OF	ELECTROMAGNETIC-WAVE• OVER ABSORBENT MATERIAL =	TFR
...EFFECT OF NUCLEAR-WEAPON BURST ON	ELECTROMAGNETIC-WAVE• PROPAGATION =	TNL
...LSSR COMPILATION OF ABSTRACT ON UPPER-ATMOSPHERE• =	ELECTROMAGNETIC-WAVE- PROPAGATION AND	WXP
...THEORY	ELECTROMAGNETIC-WAVE PROPAGATION IN IONOSPHERE•	SGM
... CONSIDERING ELECTRON VELOCITY AND COLLISION =	ELECTROMAGNETIC-WAVE• PROPAGATION THROUGH IONIZED	TND
... ATMOSPHERE FROM NUCLEAR-WEAPON DETONATION =	ELECTROMAGNETIC-WAVE• RADIATION FROM	VFR
...REVIEW OF MILLIMETER PERIODIC-STRUCTUR EXCITED BY A WAVEGUIDE =	ELECTROMAGNETIC-WAVE• RESEARCH =	SSX
...	ELECTROMAGNETIC-WAVE SPECTRAL-ABSORPTION• IN AIR	SIN
...PROPAGATION OF OPTICAL T4P5-T5P12 =	ELECTROMAGNETIC-WAVE• THROUGH	WAA
...S-BAND COUPLING TURBULENT-ATMOSPHERE =	ELECTROMAGNETIC-WAVE TO SURFACE	ABBF
... MAGNETOSTATIC-WAVE IN FERROMAGNETIC POWER-LIMITER• =	ELECTROMAGNETIC-WAVE TRANSMISSION THROUGH	WSV
... PARABOLIC PLASMA• SLAB AT ARBITRARY-INCIDENCE-ANGLE =	ELECTROMAGNETIC-WAVE-PROPAGATION =	TTR
...EFFECT OF HIGH ALTITUDE NUCLEAR-BURST• ON	ELECTROMAGNETIC-WAVE-PROPAGATION• IN A MEDIUM	SGM
...TRANSIENT WITH AN EXPONENTIALLY-INCREASING CHARGE-DENSITY =	ELECTROMAGNETIC-WAVE-PROPAGATION• IN	WKV
... LOWER-ATMOSPHERE =	ELECTROMAGNETIC-WAVE-PROPAGATION IN SQUARE-WAVE-	WJV
... STRATIFIED PERIODIC-DIELECTRIC-MEDIUM• =	ELECTROMAGNETIC-WAVE-PROPAGATION• THROUGH MEDIA =	ZND
...TEMPORAL AND SPATIAL DISPERSION OF	ELECTROMAGNETIC-WAVE-REFLECTION =	SNR
...STRUCTURE OF THE SOLUTION OF AN INTEGRAL-EQUATION• IN	ELECTROMAGNETIC-WAVES• BY FINITE HOLLOW CYLINDERS	SKX
...SCATTERING OF AND COATED INFINITE CYLINDERS =	ELECTROMAGNETIC-WEAPON SYSTEM =	UDR
...PLANNING GUIDE FOR SATELLITE ECM• SUBSYSTEM AGAINST ENEMY	ELECTROMECHANICAL-INSTRUMENT• =	AAGM
...SUMMARY OF SOVIET WORK ON	ELECTROMECHANICAL-SYSTEM• BIBLIOGRAPHY OF FOREIGN	ABMV
... LITERATURE =	ELECTROMETER• AND ACCESSORY =	WUQ
...ANNUAL REPORT ON	ELECTROMETER FOR PORTABLE-RADIATION-MONITOR• =	WDE
...SOLID-STATE	ELECTRON =	ZTP
...EFFECT ON UNIJUNCTION TRANSISTOR• OF E7P15	ELECTRON =	UBQ
...VISIBLE AND UV RADIATION• FROM METAL BOMBARDED BY	ELECTRON• AND LIGHT MEASUREMENT BY ROCKET	INF
...AURORAL INSTRUMENTATION =	ELECTRON ATTENUATION IN GOLD FILM FOR SLOW	ZLN
... ELECTRON• BEAM =	ELECTRON• BEAM =	ZLN
...ELECTRON ATTENUATION IN GOLD FILM FOR SLOW	ELECTRON BEAM AND A WAVEGUIDE• =	ACDB
...COUPLED-MODE THEORY OF INTERACTION BETWEEN A ROTATING		

SUPPLEMENT B. AUTOMATED RETRIEVAL SYSTEM

Because many of the volunteer retrieval operators employed in our first test had stopped their search as soon as they had looked up a few clusters in the ABC Dictionary and located several answers that satisfied the query, they did not exhaust the available resources; and the relevance and recall figures for the system derived from the test runs were not definitive.

To comply with the reasonable demand for a 100-percent recall operation we automated the retrieval process by imposing a vector-like system upon the analyzed collection and its queries, and conducted a second test. This automated test and the vector system have been discussed previously.[20] In this connection we call attention to several shortcomings that we discovered during the test because the efforts exerted later to eliminate these shortcomings contributed to the enhancement of the abstracts and the method of abstracting.

The fact that the test collection was processed by a number of experts caused variations in the formulation of the descriptors (abstracts) and, consequently, a spread of congeneric or closely allied subjects over a number of different clusters. It became obvious that in order to streamline the system, the descriptors had to be standardized with respect to semantics as well as to syntax; and because we were forced to automate the retrieval operations for the purpose of achieving the 100 percent recall, we considered the possibility of developing a simple and economic method to computerize the analytic process. This was easier to contemplate than to accomplish, We would probably have abandoned the effort if we had not been instructed by an expert[21] to make each element of the ABC descriptors encodeable and, in fact, encoded for the sake of retrieving, correcting, or annotating all inserted data rapidly and effectively.

SUPPLEMENT C

THE PROGRAMS FOR THE PRODUCTION OF STRUCTURED ABSTRACTS

All programs were designed and produced by Business Applications Section, Computer Service Division, National Bureau of Standards

A. Purpose

The Structured Abstracts System combines several computer programs which were developed to support experimentation in the development of "standardized" descriptors for technical reports and journal literature. The programs are used (a) to update magnetic tape files of coded descriptive information, (b) to produce listings of new descriptive information, as well as (c) a thesaurus representing the entire collection of information, and (d) to print standard descriptors by inserting prepositions and other connectors into the source data. A modified version of the original system, consisting of three programs, produces listings of new data, prints descriptors, and punches the descriptors in the form of additions to the ABC (Approach-by-Concept) Dictionary Subsystem maintained by Harry Diamond Laboratories.

B. The Elements of the System: (Listings 1 - 4)

1. File Update Subsystem

a. Program DS005 (COBOL) - Reads a deck of punched cards from the system input tape and writes them on an intersystem tape for the following sort. The deck contains a run date card and structured descriptor cards punched from the structured abstract questionnaire.

b. Sort DS010 (7094 Sort) - Sorts the input cards into ascending alphabetic sequence by document code, shelf number, questionnaire column, and questionnaire row respectively.

c. Program DS020 (COBOL) - Edits the structured descriptor cards, prints their contents in the form of subject and descriptor elements, and uses them to update the STRUCTURE-ABSTRACT file on magnetic tape. Also prepares additions to the ABSTRACT-THESAURUS file.

d. Sort DS030 (7094 Sort) - Sorts the ABSTRACT-THESAURUS additions into ascending alphabetic sequence by subject term, modifying term, questionnaire row, questionnaire column, document and shelf number respectively.

e. Program DS050 (COBOL) - Updates and prints the ABSTRACT-THESAURUS file.

2. Program DS050 (COBOL) - Prints structured descriptors using the STRUCTURE-ABSTRACT file as input. Descriptors to be printed are selected on the basis of the date they entered the file. Inclusive dates may be requested and the entire file printed by using inclusive dates representing the earliest and latest entries in the file.

C. Adding New Structured Abstracts

1. Subject specialists review the documents and complete the structured abstract questionnaire (Attachment 1) for each selected item.

2. Cards are punched from the questionnaire work sheet according to established keypunch rules (Attachments 2A & 2B).

3. A run date card is prepared having the following format:

Column	Contents
1	an asterisk "*"
2-7	date to be assigned to the particular batch of abstracts in the form YRMODA (e.g., 690428).

4. Run date card is placed in front of the structured abstract cards and inserted into run deck for FILE UPDATE SUBSYSTEM (Attachment 3).

5. A copy of the Operations Flow Chart (Attachment 4), is completed by filling in the reel numbers of the most current STRUCTURE-ABSTRACT and ABSTRACT-THESAURUS files. For transfer of the updated files to the library tapes the reel numbers for NEW-STRUCTURE-ABST and NEW-ABST-THESAURUS are added.

6. A run instruction form (803) is completed (Attachment 5) and 30 minutes are allowed for the run.

7. The deck, tapes, production flow chart, and run instruction form are forwarded to the computer room.

8. The computer output will consist of two listings: (a) the console log and (b) the system output of the program.

a. Review of the console log. In order to be correct, it must contain a start and end message (e.g., "START OF PROGRAM DS010": "END OF PROGRAM DS010") for each of the five programs in this subsystem.

b. Review of the listing produced by program DS010 for rejects and/or errors in the data. It may be desirable to rerun or, at least, to re-enter some of the data in the next run.

c. The listing of the input data and the thesaurus listing are removed and forwarded to the person responsible for the file.

9. The output tapes NEW-STRUCTURE-ABST and NEW-ABST-THESAURUS serve as input to the next update run. The STRUCTURE-ABSTRACT and ABSTRACT-THESAURUS files from which they were made should be retained as backup until the next update run in successfully completed.

D. Production of Structured Abstracts Listing

1. The data to be included in the listing will be selected from the STRUCTURE-ABSTRACT file by the date of entry into the file. A date parameter card, controlling the selection, is prepared in the following format.

Column	Contents
1	an asterisk (*)
2-7	first (or only) date to be selected, in the form YRMODA (e.g., 690928)
8	a dash (-) if a "through" date follows
9-14	final "through" date to be selected, in the form YRMODA

2. The date parameter card is inserted between the $DATA card and the "7/8" card at the end of the DS050 object deck.

3. A run instruction form is completed, providing the reel number of the current STRUCTURE-ABSTRACT tape file (Attachment 6)

4. The deck, form, and tape are forwarded to the computer room.

E. Note: The File Update Subsystem and Program DS050, described above, were written for the IBM 7094 utilizing COBOL and the IBM 7094 Generalized Sorting System. They have been logic tested on the IBM 7094 at Harry Diamond Laboratories. The modified version of the system, mentioned in Section A, was tested on a UNIVAC 1108. The source decks available at HDL for that system are UNIVAC 1108 COBOL After testing on the UNIVAC 1108, source decks for the modified version were reproduced.

PROGRAM DS050

SPECIFICATIONS

A. Purpose: Produce readable English phrases describing a document from entries on a structured work sheet used by the document analyst. The phrases will be printed. If the program is successful, a later version will produce a tape containing additions to HDL's ABC Dictionary.

B. Input Files
   1. PARAMETER CARD
      a. Follows program on system input tape "SYSIN1"
      b. Volume - one card containing inclusive search dates in the form YRMODAY (e.g. 681021).
      c. Format -(See Attachment 7)
   2. STRUCTURE - ABSTRACT
      a. File Name: "STRUCTURE - ABSTRACT"
      b. Recording Mode: BCD, high density (556BPI)
      c. Labels: standard, value of ident is "STRUCTURED-ABSTRACT"
      d. Record Length: variable 72 - 360 characters
      e. Block Length: variable, manimum is 3660 characters
      f. Record Format: (See Attachment 8)
      g. Sequence: Ascending in "commercial collating sequence". primary key is tape positions 7 - 34, secondary key is tape positions 41 - 42.
      h. Tape Assignment: unit A (1).

C. Output Files
   1. PRINT - TAPE
      a. Tape assignment: System print tape "SYSOU1"
      b. Labels: omitted
      c. Record Length: fixed, 84 characters
      d. Block Length: one record
      e. Record Format: (See Attachments 9)

D. Processing
   1. The parameter card must be on the system input tape or the job cannot continue. If a single "ACCEPT" or "READ" doesn't get it, print a message such as "DATE CARD MISSING" and end the run. The card may be identified by the asterisk in column 1.
   2. The first step in the program must be a DISPLAY (on the console) of the message "START OF PROGRAM DS050". The last step before "STOP RUN" must be a display of "END OF PROGRAM DS050".
   3. Select only those input records which fall into the time period defined by the parameter card. The period may be as short as one day.
   4. Several input tape records are normally required for a single document. It will be necessary to read them all and store their contents before starting to build the output. Note that all records for a single document will have the same document code and shelf number.

ATTACHMENT 2A

Work Sheet for Structured Abstracts (A)

Document Code: A
Shelf Number : P65-0015

Line	Column 1 Refers to:	Column 2 Refers to: 1H	Column 3 Refers to: 1R	Column 4 Refers to: 2H
	antenna	fuze	gamma radiation	anti-missile missile
A	design study			
B				
C	parallel, spiral			
D				
E			nuclear blast	
H	fuze	anti-missile missile		
I				Nike-X
J		ATTACHMENTS		
R	gamma radiation			
W		chirp-radar		

1-79

THE FOLLOWING CARDS ARE PUNCHED FROM THE WORK SHEET

```
AP65-0015      42H ./ANTI-MISSILE MISSILE,I/NIKE-X
AP65-0015      31R ./GAMMA RADIATION,E/NUCLEAR BLAST
AP65-0015      21H ./FUZE,H/ANTI-MISSILE MISSILE,W/CHIRP-RADAR
AP65-0015      1  R/RADIATION
AP65-0015      1  ./ANTENNA,A/DESIGN STUDY,C/PARALLEL, SPIRAL,H/FUZE,R/GAMMA
```

5 4 3 2 1

Attachment 1
Worksheet for Analyst

Document:			Reference:
1	(type of publication)	,A/	
2	(properties - adj)	,B/	
3	(shape, form - adj)	,C/	
4	(physical phase - adj)	,D/	
5	(main subject) * * * *	./	
6	(tool,) (method) PRODUCED BY	,E/	
7	INFLUENCED BY	,F/	
8	RELATED TO	,G/	
9	BEING PART OF	,H/	
10	LIMITED TO	,I/	
11	WITHOUT	,J/	
12	DESIGNATED	,K/	
13	SIMULATED BY	,L/	
14	MODELLED BY	,M/	
15	(materials) WITH	,N/	
16	(components) WITH	,O/	
17	(devices) WITH	,P/	
18	(instruments) WITH	,Q/	
19	(purpose) FOR	,R/	
20	RESISTANT TO	,S/	
21	VULNERABLE TO	,T/	
22	RESULTING IN	,U/	
23	(influence on) OF	,V/	
24	(operating, performing)	,W/	
25	(principle, energy)USING (instrument)	,X/	
26	BECAUSE OF	,Y/	
27	LIKE	,Z/	
28	(environment) IN, AT	,AA/	
29	(where) IN, AT	,AB/	
30	(when) DURING	,AC/	

ATTACHMENT 2A

Work Sheet for Structured Abstracts (A)

Document Code: A
Shelf Number : P65-0015

Line	Column 1 Refers to:	Column 2 Refers to: 1H	Column 3 Refers to: 1R	Column 4 Refers to: 2H
	antenna	fuze	gamma radiation	anti-missile missile
A	design study			
B				
C	parallel, spiral			
D				
E			nuclear blast	
H	fuze	anti-missile missile		
I				Nike-X
J				
R	gamma radiation			
W		chirp-radar		

THE FOLLOWING CARDS ARE PUNCHED FROM THE WORK SHEET

```
AP65-0015      42H ./ANTI-MISSILE MISSILE,I/NIKE-X
AP65-0015      31R ./GAMMA RADIATION,E/NUCLEAR BLAST
AP65-0015      2 H ./FUZE,H/ANTI-MISSILE MISSILE,W/CHIRP-RADAR
AP65-0015      1   R/RADIATION
AP65-0015      1   ./ANTENNA,A/DESIGN STUDY,C/PARALLEL, SPIRAL,H/FUZE,R/GAMMA
```

5 4 3 2 1

ATTACHMENT 2B

Work Sheet for Structured Abstracts (8)

Document Code: A
Shelf Number : P64-0001

Line	Column 1 Refers to: V	Column 2 Refers to: 10	Column 3 Refers to: 2W
.	switching functions	feedback control systems	coordinate transformation
A	analysis		
B	suboptimal	time-optimal high order	
C			
D			
E			Kalman method
O	feedback control systems		
U			sensitivity functions
V			
W		coordinate transformation	

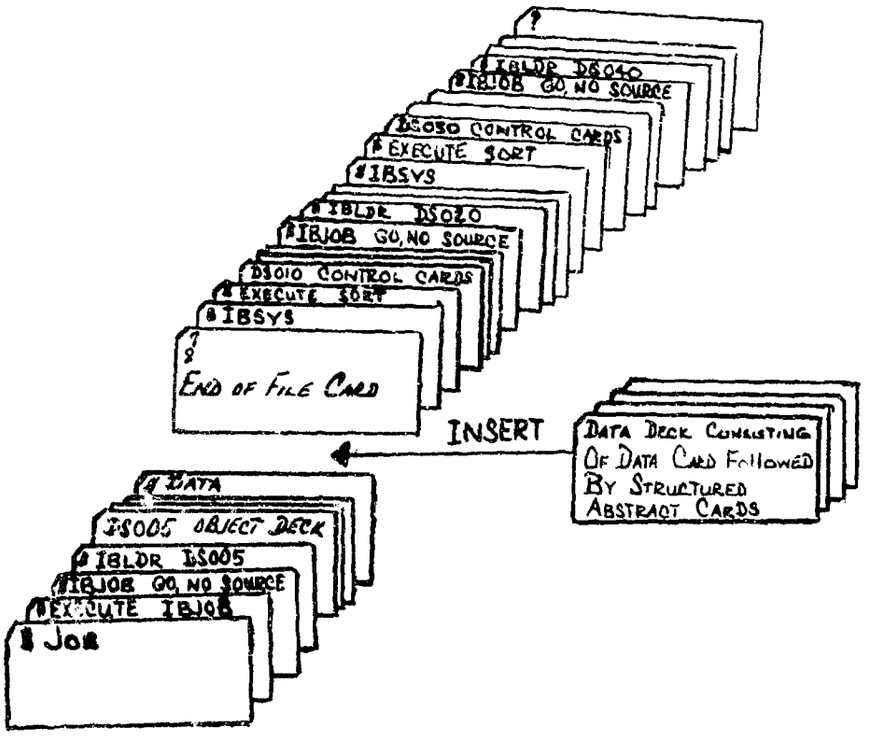
THE FOLLOWING CARDS ARE PUNCHED FROM THE WORK SHEET.

```
AP64-0001        32W U/UNCTIONS
AP64-0006        32W ./COORDINATE TRANSFORMATION,E/KALMAN METHOD,U/SENSITIVITY F
AP64-0001        21Q W/COORDINATE TRANSFORMATION
AP64-0001        21Q ./FEEDBACK CONTROL SYSTEMS,B/TIME-OPTIMAL HIGH ORDER
AP64-0001        1V  O/NTROL SYSTEMS
AP64-0001        1V  ./SWITCHING FUNCTIONS,A/ANALYSIS,B/SUBOPTIMAL,O/FEEDBACK CO
```

ATTACHMENT 3

STRUCTURED ABSTRACTS FILE UPDATE SUBSYSTEM

LAYOUT OF DECK PREPARED FOR A PRODUCTION RUN

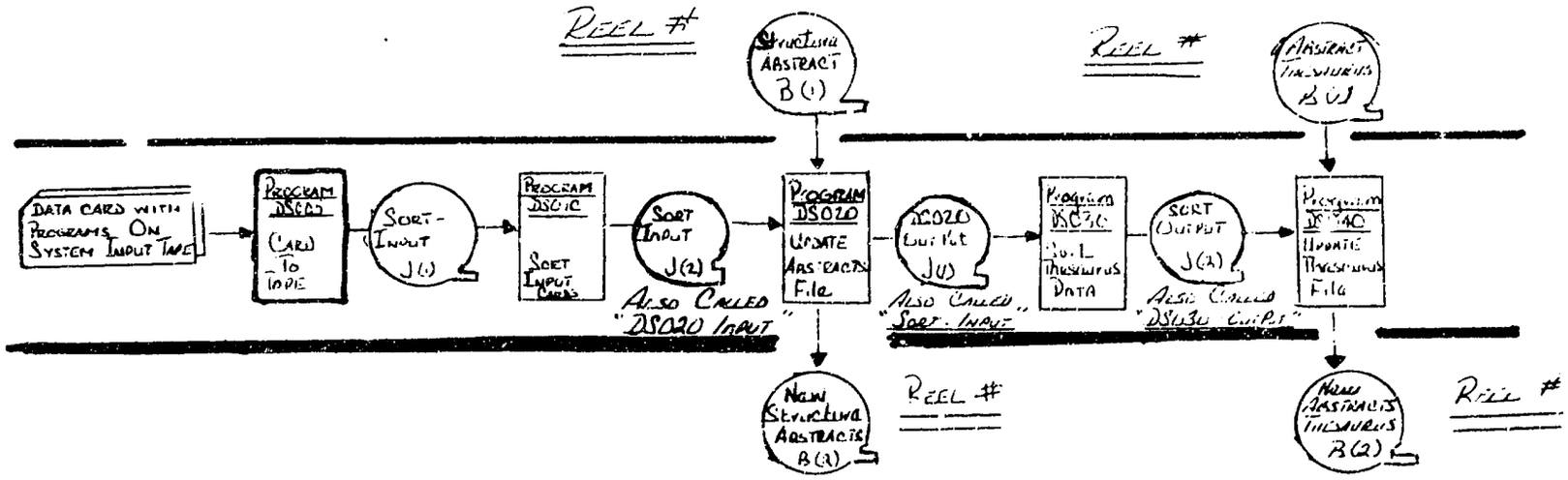


Attachment 4

OPERATIONS FLOW CHART -- STRUCTURED ABSTRACTS FILE UPDATE SUBSYSTEM

OPERATING INSTRUCTIONS:

1. The run when initiated will continue through all five programs.
2. Tapes indicated above the upper heavy line are input files. They must be mounted when the name shown on the flow chart appears in a tape mounting instruction, and they should be removed when they rewind and unload.
3. Tapes below the second heavy line are output files. They should be dismounted and saved when they rewind. If the user doesn't provide output reels, assign pool tapes and enter their reel numbers directly on the flow chart.
4. Labeled tapes are used. Input label errors must be avoided by either stopping the run or correcting the mistake.
5. Tapes labeled "J" on the flow chart are intersystem scratch units. They should not be dismounted or disabled after the run begins. Console messages specify which physical units have been assigned to the "J" function.



