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DEVELOPMENT AND EXPERIMENTAL EVALUATION OF A RETRIEVAL SYSTEM FOR AIR FORCE CONTROL-DISPLAY INFORMATION

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FOREWORD

This report was prepared by the University of Dayton Research Institute under Air Force Contract AF 33(615)-5310. The objective of the work reported herein was to develop and to evaluate by experimental techniques a model retrieval system for control-display information. The work was accomplished under Project No. 6190 and Task No. 61907. The effort was administered under the direction of the Control Systems Research Branch of the Flight Control Division of the Air Force Flight Dynamics Laboratory with Lt. Eugene Rathswohl, FDCR, as project monitor.

This is a summary technical report and covers the work accomplished from 30 Jun 66 through 1 Jul 67. This report was submitted July 1967.

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This technical report has been reviewed and is approved.

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ABSTRACT

A proposed classification system was studied to determine its efficacy to the Air Force Control-Display Area. Based on negative outcomes from a logical assessment of the proposed system, an alternate system was proposed to include the coordinate index concept. Upon development of a thesaurus and an index system on 106 documents in the VSTOL/VTOL area, an experiment was conducted to determine the acceptance and effectiveness of the system for professional workers using the system. Findings revealed that the coordinate system was acceptable to the user and that it provided for the retrieval of relevant documents beyond that expected by chance. The study suggests that the coordinate index system and the present measures used to study its effectiveness provide a rationale for further experimentation which can expand the base of the system to meet the need of the control-display area.

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I. INTRODUCTION

The need for efficient organizing, storing and retrieving of information has become increasingly acute in today's rapidly changing technological society. In an effort to cope with this need a number of information systems have been established which vary considerably in degree of sophistication. The urgency in establishing systems has been so great that frequently systems have been started without the benefit of careful empirical studies beforehand. A number of user survey type studies have been performed, and these studies have been helpful. Some systems have been initiated with the best of intentions, but in their actual operation considerable modifications have been necessary.[6] One reason for this situation is that the interactions between the users and the system had not been investigated until the system was already established and operating. Then the user requirements and preferences served as guides for system modifications.

It is well accepted industrial practice to design a prototype or model of a machine or vehicle and to subject this model to extensive testing to determine its desirable and undesirable characteristics. Modification and retesting are readily effected and the final design may be extensively tempered by experimental findings. This same procedure should prove valid in the design of an information retrieval system.

The Air Force Flight Dynamics Laboratory (AFFDL) has a collection of documents on control-display known as the Control Display Information Center (CDIC). A hierarchical classification scheme had been proposed through in-house effort at the AFFDL which might serve as a tool for document retrieval in aerospace technology. The possibility of using this classification scheme for document retrieval in the area of Air Force control-display information was considered. Fundamental to the consideration of the classification scheme, however, was that experimental evaluation of the system would be performed before the system would actually be put into use.

In July, 1966 a contract was awarded to the University of Dayton to evaluate the proposed classification scheme as to its efficacy in document retrieval. The evaluation was to be performed by experimentally testing a model which would simulate the conditions of use of the proposed system to determine the user/retrieval system interactions quantitatively. This procedure would provide valuable data which might be used subsequently in the actual design of a system. These data should provide a much better basis for system design than merely a survey of user information needs, and would not involve the very expensive procedures of first designing an entire system and then modifying it to reflect user requirements and preferences.

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II. EVALUATION OF THE PROPOSED CLASSIFICATION SYSTEM

The AFFDL has approximately 2700 documents on control-display. For all documents in the system, abstract/bibliographic cards have been prepared which contain the abstract on one side and the following bibliographic information as applicable on the other: Access Number (randomly assigned); Title; Personal Author; Corporate Author or Source; Report No.; DDC No.; Project No.; Task No.; Contract No.; Date. A sample card is shown in Appendix I.

To identify a particular document or group of documents, a 6-digit classification scheme had been developed. This scheme was a hierarchical scheme which encompassed a large subject speciality area, but the classification system did not provide for the subject area of control-display research and development. The essence of the classification scheme is presented in Appendix II. The first step in performing an evaluation of this scheme was the modification of this classification scheme to incorporate the subject area of control-display. Problems of inserting documents into the system even before modification proved formidable if not impossible. CDIC Document 2004 is entitled Near-Ground Hover Complicates Piloting Tasks in XV-5A Tests. Referring to Appendix II, the classifier must determine which classification pigeon-hole is appropriate for this document. First, it must be determined if this document deals with 1. Systems, 2. Assemblies or 3. Subjective Data. Then decisions must be made regarding the other digits in the six digit system. Applying the classification system, several classifications would be possible. A listing of the classification for CDIC Document 2004 and their meanings is presented in Table 1.

It is apparent that classification of the document into the classification scheme is a difficult and ambiguous task, since multiple classification possibilities exist. There are probably other equally logical possibilities which are not listed in Table 1. It should be recognized that these difficulties exist even before modifying the system to include the area of control-display. Efforts to change the proposed classification system to assimilate the control-display information were unsuccessful. Attempts were made to restructure the classification scheme to accommodate control-display information. However, the same difficulties which caused problems in the originally proposed classification scheme also created similar problems in revised systems.

As a result of the practical difficulties encountered in attempting to use and expand the proposed classification scheme it was decided to consider the scheme from a theoretical standpoint. The majority of the literature in CDIC consists of technical reports. By their very nature, technical reports deal with specific information having relatively narrow scope. Books, on the other hand, deal with information on a far broader level, and classification is

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TABLE 1

Classification of CDIC Document 2004 Near Ground Hover Complicates Piloting Tasks in XV-5A Tests

Classification No.	1st digit	2nd digit	3rd digit	4th, 5th, and 6th digits
111410	Systems	Aircraft systems	IPI	Experimental, 1 engine
313410	Subjective data	Aircraft systems	Personnel	Experimental, 1 engine
114100	Systems	Aircraft systems	Personnel	Aircrew
116400	Systems	Aircraft systems	Real estate	Approaches
110410	Systems	Aircraft systems	Unspecified	Experimental, 1 engine
311410	Subjective data	Aircraft systems	IPI	Experimental, 1 engine

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possible. To be of use, a classification scheme for technical literature would have to be minutely detailed to provide the level of specificity required. The classification scheme would undoubtedly contain areas between the highly specific units and the rather broad subjects which would be fairly arbitrary and would be seldom used. The classification scheme would be so complicated that a subject index to the classification scheme would be necessitated.

The classification scheme under evaluation was a hierarchical scheme; that is, subjects were related vertically from the general to the specific. Such an order can only be superimposed on the area of control-display which is interdisciplinary. The classification system cannot reflect the nature of the literature or the use approach of the researcher in the area. Therefore, the classification system would enable a researcher to browse in areas of general interest to him, but could not enable him to retrieve those select documents related to a specific subject. The literature often reflects horizontal relationships between subjects and/or varying degrees of subject integration; thus, the logical insertion of the literature into a hierarchical scheme becomes impossible. On the other hand, if the literature can be forced into the scheme, the user is faced with an extremely complex problem of retrieval. His proficiency in the subject area of interest would be useless unless he has a complete knowledge of the classification scheme and the idiosyncrasies of the classifiers.

Another limitation of the classification scheme under evaluation was the proposed notation of six digits. By limiting the notation to six digits, the scheme is limited to 999,999 classes. Since the first three digits were already designated, the scheme was limited to 999 classes. Considering the specificity of the material to be classified and the desire for an expandable system, 999,999 classes would not be sufficient.

To corroborate further these assertions about the classification system, reference was made to an excerpt from Classifying and Indexing for the Special Library by Saul Herner and R. S. Meyer.[5] This article describes seven basic requirements which must be met in the custom design of classification and index systems. The basic requirements are: 1) The subject classes and the terms used to define these classes must be directly reflective of the viewpoints and language of the users. 2) The system must reflect the actual literature to be organized as well as the actual purposes for which this literature is used. 3) All classes and descriptive terms must be mutually exclusive in their content and meanings. True mutual exclusiveness is a difficult, if not impossible, thing to obtain in nature, but, in a system designed for a specific population and a specific body of literature, it can be accomplished by means of delimiting labels which define clearly the scope and content of each class and descriptive term. 4) The number of documents within classes must be approximately equal and of such magnitude as to permit ready perusal. 5) The system must be readily and logically expandable to

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permit the assimilation of new documents and new subjects. 6) The notation used to identify classes must be constant in its number of characters and otherwise simple to transmit and recognize. 7) The classification must be constructed by means of groupings of like subjects and any hierarchical relationships designed into the system must reflect the intellectual habits and preferences of the users rather than any philosphic laws of nature. Each of these requirements was considered and logically applied to the classification system proposed for CDIC.

The first criterion established by Herner is that the subject classes and terms used to define these classes must be directly reflective of the viewpoints and language of the users. Since the area of control-display includes psychologists, electronic engineers, aeronautical engineers, mechanical engineers, human factors engineers, instrument designers and perhaps other disciplines, it becomes apparent that a finite set of classification units which would satisfy the requirements of people of such varied backgrounds would be almost impossible to achieve. This perhaps is the primary obstacle to the immediate use of the proposed classification system for CDIC.

The second condition set forth by Herner and Meyer states that the system must reflect the actual literature to be organized as well as the purpose for which this literature is used. A major problem in satisfying this condition is that the actual literature to be organized is not necessarily related to the purposes for which this literature is to be used. Literature generated by design engineers might be of interest or importance to the psychologist or the human factors engineer. It is therefore necessary that the disciplines involved in both the generation and recall of the data bank. This requirement precludes the use of a classification system and almost suggests the coordinate indexing system.