ATTACHMENT 5

STRUCTURED ABSTRACTS FILE UPDATE SUBSYSTEM

SAMPLES OF RUN INSTRUCTION FORM AND $JOB CARD

USE BALL POINT PEN ONLY

REGISTERED USER NAME	TASK NO.	RUN	PHONE	DATE	MAX TIME		
BEATTY	160202	A	9715	1-2-70	30 min.		93438

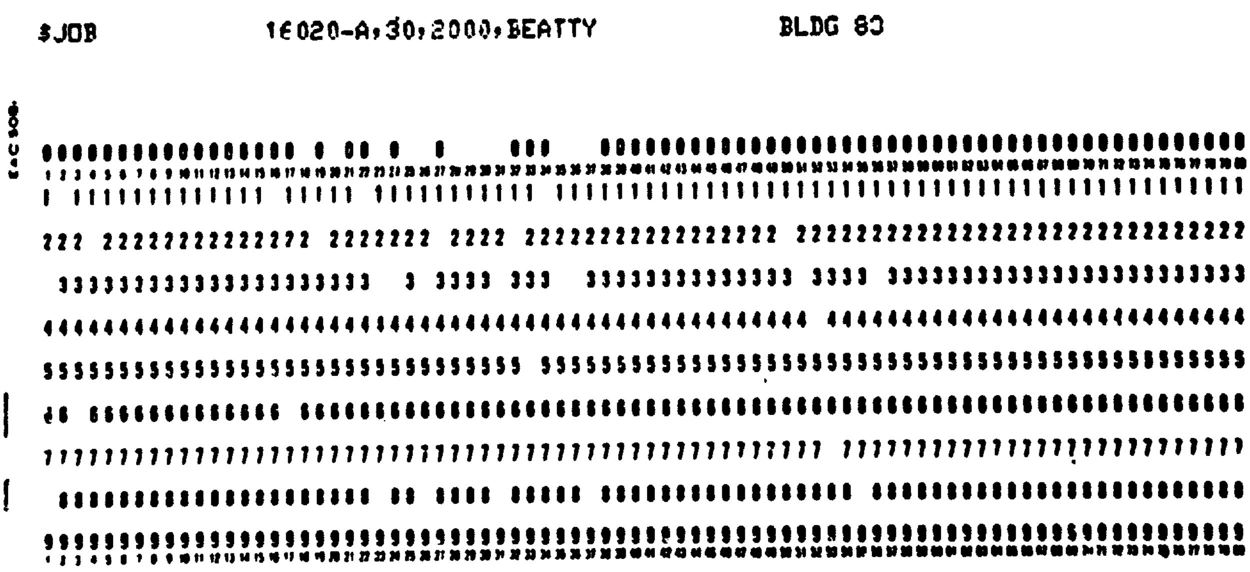
DRIVE		TAPE ID	TAPE TITLE	DRIVE		TAPE ID	TAPE TITLE
	I O S	SEE FLOW CHART			I O S		
	I O S				I O S		
	I O S				I O S		
	I O S				I O S		
	I O S				I O S		

PRINT		PUNCH	
TAPE IDENTITY	A3	TAPE IDENT	
FILES/TAPE	1	FILES/TAPE	
LINES/FILES	2000	CARDS/FILE	
CONTROL	PROG	CARD TYPE	
PRINTER COPIES	1	SENSE SW	1 2 3 4 5 6
XEROX COPIES		PROGRAM STOP	

SPECIAL INSTRUCTIONS:

1. SEE FLOW CHART FOR TAPE ASSIGNMENTS.
2. RETURN TO BLDG 83.

SYSIN	SYSOUT	SYSPPI	SYSPLOT



ATTACHMENT 6

PROGRAM DS050 (Used to print structured abstracts.)
SAMPLES OF RUN INSTRUCTION FORM AND $JOB CARD

USE BALL POINT PEN ONLY

REGISTERED USER NAME	TASK NO.	RUN	PHONE	DATE	MAX TIME	93439
BEATTY	160202	B	9715	1-4-70	15 min	

DRIVE		TAPE ID #	TAPE TITLE	DRIVE		TAPE ID #	TAPE TITLE
A (1)	IOS	010-104	STRUCTURE-ABSTRACT		IOS		
	IOS				IOS		
	IOS				IOS		
	IOS				IOS		
	IOS				IOS		

PRINT				PUNCH			
TAPE IDENTITY	A3			TAPE IDENT			
FILES/TAPE	1			FILES/TAPE			
LINES/FILES	1000			CARDS/FILE			
CONTROL	PROG			CARD TYPE			
PRINTER COPIES	1			SENSE SW	1 2 3 4 5 6		
XEROX COPIES				PROGRAM STOP			

SPECIAL INSTRUCTIONS:

SYSIN1 | SYSOU1 | SYSPP1 | SYSPLOT

BARRY DIAMOND LABORATORIES 7004 INSTRUCTION FORM 863 REV. 8 APRIL 1969

P/N 875087

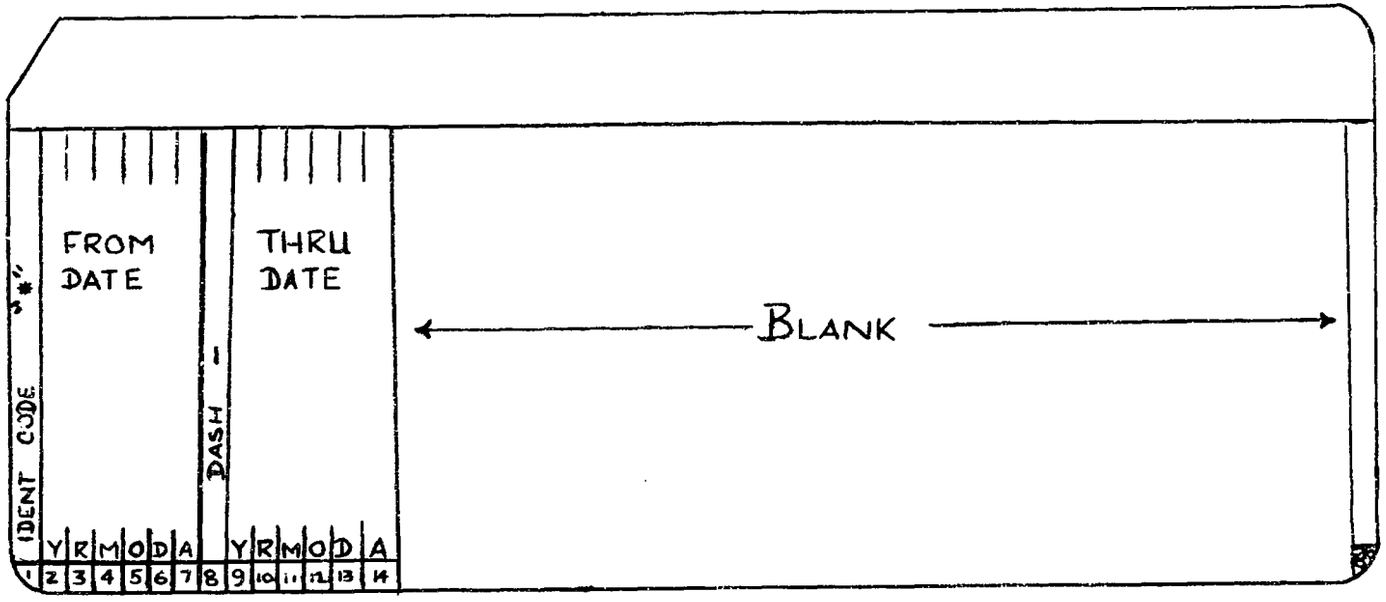
THIS IS AN EXAMPLE ASSUMING THE MOST CURRENT FILE OF STRUCTURED ABSTRACT INFORMATION IS ON REEL 010 - 104.

```
$JOB          160202-B,15,1000,BEATTY          BLDG 83
```

EAC 508

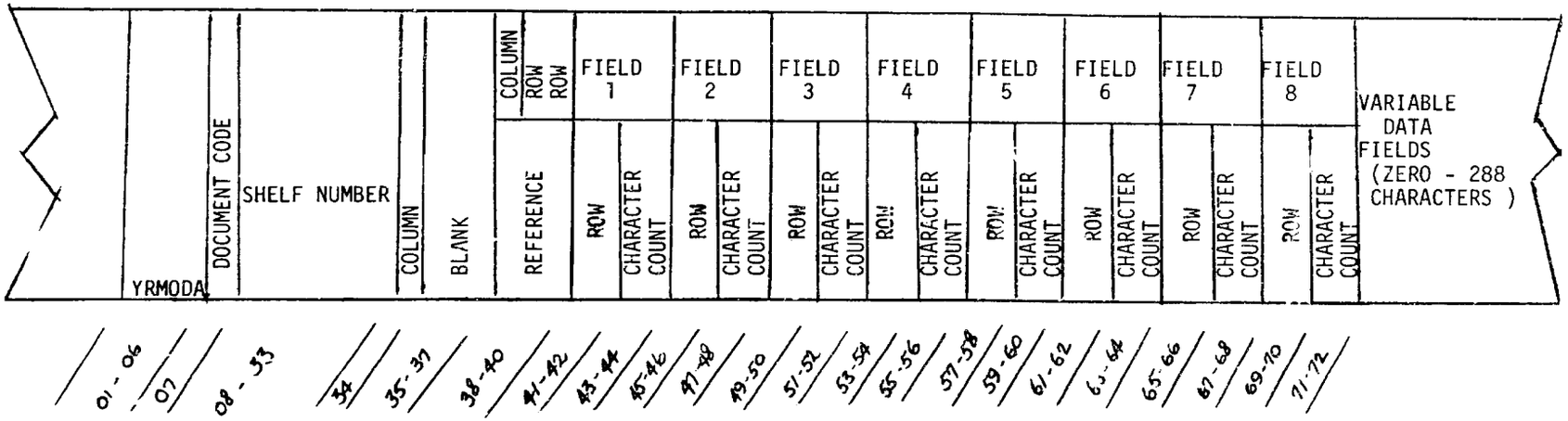
ATTACHMENT 7

PARAMETER CARD FOR PROGRAM DS050



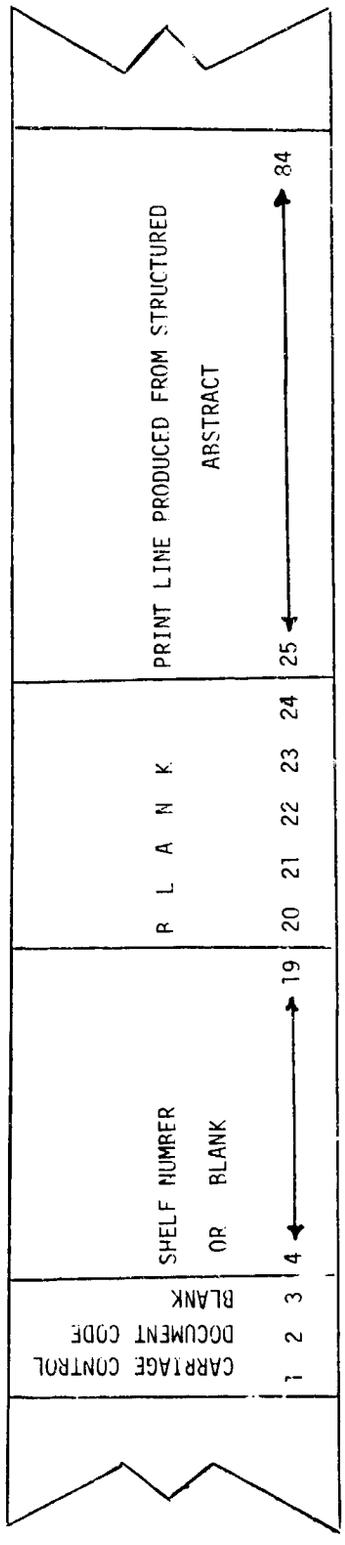
ATTACHMENT 8

STRUCTURED ABSTRACT RECORD



ATTACHMENT 9

PRINT RECORD DS050



LISTINGS

1 - 4

Listing 1 DS 005

SORT DS 010

Listing 2 DS 020

SORT DS 030

Listing 3 DS 040

Listing 4 DS 050

LISTING 1

PROGRAM DS005

```
$I8CBC DS005
010010 IDENTIFICATION DIVISION.
010020 PROGRAM-ID. DS005.
010030 REMARKS.    READ PUNCHED CARDS CONTAINING STRUCTURED ABSTRACTS
010040     OR DESCRIPTORS FROM THE SYSTEM INPUT TAPE AND WRITE THEM
010050     ONTO AN INTERSYSTEM TAPE.  THE SUCCEEDING PROGRAM, A STANDARD
010060     SORT, WILL USE THE INTERSYSTEM UNIT AS INPUT.
010100 ENVIRONMENT DIVISION.
010110 CONFIGURATION SECTION.
010120 SOURCE-COMPUTER. IBM-7094.
010130 OBJECT-COMPUTER. IBM-7094.
010200 INPUT-OUTPUT SECTION.
010210 FILE-CONTROL.
010220     SELECT INPUT-CARDS ASSIGN TO SYSIN1.
010230     SELECT SORT-INPUT ASSIGN TO J(1).
100010 DATA DIVISION.
100020 FILE SECTION.
100030 FD  INPUT-CARDS
100040     LABEL RECORDS ARE OMITTED
100050     DATA RECORD IS CARD-IN.
100060 01  CARD-IN.
100070     03  FILLER PICTURE X(80).
100100 FD  SORT-INPUT
100110     LABEL RECORDS ARE STANDARD
100120     VALUE OF FILE-IDENTIFICATION IS 'SORT-INPUT'
100130     DATA RECORD IS CARD-OUT
100140     BLOCK CONTAINS 50 RECORDS.
100150 01  CARD-OUT.
100160     03  FILLER PICTURE X(84).
200010 WORKING-STORAGE SECTION.
200020 77  CARD-COUNT PICTURE 9(5) COMPUTATIONAL SYNCHRONIZED RIGHT
200030     VALUE ZERO.
200040 77  BCD-COUNT PICTURE 9(6).
400010 PROCEDURE DIVISION.
400020 010-OPEN SECTION.
400030 010-A.
400040     DISPLAY 'START OF PROGRAM DS005.'.
400050     OPEN INPUT INPUT-CARDS OUTPUT SORT-INPUT.
400100 020-COPY SECTION.
400110 020-A.
400120     READ INPUT-CARDS
400130         AT END GO TO 900-END-JOB.
400140     ADD 1 TO CARD-COUNT.
400150     WRITE CARD-OUT FROM CARD-IN.
400160     GO TO 020-COPY.
900010 900-END-JOB SECTION.
900020 900-A.
900030     IF CARD-COUNT LESS THAN 1
900040         DISPLAY ' NO DATA CARDS READ -- DO NOT CONTINUE JOB'
900050         CLOSE SORT-INPUT WITH LOCK
900060     OTHERWISE
900070         CLOSE SORT-INPUT.
900080     CLOSE INPUT-CARDS.
```

```
900090      MOVE CARD-COUNT TO BCD-COUNT.
900100      DISPLAY ' PROGRAM DS005 PROCESSED ' BCD-COUNT ' CARDS.'
900110          UPON SYSOUT.
900120      DISPLAY 'END OF PROGRAM DS005.'.
900130      STOP RUN.
$CBEND
```

SORT DS010 (7094 Generalized Sorting System)

Date card and data cards on tape are sorted into ascending alphabetic sequence by document code, shelf number, questionnaire column and questionnaire row respectively.

LISTING 2

PROGRAM DS020

```
$IBCBC DS020   REACCN
000000 IDENTIFICATION DIVISION.                                          DS020
000010                                                                   DS020
000020 PROGRAM-ID.          DS020.                                       DS020
000040 INSTALLATION.        HARRY DIAMOND LABORATORIES.                  DS020
000050 DATE-WRITTEN.        DECEMBER, 1967.                              DS020
000060 REMARKS.             BASED ON ANSWERS TO A QUESTIONNAIRE, A       DS020
000070     DOCUMENT IS DESCRIBED BY CONCEPTS   THESE CONCEPTS ARE        DS020
000080     THEN KEYPUNCHED AS A STRING IN ORDER BY COLUMN AND            DS020
000090     THEN ROW. ALSO KEYPUNCHED ON EACH CARD IS IDENTIFYING         DS020
000100     INFORMATION ABOUT THE DOCUMENT (SHELF NUMBER, DOCUMENT        DS020
000110     CODE, COLUMN NUMBER, REFERENCE NUMBER, ROW DESIGNATION).      DS020
000120     THESE CARDS ARE INPUT TO DS020.                               DS020
000130     DS020 EDITS THEM,  PRODUCES A STORAGE RECORD FROM EACH OF
000140     THE CONCEPTS, DIVIDES EACH CONCEPT INTO SUBJECT AND
000150     DESCRIPTOR ELEMENTS AND PRINTS IT.
000160                                                                   DS020
000170 ENVIRONMENT DIVISION.                                              DS020
000180                                                                   DS020
000190 CONFIGURATION SECTION.                                             DS020
000200 SOURCE-COMPUTER.      IBM-7094.                                    DS020
000210 OBJECT-COMPUTER.      IBM-7094.                                    DS020
000220                                                                   DS020
000230 INPUT-OUTPUT SECTION.                                              DS020
000240                                                                   DS020
000250 FILE-CONTROL.                                                      DS020
000260     SELECT DSC20-INPUT ASSIGN TO J(2)R.
000270     SELECT STRUCTURE-ABSTRACT ASSIGN TO B(1).
000280     SELECT PRINT-TAPE       ASSIGN TO SYSOU1.                     DS020
000290     SELECT NEW-STRUCTURE-ABST ASSIGN TO B(2).
000295     SELECT DSC20-OUTPUT ASSIGN TO J(1).
000300 DATA DIVISION.                                                     DS020
000310                                                                   DS020
000320 FILE SECTION.                                                      DS020
000330                                                                   DS020
000340 FD  DS020-INPUT                                                    DS020
000350     RECORD CONTAINS 84 CHARACTERS                                 DS020
000355     BLOCK CONTAINS 50 RECORDS                                     DS020 20
000360     LABEL RECORDS ARE STANDARD                                    DS020
000370     VALUE OF FILE-IDENTIFICATION IS 'DS020-INPUT'                 DS020
000380     DATA RECORD IS IN-ABSTRACT.                                   DS020
000390                                                                   DS020
000400 01  IN-ABSTRACT.                                                  DS020
000405     02  IN-DOC-SHELF.                                            DS020 01
000410     03  IN-DOC-CODE              PICTURE X.                      DS020
000420     03  IN-SHELF-NO.                                             DS020 20
000421         05  IN-DATE      PICTURE X(6).                           DS020 20
000422         05  FILLER       PICTURE X(10).                          DS020 20
000425     02  IN-REST.                                                 DS020 01
000430     03  IN-COLUMN            PICTURE 9.                          DS020
000440     03  IN-REFERENCE.                                            DS020
000450         05  IN-REF-COL           PICTURE X.                      DS020
000460         05  IN-REF-LINES.
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000465              07  IN-REF-LINE-1 PICTURE X.
000470              07  IN-REF-LINE-2 PICTURE X.
000480      03  IN-STRING.                                              DS020
000490          05  IN-CHAR      PICTURE X  OCCURS 59 TIMES.            DS020 20
000500      03  FILLER                    PICTURE X(4).                 DS020
000510                                                                   DS020
010000 FD   NEW-STRUCTURE-ABST                                         DS020 01
010010      RECORD CONTAINS 72 TO 360 CHARACTERS                       DS020 01
010020      BLOCK CONTAINS 3660 CHARACTERS                             DS020 01
010030      LABEL RECORDS ARE STANDARD                                 DS020
010040      VALUE OF FILE-IDENTIFICATION IS 'STRUCTURE-ABSTRACT'       DS020 01
010050      DATA RECORDS ARE                                           DS020
010060      NEW-ABSTRACT
010070      OUT-ABSTRACT-STRING.                                       DS020
010080                                                                 DS020
010090 01   NEW-ABSTRACT.
010092      03  NA-DATE PICTURE X(6).
010094      03  NA-DOC-SHELF PICTURE X(27).
010096      03 NA-COLUMN PICTURE X.
010098      03  NA-BLANKS PICTURE XXX.
010100      03  NA-REF.
010102          05  NA-REF-COL PICTURE X.
010104          05  NA-REF-ROW PICTURE XX.
010106      03  NA-FIELDS.
010108          05  NA-FIELD OCCURS 8 TIMES.
010110              07  NA-ROW  PICTURE XX.
010112              07  NA-LENGTH  PICTURE XX.
010114      03  NA-DATA.
010116          05  NA-CHAR OCCURS 288 TIMES PICTURE X.
010120 01   OUT-ABSTRACT-STRING.                                       DS020
010130      03  OUT-DATA         PICTURE X   OCCURS 360 TIMES         DS020 01
010140          DEPENDING ON REC-CHAR-COUNT.                           DS020
010150                                                                 DS020
010160 FD   PRINT-TAPE                                                 DS020
010170      RECORD CONTAINS 132 CHARACTERS                             DS-020
010180      LABEL RECORDS ARE OMITTED                                  DS020
010190      DATA RECORDS ARE PRINT-LINE
010192                       PRINT-LINE-1
010194                       PRINT-LINE-3,
010200                                                                 DS020
010210 01   PRINT-LINE.                                                DS020
010220      03  PL-SKIP-CODE PICTURE X.
010222      03  PL-DATA PICTURE X(80).
010224      03  PL-NOTE PICTURE X(51).
100300 01   PRINT-LINE-1.                                             DS-020
100310      03  PRO1-CC              PICTURE X.                       DS-020
100320      03  PRO1-DOC             PICTURE X.                       DS-020
100330      03  FILLER               PICTURE X.                       DS-020
100340      03  PRO1-SHELF           PICTURE X(26).                   DS-020
100350      03  FILLER               PICTURE X(103).                  DS-020
100360                                                                 DS-020
100430 01   PRINT-LINE-3.                                             DS-020
100440      03  PRO3-CC              PICTURE X.                       DS-020
100450      03  FILLER               PICTURE XXX.                     DS-020
100460      03  PRO3-COL             PICTURE X.                       DS-020
100470      03  FILLER               PICTURE XX.                      DS-020
100480      03  PRO3-REF             PICTURE XXX.                     DS-020
100490      03  FILLER               PICTURE X(4).                    DS-020
100500      03  PRO3-SUBJECT.                                         DS-020
100510          05  PRO3-CHAR        PICTURE X   OCCURS 55 TIMES.     DS-020
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100520      03  FILLER                  PICTURE X.                          DS-020
100522      03  PR03-ROW       PICTURE XX.                                  DS020 01
100524      03  FILLER         PICTURE X.                                   DS020 01
100530      03  PR03-MODIFIER.                                              DS-020
100540          05  PR03-MOD      PICTURE X  OCCURS 59 TIMES.               DS020 01
010240 FD  STRUCTURE-ABSTRACT                                               DS020 01
010250      RECORD CONTAINS 72 TO 360 CHARACTERS                            DS020 01
010260      BLOCK CONTAINS 3660 CHARACTERS                                  DS020 01
010270      LABEL RECORDS ARE STANDARD                                      DS020 01
010280      VALUE OF FILE-IDENTIFICATION IS 'STRUCTURE-ABSTRACT'            DS020 01
010290      DATA RECORDS ARE                                                DS020 01
010300      SA-RECORD-1                                                     DS020 01
010310      SA-RECORD-2.                                                    DS020 01
010320                                                                      DS020 01
010330 01  SA-RECORD-1.                                                    DS020 01
010340      03  FILLER             PICTURE X(6).
010360      03  SA-CCC-SHELF-NO PICTURE X(27).                             DS020 01
010370      03  FILLER             PICTURE X(7).
010372      03  SA-FIELDS.
010374          05  SA-FIELD OCCURS 8 TIMES.
010376              07  SA-ROW PICTURE XX.
010378              07  SA-LENGTH PICTURE 99.
010380                                                                      DS020 01
010390 01  SA-RECORD-2.                                                    DS020 01
010400      03  SA-CHAR            PICTURE X(360).                         DS020 01
010410                                                                      DS020 01
010430 FD  DS020-OUTPUT                                                     DS020 01
010440      RECORD CONTAINS 84 CHARACTERS
010450      BLOCK CONTAINS 50 RECORDS                                       DS020 01
010460      LABEL RECORDS ARE STANDARD                                      DS020 01
010470      VALUE OF FILE-IDENTIFICATION IS 'DS020-OUTPUT'                  DS020 01
010480      DATA RECORD IS OUTPUT-RECORD.                                   DS020 01
010490                                                                      DS020 01
010500 01  OUTPUT-RECORD.                                                  DS020 01
010510      03  FILLER PICTURE X(84).
010520                                                                      DS020 01
020000 WORKING-STORAGE SECTION.                                             DS020
020010                                                                      DS020
020280 77 CHAR-NO PICTURE 99 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020285 77 TOTAL-ROWS PICTURE 99 USAGE COMPUTATIONAL SYNCHRONIZED
020286      RIGHT VALUE ZEROS.
020290 77  TOTAL-CHARS PICTURE 999 USAGE COMPUTATIONAL SYNCHRONIZED
020291      RIGHT VALUE ZEROS.
020295 77 CURRENT-COLUMN PICTURE X VALUE SPACE.
020310 77  CURRENT-ROW PICTURE XX VALUE SPACES.
020320 77  TEST-CHAR PICTURE 999 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020330 77  MASTER-STATUS PICTURE 9 VALUE ZERO.
020331      88  MASTER-FILE-AT-END VALUE 1.
020340 77  EOF-CODE PICTURE 9 VALUE 1.
020350 77  STO-ROW PICTURE 99 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020360 77  STO-CHAR PICTURE 999 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020370 77  OUT-ROW PICTURE 99 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020380 77  OUT-CHAR PICTURE 999 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT.
020390 77  CHAR-LIMIT PICTURE 999 USAGE COMPUTATIONAL SYNCHRONIZED
020391      RIGHT.
020400 77 SUBJ-ROW PICTURE XX VALUE ' .'.
020410 77  ERROR-MESSAGE-3 PICTURE X(21) VALUE 'COLUMN NUMBER INVALID'.
020415 77  LAST-IDENT-PRINTED PICTURE X(17) VALUE SPACES.
020420 77  DATE-CARD-ID PICTURE X VALUE '*'.
020430 77  STO-DATE PICTURE X(6).
```

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020440 77  ERROR-MESSAGE-7 PICTURE X(20) VALUE 'REFERENCE INVALID
020450 77  REC-CHAR-COUNT PICTURE 9(5) USAGE COMPUTATIONAL
020451      SYNCHRONIZED RIGHT.
020460 77  ADDITIONS-STATUS PICTURE 9 VALUE ZERO.
020461      88  ADDITIONS-AT-END VALUE 1.
020470 77  HEADING-LINE-1 PICTURE X(18) VALUE '1DOC SHELF-NO     '.
020480 77  HEADING-LINE-2 PICTURE X(82) VALUE '   COL REF    SUBJECT
020481-     '                                          ROW  MODIFIER'.
020490 77  LINE-COUNT PICTURE 99 USAGE COMPUTATIONAL SYNCHRONIZED RIGHT
020491      VALUE ZEROS.
020500 01  ERROR-MESSAGE-1          PICTURE X(24)   VALUE                 DS020
020510      'INVALID DOCUMENT CODE   '.                                  DS020
020520                                                                   DS020
020530 01  ERROR-MESSAGE-2          PICTURE X(18)   VALUE                 DS020
020540      'NO SHELF NUMBER                                             DS020
020550                                                                   DS020
020590 01  ERROR-MESSAGE-4          PICTURE X(24)   VALUE
020600      'INVALID LINE NUMBER
020610                                                                   DS020
020620 01  ERROR-MESSAGE-5  PICTURE X(48)  VALUE                        DS020 20
020630      '1DATE CARD MISSING- PROGRAM DS020 CANNOT EXECUTE'.          DS020 20
020640                                                                   DS020 20
110010 01  RCW-INFO.
110015      03  RI-RCW OCCURS 30 TIMES.
110020          05  RI-ROW-1 PICTURE X.
110025          05  RI-ROW-2 PICTURE X.
110030      03  RI-LENGTH PICTURE 99 USAGE COMPUTATIONAL OCCURS 30 TIMES.
110040 01  RCW-DATA.
110045      03  RD-CHAR PICTURE X OCCURS 600 TIMES.
110050 01  NEW-ROW.
110055      03  NEW-RCW-1 PICTURE X.
110060      03  NEW-RCW-2 PICTURE X.
110070 01  MESSAGE-6.
110075      03  FILLER PICTURE X(24) VALUE '0DO NOT ALLOW EXECUTION '.
110080      03  FILLER PICTURE X(24) VALUE 'OF PROGRAMS DS030 AND DS'.
110085      03  FILLER PICTURE X(6)  VALUE '040
110090 01  NEW-REF.
110091      03  NEW-REF-COL PICTURE X.
110092      03  NEW-REF-LINES.
110093          05  NEW-REF-LINE-1 PICTURE X.
110094          05  NEW-REF-LINE-2 PICTURE X.
120010 01  CURRENT-REF.
120020      03  CR-COL PICTURE X.
120030      03  CR-ROW PICTURE XX.
140550 01  THESAURUS-DATA.
140560      03  TD-SUBJECT      PICTURE X(30).                           DS020 01
140570      03  TD-MODIFIER     PICTURE X(30).                           DS020 01
140580      03  FILLER          PICTURE XXX VALUE SPACES.
140600      03  TD-LINE         PICTURE XX.                              DS020 01
140605      03  TD-COL          PICTURE X.                               DS020 01
140610      03  TD-DOC-SHELF    PICTURE X(16).
140615      03  FILLER          PICTURE XX VALUE SPACES.
140800 01  CURRENT-IDENT.
140810      03  CURRENT-DOC PICTURE X VALUE SPACES.
140820          88  NO-STORED-DATA VALUE SPACES.
140830      03  CURRENT-NO PICTURE X(16) VALUE SPACES.
190900 PROCEDURE DIVISION.
200010 A-OPEN-FILES SECTION.
200020 A010.
200030      DISPLAY 'START OF PROGRAM DS020'.
```

```
200040     OPEN INPUT DS020-INPUT STRUCTURE-ABSTRACT
200050          OUTPUT DS020-OUTPUT NEW-STRUCTURE-ABST PRI...-TAPE.
200052     PERFORM C-READ-STR-ABSTRACT.
200055     PERFORM S-WRITE-HEADINGS.
200060     READ DS020-INPUT
200070         AT END GO TO A020.
200080     IF IN-DCC-CODE EQUAL TO DATE-CARD-ID
200090         MOVE IN-DATE TO STO-DATE
200100         GO TO B-READ-NEW-RECORDS.
200120 A020.
200130     DISPLAY ERROR-MESSAGE-5.
200140     MOVE ERROR-MESSAGE-5 TO PRINT-LINE.
200150     WRITE PRINT-LINE.
200160     DISPLAY MESSAGE-6.
200170     MOVE MESSAGE-6 TO PRINT-LINE.
200180     WRITE PRINT-LINE.
200190     GO TO M-END-JOB.
200300 B-READ-NEW-RECORDS SECTION.
200310 B010.
200320     READ DS020-INPUT
200330         AT END GO TO G-END-OF-ADDITIONS.
200340     IF IN-DCC-CODE EQUAL TO 'A' OR 'B' OR 'P' OR 'R' OR 'V'
200350         GO TO B020.
200360     MOVE ERROR-MESSAGE-1 TO PL-NOTE.
200400 B015.
200410     MOVE SPACE TO PL-SKIP-CODE.
200420     MOVE IN-ABSTRACT TO PL-DATA.
200430     PERFORM R-WRITE-REJECT.
200440     GO TO B-READ-NEW-RECORDS.
200500 B020.
200510     IF IN-SHELF-NO EQUAL TO SPACES
200520         MOVE ERROR-MESSAGE-2 TO PL-NOTE
200530         GO TO B015.
200540     IF IN-CCLUMN ALPHABETIC
200541         NEXT SENTENCE
200543     ELSE
200545       IF IN-CCLUMN NOT NUMERIC
200546         NEXT SENTENCE
200548     ELSE
200550       IF IN-CCLUMN LESS THAN 1
200551         NEXT SENTENCE
200553     OTHERWISE
200555         GO TO B025.
200557     MOVE ERROR-MESSAGE-3 TO PL-NOTE.
200558     GO TO B015.
200560 B025.
200585     IF IN-CHAR (2) EQUAL TO '/'
200590         MOVE IN-CHAR (1) TO NEW-ROW-2
200595         MOVE SPACE TO NEW-ROW-1
200600         MOVE 3 TO CHAR-NO
200610     ELSE
200615       IF IN-CHAR (3) NOT EQUAL TO '/'
200620         MOVE ERROR-MESSAGE-4 TO PL-...TE
200625         GO TO B015
200630     OTHERWISE
200635         MOVE IN-CHAR (1) TO NEW-ROW-1
200640         MOVE IN-CHAR (2) TO NEW-ROW-2
200645         MOVE 4 TO CHAR-NO.
200650     IF NEW-ROW EQUAL TO SPACES
200655         MOVE ERROR-MESSAGE-4 TO PL-NOTE
```