The third criterion is that all classes and descriptive terms must be mutually exclusive in their content and meanings. True mutual exclusiveness is a difficult if not impossible thing to obtain in nature, but in a system designed for a specific population of users and a specific body of literature, it can be accomplished by means of delimiting labels which define clearly the scope and content of each class and descriptive term. In the case of CDIC the population of users is not specific nor is the body of literature. This criterion might be met for small segments of CDIC independently but could not be consolidated easily nor could expansion be readily obtained. This is due in large part to the inability to give universal definitions to terms used by the various disciplines involved in the use of CDIC.

The authors also state that the number of documents within classes must be approximately equal and of such magnitude as to permit ready perusal. This is perhaps a minor objection to the establishment of a classification system for CDIC. However, it must be remembered that the present state of the art does not dictate the expansion directions nor the magnitude

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of the directions, so that the size of the classes as established might become very unequal in the near future, so provision would necessarily have to be made to re-define classes.

The fifth required characteristic is that the system must be readily and logically expandable to permit the assimilation of new documents and new subjects. The proposed classification system was designed to incorporate the entire universe of a class at a particular level. Endeavors to expand this classification system into the area of control-display devices was unsuccessful because there simply were not enough character positions to allow the depth or specificity required to make the classification system useful. Provision was not made nor can it readily be made for the level of classification necessary to make relevant documents easily available to the user needing information.

The sixth condition is that the notation used to identify classes must be constant in its number of characters and otherwise simple to transmit and recognize. The notation proposed is simple enough, but it is totally inadequate for classifying to the depth that would be desirable for retrieving specific information. Extending the notation system would result in a loss of this simplicity and it would necessarily become increasingly difficult to transmit and recognize.

The seventh condition is that a classification must be constructed by means of grouping of like subjects. Any hierarchical relationships designed into the system must reflect the intellectual habits and preferences of the users rather than any philosophic laws of nature. Groupings in CDIC could certainly be made according to subjects. However, hierarchical relationships could not reflect the intellectual habits or perferences of the user to a very logical standpoint. The users of this library constitute several different disciplines and therefore they have a variety of intellectual habits and preferences for organization. To satisfy one group of users would mean to ignore another.

In developing a document retrieval scheme for control-display the user requirements are of prime importance because, as was stated previously, their backgrounds are made up of several different disciplines. The hierarchical classification system proposed could not meet this need. A review of the literature was made to investigate other methods of document retrieval. One such method was alphabetical subject indexing. This method utilizes a word or words in the title that adequately express the subject of the material being indexed, and then arranges these words alphabetically. But, "according to users, alphabetically arranged subject headings or titles are most convenient for those who can precisely name the subject of search, using the same terminology as the system. However, learning the system is a difficult task, and for those who do not know the general subject or what to learn, it is impossible. Subject headings are often very general because it is uneconomic to maintain a subject heading for every item". [15]

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"An alphabetical subject index separates references to related subjects and even to the same subject and brings together entirely unconnected topics. The idea of the alphabetical arrangement of subjects is quite incompatible with the conception of their classification. The number of possible arrangements of words, that might be chosen to express each of the ideas to be indexed, is so enormous, that it becomes imperative to use only a carefully chosen selection of subject headings. Alphabetical subject indexes are constructed on a carefully selected series of subject headings, combined with an elaborate system of cross-references, which amount, together, to a concealed classification. This concealed classification is before the bibliographer (indexer) in making each new entry. It is withheld from the enquirer (user), who is compelled patiently to piece it together as he laboriously digs out the hidden information". [3] "Thus for alphabetical systems (whether or not hierarchy was also employed), cross-referencing between terms (e.g., "see", "see also") became essential. The probability of finding relevant terms was, to a large extent, a function of the ingenuity of the user". [2]

The most used method indicated in the literature for classification of information is some form of coordinate indexing. Coordinate indexing offers a number of features which make this scheme particularly attractive for use with control-display information. With coordinate indexing, the terms "can be assigned rapidly and liberally so that the searcher (user) can approach the coordinate index from any point of view and will not fail to find the information because his form of expression differs from that used by the indexer". [4]

Coordinate indexing, as applied in this report, may be defined as "a method of analyzing and describing items of information so that retrieval is performed by the logical operations of the product, sum, and complement on the codes in the store". [2] "Basically an extremely simple scheme, it (coordinate indexing) was developed in an attempt to answer one of the principal difficulties in traditional subject heading catalogs and classification schedules. In particular, with these traditional tools, while it is theoretically possible to include entries for each permutation of a combination of fundamental subjects, it is economically impractical to do so. In view of this a library will make a choice among the possible permutations to accommodate the usage which appears most likely. Coordinate indexing is intended to bypass this difficulty by providing a method of coordinating concepts as a combination rather than a permutation. With respect to the choice of terms, it must be recognized that the initial aim in developing coordinate indexing is to eliminate any precoordination of concepts such as is represented by a traditional subject heading". [1]

An important tool which is used in conjunction with coordinate index systems is a thesaurus. The thesaurus serves several functions. It guides the indexer in the selection of appropriate indexing terms, it provides a degree of control on the system vocabulary, it guides the person searching the

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system in selecting active index/retrieval terms. More generally it indicates the scope of the coordinate index system. A thesaurus for a system dealing with the subject area of ferrous metals would have much different and more specific terms than a thesaurus for a system dealing with materials information.

In developing a thesaurus as a vocabulary control of terms, several items should be kept in mind. (a) "Let the documents themselves generate their own uniterms. Weed this list carefully, combining synonyms. The rate of adding terms falls off very rapidly, even in highly varied subject matter. (b) 'Bound' terms almost inevitably free themselves sooner or later and the intermediate step serves only to make extra work. Multiple words, however, should be used for exact description of concepts, whenever the idea is expressed as a unit. (c) Use see and see also references on the headings of uniterm cards. No other satisfactory solution for problems of near synonyms, for synonyms-in-some-meanings of words, and for all the other perplexities born of the fact that uniterm coordinate indexing uses the living fabric of language for its base".[12]

The information retrieval thesaurus generally has several characteristics: "(a) It lists vocabulary terms authorized for use in the system, (b) it exhibits relationships among these terms - relationships such as synonymy or hierarchy, and also relationships which may indicate synonymy or hierarchy from some points-of-view but not generally, and (c) it defines the vocabulary terms to the extent required. The functions of an information retrieval thesaurus are (a) to permit indexers of documents containing valuable technical information to index (i.e., describe) more fully, and at different levels of generality and from many technical points-of-view, the information contained in documents and (b) to permit searchers for information to phrase inquiries appropriate to the scope and degree of their immediate interests - inquiries employing all terms of the retrieval vocabulary which have appropriate meaning and specificity."[2]

False coordinations of "noise" can be kept to a minimum by: (a) "the more specific the subject field being cataloged (indexed) the tighter is the information control gained; (b) the more specific the uniterming the fewer the false hits created; (c) skillful uniterming is a logical fractioning process, not a mere slicing of a document's title into separate words -- this is true in the exact sciences; (d) whenever the man-bites-dog difficulty can be foreseen by the cataloger (indexer), the addition of a simple delta sign (Δ) after the index word will signal the user which is the correct reading."[12] "False coordinations never cause the loss of information but can only produce additional material which may or may not be of interest. In any case, the error is on the side of providing too much rather than too little. We are familar with some of the dire warnings issued about the incidence of these false coordinations; however, we refuse to be dismayed by these reports since our experience does not bear out their predictions."[8]

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Regarding coordinate indexing systems, the following characteristics are advantageous: (a) "The uniterms can be coordinated to provide varying degrees of specificity to the searcher";[8] (b) The system can be automated easily; (c) On retrieval the system can be entered by generic and specific access points; (d) Indexing in depth can be accomplished; (e) Coordinate indexing "does not require distortion of the document to fit arbitrarily selected headings";[7] (f) "The small size of the file compared to the size of the document collection as the collection grows larger; (g) Searching itself is simplified; (h) It is flexible and adjustable to particular needs and conditions."[15]

Some of the characteristics of coordinate indexing that are disadvantageous are: (a) It deals more with specific terms than those of a general subject; (b) It has a tendency to result in false coordinations or noise; (c) Searching provides document numbers only and requires the user to examine all documents whose access numbers were retrieved by the search.

Reaction from users of coordinate indexing systems has been favorable. The users enjoy using the systems as stated in Sanford's[12] and Mines'[8] discussion of uniterm coordinate indexing.

III. ESTABLISHMENT OF THE MODEL COORDINATE INDEX SYSTEM

The present investigators proposed that a coordinate indexing method of providing a means of document retrieval for CDIC be established. The same philosophy outlined in the introduction was to be followed in evaluating the proposed coordinate index system; that is, evaluation parameters were to be quantified according to classical experimental techniques for a model which would simulate conditions of use of the system. The concept of coordinate indexing was evaluated rather than specific manipulation techniques. A manual retrieval tool was used in the experimental testing of the system, but the use of a manual system certainly does not at all preclude the use of advanced computer techniques for some future system for CDIC.

It was decided that the documents in CDIC on the subject of control-display for V/STOL aircraft would serve as a basis for establishing a model coordinate index system for document retrieval. 106 CDIC documents were selected for the model system. These documents were identified by their CDIC access numbers. The documents were indexed by "free indexing", that is, keywords or index terms were selected without reference to a thesaurus or other guide. Usually the author's terminology was maintained in the indexing as much as possible. Indexing was done from the abstracts only, except in those few cases where the abstract provided so little information that reference had to be made to the document itself. The indexing was reviewed by at least two individuals besides the original indexer for completeness,

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accuracy and means of expression. After the abstracts had been indexed and the index cards reviewed, the terms on the index cards were keypunched along with the access numbers, sorted and printed in alphabetical order.