```
200656          GO TO B015.
200658      IF NEW-ROW-2 EQUAL TO SPACE
200659          NEXT SENTENCE
200660      ELSE
200661        IF NEW-ROW-2 ALPHABETIC
200662          GO TO B027
200663      ELSE
200664        IF NEW-ROW-2 NOT EQUAL TO '.'
200665          NEXT SENTENCE
200666      ELSE
200667        IF NEW-ROW-1 EQUAL TO SPACE
200668          GO TO B030.
200670      MOVE ERROR-MESSAGE-4 TO PL-NOTE.
200675      GO TO B015.
200680 B027.
200690      IF NEW-ROW-1 EQUAL TO SPACE
200695          GO TO B030.
200697      IF NEW-ROW-1 ALPHABETIC
200698          NEXT SENTENCE
200699      ELSE
200700        IF NEW-ROW-1 NOT NUMERIC
200705          NEXT SENTENCE
200710      ELSE
200720        IF NEW-ROW-1 LESS THAN '1'
200730          NEXT SENTENCE
200740      OTHERWISE
200745          GO TO B030.
200750      MOVE ERROR-MESSAGE-4 TO PL-NOTE.
200760      GO TO B015.
200800 B030.
200810      MOVE SPACES TO NEW-REF.
200820      IF IN-COLUMN NOT EQUAL TO 1
200830          GO TO B040.
200840      IF IN-REFERENCE EQUAL TO SPACES
200850          GO TO C-COMPARE-ADDITIONS.
200900      IF IN-REF-COL EQUAL TO SPACE
200910          GO TO B060.
200920      IF IN-REF-LINES EQUAL TO SPACES
200930          MOVE IN-REF-COL TO NEW-REF-LINE-2
200940          GO TO B050.
200950      IF IN-REF-LINE-2 NOT EQUAL TO SPACE
200960          GO TO B060.
200970      MOVE IN-REF-COL TO NEW-REF-LINE-1.
200980      MOVE IN-REF-LINE-1 TO NEW-REF-LINE-2.
200990      GO TO B050.
210010 B040.
210020      IF IN-REF-COL ALPHABETIC
210030          GO TO B060.
210040      IF IN-REF-COL NOT NUMERIC
210050          GO TO B060.
210060      IF IN-REF-COL EQUAL TO ZERO
210065          GO TO B060.
210090      IF IN-REF-LINES EQUAL TO SPACES
210100          GO TO B060.
210105      MOVE IN-REF-COL TO NEW-REF-COL.
210110      IF IN-REF-LINE-2 EQUAL TO SPACE
210120          MOVE IN-REF-LINE-1 TO NEW-REF-LINE-2
210130          GO TO B050.
210140      MOVE IN-REF-LINE-2 TO NEW-REF-LINE-2.
210150      MOVE IN-REF-LINE-1 TO NEW-REF-LINE-1.
```

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210200 B050.
210220     IF NEW-REF-LINE-2 NOT ALPHABETIC
210222         GO TC B060.
210224     IF NEW-REF-LINE-1 EQUAL TO SPACE
210225         GO TC C-COMPARE-ADDITIONS.
210226     IF NEW-REF-LINE-1 ALPHABETIC
210227         GO TC B060.
210228     IF NEW-REF-LINE-1 NOT NUMERIC
210230         GO TC B060.
210232     IF NEW-REF-LINE-1 LESS THAN '1'
210234         GO TC B060.
210236     GC TO C-CCMPARE-ADDITIONS.
210240 B060.
210242     MCVE ERRCR-MESSAGE-7 TO PL-NOTE.
210250     GC TO B015.
210600 C-COMPARE-ACCITIONS SECTION.
210610 C010.
210620     IF NO-STCRED-DATA
210630         MOVE IN-DOC-SHELF TO CURRENT-IDENT
210640         MOVE IN-COLUMN TO CURRENT-COLUMN
210645         MOVE NEW-REF TC CURRENT-REF
210650         GO TC D-STORE-INPUT.
210660     IF IN-DCC-SHELF NOT EQUAL TO CURRENT-IDENT
210670         GO TC E-UPDATE-MASTER.
210680     IF IN-CCLUMN NOT EQUAL TO CURRENT-COLUMN
210690         GO TC E-UPDATE-MASTER.
210900 D-STORE-INPUT SECTION.
210910 D010.
210920     IF NEW-RCW EQUAL TO CURRENT-ROW
210930         GO TC D020.
210932     IF TOTAL-ROWS LESS THAN 1
210933         NEXT SENTENCE ELSE
210934       IF RD-CHAR (TOTAL-CHARS) EQUAL TO SPACE
210935         SUBTRACT 1 FROM TOTAL-CHARS
210936         SUBTRACT 1 FROM RI-LENGTH (TOTAL-ROWS).
210940     IF TOTAL-ROWS GREATER THAN 29
210950         MOVE ' DATA IGNORED IN ROWS BEYOND 30' TO PL-NOTE
210960         GO TC B015.
210970     ACD 1 TC TOTAL-ROWS.
210980     MCVE NEW-ROW TO CURRENT-ROW RI-ROW (TOTAL-ROWS).
210990     MCVE ZERCS TO RI-LENGTH (TOTAL-ROWS).
220010 D020.
220020     IF TOTAL-CHARS GREATER THAN 599
220030         MOVE ' DATA IGNORED BEYOND CHARACTER 600' TO PL-NOTE
220040         GO TC B015.
220045     ACD 1 TC RI-LENGTH (TOTAL-ROWS).
220050     ACD 1 TC TOTAL-CHARS.
220060     MCVE IN-CHAR (CHAR-NO) TO RD-CHAR (TOTAL-CHARS).
220100 D030.
220104     IF CHAR-NC LESS THAN 59
220106         NEXT SENTENCE ELSE
220116       GO TO B-READ-NEW-RECORDS.
220130     ACD 1 TC CHAR-NO.
220140     IF IN-CHAR (CHAR-NC) EQUAL TO ','
220150         GO TC D040.
220160     IF IN-CHAR (CHAR-NO) NOT EQUAL TO SPACE
220170         GO TC D020.
220180     IF RD-CHAR (TOTAL-CHARS) EQUAL TO SPACE
220190         GO TC D030.
220200     GC TO D020.
```

```
220250 D040.
220260     IF CHAR-NC GREATER THAN 56
220270         GO TC D020.
220280     COMPUTE TEST-CHAR = CHAR-NO + 2.
220290     IF IN-CHAR (TEST-CHAR) EQUAL TO '/'
220300         GO TC D050.
220310     IF TEST-CHAR GREATER THAN 57
220320         GO TC D020.
220330     ADD 1 TC TEST-CHAR.
220340     IF IN-CHAR (TEST-CHAR) NOT EQUAL TO '/'
220350         GO TC D020.
220360     SUBTRACT 2 FROM TEST-CHAR.
220370     MOVE IN-CHAR (TEST-CHAR) TO NEW-ROW-1.
220380     ADD 1 TC TEST-CHAR.
220390     MCVE IN-CHAR (TEST-CHAR) TO NEW-ROW-2.
220400     IF NEW-RCW-1 EQUAL TO SPACE
220405         NEXT SENTENCE
220406     ELSE
220407       IF NEW-ROW-1 ALPHABETIC
220408         GO TC D020
220410     ELSE
220414       IF NEW-ROW-1 NOT NUMERIC
220416         GO TC D020
220420     ELSE
220425       IF NEW-ROW-1 LESS THAN '1'
220430         GO TC D020.
220440     IF NEW-RCW-2 NOT ALPHABETIC
220450         GO TC D020.
220460     IF NEW-RCW-2 EQUAL TO SPACE
220470         GO TC D020.
220480     ADD 4 TC CHAR-NO.
220490     GC TO D010.
220600 D050.
220610     SUBTRACT 1 FROM TEST-CHAR.
220620     MCVE IN-CHAR (TEST-CHAR) TO NEW-ROW-2.
220630     IF NEW-RCW-2 NOT ALPHABETIC
220640         GO TC D020.
220650     IF NEW-RCW-2 EQUAL TO SPACE
220660         GO TC D020.
220670     MCVE SPACE TO NEW-ROW-1.
220680     ADD 3 TC CHAR-NO.
220690     GC TO D010.
220900 E-UPDATE-MASTER SECTION.
220910 E010.
220920     IF MASTER-FILE-AT-END
220930         GO TC E015.
220940     IF CURRENT-IDENT GREATER THAN SA-DOC-SHELF-NO
220950         PERFCRM P-WRITE-FROM-MASTER
220960         PERFCRM Q-READ-STR-ABSTRACT
220970         GO TC E-UPDATE-MASTER.
220980     IF CURRENT-IDENT EQUAL TO SA-DOC-SHELF-NO
220990         MOVE SPACE TO PL-SKIP-CODE
230010         MOVE SA-DOC-SHELF-NO TO PL-DATA
230020         MOVE 'EXISTING ABSTRACT REPLACED' TO PL-DATA
230030         PERFCRM R-WRITE-REJECT
230040         PERFCRM Q-READ-STR-ABSTRACT
230050         GO TC E-UPDATE-MASTER.
230100 E015.
230102     IF RT-LENGTH (TOTAL-ROWS) LESS THAN 1
230103         NEXT SENTENCE ELSE
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```
230105         IF RD-CHAR (TOTAL-CHARS) EQUAL TO SPACE
230106           SUBTRACT 1 FROM TOTAL-CHARS
230107           SUBTRACT 1 FROM RI-LENGTH (TOTAL-ROWS).
230110       MOVE ZEROS TO STO-ROW STO-CHAR OUT-ROW OUT-CHAR CHAR-LIMIT.
230120 E020.
230130       MOVE 72 TO REC-CHAR-COUNT.
230140       MOVE SPACES TO NA-BLANKS NA-FIELDS.
230150       MOVE STO-DATE TO NA-DATE.
230160       MOVE CURRENT-IDENT TO NA-DOC-SHELF.
230170       MOVE CURRENT-COLUMN TO NA-COLUMN.
230180       MOVE CURRENT-REF TO NA-REF.
230200 E030.
230210       ADD 1 TO STO-ROW.
230220       IF STO-ROW GREATER THAN TOTAL-ROWS
230230           GO TO E040.
230240       ADD 1 TO OUT-ROW.
230250       ADD RI-LENGTH (STO-ROW) TO CHAR-LIMIT.
230260       IF CHAR-LIMIT GREATER THAN 288
230270           SUBTRACT RI-LENGTH (STO-ROW) FROM CHAR-LIMIT
230280           SUBTRACT 1 FROM OUT-ROW
230290           SUBTRACT 1 FROM STO-ROW
230300           GO TO E040.
230310       MOVE RI-ROW (STO-ROW) TO NA-ROW (OUT-ROW).
230320       MOVE RI-LENGTH (STO-ROW) TO NA-LENGTH (OUT-ROW).
230330       IF OUT-ROW LESS THAN 8
230340           GO TO E030.
230500 E040.
230510       ADD 1 TO OUT-CHAR.
230520       IF OUT-CHAR GREATER THAN CHAR-LIMIT
230530           GO TO E050.
230540       ADD 1 TO STO-CHAR.
230550       MOVE RD-CHAR (STO-CHAR) TO NA-CHAR (OUT-CHAR).
230560       GO TO E040.
230600 E050.
230610       ADD CHAR-LIMIT TO REC-CHAR-COUNT.
230630       WRITE OUT-ABSTRACT-STRING.
230640       IF STO-ROW GREATER THAN TOTAL-ROWS
230650           GO TO F-PRINT-AND-EXTRACT.
230660       MOVE ZEROS TO OUT-ROW OUT-CHAR CHAR-LIMIT
230670       GO TO E020.
240010 F-PRINT-AND-EXTRACT SECTION.
240020 F010.
240030       MOVE CURRENT-IDENT TO TD-DOC-SHELF.
240040       IF CURRENT-IDENT EQUAL TO LAST-IDENT-PRINTED
240050           GO TO F015.
240060       IF LINE-COUNT GREATER THAN 49
240070           PERFORM S-WRITE-HEADINGS.
240080       MOVE SPACES TO PRINT-LINE-1.
240090       MOVE ZERO TO PR01-CC.
240100       MOVE CURRENT-DOC TO PR01-DOC.
240110       MOVE CURRENT-NO TO PR01-SHELF.
240120       WRITE PRINT-LINE-1.
240130       ADD 2 TO LINE-COUNT.
240200 F015.
240210       MOVE SPACES TO PRINT-LINE-3 TD-SUBJECT TD-COL.
240220       MOVE CURRENT-COLUMN TO PR03-COL.
240230       MOVE CURRENT-REF TO PR03-REF.
240240       MOVE ZEROS TO OUT-CHAR STO-CHAR CHAR-LIMIT.
240250       MOVE 1 TO STO-ROW.
240260       IF STO-ROW GREATER THAN TOTAL-ROWS
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240270          GO TC F060.
240280      IF RI-RCW (STO-ROW) NOT EQUAL TO SUBJ-ROW
240290          GO TC F040.
240300      ADD RI-LENGTH (STO-ROW) TO CHAR-LIMIT.
240500 F020.
240510      IF STO-CHAR NOT LESS THAN CHAR-LIMIT
240520          GO TC F030.
240530      ADD 1 TC STO-CHAR.
240540      ADD 1 TC CUT-CHAR.
240550      MCVE RD-CHAR (STO-CHAR) TO PR03-CHAR (OUT-CHAR).
240560      GC TO F02C.
240600 F030.
240610      IF STO-RCW NOT LESS THAN TOTAL-ROWS
240620          GO TC F060.
240630      ADD 1 TC STO-ROW.
240640      MCVE CURRENT-COLUMN TO TD-COL.
240650      MCVE PRC3-SUBJECT TO TD-SUBJECT
240700 F040.
240710      MCVE RI-RCW (STO-RCW) TO PR03-ROW.
240715      MCVE RI-RCW (STO-RCW) TO TD-LINE.
240720      MCVE ZERCS TO OUT-CHAR.
240730      ADD RI-LENGTH (STO-ROW) TO CHAR-LIMIT.
240800 F050.
240810      IF STO-CHAR NOT LESS THAN CHAR-LIMIT
240820          GO TC F055.
240830      ADD 1 TC STO-CHAR.
240840      ADD 1 TC CUT-CHAR.
240850      MCVE RD-CHAR (STO-CHAR) TO PR03-MOD (OUT-CHAR).
240860      IF OUT-CHAR LESS THAN 59
240870          GO TC F050.
240900 F055.
240910      MCVE CURRENT-COLUMN TO TD-COL.
240920      MCVE PR03-MODIFIER TO TD-MODIFIER,
250010 F060.
250020      WRITE PRINT-LINE-3.
250025      ADD 1 TC LINE-COUNT.
250030      IF LINE-CCUNT GREATER THAN 53
250040          PERFCRM S-WRITE-HEADINGS.
250050      IF TD-CCL NOT EQUAL TO SPACE
250060          WRITE OUTPUT-RECORD FROM THESAURUS-DATA
250070      MCVE SPACE TO TD-COL.
250100 F070.
250110      IF STO-RCW NOT LESS THAN TOTAL-ROWS
250120          GO TC F080.
250130      MOVE CHAR-LIMIT TO STO-CHAR.
250140      ADD 1 TC STO-ROW.
250150      MCVE SPACES TO PRINT-LINE-3.
250160      GC TO F040.
250200 F080.
250210      IF ADDITIONS-AT-END
250220          GO TC M-FINISH-MASTER.
250230      MCVE IN-CCC-SHELF TO CURRENT-IDENT.
250240      MCVE IN-CCLUMN TO CURRENT-COLUMN.
250250      MCVE SPACES TO CURRENT-ROW.
250260      MCVE ZERCS TO TOTAL-ROWS TOTAL-CHARS.
250265      MCVE NEW-REF TO CURRENT-REF.
250270      GC TO D-STORE-INPUT.
250500 G-END-OF-ADDITIONS SECTION.
250510 G010.
250520      IF NO-STCRED-DATA
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250530          GO TO H-FINISH-MASTER.
250540      MOVE EOF-CODE TO ADDITIONS-STATUS.
250550      GO TO E-UPDATE-MASTER.
250800 H-FINISH-MASTER SECTION.
250810 H010.
250820      IF MASTER-FILE-AT-END
250830          GO TO M-END-JOB.
250840      PERFORM P-WRITE-FROM-MASTER.
250850      PERFORM Q-READ-STR-ABSTRACT.
250860      GO TO H-FINISH-MASTER.
300010 M-END-JOB SECTION.
300020 M010.
300030      CLOSE    DS020-INPUT
300035               PRINT-TAPE
300040               STRUCTURE-ABSTRACT WITH LOCK
300050               DS020-OUTPUT
300060               NEW-STRUCTURE-ABST WITH LOCK.
300070      DISPLAY 'END OF PROGRAM DS020'.
300080      STOP RUN.
400010 P-WRITE-FROM-MASTER SECTION.
400020 P010.
400030      MOVE 72 TO REC-CHAR-COUNT.
400040      MOVE 1 TO OUT-ROW.
400100 P020.
400110      IF SA-ROW (OUT-ROW) EQUAL TO SPACES
400120          GO TO P030.
400130      ADD SA-LENGTH (OUT-ROW) TO REC-CHAR-COUNT.
400140      IF OUT-ROW LESS THAN 8
400150          ADD 1 TO OUT-ROW
400160          GO TO P020.
400200 P030.
400210      WRITE OUT-ABSTRACT-STRING FROM SA-RECORD-2.
420010 Q-READ-STR-ABSTRACT SECTION.
420020 Q010.
420030      READ STRUCTURE-ABSTRACT
420040          AT END MOVE EOF-CODE TO MASTER-STATUS.
440010 R-WRITE-REJECT SECTION.
440020 R010.
440030      IF LINE-COUNT GREATER THAN 53
440040          PERFORM S-WRITE-HEADINGS.
440050      WRITE PRINT-LINE.
440060      ADD 1 TO LINE-COUNT.
480010 S-WRITE-HEADINGS SECTION.
480020 S010.
480030      MOVE HEADING-LINE-1 TO PRINT-LINE.
480040      WRITE PRINT-LINE.
480050      MOVE HEADING-LINE-2 TO PRINT-LINE.
480060      WRITE PRINT-LINE.
480070      MOVE 2 TO LINE-COUNT.
$CBEND
```

SORT DS030 (7094 Generalized Sorting System)

ABSTRACT-THESAURUS additions from the DS020 -output file are sorted into ascending alphabetic sequence by subject term, modifying term, questionnaire row, questionnaire column, document and shelf number respectively.

LISTING 3

PROGRAM DS04C

```
$IBCBC DS040   READCR
000000 IDENTIFICATION DIVISION.                                        DS040
000010                                                                 DS040
000020 PROGRAM-ID.      DS040.                                         DS040
000030 AUTHOR.          P.MCGUIRE.                                     DS040
000040 INSTALLATION.    HARRY DIAMOND LABORATORIES.                    DS040
000050 DATE-WRITTEN.    MAY. 1968.                                     DS040
000060 REMARKS.     THE SORTED THESAURUS DATA IS USED TO UPDATE        DS040
000070      THE CURRENT FILE OF THESAURUS DATA AND A PRINTOUT OF       DS040
000080      NEW ITEMS IS MADE.                                         DS040
000090                                                                 DS040
000100 ENVIRONMENT DIVISION.                                            DS040
000110                                                                 DS040
000120 CONFIGURATION SECTION.                                           DS040
000130 SOURCE-COMPUTER.     IBM-7094.                                   DS040
000140 OBJECT-COMPUTER.     IBM-7094.                                   DS040
000150                                                                 DS040
000160 INPUT-OUTPUT SECTION.                                            DS040
000170                                                                 DS040
000180 FILE-CONTROL.                                                    DS040
000190      SELECT DS030-OUTPUT      ASSIGN TO J(2)R.                  DS040
000200      SELECT ABSTRACT-THESAURUS  ASSIGN TO B(1).
000210      SELECT NEW-ABST-THESAURUS  ASSIGN TO B(2).                 DS040
000220      SELECT PRINT-FILE    ASSIGN TO SYSOU1.                     DS040
000230                                                                 DS040
000240 DATA DIVISION.                                                   DS040
000250 FILE SECTION                                                     DS040
000260                                                                 DS040
000270 FD  DS030-OUTPUT                                                 DS040
000280      RECORD CONTAINS 84 CHARACTERS
000290      BLOCK CONTAINS 50 RECORDS                                  DS040
000300      LABEL RECORDS ARE STANDARD                                 DS040
000310      VALUE OF FILE-IDENTIFICATION IS 'DS030-OUTPUT'             DS040
000320      DATA RECORD IS NEW-THESAURUS-DATA.                         DS040
000330                                                                 DS040
000340 01  NEW-THESAURUS-DATA.                                        DS040
000350      03  FILLER PICTURE X(84).
000360                                                                 DS040
000370 FD  ABSTRACT-THESAURUS                                           DS040
000380      RECORD CONTAINS 84 CHARACTERS
000390      BLOCK CONTAINS 50 RECORDS                                  DS040
000400      LABEL RECORDS ARE STANDARD                                 DS040
000410      VALUE OF FILE-IDENTIFICATION IS 'ABSTRACT-THESAURUS'       DS040
000420      DATA RECORD IS OLD-THESAURUS-DATA.                         DS040
000430                                                                 DS040
000440 01  OLD-THESAURUS-DATA.                                        DS040
000450      03  FILLER PICTURE X(84).
000460                                                                 DS040
000470 FD  NEW-ABST-THESAURUS                                           DS040
000480      RECORD CONTAINS 84 CHARACTERS
000490      BLOCK CONTAINS 50 RECORDS                                  DS040
000500      LABEL RECORDS ARE STANDARD                                 DS040
000510      VALUE OF FILE-IDENTIFICATION IS 'ABSTRACT-THESAURUS'       DS040
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000520     DATA RECCRD IS NEW-ABST-RECORD.                                  DS040
000530                                                                      DS040
000540 01  NEW-ABST-RECORD.                                                 DS040
000550     03  FILLER PICTURE X(84).                                        DS040
000560                                                                      DS040
000570 FD  PRINT-FILE                                                       DS040
000580     RECORD CCNTAINS 108 CHARACTERS                                   DS040
010000     LABEL RECORDS ARE OMITTED                                        DS040
010010     DATA RECCRD IS PRINT-LINE.                                       DS040
010020                                                                      DS040
010030 01  PRINT-LINE.                                                      DS040
010040     03  FILLER      PICTURE X(108).                                  DS040
010050                                                                      DS040
010060 WORKING-STORAGE SECTION.                                             DS040
010070                                                                      DS040
010080 01  PRINT-1ST.                                                       DS040
010090     03  FILLER      PICTURE X(72)   VALUE                            DS040
010100     '1                                    STRUCTURED ABSTRACTS       DS040
010110-    'THESAURUS   '.                                                  DS040
010120                                                                      DS040
010130 01  PRINT-2ND.                                                       DS040
010140     03  FILLER      PICTURE X(90)   VALUE                            DS040
010150     '0              TERM                    MODIFIER                 DS040
010160-    '     ASSOC  IDENTIFICATION                                      DS040
010170                                                                      DS040
010180 01  PRINT-DATA.                                                      DS040
010190     03  FILLER      PICTURE X.                                       DS040
010200     03  PD-TERM     PICTURE X(30).                                   DS040
010210     03  FILLER      PICTURE XX.                                      DS040
010220     03  PD-MCDIFIER PICTURE X(30).                                   DS040
010230     03  FILLER      PICTURE X(4).                                    DS040
010240     03  PD-ASSOC    PICTURE XX.                                      DS040
010250     03  FILLER      PICTURE X(4).                                    DS040
010260     03  PD-IC       PICTURE X(16).                                   DS040
010270     03  FILLER      PICTURE X.                                       DS040
010280                                                                      DS040
010290 01  STO-NEW-DATA.                                                    DS040
010300     03 STO-TERM     PICTURE X(30).                                   DS040
010310     03 STO-MCDIFIER PICTURE X(30).                                   DS040
010320     03 FILLER       PICTURE XXX.                                     DS040
010330     03 STO-ASSOC    PICTURE XX.                                      DS040
010340     03 FILLER       PICTURE X.                                       DS040
010350     03  STO-IC      PICTURE X(16).                                   DS040
010355     03  FILLER      PICTURE XX.                                      DS040
010360                                                                      DS040
010370 01  STO-OLD-DATA.                                                    DS040
010376     03  SOD-TERM PICTURE X(30).                                      DS040
010378     03  SOD-MCDIFIER PICTURE X(30).                                  DS040
010380     03  FILLER PICTURE XXX.                                          DS040
010382     03  SOD-ASSOC PICTURE XX.                                        DS040
010384     03  FILLER PICTURE X.                                            DS040
010386     03  SOD-IC PICTURE X(16).                                        DS040
010388     03  FILLER PICTURE XX.                                           DS040
010390                                                                      DS040
010400 01  ALL-9S          PICTURE X(84) VALUE ALL '9'.                     DS040
010410                                                                      DS040
010420 01  LINE-COUNT      PICTURE 99.                                      DS040
010430                                                                      DS040
010440 01  PREVIOUS-TERM   PICTURE X(30)   VALUE SPACES.                    DS040
010450                                                                      DS040
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```
020000 PRCCECURE DIVISICN.                                              DS040
020010                                                                  DS040
020020 A010.                                                            DS040
020030     DISPLAY 'START OF PROGRAM DS040                              DS040
020040     OPEN INPLT DS030-OUTPUT
020041                ABSTRACT-THESAURUS
020050         OUTPLT NEW-ABST-THESAURUS, PRINT-FILE.                   DS040
020060     PERFORM A120-PRINT-HEADING                                   DS040
020070     PERFORM A070-READ-NEW-ABST  THRU A100                        DS040
020080     PERFORM A030-READ-MASTER THRU A060.                          DS040
020090                                                                  DS040
020100 A020.                                                            DS040
020110     IF STO-NEW-DATA IS GREATER THAN STO-OLD-DATA                 DS040
020115         WRITE NEW-ABST-RECORD FROM STO-OLD-DATA
020117         MOVE SPACES TO PRINT-DATA
020120         MOVE SOD-TERM TO PD-TERM
020122         MOVE SOD-MODIFIER TO PD-MODIFIER
020124         MOVE SOD-ASSOC TO PD-ASSOC
020126         MOVE SOD-ID TO PD-ID
020130         PERFORM A115-WRITE-LINE
020132         PERFORM A030-READ-MASTER THRU A060
020134         GO TO A020
020150     ELSE                                                         DS040
020160     IF STO-NEW-DATA IS LESS THAN STO-OLD-DATA                    DS040
020170         WRITE NEW-ABST-RECORD FROM STO-NEW-DATA
020180         PERFORM A110-MAKE-LISTING THRU A115-WRITE-LINE
020190         PERFORM A070-READ-NEW-ABST THRU A100
020200         GO TO A020
020210     ELSE                                                         DS040
020220     IF STO-NEW-DATA IS EQUAL TO ALL-9S                           DS040
020230         GO TO A999-EOJ
020240     ELSE                                                         DS040
020250     PERFORM A030-READ-MASTER THRU A060
020260     GO TO A020.                                                  DS040
020270                                                                  DS040
020280 A030-READ-MASTER.                                                DS040
020290     READ ABSTRACT-THESAURUS                                      DS040
020300         AT END GO TO A040.                                       DS040
020310          GO TO A050.                                             DS040
020320 A040.                                                            DS040
020330     MOVE ALL-9S TO STO-OLD-DATA                                  DS040
020340     GO TO A060.                                                  DS040
020350 A050.                                                            DS040
020360     MOVE OLD-THESAURUS-DATA TO STO-OLD-DATA.                     DS040
020370 A060.                                                            DS040
020380     EXIT.                                                        DS040
020390                                                                  DS040
020400 A070-READ-NEW-ABST.                                              DS040
020410     READ DS030-OUTPUT   AT END GO TO A080.                       DS040
020420              GO TO A090.                                         DS040
020430 A080.                                                            DS040
020440     MOVE ALL-9S TO STO-NEW-DATA                                  DS040
020450     GO TO A100.                                                  DS040
020460 A090.                                                            DS040
020470     MOVE NEW-THESAURUS-DATA TO STO-NEW-DATA.                     DS040
020480 A100.                                                            DS040
020490     EXIT.                                                        DS040
020500                                                                  DS040
020510 A110-MAKE-LISTING.                                               DS040
020520     MOVE SPACES TO PRINT-DATA                                    DS040
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020530      MOVE STC-TERM TO PD-TERM                                    DS040
020540      MOVE STC-MODIFIER TO PD-MODIFIER                            DS040
020550      MOVE STC-ASSOC TO PD-ASSOC                                  DS040
020560      MOVE STC-ID TO PD-ID.                                       DS040
020570                                                                  DS040
020578 A115-WRITE-LINE.
020580      ADD 1 TO LINE-COUNT                                         DS040
020590      IF LINE-COUNT IS GREATER THAN 56                            DS040
030000      PERFORM A120-PRINT-HEADING.                                 DS040
030010      IF PD-TERM IS EQUAL TO PREVIOUS-TERM                        DS040
030020      MOVE SPACES TO PD-TERM                                      DS040
030030      ELSE                                                        DS040
030040      MOVE PD-TERM TO PREVIOUS-TERM.                              DS040
030050      WRITE PRINT-LINE FROM PRINT-DATA.                           DS040
030060                                                                  DS040
030070 A120-PRINT-HEADING.                                             DS040
030080      WRITE PRINT-LINE FROM PRINT-1ST                             DS040
030090      WRITE PRINT-LINE FROM PRINT-2ND                             DS040
030100      MOVE SPACES TO PRINT-LINE                                   DS040
030110      WRITE PRINT-LINE                                            DS040
030120      MOVE 4 TO LINE-COUNT.                                       DS040
030130                                                                  DS040
030140 A999-EOJ.                                                       DS040
030150      CLOSE DS030-OUTPUT
030160      ABSTRACT-THESAURUS WITH LOCK,                               DS040
030170      NEW-ABST-THESAURUS WITH LOCK
030174      PRINT-FILE.
030180      DISPLAY 'END OF PROGRAM DS040                               DS040
03019C      STOP RUN.                                                   DS040
$CBEND                                                                DS040
```