Review of this list indicated that many of the terms would be suitable as index terms. However, some terms would not be good index terms. For instance, the term NEW YORK AREA appeared in reference to air traffic control problems in New York City airports. If one were to accept this as an index term, it would be just as logical to accept CHICAGO AREA, PARIS AREA, BERLIN AREA, etc. and the proliferation of terminology could go on endlessly. The major concept involved is the air traffic control problem in a densely populated area. Consideration of this concept led to the index term METROPOLITAN AREA which could be applied to any such situation. There were instances in which there was more than one term to express the same concept, e.g., VTOL, VTOL AIRCRAFT, and VERTICAL TAKE OFF AND LANDING AIRCRAFT were all applied to the same concept. Additionally, there were minor difficulties of both singular and plural form being used, spelling inconsistencies, etc. Further, no provision had been made at this point for hierarchical relationships. If one were to select AIRCRAFT as a retrieval term, he would want all types of aircraft in the system including VTOL AIRCRAFT, MILITARY AIRCRAFT, JET AIRCRAFT, etc. In the absence of a hierarchical relationship provision, he would have to look under all the specific classes of aircraft to be sure he got all aircraft in the system.

To provide an adequate model system, it was decided that every term on the list should be reviewed with the thought of its acceptability as an index term, its relationship to other index terms, and its hierarchical relationships. If the term were not to be accepted as such, reference to the appropriate index term(s) should be made. In other words, a thesaurus was to be generated from the list of index terms obtained from free indexing of the abstracts.

The list of terms was first reviewed without reference to the abstracts of documents. Each term was reviewed as indicated above. The thesaurus symbols used are as follows:

1. AS - Also See. This indicates a near synonomous relationship between the terms and strongly suggests consideration of the other term.

VTOL AIRCRAFT

AS V/STOL AIRCRAFT

2. BT - Broader Term. This indicates a higher order class term which includes the term under consideration.

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3. NT - Narrower Term. This is the converse of BT and indicates a lower order term which is included in the term under consideration.

FLIGHT INSTRUMENTS

NT ALTIMETERS

4. RT - Related Term. This indicated an unspecified degree of relationship between the considered term and the other term(s). Its primary purpose is to alert one to the existence of the other term(s) which might be considered in addition to or instead of the term looked up.

FLIGHT REPORTS

RT FLIGHT DATA

5. Reference Terms. These "terms" indicate the index term(s) to be used to express the concept suggested by the reference term.

FLIGHT OPTIMIZATION * FLIGHT AND OPTIMIZATION *

A flow chart representing the processes undergone by each and every term is shown in Figure 1.

By this process each index term generated from free indexing of abstracts was converted into accepted index terms, or active terms. All the thesaurical relationships of these terms were provided, and reference terms were created as necessary. The treatment undergone by each term was recorded on cards so these cards could be manipulated readily.

From the cards several model system components were assembled. The first component was a sequential listing of all the active index terms which was called the vocabulary or master word list. The second element was a list which indicated the hierarchical relationships of terms. This list contained all index terms which were related hierarchically to broader index terms. For instance, the term ALTIMETERS was shown as belonging to the first order broader class FLIGHT INSTRUMENTS and to the second order broader class INSTRUMENTS. Similarly the term FLIGHT INSTRUMENTS was shown to belong to the first order broader class INSTRUMENTS. This list was called the generic list. The third part was a listing of all the information on the cards and was called the thesaurus. A fourth component was a listing of all reference terms which showed those concepts which were expressed in active vocabulary rather than being maintained as active index terms themselves, e.g., FLIGHT OPTIMIZATION * FLIGHT AND OPTIMIZATION *.

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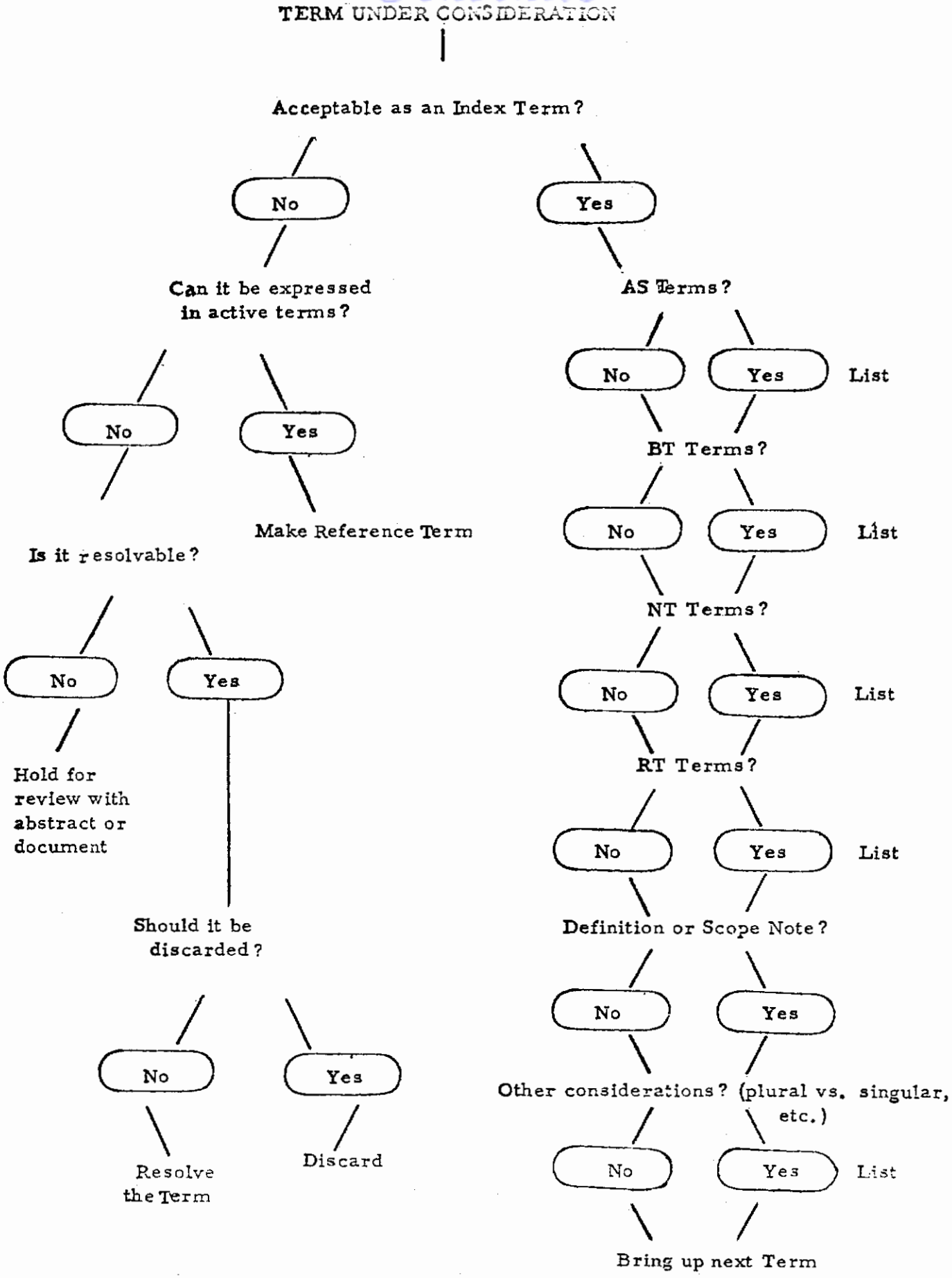

FIGURE 1. Flow Chart of Term Under Consideration

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Computer programs had already been established for manipulating the terms. The model system components were compiled by assigning appropriate term numbers to the index terms and reference terms and operating the computer programs. The term numbers were assigned such that the terms would fall in proper alphabetic sequence. These numbers have no particular significance except as a means for allowing the digital computer to perform the desired manipulations. The programs operate much more efficiently with numbers than with English terminology. The components described in the preceding paragraph were compiled on computer tape and produced as computer print-out. The master word list and the thesaurus are presented in Appendix III. It should be emphasized that all these items were derived from free indexing of a limited number of control-display documents and they do not in any way purport to represent complete coverage of the area of control-display.

The treatment of terminology is necessary but not sufficient for actual retrieval of documents. To provide retrieval of documents a tool called the posting index was prepared. The posting index is a listing of the master word list or vocabulary with the access numbers listed under the terms in ascending numerical order within columns, each column representing the terminal digits 0-9. A portion of the posting index is presented in Appendix IV. To understand the mechanism by which documents are indexed and added to the system, it should prove helpful to follow a hypothetical example. Assume that Document #25 (hypothetical) was indexed by the terms VTOL AIRCRAFT, FLIGHT INSTRUMENTS, and CONTROL CHARACTERISTICS. This indexing would be keypunched into the proper format and run through the appropriate program to add these items to the posting index.

The document number should appear under the three index terms in the posting index. The entries in the posting index would appear as shown in Figure 2. The documents should also appear under all the appropriate higher order generic or hierarchical terms. Thus Document #25 should also be listed under AIRCRAFT (a higher order term which includes VTOL AIRCRAFT as well as other types of aircraft); it should appear under INSTRUMENTS (a higher order term which includes FLIGHT INSTRUMENTS as well as other types of instruments). A computer program based on the generic list described previously assures the inclusion of this access number under the appropriate higher order generic terms as well as under the actual index term keypunched originally. Thus, if a person were to look in the posting index under AIRCRAFT, he would then find Document #25 listed in its proper location (correct numeric position in the column representing terminal digit 5). Likewise it would appear under INSTRUMENTS.

In the searching of the hypothetical posting index for documents relating to control characteristics in conjunction with flight instruments for VTOL aircraft it can be seen that Document #25 appears under each of these terms and would therefore be retrieved using the following search strategy: AND - CONTROL CHARACTERISTICS: AND-FLIGHT INSTRUMENTS; AND-VTOL

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FIGURE 2

Posting Index terms for Document #25 (hypothetical)

VTOL AIRCRAFT									
10	1	12		4	5	26	17	8	19
30	21	32		44	25		37	18	39
	41				55			28	
								48	
FLIGHT INSTRUMENTS									
20	11	12	13	14	25	36	17	18	29
		42	33		35		27	38	39
								48	
CONTROL CHARACTERISTICS									
10	31	12	23	14	15	16	17	18	9
40	41	22	43		25	36		28	39
					35				49

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AIRCRAFT. The AND refers to the boolean logic element from AND, OR, NOT logic possibilities. Each AND represents a coordination. The search strategy requires that all documents which contain all three terms be retrieved. Furthermore, other documents appear under each of these terms, in particular, 12, 17, 18 and 39, and it would be expected that these documents also should contain information on control characteristics and flight instruments of VTOL aircraft. It is from this search technique that coordinate indexing derives its name. The terms (now serving as retrieval terms) are coordinated, and the retrieved documents should relate to the coordinated terms.

It was indicated previously that the thesaurus, posting index, master word list, and generic list had all been generated from the list of free index terms without reference to the abstracts or documents. There were some terms which could not be resolved as was indicated in Fig. 1. A final review of the original index cards with reference to the abstracts and the now available thesaurus was made. Supplementary indexing was performed and heretofore unresolved terms were resolved. Modifications were made in the system as required. New active terms were added, many additional reference term items were included, and new AS, BT, NT, RT entries were made in the thesaurus and generic list as appropriate. These modifications and the final supplemental indexing were keypunched, and the computer tapes were updated and final versions of all the model retrieval system elements were printed.

IV. EXPERIMENTAL TESTING OF THE MODEL COORDINATE INDEX SYSTEM

Introduction

Most of the evaluations of coordinate indexing systems have been theoretical in nature. However, the need for empirical studies on user variables has been stressed in the literature. Several empirical evaluations have been undertaken, e.g., Sinnett (1963),[13] Van Oot, et al. (1966),[14] Montague (1964).[9] Montague compared a classification system with two coordinate indexing systems which applied to a common store of documents. Montague discovered that the two coordinate indexing systems were superior to the classification system in both relevance and recall.

In the present experiment, as in the other experiments assessing the effectiveness of indexing systems, the concept of relevance is very important. In terms of the retrieval task, the documents in the store may be arranged in a paradigm regarding the relevance or non-relevance of a document and whether or not it is retrieved.

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The following paradigm may be employed:

	Retrieved	Not-retrieved
Relevant	A	B
Not Relevant	C	D

Entries in each cell are the number of documents

From this paradigm a number of measures of the effectiveness of a retrieval system may be derived. For example, the number of relevant documents retrieved (A) may be compared to the number of relevant documents not retrieved (B) or to the total number of relevant documents (A+B). An indication of what may be called "noise" in the system may be derived from the number of non-relevant documents retrieved (C).

However, it appears that the relevance of a document is not a completely static, reliable phenomenon. When users of the system are considered, relevance has a subjective component. Judgments of relevance by a particular user will vary from day to day. Several users may disagree on the relevance of a particular document. There are indications that one of the parameters determining relevance is the stage of a scientific research project (Rees and Schultz 1966a,[10] Rees and Schultz 1966b).[11] Concerning the concept of relevance Rees states: "Relevance is therefore an unstable and dynamic phenomenon which reflects subjective responses on the part of individuals."

The experiment was undertaken to evaluate the effectiveness of the coordinate indexing system developed under the contract. Special emphasis was placed on the role of user variables in determining the usability of the system.

A model store consisting of 106 documents was available. Control-display information for VTOL and V/STOL aircraft was the major area of documentation under study. This small model store made it possible to judge the relevance of every document in the store to a particular task and to use the measure of relevance in the evaluation of the system.

Method

Several measures were used in this experiment to obtain quantitative indices of user performance and acceptance of the system. These measures were:

a. Request Time

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The request time is the amount of time the user consumed between the presentation of the task and the point at which access numbers were retrieved which resulted in a request for those documents.

b. Recall

Recall is the ratio of number of relevant documents retrieved to the total number of relevant documents available in the store.

$$\text{Recall} = \frac{A}{A + B} \times 100$$

With reference to the paradigm.
A = No. of relevant documents retrieved
B = No. of relevant documents not retrieved

c. General Relevance

General relevance is the ratio of the number of relevant documents retrieved to the total number of documents retrieved. (The measure permits the determination of the "noise" elicited by the coordinate indexing system.)

$$\text{General Relevance} = \frac{A}{A + C} \times 100$$

With reference to the paradigm.
A = No. of relevant documents retrieved
C = No. of non-relevant documents retrieved

d. Comparative Relevance

Comparative relevance is the ratio of the number of "relevant documents retrieved, where "relevant" refers to the user's a posteriori estimate of the documents, to the number of relevant documents as judged by a panel experts.

$$\text{Comparative Relevance} = \frac{\text{No. of retrieved docs. judged relevant by user}}{\text{No. of retrieved docs. judged relevant by panel}} \times 100$$

e. Subjective Relevance

Subjective Relevance is the ratio of the number of retrieved documents judged relevant by the user to the total number of documents retrieved.

$$\text{Subject Relevance} = \frac{\text{No. of documents judged relevant by user}}{\text{No. of documents retrieved}}$$

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The subjective component of relevance was evaluated in this experiment by requiring each user to judge the relevance and non-relevance of each retrieved document to a particular task. Then comparisons were made with judgments of relevance by a panel of experts.

f. Number of Concepts

The number of concepts coordinated or searched for each task was recorded. This quantity only indicates the range of concepts sampled for each task but does not reflect the individual logical search stragegy employed by the user.

g. Learning

Improvement in all the parameters under study as a function of exposure to the sequence of tasks was a measure of learning.

Another user variable studied was the professional type. Two professional types were included: psychologists and engineers. (The names, occupation, and place of employment of each subject are listed in Appendix V.) All but one of the subjects were familiar with control-display data and were representative of individuals who would actually use the coordinate indexing system.

The user variable of instructional level provided was also investigated. (The instructions are presented in Appendix VI). Three levels of instructions were employed. The levels were representative of increasing degree of detail as to the manner in which the greatest number of relevant documents could be obtained. This user variable was particularly pertinent in this experiment because the users were totally unfamiliar with the indexing system. Accordingly, it was necessary to evaluate the influence of different types of instruction. Most studies have utilized experienced technicians to retrieve the documents. By experienced technicians one refers to individuals who are thoroughly familiar with an indexing system and who are familiar with developing the search strategies. In our case, each user developed his own search strategy without prior experience and retrieved the documents. The search strategy was subject to assessment by the experimenter.

Also, this experiment was conducted in the actual working environment under the usual working conditions.

Procedure

Pretesting of Model

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With the establishment and application of the model coordinate index system, the experimental testing of the model system required consideration. It was desired to quantify the experimental aspect of the system as much as possible. Prior to quantification, it was necessary to identify and define those independent and dependent variables which would be used as measures of system effectiveness. A concomitant consideration was to simulate conditions of use of the model system to the actual working conditions.

It was determined that the best way to identify variables and simultaneously to simulate realistic use conditions would be to run a pilot study in which several subjects naive to the model retrieval system would be taught to use the system with verbal instructions and then would use the system to retrieve documents to provide information for a retrieval task. In these preliminary studies, the subjects were permitted to interact verbally with the instructor to clarify points which were unclear. The instructor was the same individual who had been responsible for setting up the model coordinate index system. During the study, observers were on hand to give due consideration to the variables which might be identified and measured. The subjects used in the pre-testing phase consisted of two psychologists and an engineer, all of whom were well-versed in the area of control-display. One engineer and one psychologist served as joint subjects in one session. The pretesting sessions were tape recorded.

The subjects were first given a briefing on the two major tools required for actual retrieval, namely, the thesaurus and the posting index. After a description of these elements, the actual use of the thesaurus to formulate search strategy and the manipulation of the posting indexes to effect CDIC document access number retrieval were explained. Spontaneous questions from the subjects were answered. When the subject felt reasonably confident in understanding the system, he was presented a retrieval task which necessitated the use of the thesaurus and posting index to retrieve CDIC document access numbers. Questions which arose during the retrieval operations were answered. Some of the questions posed indicated that there were points from the preliminary explanation which were not really clearly understood. Each subject formulated a search strategy with assistance from the instructor as required, and the search strategy was carried out using the posting indexes to retrieve the CDIC document access numbers.

Once the CDIC document access numbers had been retrieved, the actual CDIC documents themselves were obtained and provided to the subject for his perusal. He was asked to determine relevance of each document as it related to the retrieval task at hand assuming that he was to use the retrieval documents as a basis for writing a research report on the subject indicated by the retrieval task. The subject was asked to comment on how the document might be used for the task. Did the document contain information and/or data itself? Would the subject use the bibliography as a guide for further searching? Was the abstract alone useful?

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After the documents had been retrieved and reviewed, the subjects' attitudes and reactions towards the model coordinate index system were explored qualitatively by round table discussion between the subject, instructor and observers. The subjects' suggestions about the model system itself and about the experimental technique to be used in evaluating the system were actively solicited. A number of excellent ideas evolved from these discussions.

The pre-testing of the model coordinate index system was of inestimable value in providing information for the subsequent establishment of the actual experimental testing program which is described in the following section. Analysis of the tape recordings of the sessions proved to be extremely helpful in assessing their value and in providing a solid basis for structuring the experimental program.