LISTING 4

?RCGRAM DS050

```
$I8CBC DS050   REACCN
1C0010 IDENTIFICATICN DIVISION.                                        DS050HDL
100020                                                                 DS050HDL
100030 PRCGRAM-ID. CS050.                                              DS050HDL
100040 AUTHOR. A C REDSTONE.                                           DS050HDL
1CC050 INSTALLATION. HARRY DIAMOND LABS.                               DS050HDL
100060 DATE-WRITTEN. NOVEMBER 1968                                     DS050HDL
100070 REMARKS.     THIS PROGRAM PRODUCES READABLE ENGLISH PHRASES,    DS05CHDL
100080         DESCRIBING A DOCUMENT, FROM CODED ENTRIES CONTAINED ON  DS050HDL
100090         THE MAGNETIC TAPE LABELED 'STRUCTURE ABSTRACT'. THE     DS050HDL
100100         PROGRAM USES TWO TABLES. ONE TABLE CONTAINS CONNECTING  DS050HDL
100110         PHRASES AND THE OTHER TABLE IS USED TO TRANSLATE THE    DS05CHDL
100120         QUESTION CODE (CALLED ROW) TO A POSITICN NUMBER TO ACCESSDS050HDL
100130         ITS CCRRESPONDING ENTRY IN THE FIRST TABLE. EACH ENGLISH DS050HDL
1C0140         WORD IS HANDLED CHARACTER BY CHARACTER WITH PUNCUATION  DS050HDL
1C0150         AND SPACING BEING INSERTED AS THE SENTENCE STRUCTURE IS DS050HDL
100160         DEVELCPED.                                              DS050HDL
200000                                                                 DS050HDL
200010 ENVIRCNMENT CIVISION.                                           DS050HDL
200020                                                                 DS050HDL
2C0030 CONFIGURATICN SECTION.                                          DS050HDL
200040 SCURCE-COMPUTER. IBM-7094.                                      DS050HDL
200050 OBJECT-COMPUTER. IBM-7094.                                      DS050HDL
2C0060                                                                 DS050HDL
200070 INPUT-OUTPUT SECTION.                                           DS050HDL
200080 FILE-CONTROL.                                                   DS050HDL
2C0090     SELECT STRUCTURE-ABSTRACT ASSIGN TO A(1).                   DS050HDL
200100     SELECT PRINT-TAPE ASSIGN TO SYSOU1.                         DS050HDL
3C0000                                                                 DS050HDL
3C0010 DATA DIVISICN.                                                  DS050HDL
3C0020                                                                 DS050HDL
30C030 FILE SECTICN.                                                   DS050HDL
300040 FD  STRUCTURE-ABSTRACT                                          DS050HDL
300050     BLOCK CONTAINS 3660 CHARACTERS                              DS050HDL
300060     RECORD CONTAINS 72 TO 360 CHARACTERS                        DS050HDL
300070     LABEL RECCRDS ARE STANDARD                                  DS050HDL
30C080     VALUE OF FILE-IDENTIFICATION IS 'STRUCTURE-ABSTRACT'        DS050HDL
3C0090     DATA RECCRDS ARE                                            DS050HDL
3C0100         INREC                                                   DS050HDL
300110         STAB.                                                   DS050HDL
3C0130 01  INREC.                                                     DS050HDL
3C0140     03  FILLER      PICTURE X(72).                             DS050HDL
300150                                                                 DS050HDL
300160 01  STAB.                                                      DS050HDL
300180     03  IDATE       PICTURE 9(6).                              DS050HDL
300190     03  ISECKY.                                                DS050HDL
3C0200         05  ICS     PICTURE X.                                 DS050HDL
3C0210         05  ISHELF  PICTURE X(26).                             DS050HDL
3C0220     03  ICLMN       PICTURE X.                                 DS050HDL
3C0230     03  FILLER      PICTURE XXX.                               DS050HDL
3C0240     03  IREF.                                                  DS05CHDL
3C0250         05  IRCOL   PICTURE X.                                 DS05CHDL
300260         05  IRROW   PICTURE XX.                                DS050HDL
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300270     03  IFLDS        PICTURE X(32).                                    DS050HDL
300280     03  IDATA        PICTURE X(288).
300290                                                                        DS050HDL
300300 FD  PRINT-TAPE                                                        DS050HDL
300310     BLOCK CONTAINS 1 RECORD                                           DS050HDL
300320     RECORD CONTAINS 85 CHARACTERS                                     DS050HDL
300330     LABEL RECORDS ARE OMITTED                                         DS050HDL
300340     DATA RECORD IS                                                    DS050HDL
300350         PRINTED.                                                      DS050HDL
300360                                                                       DS050HDL
300370 01  PRINTED          PICTURE X(85).                                   DS050HDL
300380                                                                       DS050HDL
300390 WORKING-STORAGE SECTION.                                              DS050HDL
300400                                                                       DS050HDL
300410 77  ECJ-SW  PICTURE XX  VALUE 'AA'.                                   DS050HDL
300420     88  AT-END  VALUE 'ON'.                                          DS050HDL
300430 77  IICOL   PICTURE XX  VALUE 'NO'.                                   DS050HDL
300440     88  COL1-ON      VALUE 'ON'.                                     DS050HDL
300450     88  COL1-OFF     VALUE 'NO'.                                     DS050HDL
300460 77  PARENSW      PICTURE XXX VALUE 'OFF'.                            DS050HDL
300470     88  PARON    VALUE ' ON'.                                        DS050HDL
300480     88  PAROFF   VALUE 'OFF'.                                        DS050HDL
300490 77  ESW          PICTURE XXX VALUE 'OFF'.                            DS050HDL
300500     88  EOJ      VALUE ' ON'.                                        DS050HDL
300510     88  EOFF     VALUE 'OFF'.                                        DS050HDL
300520 77  REFIND       PICTURE XXX VALUE 'OFF'.                            DS050HDL
300530     88  RION     VALUE ' ON'.                                        DS050HDL
300540     88  RIOFF    VALUE 'OFF'.                                        DS050HDL
300542 77  ERRORIND     PICTURE XXX VALUE 'OFF'.                            DS050HDL
300544     88  ERRON    VALUE ' ON'.                                        DS050HDL
300546     88  ERROFF   VALUE 'OFF'.                                        DS050HDL
300550 77  BIONE    PICTURE 9(4)     VALUE IS 0001   SYNCHRONIZED RIGHT     DS050HDL
300560         USAGE IS COMPUTATIONAL.                                       DS050HDL
300570 77  BIZERO   PICTURE 9(4)     VALUE IS ZEROS  SYNCHRONIZED RIGHT     DS050HDL
300580         USAGE IS COMPUTATIONAL.                                       DS050HDL
300590 77  CIFDI    PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300600         USAGE IS COMPUTATIONAL.                                       DS050HDL
300610 77  CSIFI    PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300620         USAGE IS COMPUTATIONAL.                                       DS050HDL
300630 77  CID      PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300640         USAGE IS COMPUTATIONAL.                                       DS050HDL
300650 77  SCD      PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300660         USAGE IS COMPUTATIONAL.                                       DS050HDL
300670 77  SCFDI    PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300680         USAGE IS COMPUTATIONAL.                                       DS050HDL
300690 77  VC       PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300700         USAGE IS COMPUTATIONAL.                                       DS050HDL
300705 77  HC       PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300710         USAGE IS COMPUTATIONAL.                                       DS050HDL
300715 77  REF      PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300720         USAGE IS COMPUTATIONAL.                                       DS050HDL
300725 77  HFL      PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300730         USAGE IS COMPUTATIONAL.                                       DS050HDL
300735 77  HCOL     PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300740         USAGE IS COMPUTATIONAL.                                       DS050HDL
300745 77  SBJ      PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300750         USAGE IS COMPUTATIONAL.                                       DS050HDL
300755 77  REFHLD   PICTURE 9(4)     VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300760         USAGE IS COMPUTATIONAL.                                       DS050HDL
300765 77  RESUP    PICTURE 9(4)     VALUE IS ZEROS  SYNCHRONIZED RIGHT     DS050HDL
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300770         USAGE IS COMPUTATIONAL.                                          DS050HDL
300775 77  HLESSE  PICTURE 9(4)    VALUE IS 1      SYNCHRONIZED RIGHT          DS050HDL
300780         USAGE IS COMPUTATIONAL.                                          DS050HDL
300785 77  [illegible]  PICTURE 9(4)    VALUE IS 1      SYNCHRONIZED RIGHT     DS050HDL
300790         USAGE IS COMPUTATIONAL.                                          DS050HDL
300795 77  RESDATA2    PICTURE 9(4)    VALUE 1      SYNCHRONIZED RIGHT         DS050HDL
300800         USAGE IS COMPUTATIONAL.                                          DS050HDL
300810 77  RESHFL2     PICTURE 9(4)    VALUE 1      SYNCHRONIZED RIGHT         DS050HDL
300820         USAGE IS COMPUTATIONAL.                                          DS050HDL
300830 77  BININE      PICTURE 9(4)    VALUE 9      SYNCHRONIZED RIGHT         DS050HDL
300840         USAGE IS COMPUTATIONAL.                                          DS050HDL
300850 77  BIEIGHT     PICTURE 9(4)    VALUE 8      SYNCHRONIZED RIGHT         DS050HDL
300860         USAGE IS COMPUTATIONAL.                                          DS050HDL
300870 77  CHARACHECK  PICTURE 9(4)    VALUE ZEROS SYNCHRONIZED RIGHT          DS050HDL
300880         USAGE IS COMPUTATIONAL.                                          DS050HDL
300890 77  ACCUM       PICTURE 9(4)    VALUE ZEROS SYNCHRONIZED RIGHT          DS050HDL
300900         USAGE IS COMPUTATIONAL.                                          DS050HDL
300910 77  ACCUM2      PICTURE 9(4)    VALUE 1      SYNCHRONIZED RIGHT         DS050HDL
300920         USAGE IS COMPUTATIONAL.                                          DS050HDL
300930 77  MULTIPLICAND PICTURE 9(4)   VALUE 1      SYNCHRONIZED RIGHT         DS050HDL
300940         USAGE IS COMPUTATIONAL.                                          DS050HDL
300950 77  TWENTYSIX   PICTURE 9(4)    VALUE 26     SYNCHRONIZED RIGHT         DS050HDL
300960         USAGE IS COMPUTATIONAL.                                          DS050HDL
300980 77  PRCNT       PICTURE 9(4)    VALUE 1      SYNCHRONIZED RIGHT         DS050HDL
300990         USAGE IS COMPUTATIONAL.                                          DS050HDL
301000 77  BITSIX      PICTURE 9(4)    VALUE 27     SYNCHRONIZED RIGHT         DS050HDL
301010         USAGE IS COMPUTATIONAL.                                          DS050HDL
301012 77  SIXTY       PICTURE 9(4)  VALUE 60  SYNCHRONIZED RIGHT              DS050HDL
301013         USAGE IS COMPUTATIONAL.                                          DS050HDL
301014 77  RESULTS     PICTURE 9(4)  VALUE ZEROS SYNCHRONIZED RIGHT            DS050HDL
301015         USAGE IS COMPUTATIONAL.                                          DS050HDL
301020 77  LINECNT     PICTURE 99  VALUE 61.                                    DS050HDL
301050                                                                          DS050HDL
301060 01  ISREC.                                                              DS050HDL
301080     03  ISDATE.                                                         DS050HDL
301090         05  ISYR            PICTURE XX.                                 DS050HDL
301100         05  ISMNTH          PICTURE XX.                                 DS050HDL
301110         05  ISDAY           PICTURE XX.                                 DS050HDL
301120     03  ISSCKY.                                                         DS050HDL
301130         05  ISDOC           PICTURE X.                                  DS050HDL
301140         05  ISSHELF         PICTURE X(26).                              DS050HDL
301150     03  ISCCL               PICTURE X.                                  DS050HDL
301160     03  FILLER              PICTURE XXX.                                DS050HDL
301170     03  ISREF.                                                          DS050HDL
301180         05  ISRCMN          PICTURE X.                                  DS050HDL
301190         05  ISRROW          PICTURE XX.                                 DS050HDL
301200     03  ISFLCS.                                                         DS050HDL
301210         05  ISF1    OCCURS 8 TIMES.                                     DS050HDL
301220         07  ISF1RW          PICTURE XX.                                 DS050HDL
301230         07  ISF1CC          PICTURE XX.                                 DS050HDL
301235         07  F1CC REDEFINES ISF1CC   PICTURE 99.                         DS050HDL
301240     03  ISDATA              PICTURE X OCCURS 288 TIMES.                 DS050HDL
301250                                                                          DS050HDL
301260 01  PARREC.                                                             DS050HDL
301280     03  ASTER               PICTURE X.                                  DS050HDL
301290         88  ASTERISK  VALUE '*'.                                        DS050HDL
301300     03  DATESALL.                                                       DS050HDL
301310      05 DATE1                PICTURE X(6).                               DS050HDL
301320      05 DASH                 PICTURE X.                                  DS050HDL
301330      05 DATE2                PICTURE X(6).                               DS050HDL
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301340      03  FILLER                  PICTURE X(5).                        DS050HDL
301350                                                                       DS050HDL
301360 01   COL1-FDL-STORE.                                                  DS050HDL
301370      03  S1FLC   OCCURS 24 TIMES.                                    DS050HDL
301380        05 S1ALL.                                                      DS050HDL
301390          07  S1COL    PICTURE X.                                     DS050HDL
301400          07  S1ROW.                                                  DS050HDL
301410          09  S1R1     PICTURE X.                                     DS050HDL
301420          09  S1R2     PICTURE X.                                     DS050HDL
301430        05 S1CC        PICTURE 99.                                    DS050HDL
301440                                                                       DS050HDL
301450 01   COMMON-FLC-STORE.                                               DS050HDL
301460      03  SCF1    OCCURS 64 TIMES.                                    DS050HDL
301470        05 SCALL.                                                      DS050HDL
301480          07  SCCOL    PICTURE X.                                     DS050HDL
301490          07  SCROW.                                                  DS050HDL
301500          09  SCR1     PICTURE X.                                     DS050HDL
301510          09  SCR2     PICTURE X.                                     DS050HDL
301520        05 SCCC        PICTURE 99.                                    DS050HDL
301530                                                                       DS050HDL
301540 01   COMMON-DATA-STORE.                                              DS050HDL
301550      03  SCDATA       PICTURE X   OCCURS 1200 TIMES.                 DS050HDL
301560                                                                       DS050HDL
301570 01   HEADER.                                                         DS050HDL
301580      03  FILLER  PICTURE X(22) VALUE '1STRUCTURED ABSTRACTS          DS050HDL
301590      03  DATE    PICTURE X(13).                                      DS050HDL
301600      03  FILLER  PICTURE X(42) VALUE SPACES.                        DS050HDL
301610      03  PGNUM   PICTURE 999   VALUE 001.                           DS050HDL
301620                                                                       DS050HDL
301630 01   FORMATTED-PRINT.                                                DS050HDL
301640      03  CCONTROL          PICTURE X.                                DS050HDL
301650      03  DOCCODE           PICTURE X.                                DS050HDL
301660      03  FILLER            PICTURE X   VALUE SPACE.                  DS050HDL
301670      03  SHELFNUMBER       PICTURE X(16).                            DS050HDL
301680      03  FILLER            PICTURE X(5) VALUE SPACES.                DS050HDL
301690      03  DATA-LINE         PICTURE X(60).                            DS050HDL
301700                                                                       DS050HDL
301710 01   SINGE-INDICATORS.                                               DS050HDL
301720      03 COMRW            PICTURE X.                                  DS050HDL
301730      03 NUMRW REDEFINES COMRW    PICTURE 9.                         DS050HDL
301740                                                                       DS050HDL
301750 01   RESERVEREFAREAS.                                                DS050HDL
301760      03 RESREF   OCCURS 64 TIMES.                                    DS050HDL
301770        05    RESHFL       PICTURE 9(4).                             DS050HDL
301780        05    RESDATA      PICTURE 9(4).                             DS050HDL
301790        05    RESREFHLD    PICTURE 9(4).                             DS050HDL
301800        05    RESG012      PICTURE 9.                                DS050HDL
301810                                                                       DS050HDL
301820 01   OLMATRIX.                                                       DS050HDL
301830      03 HORIZON OCCURS 20 TIMES.                                     DS050HDL
301840          05  VERT       PICTURE X OCCURS 60 TIMES.                  DS050HDL
301850                                                                       DS050HDL
301860 01   OTEHLD.                                                         DS050HDL
301870      03  HD1      PICTURE 9(6).                                      DS050HDL
301880      03  HDDSH    PICTURE X.                                         DS050HDL
301890      03  HD2      PICTURE 9(6).                                      DS050HDL
301900                                                                       DS050HDL
301910 01   REFERENCES.                                                     DS050HDL
301920      03  REFLOC  OCCURS 64 TIMES.                                    DS050HDL
301930          05 REFNO     PICTURE XXX.                                   DS050HDL
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301940          05 FLCLOC   PICTURE 99.                                    DS050HDL
301950          05 DATALOC  PICTURE 9(4).                                 DS050HDL
301960                                                                    DS050HDL
301970 01  CISRCH.                                                        DS05CHDL
301980      03  CICI     PICTURE X.                                        DS050HDL
301990      03  CIRSCH   PICTURE XX.                                       DS050HDL
302000                                                                    DS050HDL
302010 01  COMSRCH.                                                       DS050HDL
302020      03  COMCCL   PICTURE X.                                        DS050HDL
302030      03  COMRCW   PICTURE XX.                                       DS050HDL
302040                                                                    DS05CHDL
302050 01  HLDREF.                                                        DS050HDL
302060      03  HLDREFNO     PICTURE XXX.                                  DS050HDL
302070      03  HLDFLCC      PICTURE 99.                                   DS050HDL
302080      03  HLDCLCC      PICTURE 9(4).                                 DS050HDL
302090                                                                    DS05CHDL
302100 01  REFERENCEINDS.                                                 DS050HDL
302110      03  REFEIND      PICTURE X   OCCURS 64 TIMES.                  DS050HDL
302120                                                                    DS050HDL
302130 01  QCR-TABLE.                                                     DS050HDL
302140      03 TBLE-ENTRIES.                                              DS05CHDL
302150        05 FILLER PICTURE X(24)   VALUE ' A00                      '.DS050HDL
302160        05 FILLER PICTURE X(24)   VALUE ' B00                      '.DS050HDL
302170        05 FILLER PICTURE X(24)   VALUE ' C0C                      '.DS050HDL
302180        05 FILLER PICTURE X(24)   VALUE ' D0C                      '.DS05CHDL
302190        05 FILLER PICTURE X(24)   VALUE ' E11PRODUCED BY           '.DS050HDL
302200        05 FILLER PICTURE X(24)   VALUE ' F13INFLUENCED BY         '.DS050HDL
302210        05 FILLER PICTURE X(24)   VALUE ' G10RELATED TO            '.DS05CHDL
302220        05 FILLER PICTURE X(24)   VALUE ' H13BEING PART OF         '.DS05CHDL
302230        05 FILLER PICTURE X(24)   VALUE ' I1CLIMITED TO            '.DS050HDL
302240        05 FILLER PICTURE X(24)   VALUE ' J07WITHOUT               '.DS050HDL