Experimental Testing of the Model System

Each user was provided with a Thesaurus two identical copies of the posting index (see Appendix III) and paper for recording search strategy and CDIC document accession numbers.

The experimental directions were read to the user by E and then handed to him for further study, if necessary. The experimental directions are presented in Appendix VII.

Next, the user was provided with the appropriate set of instructions concerning the details of the operation of the coordinate indexing retrieval system and a task to perform. Request time was recorded, i.e., the time intervening between the presentation of instructions and task until the user requested specific documents. No additional clues or suggestions were provided the user on the operation of the system other than those provided in the instructions.

During the experiment, the user coordinated terms manually using the two posting indexes. Later on, the indexing retrieval system could be placed on a computer. Therefore, it can be estimated that the request time must be influenced by the fact that the user had to establish visually the references in the system.

The secretary at the CDIC document room retrieved requested documents from the files. Then the user judged the relevance of each document to the task in terms of using them to prepare a technical report. The evaluation of documents by the user was realistic inasmuch as the individual's evaluating procedure represented exactly what a user would do in judging the relevance of a document in the actual situation.

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Each user was exposed to three tasks (in the form of written questions) sequentially. The questions were established after an examination of all the documents to insure that there would be some relevant documents in the store. The tasks were judged as typical of those commonly encountered at CDIC. (The tasks are presented in Appendix VIII). E attempted to determine changes in user performance as a function of exposure to the sequential tasks.

No time limits were imposed for the completion of each task. Only one user required more than one afternoon to complete the experiment.

Two professional types were studied: psychologists and engineers. Only one user, an electrical engineer, was unfamiliar with the subject matter. All the other subjects were knowledgeable in the area of control-display.

At the conclusion of the experiment, protocols were recorded. Each user was questioned concerning the acceptibility of the coordinate indexing system and any suggestions for improving the system. Each experimental session was tape recorded in its entirety.

Absolute judgments of the relevance of documents to the tasks were made by a panel consisting of 2 professional psychologists. Each judge had had considerable experience in the control-display area. (The judges are listed in Appendix IX). All 106 documents in the store were evaluated with respect to each task. The tasks were considered independently, i. e., all documents were evaluated with respect to one task and then evaluated with respect to the next task. During the first phase, each judge worked independently. Then the judges met to reconcile any differences in their judgments of relevance.

Experimental Design

The schematic form of the design is presented in Figure 3. Statistical analyses suggested by Winer (1962)[16] were employed.

A 3-way analysis of variance was used:

a. Three levels of instruction-differing in detail.
b. Two professional levels-psychologists and engineers.
c. Three sessions-sequentially implemented.

The number of subjects used was 12: 6 psychologists and 6 engineers.

Three tasks in the form written questions were used. The questions as such were presented in a counterbalanced order. With 3 questions there were six possible orders in which they could be presented to the subject. Since there were 12 subjects, each order could be presented twice. Orders were randomly assigned to subjects.

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Instruction	Professional Involvement	Sessions 1	2	3
Level 3 Z	P_1	A	C	B
	P_2	B	A	C
	E_1	B	C	A
	E_2	C	B	A
Level 2 Y	P_3	C	A	B
	P_4	A	B	C
	E_3	A	B	C
	E_4	B	A	C
Level 1 X	P_5	B	C	A
	P_6	A	C	B
	E_5	C	A	B
	E_6	C	B	A

Questions: A B C

P = psychologist
E = engineer

FIGURE 3. The Design of the Experiment

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In addition, a one-way analysis of variance was computed for the individual tasks. These results are considered only suggestive as to performance on the individual tasks.

Results

The raw data and computed data are presented in Appendix X.

Request Time

The analysis of variance for request time is presented in Table 2. Interaction between levels of instructions and professional levels was significant, $F(2, 6)=7.71$, $P < .05$. Also, the main effects for S were very significant, $F(2, 12)=45.21$, $P < .01$. The third order interaction IPS was significant, $F(4, 12)=4.57$, $P < .05$.

The Studentized Range Statistic was computed between the means for S. The mean for Session 1 was significantly different from the means for Sessions 2 and 3, $P < .01$.

The S means are plotted in Fig. 4. A test for trend indicated a significant quadratic trend, $P < .01$. Request time decreases rapidly as a function of sessions. In the figure, a quadratic curve has been fitted to the data. The equation for the curve is listed on the figure.

The IP interaction profile is presented in Fig. 5. The mean request time for psychologists and engineers is plotted as a function of levels of instruction. Instruction X is the least detailed and Instruction Z the most detailed instructions. The Studentized Range Statistic indicated that the mean for the engineers on Instruction Z was significantly different, $P < .05$ from all the other means. No other significant differences were found.

Analysis of variance of request times for questions is presented in Table 3. No significant difference between the request times for questions was obtained.

Number of Concepts Searched

An analysis of variance of the number of concepts searched is presented in Table 4. The main effect for professional level is significant, $F(1, 6)=26.26$, $P < .01$. Psychologists employ more concepts than engineers. The IP interaction was also significant, $F(2, 6)=16.19$, $P < .01$.

The analysis of variance for number of concepts searched on the questions is presented in Table 5. No significant differences between the number of concepts searched on the 3 questions was obtained.

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Table 2
Analysis of Variance of Request Times

Source of Variation	S	df	MS	F
Between subjects	15123524.22	11		–
I (level of Inst.)	2345950.05	2	1172975.02	1.97
P (Professional)	11236.00	1	11236.00	----
IP	9191995.17	2	4595997.58	7.71*
Subj. w groups (error between)	3574343.00	6	595723.83	
Within Subjects	49709308.00	24	---------	----
S (sessions)	33801724.39	2	16900362.20	45.21**
IS	4290274.78	4	1072568.70	2.87
PS	306188.16	2	153094.08	----
IPS	6825674.67	4	1706418.67	4.57*
Sx subj. w. groups (error within)	4485446.00	12	373787.17	

*P < .05
*P < .01

Table 3: Analysis of Variance of Request Times for Questions

Source of Variation	SS	df	MS	F
Between People	15123524.22	11		
Within People	49709308.00	24		
Questions	1097444.22	2	548722.11	---
Residual	48611863.78	22	2209630.17	
Total	64832332.22	35		

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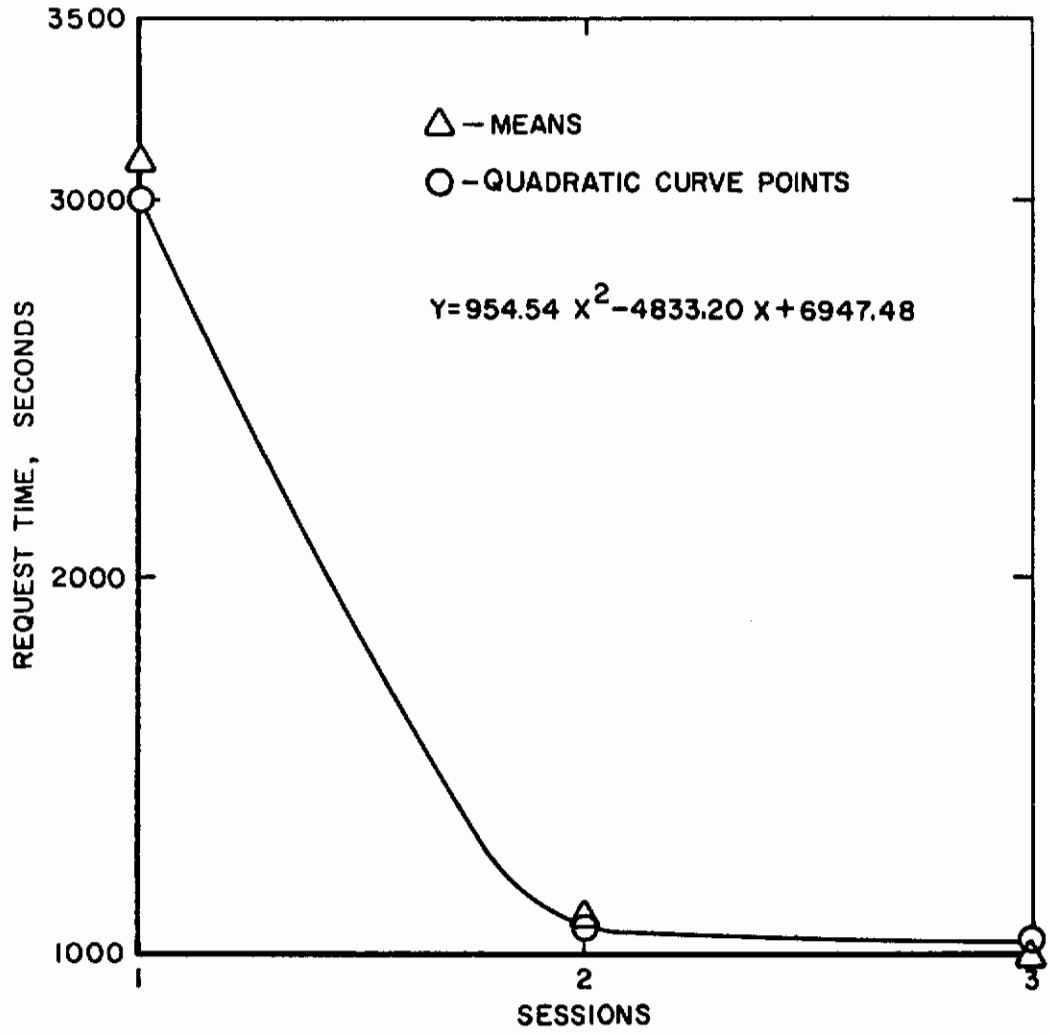

Figure 4. Mean Request Time as a Function of Sessions.

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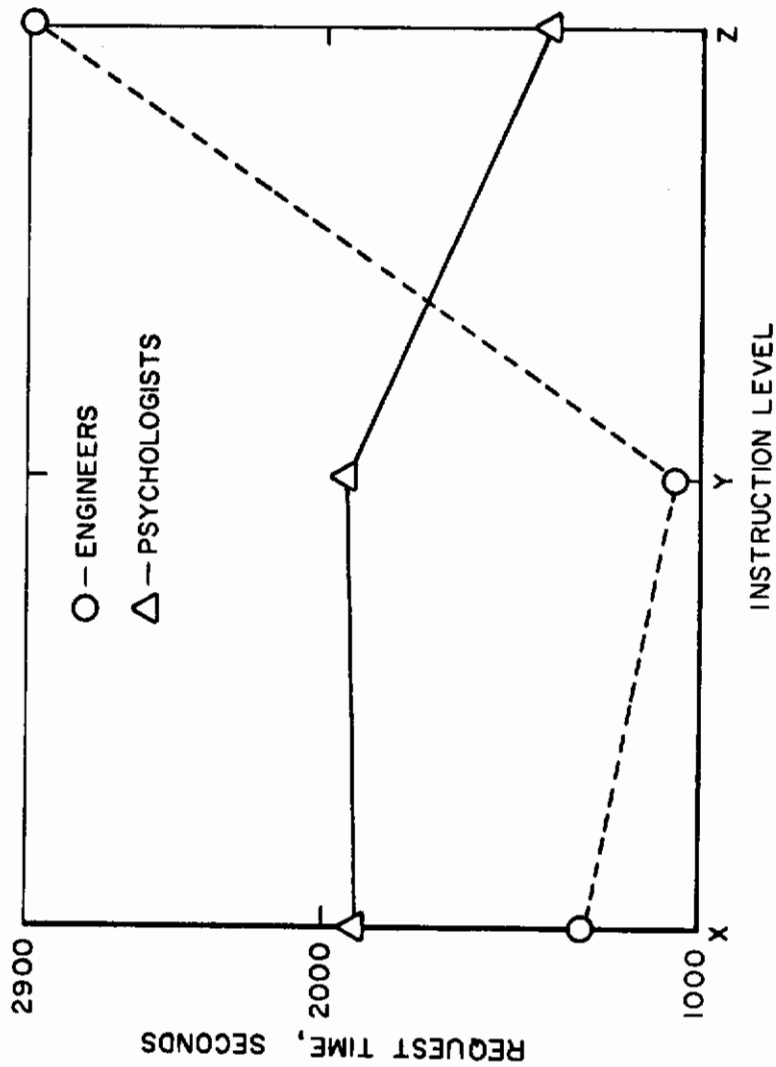

Figure 5. Mean Request Time For Psychologists And Engineers as a Function of Levels of Instruction.

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Table 4: Analysis of Variance of the Number of Concepts Searched

Source	SS	df	MS	F
Between subjects	161.23	11		
I (Instructions)	26 06	2	13.03	4.69
P (professional category)	28 45	1	28.45	26.26**
IP	90.05	2	45.02	16.19**
Subj. w groups (error between)	16 67	6	2.78	
Within Subjects	223.33	24		
S (sessions)	26.73	2	13.36	1.26
IS	15.27	4	3.82	----
PS	26.71	2	13.35	1.26
IPS	27.29	4	6.82	----
Sx subj. w. groups (error within	127 33	12	10 61	

**P< .01

Table 5: Analysis of Variance of Numbers of Concepts Searched for Questions

Source	SS	df	MS	F
Between People	161.23	11		
Within People	223.33	24		
Questions	16.89	2	8.44	----
Residual	206.44	22	9.38	
Total	384.56	35		

Table 6: Analysis of Variance of Arcsin Recall Scores

Source	SS	df	MS	F
Between subjects	1.7846	11		
I (Instructions)	4216	2	.2108	1.52
P (Professional category)	2175	1	.2175	1.56
IP	3113	2	.1556	1.12
Subj w groups (error between)	8342	6	.1390	
Within subjects	2.4633	24		
S(sessions)	4471	2	2236	1.74
IS	3732	4	0933	.72
PS	0227	2	0114	---
IPS	0765	4	0191	---
Sx subj w groups. (error between)	1 5443	12	1287	

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Recall

The analysis of variance for recall scores is presented in Table 6. The recall scores have been transformed to arcsin scores to stabilize the variances. No statistically significant effects were obtained. The grand mean recall was 14.61.

In Table 7, the analysis of variance of arcsin recall scores for questions is presented. No statistically significant effect was obtained.

General Relevance

The analysis of variance for general relevance scores is presented in Table 8. The general relevance scores were transformed to arcsin scores to stabilize the variances. No statistically significant effects were obtained. The grand mean for general relevance was 52.93.

The analysis of variance of arcsin general relevance scores for questions is presented in Table 9. No statistically significant difference between the questions was obtained.

Comparative Relevance

In Table 10, the analysis of variance of comparative relevance scores is presented. No significant F-ratios were obtained. The grand mean for the comparative relevance scores was 120.24.

Table 11 contains the analysis of variance of comparative relevance scores for questions. No statistically significant effect was obtained. One of the difficulties inherent in the comparative relevance concept is that the comparison is based on the number of documents in the retrieved sample judged relevant by the user and the panel. There is no indication in this score as to whether the users and panel agree in judgments upon the same documents. To measure this agreement correlations were made between the judgments. The results are presented in Table 19. In every case there was a significant ϕ correlation. Psychologists showed greater agreement with the panel than did the engineers. The combined agreement of users and panel on all questions was .38.

Subjective Relevance

The analysis of variance for subjective relevance scores are presented in Table 12. Levels of instruction were significant, $F(2,6)=5.73$, $P < .05$.

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Table 7: Analysis of Variance of Arcsin Recall Scores for Questions

Source	SS	df	MS	F
Between People	1.7846	11		
Within People	2.4638	24		
Questions	.1312	2	.0656	----
Residual	2.3326	22	.1062	
Total	4.2484	35		

Table 8: Analysis of Variance of Arcsin General Relevance Scores

Source	SS	df	MS	F
Between Subjects	8.5568	11		
I (Instructions)	2.0643	2	1.0322	1.06
P (Professional category)	.0349	1	.0349	----
IP	.6124	2	.3062	----
Subj. w. groups (error between)	5.8452	6	.9742	
Within subjects	26.8856	24		
S (sessions)	2.9513	2	1.4756	1.28
IS	1.1466	4	.2866	----
PS	.8454	2	..4227	----
IPS	8.1461	4	2.0365	1.77
Sx subj. w groups (error within)	13.7963	12	1.1497	

Table 9: Analysis of Variance of Arcsin General Relevance Scores for Questions

Source	SS	df	MS	F
Between People	8.5568	11		
Within People	26.8856	24		
Questions	9340	2	.4670	----
Residual	25.9516	22	1.1796	
Total	35.4424	35		

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Table10: Analysis of Variance of Comparative Relevance Scores

Source	SS	df	MS	F
Between subjects	20.0952	11		
I (Instructions)	9.0339	2	4.5170	4.38
P (Professional category)	.0001	1	.0001	----
IP	4.8780	2	2.4390	2.37
Subj. w groups	6.1832	6	1.0305	
Within subjects	25.6391	24		
S (sessions)	.4324	2	.2162	----
IS	3.0186	4	.7546	----
IP	.0292	2	.0146	----
IPS	4.1053	4	1.0263	----
Sx subj. w groups (error Between)	18.0536	12	1.5045	

Table 11: Analysis of Variance of Comparatives Relevance Scores for Questions

Source	SS	df	MS	F
Between People	20.0952	11		
Within People	25.6391	24		
Questions	3.3198	2	1.6599	1.64
Residual	22.3193	22	1.0145	
Total	45.7343	35		

Table 12: Analysis of Variance of Arcsin Subjective Relevance

Source of Variation	SS	df	MS	F
Between subjects	15.3493	11		
I (level of Inst.)	4.9829	2	2.4914	5.73*
P (Professionals)	2.8445	1	2.8445	6.54*
IP	4.9114	2	2.4557	5.64*
Subj. w groups (error between)	2.6105	6	.4351	
Within subjects	14.7644	24		
S (sessions)	.9796	2	.4898	1.10
IS	1.2066	4	.3016	----
PS	.2243	2	.1124	----
IPS	7.0036	4	1.7509	3.93*
Sx subj. w. groups (error within)	5.3111	12	.4459	

*P<.05

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The Studentized Range Statistic indicated that the mean subjective relevance score for Instruction X was significantly different from the others, $P < .05$.

Professional levels was also statistically significant. $F(1, 6)=6.54$, $P < .05$. Psychologists display higher subjective relevance than engineers.

The IP interaction was significant, $F(2, 6)=5.64$, $P < .05$. The largest subjective relevance was obtained by psychologists using Instruction X.

The IPS interaction was also significant, $F(4, 12)=3.93$, $P < .05$.

The analysis of variance for the questions is presented in Table 13. No significant results were obtained.

Correlations

Table 14 presents the correlations between some of the measures taken. None of the Pearson Product-Moment r's were significant at the 5% level.

Range of Concepts Searched

Considering the 3 questions used, engineers and psychologists differed in the range of concepts searched on each question. Also, the range of concepts searched for each question varied.

Table 15 contains the range of concepts searched by psychologists and engineers for each question. Psychologists searched a greater range of concepts on Questions A and C.

Table 16 contains the range of concepts searched for each question. 35 concepts were searched for Question C while only 16 concepts were searched for Question A.

In Appendix XI Tables 23, 24, 25 contain the concepts searched under each question and the frequency of usage. The starred items indicate the concepts actually named in the question.