302250        05 FILLER PICTURE X(24)   VALUE ' K1CDESIGNATED            '.DS05CHDL
302260        05 FILLER PICTURE X(24)   VALUE ' L12SIMLLATED BY          '.DS05CHDL
302270        05 FILLER PICTURE X(24)   VALUE ' M11MODELLED BY           '.DS050HDL
302280        05 FILLER PICTURE X(24)   VALUE ' N04WITH                  '.DS050HDL
302290        05 FILLER PICTURE X(24)   VALUE ' O04WITH                  '.DS05CHDL
302300        05 FILLER PICTURE X(24)   VALUE ' P04WITH                  '.DS050HDL
302310        05 FILLER PICTURE X(24)   VALUE ' Q04WITH                  '.DS050HDL
302320        05 FILLER PICTURE X(24)   VALUE ' R03FOR                   '.DS05CHDL
302330        05 FILLER PICTURE X(24)   VALUE ' S12RESISTANT TO          '.DS05CHDL
302340        05 FILLER PICTURE X(24)   VALUE ' T13VULNERABLE TC         '.DS050HDL
302350        05 FILLER PICTURE X(24)   VALUE ' U12RESULTING IN          '.DS050HDL
302360        05 FILLER PICTURE X(24)   VALUE ' V02OF                    '.DS05CHDL
302370        05 FILLER PICTURE X(24)   VALUE ' W00                      '.DS050HDL
302380        05 FILLER PICTURE X(24)   VALUE ' X05USING                 '.DS050HDL
302390        05 FILLER PICTURE X(24)   VALUE ' Y1CBECAUSE OF            '.DS050HDL
302400        05 FILLER PICTURE X(24)   VALUE ' Z04LIKE                  '.DS050HDL
302410        05 FILLER PICTURE X(24)   VALUE '1A00                      '.DS050HDL
302420        05 FILLER PICTURE X(24)   VALUE '1B00                      '.DS050HDL
302430        05 FILLER PICTURE X(24)   VALUE '1C0C                      '.DS05CHDL
302440                                                                    DS05CHDL
302450      03 TABLE REDEFINES TBLE-ENTRIES.                              DS050HDL
302460        05 TBLE            OCCURS 29 TIMES.                        DS05CHDL
302470          07  TCODE    PICTURE XX.                                 DS050HDL
302480          07  TCNT     PICTURE 99.                                 DS05CHDL
302490          07  TENTRY   PICTURE X  OCCURS 20 TIMES.                 DS050HDL
302500                                                                    DS05CHDL
302510 01  HOLD-AREAS.                                                    DS05CHDL
302520      03 TEC       PICTURE 99.                                     DS050HDL
302530                                                                    DS05CHDL
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302540 01  TROW.                                                          DS050HDL
302550     03  TROW1    PICTURE X.                                        DS050HDL
302560     03  TROW2    PICTURE X.                                        DS050HDL
302570                                                                    DS050HDL
302580 01  ALPHA-TABLE.                                                  DS050HDL
302590     03  ALPHATBLE.                                                DS050HDL
302600       05 FILLER      PICTURE X(20)   VALUE 'A0B1C2D3E4F5G6H7I8J9'.DS050HDL
302610       05 FILLER      PICTURE X(20)   VALUE 'K0L1M2N3O4P5Q6R7S8T9'.DS050HDL
302620       05 FILLER      PICTURE X(14)   VALUE 'U0V1W2X3Y4Z510'.      DS050HDL
302630                                                                    DS050HDL
302640     03  TBLENTRY REDEFINES ALPHATBLE OCCURS 27 TIMES.             DS050HDL
302650       05 ACTA        PICTURE X.                                    DS050HDL
302660       05 ACTN        PICTURE 9.                                    DS050HDL
302670                                                                    DS050HDL
400000                                                                    DS050HDL
400010 PROCEDURE DIVISION.                                               DS050HDL
400020                                                                    DS050HDL
400030 A-HOUSEKEEPING SECTION.                                           DS050HDL
400031                                                                    DS050HDL
400040 A-SECTION-NOTE.                                                   DS050HDL
400041                                                                    DS050HDL
400042     NOTE THIS SECTION OPENS ALL FILES, INITIALIZES DATA STORAGE   DS050HDL
400043          AREAS AND INDICATOR STORAGE AREAS TO SPACES, INSURES     DS050HDL
400044          THAT A DATE RECORD IS PRESENT, AND DOES INITIAL READ OF  DS050HDL
400045          THE INPUT FILE.                                          DS050HDL
400046                                                                    DS050HDL
400050 A010.                                                             DS050HDL
400060     DISPLAY 'START OF PROGRAM DS050.'.                            DS050HDL
400070     OPEN INPUT STRUCTURE-ABSTRACT.                                DS050HDL
400080     OPEN OUTPUT PRINT-TAPE.                                       DS050HDL
400082     MOVE SPACES TO ISREC  COL1-FDL-STORE  COMMON-FLD-STORE.       DS050HDL
400084     MOVE SPACES TO COMMON-DATA-STORE  RESERVEREAREAS.             DS050HDL
400086     MOVE SPACES TO REFERENCES  REFERENCEINDS.                     DS050HDL
400090     ACCEPT PARREC FROM SYSIN1.                                    DS050HDL
400100     IF ASTERISK GO TO A015.                                       DS050HDL
400110     MOVE 'ON' TO EOJ-SW                                           DS050HDL
400120     MOVE SPACES TO PRINTED                                        DS050HDL
400130     MOVE '1PARAMETER DATES MISSING, CANNOT PROCEED.' TO PRINTED   DS050HDL
400140     WRITE PRINTED                                                 DS050HDL
400150     MOVE SPACES TO PRINTED  MOVE 1 TO PRINTCD                     DS050HDL
400160     WRITE PRINTED                                                 DS050HDL
400170     GO TO B010.                                                   DS050HDL
400180                                                                   DS050HDL
400190 A015.                                                             DS050HDL
400200     IF DATE2 EQUAL SPACES MOVE DATE1 TO DATE2                     DS050HDL
400210         MOVE '-' TO DASH.                                         DS050HDL
400220     MOVE DATESALL TO DATE, DTEHLD.                                DS050HDL
400230                                                                   DS050HDL
400260 A020.                                                             DS050HDL
400270     READ STRUCTURE-ABSTRACT INTO ISREC AT END MOVE 'ON' TO        DS050HDL
400280         EOJ-SW GO TO B020.                                        DS050HDL
400290                                                                   DS050HDL
400300 B-MAIN-LINE-PROCESSING SECTION.                                   DS050HDL
400301                                                                   DS050HDL
400302 B-SECTION-NOTE.                                                   DS050HDL
400303                                                                   DS050HDL
400304     NOTE MAIN LINE PROCESSING IS DONE BY DETERMINING IF THE       DS050HDL
400305          RECORD IS TO BE PROCESSED (THRU DATE SELECTION) AND      DS050HDL
400306          IF SELECTED FOR PROCESSING, DETERMINING WHAT TYPE        DS050HDL
400307          RECORD IT IS (SUBJECT RECORD WITH A 1 IN ISCOL OR        DS050HDL
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400308           REFERENCE RECORD WITH OTHER THAN 1 IN ISCOL). STORAGE  DS050HDL
400309          OF THE SUBJECT RECORD DATA AND RELATED INDICATORS IS    DS050HDL
400310          DONE BY PERFORMING C-COLUMN-1-STORE SECTION. STORAGE OF DS050HDL
400311          REFERENCE INFORMATION IS DONE BY PERFORMING              DS050HDL
400312          D-ALL-OTH-STORE SECTION. ALL RECORDS RELATED TO A       DS050HDL
400313          SUBJECT ARE STORED BEFORE THE OUTPUT SENTENCE IS BUILT. DS050HDL
400314          THE OUTPUT SENTENCE IS BUILT BY PERFORMING              SECTION.
400315          E-FORMATTING SECTION.                                   SECTION.
400316                                                                  SECTION.
400320 B010.                                                           DS050HDL
400330     IF AT-END GO TO I010.                                       DS050HDL
400335     MOVE SPACES TO ISEQKY.                                      DS050HDL
400340     READ STRUCTURE-ABSTRACT AT END MOVE 'ON' TO EOJ-SW.         DS050HDL
400350                                                                 DS050HDL
400360 B020.                                                           DS050HDL
400370     IF ISDATE LESS THAN HD1 OR ISDATE GREATER THAN HD2          DS050HDL
400380         MOVE STAB TO ISREC GO TO B010.                          DS050HDL
400390     IF ISCOL EQUAL '1' PERFORM C010 THRU C050 GO TO B030.       DS05CHDL
400400     PERFORM CC10 THRU C050.                                     DS050HDL
400410                                                                 DS050HDL
400420 B030.                                                           DS050HDL
400430     IF ISEQKY EQUAL ISSQKY MOVE STAB TO ISREC GO TO B010.       DS05CHDL
400440     IF COLI-OFF GO TO B040.                                     DS050HDL
400450     PERFORM EC10 THRU E160.                                     DS050HDL
400470     GO TO G04C.                                                 DS05CHDL
400480                                                                 DS050HDL
400490                                                                 DS050HDL
400500 B040.                                                           DS050HDL
400510     MOVE SPACES TO FORMATTED-PRINT                              DS05CHDL
400520     MOVE '0' TO CCONTROL                                        DS050HDL
400530     MOVE ISDOC TO DOCCODE                                       DS05CHDL
400540     MOVE ISSHELF TO SHELFNUMBER                                 DS050HDL
400550     MOVE 'KEY FACTORS NOT IN FILE.' TO DATA-LINE.               DS05CHDL
400560     WRITE PRINTER FROM FORMATTED-PRINT.                         DS050HDL
400570     ADD 2 TO LINECNT                                            DS050HDL
400580     GO TO G01C.                                                 DS05CHDL
400590                                                                 DS050HDL
400600                                                                 DS050HDL
400610 C-COLUMN-1-STORE SECTION.                                       DS05CHDL
400611                                                                 DS05CHDL
400612 C-SECTION-NOTE.                                                 DS050HDL
400613                                                                 DS05CHDL
400614     NOTE THIS SECTION STORES THE DATA AND ITS RELATED INDICATORS DS050HDL
400615          FOR SUBJECT RECORDS. THE DATA ITSELF IS STORED IN A    DS050HDL
400616          COMMON STORAGE AREA WITH ALL OTHER TYPE DATA BUT THE   DS050HDL
400617          INDICATORS, WORD-LENGTH COUNTERS, AND SUBSCRIPT        DS05CHDL
400618          COUNTERS ARE MAINTAINED SEPERATELY FROM REFERENCE      DS050HDL
400619          RECORD INDICATORS AND COUNTERS. ABILITY TO ACCESS THE  DS05CHDL
400620          DATA IN COMMON STORAGE IS MAINTAINED BY ALWAYS STORING DS05CHDL
400621          THE SUBJECT AS THE FIRST ENTRY IN THE COMMON STORAGE   DS050HDL
400622          AREA FOLLOWED BY ALL THE OTHER DATA IN THE SUBJECT     DS05CHDL
400623          RECORD, EACH IN SEQUENCE BY ROW CODE. CHARACTER COUNTS  DS050HDL
400624          ARE KEPT FOR EACH WORD IN STORAGE.                     DS05CHDL
400625                                                                 DS050HDL
400630 C010.                                                           DS05CHDL
400640     MOVE 'ON' TO IICOL.                                         DS050HDL
400650                                                                 DS05CHDL
400660 C020.                                                           DS05CHDL
400670     IF ISFIRW (CIFDI) EQUAL SPACES GO TO C050.                  DS05CHDL
400675     IF ISFICC (CIFDI) IS ALPHABETIC GO TO C05C.                 DS05CHDL
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400680     IF ISF1CC (CIFDI) IS NOT NUMERIC GO TO C050.                  DS050HDL
400690     MOVE ISCCL TO S1COL (CS1FI).                                  DS050HDL
400692     MOVE ISF1RW (CIFDI) TO S1ROW (CS1FI).                         DS050HDL
400694     MOVE F1CC (CIFDI) TO S1CC (CS1FI).                            DS050HDL
400700     ADD 1 TO CS1FI.                                               DS050HDL
400710                                                                   DS050HDL
400720 C030.                                                           DS050HDL
400730     IF ISF1CC (CIFDI) EQUAL ZEROS GO TO C040.                     DS050HDL
400740     MOVE ISDATA (CID) TO SCDATA (SCD).                            DS050HDL
400750     ADD 1 TO CID                                                  DS050HDL
400760     ADD 1 TO SCD                                                  DS050HDL
400770     SUBTRACT 1 FROM F1CC (CIFDI).                                 DS050HDL
400780     GO TO C030.                                                   DS050HDL
400790                                                                   DS050HDL
400800 C040.                                                           DS050HDL
400810     ADD 1 TO CIFDI.                                               DS050HDL
400820     IF CIFDI LESS THAN BININ GO TO C020.                          DS050HDL
400830                                                                   DS050HDL
400840 C050.                                                           DS050HDL
400850     MOVE BICNE  TO CIFDI.                                         DS050HDL
400860     MOVE BICNE  TO CID.                                           DS050HDL
400870 C060.                                                           DS050HDL
400880     EXIT.                                                         DS050HDL
400890                                                                   DS050HDL
400900 D-ALL-OTH-CCL-STORE SECTION.                                     DS050HDL
400901                                                                   DS050HDL
400902 D-SECTION-NOTE.                                                 DS050HDL
400903                                                                   DS050HDL
400904     NOTE THIS SECTION STORES DATA IN THE SAME WAY C-SECTION       DS050HDL
400905          STORES ITS DATA (READ C-SECTION-NOTE). MAINTAINING THE   DS050HDL
400906          ABILITY TO ACCESS DATA IN COMMON STORAGE DIFFERS         DS050HDL
400907          SOMEWHAT FROM THE SUBJECT SECTION BY KEEPING A POSITION DS050HDL
400908          INDICATOR FOR EACH KEY WORD (IDENTIFIED BY A PERIOD IN   DS050HDL
400909           ROW). THIS POSITION INDICATOR CONTAINS THE ACTUAL       DS050HDL
400910          CHARACTER POSITION COUNT IN COMMON STORAGE, THEREBY      DS050HDL
400911          ALLOWING ACCESS TO ANY REFERENCE WORD BY CALCULATING     DS050HDL
400912          ITS POSITION IN RELATION TO ITS KEY WORD.  THE KEY WORD  DS050HDL
400913          AND ITS POSITION INDICATOR'S RELATION TO THE FOLLOWING   DS050HDL
400914          WORDS ARE SIMILAR TO THAT OF THE SUBJECT AND THE FIRST   DS050HDL
400915          POSITION OF COMMON STORAGE'S RELATIONSHIP TO THE OTHER    DS050HDL
400916          WORDS IN THE SUBJECT RECORD.                             DS050HDL
400917                                                                   DS050HDL
400920 D010.                                                           DS050HDL
400930     IF ISREF EQUAL SPACES GO TO D050.                             DS050HDL
400940     IF ISF1RW (CIFDI) EQUAL SPACES GO TO D050.                    DS050HDL
400945     IF ISF1CC (CIFDI) IS ALPHABETIC GO TO D050.                   DS050HDL
400950     IF ISF1CC (CIFDI) IS NOT NUMERIC GO TO D05C.                  DS050HDL
400960     MOVE ISREF TO REFNO (REF).                                    DS050HDL
400970     MOVE SCFCI TO FLOLOC (REF).                                   DS050HDL
400980     MOVE SCC TO DATALOC (REF).                                    DS050HDL
400990     ADD 1 TO REF.                                                 DS050HDL
401000                                                                   DS050HDL
401010 D020.                                                           DS050HDL
401020     IF ISF1RW (CIFDI) EQUAL SPACES GO TO D050.                    DS050HDL
401025     IF ISF1CC (CIFDI) IS ALPHABETIC GO TO D050.                   DS050HDL
401030     IF ISF1CC (CIFDI) IS NOT NUMERIC GO TO D050.                  DS050HDL
401040     MOVE ISCCL TO SCCOL (SCFDI).                                  DS050HDL
401042     MOVE ISF1RW (CIFDI) TO SCROW (SCFDI).                         DS050HDL
401044     MOVE F1CC (CIFDI) TO SCCC (SCFDI).                            DS050HDL
401050     ADD 1 TO SCFDI.                                               DS050HDL
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401060                                                                  DS050HDL
401070 D030.                                                            DS050HDL
401080     IF ISF1CC (CIFDI) EQUAL ZEROS GO TO D040.                    DS050HDL
401090     MOVE ISCATA (CID) TO SCDATA (SCD).                           DS050HDL
401100     ADD 1 TO CID.                                                DS050HDL
401110     ADD 1 TO SCD.                                                DS050HDL
401120     SUBTRACT 1 FROM F1CC (CIFDI).                                DS050HDL
401130     GO TO D030.                                                  DS050HDL
401140                                                                  DS050HDL
401150 D040.                                                            DS050HDL
401160     ADD 1 TO CIFDI.                                              DS050HDL
401170     IF CIFDI LESS THAN BIMINE GO TO D020.                        DS050HDL
401180                                                                  DS050HDL
401190 D050.                                                            DS050HDL
401200     MOVE BICNE TO CIFDI, CID.                                    DS050HDL
401210                                                                  DS050HDL
401220 D060.                                                            DS050HDL
401230     EXIT.                                                        DS050HDL
401240                                                                  DS050HDL
401250 E-FORMATTING SECTION.                                            DS050HDL
401251                                                                  DS050HDL
401252 E-SECTION-NOTE.                                                  DS050HDL
401253                                                                  DS050HDL
401254     NOTE E-SECTION IS DIVIDED INTO THREE SUB-SECTIONS. THE FIRST DS050HDL
401255          IS THE FORMATTING SUB-SECTION, THE SECOND IS THE         DS050HDL
401256          PRINTING SUB-SECTION, AND THE THIRD IS THE REPORT-LINE-  DS050HDL
401257          CONTROL SUB-SECTION.                                     DS050HDL
401258          THE FORMATTING SUB-SECTION FORMATS THE OUTPUT RECORD,    DS050HDL
401259          PARTIALLY WITHIN ITS OWN SECTION AND PARTIALLY WITHIN    DS050HDL
401260          THE F-REFERENCE-SEARCH SECTION. STRAIGHT LINE FORMATTINGDS050HDL
401261          IS DONE IN THE FORMATTING SUB-SECTION AND INDIRECT       DS050HDL
401262          REFERENCE FORMATTING IS DONE BY PERFORMING THE H-SECTIONDS050HDL
401263          . THE ENTIRE OUTPUT MESSAGE IS FORMATTED A CHARACTER     DS050HDL
401264          AT A TIME IN A MATRIX WITH A MAXIMUM OF SIXTY CHARACTERSDS050HDL
401265          PER LINE. THE PRINTING SUB-SECTION PRINTS OUT THE LINES DS050HDL
401266          FORMATTED IN THE MATRIX AND USES THE REPORT-LINE-        DS050HDL
401267          CONTROL-SUBSECTION FOR LINE CHARACTER COUNT CONTROL.     DS050HDL
401268                                                                  DS050HDL
401270 E010.                                                            DS050HDL
401280     MOVE SPACES TO DLMATRIX.                                     DS050HDL
401290     MOVE '0' TO CCONTROL.                                        DS050HDL
401300     MOVE ISCCC TO DOCCODE.                                       DS050HDL
401310     MOVE ISSHELF TO SHELFNUMBER.                                 DS050HDL
401320     MOVE BIZERO TO RESUP.                                        DS050HDL
401330     MOVE BICNE TO CIFDI, CS1FI, CID, SCD, SCFDI, VC, HC, SBJ.    DS050HDL
401340     IF S1R2 (CS1FI) NOT EQUAL '.' MOVE SPACES TO DATA-LINE       DS050HDL
401350         MOVE 'NO SUBJECT FOR THIS ENTRY' TO DATA-LINE            DS050HDL
401360         WRITE PRINTED FROM FORMATTED-PRINT                       DS050HDL
401370         ADD 2 TO LINECNT                                         DS050HDL
401380         GO TO G010.                                              DS050HDL
401390     ADD S1CC (CS1FI) TO SCD.                                     DS050HDL
401400     ADD 1 TO CS1FI.                                              DS050HDL
401410     IF S1R0W (CS1FI) NOT EQUAL ' A' GO TO E040.                  DS050HDL
401420                                                                  DS050HDL
401430 E020.                                                            DS050HDL
401440     IF S1CC (CS1FI)     EQUAL ZEROS GO TO E030.                  DS050HDL
401450     MOVE SCDATA (SCD) TO VERT (VC HC).                           DS050HDL
401460     ADD 1 TO HC.                                                 DS050HDL
401470     ADD 1 TO SCD.                                                DS050HDL
401480     SUBTRACT 1 FROM S1CC (CS1FI).                                DS050HDL
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401490      GO TO E020.                                                    DS050HDL