Tables 26, 27, and 28 contain the concepts searched by the psychologists and the frequency of usage for each question.

Tables 29, 30, and 31 present the concepts searched by the engineers and the frequency of usage for each question.

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Table 13: Analysis of Variance of Arcsin Subjective Relevance for Questions

Source	SS	df	MS	F
Between People	15.3493	11		
Within People	14.7644	24		
Questions	.5334	2	.2667	----
Residual	14.2310	22	.6468	
Total	30.1137	35		

Table 14: Correlations Between Several Measured Variables

Variables	r	Significance
Recall vs. General Relevance	.02	not significant
No. of Concepts Searched vs. General Relevance	-.04	not significant
No. of Concepts Searched vs. Recall	.19	not significant

Table 15: Range of Concepts Searched for Each Question by Psychologist and Engineers

Question	Psychologist Range	Engineers Range
A	14	12
B	15	15
C	27	16

Table 16: Range of Concepts Searched for Each Question

Question	Range
A	16
B	21
C	35

Table 17: Number of Documents Judged Relevant by the Judges and Amount of Agreement and Disagreements

Question	Documents in Common	Documents not in Common	
		Judge 1	Judge 2
A	3	10	30
B	32	38	3
C	10	7	21

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Panel Judgments

Two psychologists who were experts in the area of control-display rated the relevance of each document for each question.

During the first phase, each judge rated the documents independently of the other. Table 17 contains the results of the judgments and compares the performances of the judges. The numbers in the table refer to number of documents judged relevant by each judge and the amount of agreement and disagreement.

Chi square was computed for each question to determine whether there was a significant agreement between judges on the documents. Also this coefficient was computed to measure the degree of agreement. Table 18 contains the results. For Question B and C there was a significant agreement between the judges and the degree of agreement for Question B was ϕ =. 35, and for Question C, ϕ = .26. For Question A, there was no statistically significant agreement between the judges.

During the second phase, the judges conferred and reconciled their disagreements on the relevancy of the documents. They concluded that 25 documents were relevant to Question A, 48 documents were relevant to Question B, and 18 documents were relevant to Question C.

Efficiency of the System as Compared with Chance

Table 20 presents a comparison of the efficiency of the coordinate indexing system with change expectancy. The performances on the 3 tasks have been combined. The average number of relevant documents in the store was 30.2 while the total number of documents in the store was 106.

The values in Table 20, may be referred to the following paradigm:

	retrieved	not retrieved
Relevant	Hit	Miss
Not-relevant	Trash	Pass

A Hit means that a relevant document is retrieved by the indexing system. A Miss means that a relevant document has not been retrieved. Trash refers to non-relevant documents which are retrieved and a Pass means that a non-relevant document has not been retrieved.

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Table 18: Test of the Agreement Between the Judges and the Degree of Agreement

Question	Chi Square	Ø
A	.12	-.03
B	13.38***	.35
C	6.94**	.26

**P < .001
***P < .01

Table 19: Agreement in Relevance Judgments Between the Users and the Panel

Correlated variables	Chi Square	Ø
Engineers and Panel	27.34***	.31
Psychologists and Panel	34.74***	.54
Question A - users and Panel	5.61*	.22
Question B - users and Panel	14.56***	.35
Question C - Users and Panel	20.74***	.34
Combined Questions - users and Panel	61.20***	.38

* P < .05
***P < .001

Table 20: Comparison of the Efficiency of the Coordinate Indexing System with Chance Expectancy

	Chance	Observed
Probability of Recall	.100	.146
Probability of a Hit	.285	.529
Probability of a Miss	.900	.854
Probability of Trash	.715	.471
Probability of Pass	.715	.742

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In Table 20, adjustments have been made for the size of the retrieved samples. These adjustments were necessary because recall is partly a function of the size of the retrieved sample. As a result, a ceiling is placed on the maximum possible value for the recall scores. With a mean of 10.6 documents retrieved, the highest possible value for the recall score if all retrieved documents were relevant was 35.1%. The observed recall score was 14.6% which is 41.6% of the maximum possible value. The recall score could be increased simply by increasing the sample size because more relevant documents could be included simply by chance. Of course, this procedure would probably decrease the general relevance score. Consequently, both values must be considered in the evaluation of a retrieval system.

The chance probabilities were computed by considering selections of samples of 10.6 documents from the store of random sampling. In other words, the probabilities are the values to be expected if the user would simply randomly select a sample for the store without suing the indexing system.

By chance, the probability of recall is .10 while the observed was .146. The probability of a hit using the system is .529 while by chance the value is only .285. In addition the probability of a miss is somewhat smaller.

The probability of obtaining trash using the system is considerably reduced. The observed value is .244 less than the chance value. Also the probability of a pass is somewhat greater.

Discussion

The purpose of the present experiment was to determine whether or not the coordinate index system provides scientists and engineers who use control display data with the ability to search the area of interest effectively, to select relevant documents, and to do so quickly. Basically, two dimensions of the problem of deriving a suitable coordinate index system were the major concern of the present investigation. Namely, is the system acceptable to the user, and secondly, at what level of effectiveness does the system provide for the retrieval of relevant information? The present experiment provides data on (1) the amount of time the user requires to understand the system and ask for the document, (2) the power of the index system to elicit ideas about a technical task which could result in the retrieval of relevant documents, (3) the relevance of the documents retrieved to the task, and (4) whether the index system permitted improvement in performance of the user to select the documents relevant to his task.

Neither the psychologists nor the engineers who were to select documents relevant to the tasks presented them showed any significant differences in their ability to understand the index system nor in the time required to

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understand the instructions and to retrieve the documents from the system. To this extent, it can be argued that the index system as now constituted is equally favorable to both engineers and psychologists. In addition, the protocols obtained from the subjects following the experimental sessions, with the exception of one of the subjects tested, both professional groups indicated their approval of the index system. There is some reason to suppose, therefore, that the coordinate index system could and would be used by individuals with different backgrounds in their day-to-day encounter with control display problems.

The measures of Subjective Relevance and Comparative Relevance are unique to this experiment. These measures provide a critical examination of the concept of relevance which is central in the evaluation of an index system.

Subjective relevance is related to user satisfaction with and acceptance of the system. General relevance involves a comparison with some absolute judgment of relevance which may or may not agree with the user's own estimate of relevance. Presumably, the higher the user's estimate of the relevance of the retrieved documents, the greater his satisfaction and tendency to use the system.

Subjective relevance is probably related to many more factors than general relevance which is based on absolute judgments by the panel.

The experiment provided the subject (user) with three levels of details (instructions) as to how he could proceed to use the system. The relation of instructions to subjective relevance is important because the degree of judgment as to the relevance of the retrieved document can be considered as an indirect measure of the acceptability of the system. The more documents the user judged relevant, the more "useful", "acceptable" the system. The data did indicate that generally the user estimated the documents that they selected as being relevant more than those selected by the panel of judges. There were differences, however. The least detailed level of instructions tended to produce the highest subjective relevance for the psychologists.

The subjective relevance measure also provides some insights on the effectiveness of the ordinary procedures by which the user usually judges the relevance of retrieved documents. The panel probably devoted more time and effort to determine relevance than the users. Judgments by the user were more cursory. Also, the panel had a much larger field in which to make judgments. The user was influenced only by the documents in the context of a small sample while the panel reacted in the context of the entire store. In this experiment, the users judged 20% more documents as relevant in the sample than the panel. One can make the assumption that the user's attitude was favorable as to the capability of the system to provide them with relevant information for their needs.

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Information was obtained on the reliability of relevance judgments. Even the expert judges on the panel disagreed considerably on the relevancy of documents in their first consideration of them.

The concept of comparative relevance provides a means of comparing the users' judgments of relevance with the composite judgments of the panel of experts. Comparative relevance does have the drawback that only the number of documents judged relevant are considered and not whether the same documents are judged relevant by both the panel and the users. This difficulty was overcome by correlating the two sets of judgments.

When the results indicated by these measures are considered, it is indicated that the use of the concept of relevance in evaluating the acceptability and effectiveness of an index system is not an easy task. Evaluation experiments must be very precise and accurate in the determination of relevance. Also considerable experimentation should be devoted to a measurement of the factors which influence relevance.

The efficiency of the index system was studied in respect to (1) the facility with which the user understands and manipulates the system, (2) the ability of the system to provide the user with concepts related to the task he is to perform, (3) the number of relevant documents the index system provides the user.

The degree of understanding the structure of an index system is important because of its relation to user browsing which permits flexibility in manipulating the system by the user, and also, the extent of familiarity with the system is conducive to acceptance and its use by the scientist and engineer. For the present experiment the data do not show that instructions have had very much effect on performance, but there were differences which are interesting, although their significance need to be determined by further experiments. The least detailed instructions produced the highest subjective relevance score. It is difficult to interpret these findings. The more detailed instructions may have produced a more critical attitude in the users which manifested itself when the relevance of the documents was judged. On the other hand, the more elaborate search stratagem described in the more details instructions may have the user feel less confident in his ability to retrieve relevant documents by using the index system. The effects of instructions again represent a complex matter. No overall statement can be made concerning the superiority of one level of instruction over the others. The interaction of instructions with other variables must be considered. For example, in terms of request time (the amount of time user scans index system, identifies and asks for documents), the most detailed instructions are decidedly inferior for the engineers as compared with other levels of instruction. Also, the medium detailed instructions are related to the number of concepts that are elicited by the user. If a choice must be made between sets

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of instructions, the least detailed set would probably be the most satisfactory. However, if the professional type is considered, the medium level or least detailed level might be employed with psychologists and the least detailed for engineers. These results point out the fallacies of some apriori assumptions that are sometimes made about instructions. At first glance, it might appear that the more detailed the instructions, the more effective. But the present results do not support the assumption. In fact, the more detailed instructions are the least efficient. As such, careful consideration should be given to the construction of instructions for an indexing system. The instructions will not only affect user performance but will influence the acceptability of the system.