401500                                                                     DS050HDL
401510 E030.                                                               DS050HDL
401520      ADD 1 TO HC.                                                   DS050HDL
401530      MOVE 'O' TO VERT (VC HC).                                      DS050HDL
401540      ADD 1 TO HC                                                    DS050HDL
401550      MOVE 'F' TO VERT (VC HC).                                      DS050HDL
401560      ADD 2 TO HC.                                                   DS050HDL
401570      ADD 1 TO CS1FI.                                                DS050HDL
401580                                                                     DS050HDL
401590 E040.                                                               DS050HDL
401600      IF S1ROW (CS1FI) EQUAL SPACES GO TO E090.                      DS050HDL
401610      IF S1ROW (CS1FI) LESS THAN ' E'                                DS050HDL
401620          MOVE S1ALL (CS1FI) TO C1SRCH                               DS050HDL
401630          PERFORM H010 THRU H170                                     DS050HDL
401640          ADD 1 TO HC                                                DS050HDL
401650          ADD 1 TO CS1FI                                             DS050HDL
401660      GO TO E085.                                                    DS050HDL
401670      MOVE S1CC (SBJ) TO CHARACHECK.                                 DS050HDL
401680      PERFORM E170.                                                  DS050HDL
401690                                                                     DS050HDL
401700 E050.                                                               DS050HDL
401710      IF S1CC (SBJ) EQUAL ZEROS ADD 1 TO HC GO TO E060.              DS050HDL
401720      MOVE SCDATA (C1D) TO VERT (VC HC).                             DS050HDL
401730      ADD 1 TO C1D.                                                  DS050HDL
401740      ADD 1 TO HC.                                                   DS050HDL
401750      SUBTRACT 1 FROM S1CC (SBJ).                                    DS050HDL
401760      GO TO E050.                                                    DS050HDL
401770                                                                     DS050HDL
401780 E060.                                                               DS050HDL
401790      MOVE S1ROW (CS1FI) TO TROW.                                    DS050HDL
401800      PERFORM F040 THRU F060.                                        DS050HDL
401805      IF ERROR MOVE 'OFF' TO ERRORIND  WRITE PRINTED FROM            DS050HDL
401806          FORMATTED-PRINT  ADD 2 TO LINECNT  GO TO G010.             DS050HDL
401810      MOVE TCNT (ACCUM) TO TEC.                                      DS050HDL
401820      IF TEC EQUAL ZEROS GO TO E080.                                 DS050HDL
401825      MOVE BIONE TO TSC.
401830      MOVE TEC TO CHARACHECK.                                        DS050HDL
401840      PERFORM E170.                                                  DS050HDL
401850                                                                     DS050HDL
401860 E070.                                                               DS050HDL
401870      IF TEC EQUAL ZEROS ADD 1 TO HC GO TO E080.                     DS050HDL
401880      MOVE TENTRY (ACCUM TSC) TO VERT (VC HC).                       DS050HDL
401890      ADD 1 TO TSC.                                                  DS050HDL
401900      ADD 1 TO HC.                                                   DS050HDL
401910      SUBTRACT 1 FROM TEC.                                           DS050HDL
401920      GO TO E070.                                                    DS050HDL
401930                                                                     DS050HDL
401940 E080.                                                               DS050HDL
401950      MOVE S1ALL (CS1FI) TO C1SRCH.                                  DS050HDL
401960      PERFORM H010 THRU H170.                                        DS050HDL
401970      ADD 1 TO CS1FI.                                                DS050HDL
401980      IF S1ROW (CS1FI) EQUAL SPACES GO TO E090.                      DS050HDL
401990      MOVE ',' TO VERT (VC HC).                                      DS050HDL
402000      ADD 2 TO HC.                                                   DS050HDL
402010      GO TO E060.                                                    DS050HDL
402011                                                                     DS050HDL
402012 E085.                                                               DS050HDL
402013      IF S1ROW (CS1FI) EQUAL SPACES GO TO E086.                      DS050HDL
402014      GO TO E040.                                                    DS050HDL
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402015                                                                  DS050HDL
402016 E086.                                                            DS050HDL
402017     MOVE S1CC (SBJ) TO CHARACHECK.
402018     PERFORM E170.
402019
402020 E087.
402021     IF S1CC (SBJ) EQUAL ZEROS GO TO E090.                        DS050HDL
402022     MOVE SCDATA (CID) TO VERT (VC HC).                           DS050HDL
402023     ADD 1 TC CID.                                                DS050HDL
402024     ADD 1 TC HC.                                                 DS050HDL
402025     SUBTRACT 1 FROM S1CC (SBJ).                                  DS050HDL
402026     GC TO E087.                                                  DS050HDL
402027                                                                  DS050HDL
402030 E090.                                                            DS05CHDL
402040     MOVE '.' TO VERT (VC HC).                                    DS050HDL
402050                                                                  DS05CHDL
402060 E-PRINT-ROUTINE-SUBSECTION.                                      DS05CHDL
402070                                                                  DS050HDL
402080 E100.                                                            DS050HDL
402090     IF LINECNT GREATER THAN 54  WRITE PRINTED FROM HEADER        DS050HDL
402100     ADD 1 TC PGNUM  MOVE 01 TO LINECNT.                          DS050HDL
402110                                                                  DS050HDL
402120 E110.                                                            DS050HDL
402130     MOVE VC TC PRCNT.                                            DS050HDL
402140     ADD 1 TC LINECNT.                                            DS050HDL
402150     MOVE BIONE TO VC.                                            DS050HDL
402160                                                                  DS050HDL
402170 E120.                                                            DS05CHDL
402180     MOVE HORIZON (VC) TO DATA-LINE.                              DS050HDL
402190     WRITE PRINTED FROM FORMATTED-PRINT.                          DS050HDL
402200     ADD 1 TC LINECNT.                                            DS050HDL
402220     MOVE SPACES TO FORMATTED-PRINT.                              DS05CHDL
402230     IF LINECNT GREATER THAN 54 GO TO E140.                       DS050HDL
402240     MOVE ' '  TO CCONTROL.                                      DS050HDL
402250                                                                  DS050HDL
402260 E130.                                                            DS050HDL
402270     ADD 1 TC VC.                                                 DS050HDL
402280     SUBTRACT 1 FROM PRCNT.                                       DS050HDL
402285     IF PRCNT EQUAL BIZERO GO TO E150.                            DS050HDL
402290     GC TO E120.                                                  DS050HDL
402300                                                                  DS05CHDL
402310 E140.                                                            DS050HDL
402320     WRITE PRINTED FROM HEADER.                                   DS05CHDL
402330     ADD 1 TC PGNUM.                                              DS050HDL
402340     MOVE 01 TC LINECNT.                                          DS050HDL
402350     MOVE '0' TO CCONTROL.                                        DS05CHDL
402360     GC TO E130.                                                  DS050HDL
402370                                                                  DS050HDL
402380 E150.                                                            DS05CHDL
402390     MOVE SPACES TO FORMATTED-PRINT.                              DS05CHDL
402400 E160.                                                            DS05CHDL
402410     EXIT.                                                        DS050HDL
402420                                                                  DS050HDL
402430 E-RPT-LNE-CNTRL-SUBSECTION.                                      DS050HDL
402440                                                                  DS050HDL
402450 E170.                                                            DS05CHDL
402459     SUBTRACT HC FROM SIXTY     GIVING RESULTS.                   DS050HDL
402460     IF CHARACHECK NOT LESS THAN RESULTS                          DS050HDL
402470         ADD 1 TO VC  MOVE BIONE TO HC.                           DS05CHDL
402480                                                                  DS050HDL
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402490 E180.                                                            DS050HDL
402500     EXIT.                                                        DS050HDL
402510                                                                  DS050HDL
402520 F-TABLE-TRANSLATION SECTION.                                     DS050HDL
402521                                                                  DS050HDL
402522 F-SECTION-NOTE.                                                  DS050HDL
402523                                                                  DS050HDL
402524     NOTE F-SECTION IS DIVIDED INTO 2 SUB-SECTIONS. THE F-ALPHA-  DS050HDL
402525          TBLE-CONV-SUBSECTION CONVERTS AN ALPHABETIC CHARACTER   DS050HDL
402526          TO A NUMBER VIA A SEARCH OF THE ALPHATBLE. IT THEN      DS050HDL
402527          PASSES THIS NUMBER BACK TO THE F-TBLE-TRANSLATION SUB-  DS050HDL
402528          SECTION. THIS SUB-SECTION, WHEN PERFORMED, TAKES THE    DS050HDL
402529          ALPHABETIC 'ROW CODE' AND CONVERTS IT INTO A NUMERIC     DS050HDL
402530          POINTER CODE FOR ADDRESSING THE RELATED CONNECTOR IN     DS050HDL
402531          THE CCR-TABLE. IT THEN PLACES THIS POINTER CODE IN A     DS050HDL
402532          HOLD AREA CALLED COMRW FOR USE BY THE PERFORMING SECTION DS050HDL
402533                                                                  DS050HDL
402540 F-ALPHA-TBLE-CONV-SUBSECTION.                                    DS050HDL
402550                                                                  DS050HDL
402560 F010.                                                            DS050HDL
402570     MOVE BICNE TO TSC.                                           DS050HDL
402580                                                                  DS050HDL
402590 F020.                                                            DS050HDL
402600     IF ACTA (TSC) EQUAL COMRW MOVE ACTN (TSC) TO COMRW           DS050HDL
402610         GO TO F030.                                              DS050HDL
402620     ADD 1 TO TSC.                                                DS050HDL
402630     IF TSC NOT GREATER THAN BITSIX GO TO F020.                   DS050HDL
402640     MOVE SPACES TO DATA-LINE.                                    DS050HDL
402650     MOVE 'ROW INDICATOR NOT ALHA OR BLANK' TO DATA-LINE.         DS050HDL
402660     MOVE ' CA' TO ERRORIND.                                      DS050HDL
402670                                                                  DS050HDL
402680 F030.                                                            DS050HDL
402690     EXIT.                                                        DS050HDL
402700                                                                  DS050HDL
402710 F-TBLE-TRANSLATION-SUBRTE.                                       DS050HDL
402720                                                                  DS050HDL
402730 F040.                                                            DS050HDL
402740     MOVE BICNE TO MULTIPLICAND, ACCUM2.                          DS050HDL
402741     MOVE BIZERO TO ACCUM.                                        DS050HDL
402750     IF TROW1 EQUAL SPACE  GO TO F050.                            DS050HDL
402755     IF TROW1 EQUAL '1' MOVE 'A' TO TROW1.
402760     IF TROW1 GREATER THAN 'J' ADD 10 TO MULTIPLICAND.            DS050HDL
402770     IF TROW1 GREATER THAN 'T' ADD 10 TO MULTIPLICAND.            DS050HDL
402780     MOVE TROW1 TO COMRW.                                         DS050HDL
402790     PERFORM F010 THRU F030.                                      DS050HDL
402800     IF ERROR GO TO F060.                                         DS050HDL
402810     ADD NUMRW TO MULTIPLICAND.                                   DS050HDL
402820     MULTIPLY TWENTYSIX BY MULTIPLICAND GIVING ACCUM.             DS050HDL
402830                                                                  DS050HDL
402[   F050.                                                            DS050HDL
402[[[     IF TROW2 GREATER THAN 'J' ADD 10 TO ACCUM2.                  DS050HDL
402860     IF TROW2 GREATER THAN 'T' ADD 10 TO ACCUM2.                  DS050HDL
402870     MOVE TROW2 TO COMRW.                                         DS050HDL
402880     PERFORM F010 THRU F030.                                      DS050HDL
402890     IF ERROR GO TO F060.                                         DS050HDL
402900     ADD NUMRW TO ACCUM2.                                         DS050HDL
402910     ADD ACCUM2 TO ACCUM.                                         DS050HDL
402920                                                                  DS050HDL
402930 F060.                                                            DS050HDL
402940     EXIT.                                                        DS050HDL
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402950                                                                  DS050HDL
402960 G-ERROR-RESET SECTION.                                           DS050HDL
402961                                                                  DS050HDL
402962 G-SECTION-NOTE.                                                  DS050HDL
402963                                                                  DS050HDL
402964     NOTE THIS SECTION IS DIVIDED INTO TWO SUB-SECTIONS. THE FIRST DS050HDL
402965          OF WHICH BYPASSES ALL TRAILING RECORDS RELATED TO A     DS050HDL
402966          RECORD IN ERROR.                                        DS050HDL
402967          THE SECOND SUB-SECTION RESETS ALL COUNTERS AND CLEARS   DS050HDL
402968          ALL STORAGE AREAS FOR THE PROCESSING OF A NEW RECORD.   DS050HDL
402970                                                                  DS050HDL
402980 G-ERROR-SUBSECTION.                                              DS050HDL
402990                                                                  DS050HDL
403000 G010.                                                            DS050HDL
403010     IF ISEQKY EQUAL ISSQKY MOVE STAB TO ISREC                    DS050HDL
403020         GO TO G020.                                              DS050HDL
403030     GO TO G040.                                                  DS050HDL
403040                                                                  DS050HDL
403050                                                                  DS050HDL
403060 G020.                                                            DS050HDL
403070     READ STRUCTURE-ABSTRACT AT END MOVE 'ON' TO EOJ-SW           DS050HDL
403080         GO TO B010.                                              DS050HDL
403090     GO TO G010.                                                  DS050HDL
403100                                                                  DS050HDL
403110 G030.                                                            DS050HDL
403120     EXIT.                                                        DS050HDL
403130                                                                  DS050HDL
403140 G-RESET-INDICATORS-SUBSECTION.                                   DS050HDL
403150                                                                  DS050HDL
403160 G040.                                                            DS050HDL
403170     MOVE 'NO' TO I1COL.                                          DS050HDL
403175     MOVE STAB TO ISREC.                                          DS050HDL
403180     MOVE 'OFF' TO PARENSW, ESW, REFIND, ERRORIND.                DS050HDL
403182     MOVE SPACES TO COL1-FDL-STORE, COMMON-FLD-STORE.             DS050HDL
403184     MOVE SPACES TO COMMON-DATA-STORE, RESERVEREFAREAS.           DS050HDL
403186     MOVE SPACES TO REFERENCES, REFERENCEINDS.                    DS050HDL
403190                                                                  DS050HDL
403200 G050.                                                            DS050HDL
403210     MOVE BIONE TO CIFDI, CS1FI, CID, SCD, SCFDI, VC, HC, REF.    DS050HDL
403220     MOVE BIONE TO HFL, HCOL, SBJ, REFHLD, HLESSE, TSC.           DS050HDL
403230     MOVE BIONE TO        ACCUM2, MULTIPLICAND, PRCNT.            DS050HDL
403240     MOVE BIZERO TO RESUP, CHARACHECK, ACCUM.                     DS050HDL
403250                                                                  DS050HDL
403260 G060.                                                            DS050HDL
403270     GO TO B010.                                                  DS050HDL
403280                                                                  DS050HDL
403290 H-SEARCH-REFERENCES SECTION.                                     DS050HDL
403291                                                                  DS050HDL
403292 H-SECTION-NOTE.                                                  DS050HDL
403293                                                                  DS050HDL
403294     NOTE THIS SECTION, WHEN PERFORMED, DOES ALL THE REFERENCE    DS050HDL
403295          SEARCHING AND DIRECT AND INDIRECT REFERENCE FORMATTING.  DS050HDL
403296          IT PERFORMS F-SECTION FOR TABLE-LOOKUPS AND TABLE        DS050HDL
403297          TRANSLATIONS AS THEY ARE NEEDED. WHEN REFERENCE SEARCH-  DS050HDL
403298          ING AND FORMATTING HAS BEEN COMPLETED FOR A WORD IN THE  DS050HDL
403299          SUBJECT RECORD, CONTROL IS THEN PASSED BACK TO THE       DS050HDL
403300          PERFORMING SECTION TO PROCESS THE NEXT WORD IN THE       DS050HDL
403301          SUBJECT RECORD. THE ONLY WORD IN THE SUBJECT RECORD      DS050HDL
403302          THAT IS PROCESSED IN THIS SECTION IS THE ONE RELATED     DS050HDL
403303          TO THE REFERENCE SEARCH.                                 DS050HDL
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403304                                                                  DS050HDL
403310 H010.                                                            DS050HDL
403320     MOVE C1SRCH TO COMSRCH.                                      DS050HDL
403330     MOVE SPACES TO HLDREF.                                       DS050HDL
403340                                                                  DS050HDL
403350 H020.                                                            DS050HDL
403360     MOVE BICNE TO REF.                                           DS050HDL
403370                                                                  DS050HDL
403380 H030.                                                            DS050HDL
403390     IF REFNC (REF) EQUAL SPACES GO TO H070.                      DS050HDL
403400     IF REFNC (REF) EQUAL COMSRCH GO TO H040.                     DS050HDL
403410     ADD 1 TC REF.                                                DS050HDL
403420     GC TO H030.                                                  DS050HDL
403430                                                                  DS050HDL
403440 H040.                                                            DS050HDL
403450     MOVE ' CA' TO REFIND.                                        DS050HDL
403460     MCVE REF TO REFHLD.                                          DS050HDL
403470     MCVE REFLCC (REF) TO HLDREF.                                 DS050HDL
403480     MCVE HLDFLOC TO HFL.                                         DS050HDL
403490     MCVE HLDCLOC TO HCDL.                                        DS050HDL
403500     IF SCR2 (HFL) NOT EQUAL '.' GO TO H050.                      DS050HDL
403510     ADD SCCC (HFL) TC HCDL.                                      DS050HDL
403520     ADD 1 TC HFL.                                                DS050HDL
403530                                                                  DS050HDL
403540 H050.                                                            DS050HDL
403550     IF SCROW (HFL) GREATER THAN ' D' GO TO H060.                 DS050HDL
403560     MCVE 'OFF' TO ESW.                                           DS050HDL
403570     MCVE HLDREFNO TO COMSRCH.                                    DS050HDL
403580     ADD 1 TO REF.                                                DS050HDL
403590     GC TO H030.                                                  DS050HDL
403600                                                                  DS050HDL
403610 H060.                                                            DS050HDL
403620     IF SCROW (HFL) EQUAL '99' GO TO H090.                        DS050HDL
403630     MCVE HCDL TO HLESSE.                                         DS050HDL
403640     MCVE ' CA' TO ESW.                                           DS050HDL
403650     GC TO H210.                                                  DS050HDL
403660                                                                  DS050HDL
403670 H070.                                                            DS050HDL
403680     IF HLDREF EQUAL SPACES GO TO H120.                           DS050HDL
403682                                                                  DS050HDL
403684 H075.                                                            DS050HDL
403690     MCVE '99' TO SCROW (HFL).                                    DS050HDL
403700     MCVE SCCC (HFL) TO CHARACHECK.                               DS050HDL
403710     PERFORM E170.                                                DS050HDL
403720                                                                  DS050HDL
403730 H080.                                                            DS050HDL
403740     IF SCCC (HFL) EQUAL ZEROS ADD 1 TO HC GO TO H090.            DS050HDL
403750     MCVE SCDATA (HCDL) TO VERT (VC HC).                          DS050HDL
403760     ADD 1 TC HC.                                                 DS050HDL
403770     ADD 1 TC HCDL.                                               DS050HDL
403780     SUBTRACT 1 FROM SCCC (HFL).                                  DS050HDL
403790     GC TO H080.                                                  DS050HDL
403900                                                                  DS050HDL
403910 H090.                                                            DS050HDL
403920     ADD 1 TC HFL.                                                DS050HDL
403930     IF SCR2 (HFL) EQUAL TO '.' GO TO H110.                       DS050HDL
403940     IF SCR2 (HFL) EQUAL TO SPACES GO TO H110.                    DS050HDL
403950     MCVE 1 TC REF.                                               DS050HDL
403970                                                                  DS050HDL
403980 H100.                                                            DS050HDL
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403990      IF SCROW (HFL) GREATER THAN ' 0' GO TO H06C.                    DS050HDL
404000      MOVE 'OFF' TO ESW.                                              DS050HDL
404010      MOVE SCALL (HFL) TO COMSRCH.                                    DS050HDL
404020      GO TO H030.                                                     DS050HDL
404030                                                                      DS050HDL
404040 H110.                                                                DS050HDL
404050      MOVE REFFLD TO REF.                                             DS050HDL
404060      MOVE '****' TO REFNO (REF).                                     DS050HDL
404070      GO TO H180.                                                     DS050HDL
404080                                                                      DS050HDL
404090 H120.                                                                DS050HDL
404500      IF COMSRCH EQUAL C1SRCH GO TO H130.                             DS050HDL
404510      IF EOFF GO TO H075.                                             DS050HDL
404520                                                                      DS050HDL
404530 H130.                                                                DS050HDL
404540      IF PARON ADD 1 TO HC                                            DS050HDL
404550      MOVE 3 TO CHARACHECK                                            DS050HDL
404560      PERFORM E170                                                    DS050HDL
404570      MOVE ')' TO VERT (VC HC)                                        DS050HDL
404580      ADD 1 TO HC                                                     DS050HDL
404590      GO TO H160.                                                     DS050HDL
404600                                                                      DS050HDL
404610 H140.                                                                DS050HDL
404620      IF RION GO TO H160.                                             DS050HDL
404630      MOVE S1CC (CS1FI) TO CHARACHECK.                                DS050HDL
404640      PERFORM E170.                                                   DS050HDL
404650                                                                      DS050HDL
404660 H150.                                                                DS050HDL
404670      IF S1CC (CS1FI) EQUAL ZEROS GO TO H160.                         DS050HDL
404680      MOVE SCDATA (SCD) TO VERT (VC HC).                              DS050HDL
404690      ADD 1 TO HC.                                                    DS050HDL
404700      ADD 1 TO SCD.                                                   DS050HDL
404710      SUBTRACT 1 FROM S1CC (CS1FI).                                   DS050HDL
404720      GO TO H150.                                                     DS050HDL
404730                                                                      DS050HDL
404740 H160.                                                                DS050HDL
404750      MOVE 'OFF' TO ESW, PARENSW, REFIND.                             DS050HDL
404755      MOVE SPACES TO REFERENCEINDS.                                   DS050HDL
404756      MOVE ZEROS TO RESERVEREFAREAS.                                  DS050HDL
404760                                                                      DS050HDL
404770 H170.                                                                DS050HDL
404780      EXIT.                                                           DS050HDL
404790                                                                      DS050HDL
404800 H180.                                                                DS050HDL
404810      SUBTRACT 1 FROM HFL.                                            DS050HDL
404820      IF SCR2 (HFL) NOT EQUAL ',' GO TO H200.                         DS050HDL
404830      ADD SCCC (HFL) TO SCD.                                          DS050HDL
404840      MOVE HLCCLOC TO HCDL.                                           DS050HDL
404850      MOVE SCCC (HFL) TO CHARACHECK.                                  DS050HDL
404860      PERFORM E170.                                                   DS050HDL
404870                                                                      DS050HDL
404880 H190.                                                                DS050HDL
404890      IF SCCC (HFL) EQUAL ZEROS                                       DS050HDL
404900          MOVE '99' TO SCROW (HFL)                                    DS050HDL
404910          GO TO H010.                                                 DS050HDL
404920      MOVE SCDATA (HCDL) TO VERT (VC HC).                             DS050HDL
404930      ADD 1 TO HC.                                                    DS050HDL
404940      ADD 1 TO HCDL.                                                  DS050HDL
404950      SUBTRACT 1 FROM SCCC (HFL).                                     DS050HDL
404960      GO TO H190.                                                     DS050HDL
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404970                                                                  DS050HDL
404980 H200.                                                            DS050HDL
404990     IF HFL EQUAL FLDLOC (REF) GO TO H010.                        DS050HDL
405000     GO TO H180.                                                  DS050HDL
405010                                                                  DS050HDL
405020 H210.                                                            DS050HDL
405030     IF REFEIND (REF) EQUAL '*' GO TO H260.                       DS050HDL
405040     IF COMSRCH EQUAL C1SRCH GO TO H240.                          DS050HDL
405050     MOVE REFFLD TO REF.                                          DS050HDL
405060     MOVE REFLOC (REF) TO HLDREF.                                 DS050HDL
405070     MOVE HLDFLOC TO HFL.                                         DS050HDL
405080     MOVE HLDDLOC TO HCDL.                                        DS050HDL
405090     MOVE SCCC (HFL) TO CHARACHECK.                               DS050HDL
405100     PERFORM E170.                                                DS050HDL
405110                                                                  DS050HDL
405120 H220.                                                            DS050HDL
405130     IF SCCC (HFL) EQUAL ZEROS MOVE '99' TO SCROW (HFL)           DS050HDL
405131     GO TO H230.                                                  DS050HDL
405140     MOVE SCDATA (HCDL) TO VERT (VC HC).                          DS050HDL
405150     ADD 1 TO HC.                                                 DS050HDL
405160     ADD 1 TO HCDL.                                               DS050HDL
405170     SUBTRACT 1 FROM  SCCC (HFL).                                 DS050HDL
405180     GO TO H220.                                                  DS050HDL
405190                                                                  DS050HDL
405200 H230.                                                            DS050HDL
405210     ADD 1 TO HFL.                                                DS050HDL
405220     IF SCROW (HFL) EQUAL '99' GO TO H230.                        DS050HDL
405230     MOVE HLESSE TO HCDL.                                         DS050HDL
405240     GO TO H260.                                                  DS050HDL
405250                                                                  DS050HDL
405260 H240.                                                            DS050HDL
405270     MOVE S1CC (CS1FI) TO CHARACHECK.                             DS050HDL
405280     PERFORM E170.                                                DS050HDL
405290                                                                  DS050HDL
405300 H250.                                                            DS050HDL
405310     IF S1CC (CS1FI) EQUAL ZEROS MOVE '*' TO REFEIND (REF)        DS050HDL
405320         MOVE '***' TO REFNO (REF)  GO TO H260.                   DS050HDL
405330     MOVE SCDATA (SCD) TO VERT (VC HC).                           DS050HDL
405340     ADD 1 TO HC.                                                 DS050HDL
405350     ADD 1 TO SCD                                                 DS050HDL
405360     SUBTRACT 1 FROM S1CC (CS1FI).                                DS050HDL
405370     GO TO H250.                                                  DS050HDL
405380                                                                  DS050HDL
405390 H260.                                                            DS050HDL
405400     IF PARON MOVE ',' TO VERT (VC HC) GO TO H270.                DS050HDL
405410     MOVE ' ON' TO PARENSW.                                       DS050HDL
405420     ADD 1 TO HC.                                                 DS050HDL
405430     MOVE 3 TO CHARACHECK.                                        DS050HDL
405440     PERFORM E170.                                                DS050HDL
405450     MOVE '(' TO VERT (VC HC).                                    DS050HDL
405460                                                                  DS050HDL
405470 H270.                                                            DS050HDL
405480     ADD 2 TO HC                                                  DS050HDL
405490     MOVE SCROW (HFL) TO TROW.                                    DS050HDL
405500     PERFORM F040 THRU F060.                                      DS050HDL
405510     IF ERRON MOVE 'OFF' TO ERRORIND                              DS050HDL
405520         WRITE PRINTER FROM FORMATTED-PRINT                       DS050HDL
405530         ADD 2 TO LINECNT                                         DS050HDL
405540         GO TO G010.                                              DS050HDL
405550     MOVE TCNT (ACCUM) TO TEC.                                    DS050HDL
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405560      IF TEC EQUAL ZEROS  GO TO H290.                          DS050HDL
405565      MOVE BICNE TO TSC.                                       DS050HDL
405570      MOVE TEC TO CHARACHECK.                                  DS050HDL
405580      PERFORM E170.                                            DS050HDL
405590                                                               DS050HDL
405600 H280.                                                         DS050HDL
405610      IF TEC EQUAL ZEROS ADD 1 TO HC  GO TO H290.              DS050HDL
405620      MOVE TENTRY (ACCUM TSC) TO VERT (VC HC).                 DS050HDL
405630      ADD 1 TO TSC.                                            DS050HDL
405640      ADD 1 TO HC.                                             DS050HDL
405650      SUBTRACT 1 FROM TEC.                                     DS050HDL
405660      GO TO H280.                                              DS050HDL
405670                                                               DS050HDL
405680 H290.                                                         DS050HDL
405690      MOVE SCALL (HFL) TO COMSRCH.                             DS050HDL
405700      MOVE SPACES TO HLDREF.                                   DS050HDL
405710      MOVE BICNE TO REF.                                       DS050HDL
405720                                                               DS050HDL
405730 H300.                                                         DS050HDL
405740      IF REFNC (REF) EQUAL SPACES GO TO H350.                  DS050HDL
405750      IF REFNC (REF) EQUAL COMSRCH GO TO H310.                 DS050HDL
405760      ADD 1 TO REF.                                            DS050HDL
405770      GO TO H300.                                              DS050HDL
405780                                                               DS050HDL
405790 H310.                                                         DS050HDL
405800      ADD 1 TO RESUP.                                          DS050HDL
405810      MOVE HFL TO RESHFL (RESUP).                              DS050HDL
405820      MOVE HCDL TO RESDATA (RESUP).                            DS050HDL
405830      MOVE REFHLD TO RESREFHLD (RESUP).                        DS050HDL
405840      MOVE REF TO REFHLD.                                      DS050HDL
405850      MOVE REFLCC (REF) TO HLDREF.                             DS050HDL
405860      MOVE HLDFLOC TO HFL.                                     DS050HDL
405870      MOVE HLDCLOC TO HCDL.                                    DS050HDL
405880      IF SCR2 (HFL) EQUAL '.' ADD SCCC (HFL) TO HCDL           DS050HDL
405890          ADD 1 TO HFL.                                        DS050HDL
405900      IF SCROW (HFL) LESS THAN ' E' GO TO H290.                DS050HDL
405910      MOVE HFL TO RESHFL2.                                     DS050HDL
405920      MOVE HCDL TO RESDATA2.                                   DS050HDL
405930      MOVE RESHFL (RESUP) TO HFL.                              DS050HDL
405940      MOVE RESDATA (RESUP) TO HCDL.                            DS050HDL
405950      MOVE '99' TO SCROW (HFL).                                DS050HDL
405960      MOVE SCCC (HFL) TO CHARACHECK.                           DS050HDL
405970      PERFORM E170.                                            DS050HDL
405980                                                               DS050HDL
405990 H320.                                                         DS050HDL
406000      IF SCCC (HFL) EQUAL ZEROS ADD 1 TO HFL GO TO H330.       DS050HDL
406010      MOVE SCDATA (HCDL) TO VERT (VC HC).                      DS050HDL
406020      ADD 1 TO HC.                                             DS050HDL
406030      ADD 1 TO HCDL.                                           DS050HDL
406040      SUBTRACT 1 FROM SCCC (HFL).                              DS050HDL
406050      GO TO H320.                                              DS050HDL
406060                                                               DS050HDL
406070 H330.                                                         DS050HDL
406080      IF SCR2 (HFL) EQUAL TO '.' GO TO H340.                   DS050HDL
406090      IF SCROW (HFL) EQUAL SPACES GO TO H340.                  DS050HDL
406100      MOVE HFL TO RESHFL (RESUP).                              DS050HDL
406110      MOVE HCDL TO RESDATA (RESUP).                            DS050HDL
406115      MOVE REFHLD TO RESREFHLD (RESUP).                        DS050HDL
406120      MOVE 9 TO RESGO12 (RESUP).                               DS050HDL
406130      GO TO H345.                                              DS050HDL
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406140                                                                  DS050HDL
406150 H340.                                                            DS050HDL
406160     SUBTRACT 1 FROM RESUP.                                       DS05CHDL
406165 H345.                                                            DS050HDL
406170     MCVE RESCATA2 TO HCDL.                                       DS050HDL
406180     MCVE RESHFL2 TO HFL.                                         DS050HDL
406190     GO TO H26C.                                                  DS050HDL
406200                                                                  DS050HDL
406210 H350.                                                            DS050HDL
406220     MOVE '99' TO SCROW (HFL).                                    DS050HDL
406230     MCVE SCCC (HFL) TO CHARACHEC..                               DS050HDL
406240     PERFORM E170.                                                DS050HDL
406250                                                                  DS050HDL
406260 H360.                                                            DS05CHDL
406270     IF SCCC (HFL) EQUAL ZEROS GO TO H370.                        DS050HDL
406280     MCVE SCCATA (HCDL) TO VERT (VC HC).                          DS050HDL
406290     ACD 1 TC HC.                                                 DS050HDL
406300     ACD 1 TC HCDL.                                               DS050HDL
406310     SUBTRACT 1 FROM SCCC (HFL).                                  DS050HDL
406320     GC TO H360.                                                  DS050HDL
406330                                                                  DS05CHDL
406340 H370.                                                            DS050HDL
406350     IF RESUP EQUAL BIZERO GO TO H380.                            DS050HDL
406360     MCVE RESHFL (RESUP) TO HFL.                                  DS050HDL
406370     MCVE RESCATA (RESUP) TO HCDL.                                DS050HDL
406380     MCVE REFHLD TO REF.                                          DS050HDL
406390     MOVE RESREFHLD (RESUP) TO REFHLD..                           DS050HDL
406400     MOVE '****' TO REFNO (REF).                                  DS050HDL
406410     IF RESGC12 (RESUP) EQUAL '9' SUBTRACT 1 FRCM RESUP           DS050HDL
406420         GO TC H260.                                              DS050HDL
406430     ACD 1 TC HC.                                                 DS050HDL
406440     SUBTRACT 1 FROM RESUP.                                       DS05CHDL
406450     GC TO H350.                                                  DS050HDL
406460                                                                  DS050HDL
406470 H380.                                                            DS050HDL
406480     ADD 1 TO HFL.                                                DS05CHDL
406490     IF SCR2 (HFL) EQUAL '.' GO TO H390.                          DS050HDL
406500     IF SCROW (HFL) EQUAL SPACES GO TO H390.                      DS050HDL
406510     IF SCROW (HFL) GREATER THAN ' D' GO TO H260.                 DS050HDL
406520     ADD 1 TO HC.                                                 DS050HDL
406530     GC TO H350.                                                  DS050HDL
406540                                                                  DS050HDL
406550 H390.                                                            DS050HDL
406560     MCVE REFHLD TO REF                                           DS050HDL
406570     MCVE '****' TO REFNO (REF).                                  DS050HDL
406580     GC TO H010.                                                  DS050HDL
406590                                                                  DS050HDL
406600 I-WRAP-UP SECTION.                                               DS050HDL
406610                                                                  DS050HDL
406620 I010.                                                            DS05CHDL
406630     CLOSE STRUCTURE-ABSTRACT, PRINT-TAPE.                        DS050HDL
406640     DISPLAY 'END OF PROGRAM DS050.'.                             DS050HDL
406650     STOP RUN.                                                    DS05CHDL
$CBEND
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13. ABSTRACT

This report reviews the purpose and development of the ABC system and presents the computer programs that were written and tested for the automatic construction and standardization of syntactical descriptors. Reasons of economy have overridden consideration of quality and have forced the installation to accept the analytical products of national and professional information centers rather than reprocess the items using the ABC system. This report contains a description of how the magnetic tapes distributed by national information centers are processed to provide the (under given conditions) best possible bibliographic (including SDI) services for HDL personnel; and presents also an outline of a prototype test which is to estimate the inherent limitations of a proposed system and thus prevent further investments in a system if it has less potential capability than required by the application.

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14. KEY WORDS	LINK A		LINK B		LINK C	
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3. Evaluation models	10	3				
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Selective dissemination of information - system	8	3				
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