The efficiency of the index system to provide meaningful information required to satisfy the task was measured primarily through the recall and general relevance score. The experiments conducted by Montague claim from 67% to 85% recall and 51% to 80% relevance of documents retrieved. Our percentages of 14.6% recall and 52.9% for relevance are not entirely comparable to the Montague studies. However, the studies differed in the methods for determining relevance for documents. Montague claims that the documents were judged by a staff of four literature analysts, although it is not clear as to what constituted the exact procedure used by the analysts to determine relevance. In the present experiment two expert judges independently evaluated the relevance of the entire store of documents to the task. Then the judges assembled and reconciled discrepancies in their judgments. It must be noted there is considerable unrealiability in judgments of relevance by two experts in the field. On our task A, there was no agreement among the judges. The agreements on Task B and C was a ϕ coefficient of .35 and .26 respectively. Also, the users showed some disagreement with the panel on relevance judgments.

In addition to the differences in determining relevance by panel consensus, a more fundamental difference between the Montague and the present study is in methodology. The Montague study required that the number of relevant documents in store be determined, the store being the total number of documents (patents). Montague assumed that two indexing systems should retrieve 95% or more of the total number of relevant documents in the store. The basis for this assumption is not clear from the technical report. In our study, the two judges examined the entire store item by item to determine relevance. From our results, there is no basis for asserting the validity of Montague's assumption. Using our system, only 14.6% of the total relevant documents were obtained. If one made a similar assumption that all the documents retrieved included 95% of all available relevant documents, then our present data would be a gross under-estimation of relevance. These findings are such that they provide an argument against the method of sampling a store to ascertain the number of relevant documents when the indexing system itself is used to determine relevance.

Another difference between Montague's study and the present investigation should be noted. In Montague's study, an experienced technician thoroughly

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familiar with the contents of the system and with the indexing, prepared search strategies to retrieve relevant documents. In our study the subjects formulated their own search strategies on the basis of the instructions provided. None of the subjects had any previous experience with the retrieval system under test. It was desired to have the subjects directly access the store of information themselves without the requirement of an experienced literature analyst as an intermediary. However, inexperienced subjects cannot be expected to formulate optimum search strategies. The less perfect the search strategy, the less probable is recall. This fact in part tends to reconcile some of the differences between Montague's study and our own.

Further, the instructions tended to emphasize the coordination procedure. The more coordination which is applied, the more restrictive the retrieved documents become, both in number and in scope. An experienced search strategist knows that a good search should allow for degrees of specificity and generality and alternate terminology to accommodate imperfections in indexing and nuances in word meanings. A subject who has suddenly been thrust into an information retrieval environment without any prior experience certainly would not recognize these factors. Nonetheless, it is desirable for the coordinate index system to be so designed that it is not hypersensitive to the search strategy applied. In other words, the information system should be directly accessible and highly effective no matter who uses the system.

Two further considerations provide support for the conviction that the relevant score obtained in our present study was deflated. First, the indexing in the present study was done from the abstracts, while the judgments of the experts were obtained from whole documents. Indexing is by its nature a tedious and expensive task. If one could index documents effectively from the abstract alone, considerable savings could be realized. One of the questions explored in this study was whether indexing from abstracts would be sufficient for the area of control display. If the entire document were indexed, more information would be available to the indexer and the more index terms would likely be selected for indexing, i.e., the "deeper" indexing would result. There is a trade-off between the "depth" of indexing, the effectiveness of the system in retrieval and the effort required in providing indexing input into the system. Furthermore, the quality of the abstract provided affects greatly the quality of the indexing and its subsequent retrievability. It can be stated with some certainty that had the indexing been performed from the entire document rather than from just the abstract, the recall would have exceeded the obtained figure of 14.6%.

There is reason to believe that the difference in the amount of information available to the two groups would influence the judgment of relevance. It is quite conceivable that the user is reacting to his task tends to select the most relevant of the documents available to him. In his use of the index system he would then be selective and particularly sensitive to differences in concepts important to his task. This would result in a selection of documents that

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were highly relevant to his task. Judges on the other hand were not pressed for this severe criterion in the performance of their evaluation of the documents.

Finally, it is of considerable interest to compare the effectiveness of the system for retrieving documents with the retrievals that could be expected by random sampling of the documents. As indicated in the results, the average number of documents retrieved in the sample was only 10.6 documents. Consequently, a recall score of only 35.1% would be obtained even if all the retrieved documents were deemed relevant. On this basis, a recall of 14.6% is not nearly as discouraging as at first glance. As shown in the results, the coordinate index system even as presently constituted performs considerably better than chance for retrieving relevant documents and not retrieving nonrelevant documents. Since for the experiments performed 100% relevance would have resulted in only 35% recall, it is logical that modifications of the system to increase recall are in order. Several means of accomplishing this have already been alluded to earlier in this section.

Chance effectiveness can be estimated from Table 20. Both as to the number of hits and misses as well as reduction of trash this system does exceed chance in the position direction. It is for further experiments to determine whether these comparisons can hold for larger samples of documents, diverse population of users, and greater task and area complexity.

The conclusions from the data indicate that the coordinate index system does indeed provide a base for the development of an inclusive system which has acceptance and usability to the control display field. The present study was conducted on a limited sample of documents to provide flexibility in exploring the parameters of the user's performance as related to the structure of an index system. The point must be stressed that the users were totally unfamiliar with the indexing system. Other studies have employed experienced technicians to formulate search strategies to retrieve the documents. One of the principle merits of this experiment is that it has employed typical users in their ordinary, usual working habitate. The encouraging levels of system effectiveness achieved from this initial test suggest that further experiments need to be conducted along several lines to increase the capability of the system to retrieve relevant documents and to expand the index base without influencing the efficiency of the system adversely.

V. CONCLUSIONS AND RECOMMENDATIONS

An experiment using 12 professional subjects was conducted in the normal habitate of the users of control-display data.

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1. All groups, psychologists and engineers, did better than chance in obtaining relevant documents (hits), avoiding non-relevant documents (trash) and reducing the probability of not retrieving a relevant document (misses). Furthermore, the system operated better than chance in keeping out the non-relevant documents.

2. The use of the coordinate index system by the professional worker shows improvement over sessions. There are learning effects specifically as to the time the user takes to request a document after he is exposed to the index systems. Improvement in retrieving relevant documents as a function of use of the system requires further study.

3. Both psychologists and engineers found the index system to be acceptable. They differ as to the amount of orientation they require on the mechanics of the system; psychologists appear to require less detailed instructions than engineers. However, factors underlying this finding are complex and require further study.

In general, the experiment supports the contention that the present index system provides a base upon which the system could be developed for the control-display field.

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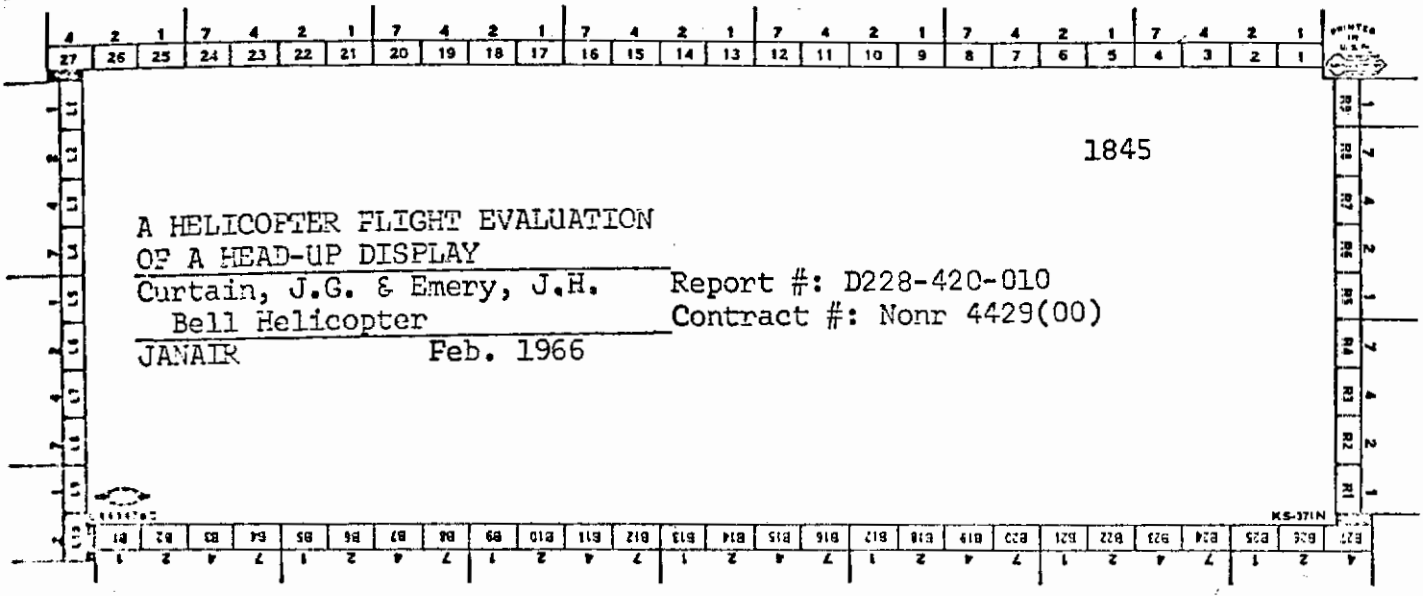
APPENDIX I

SAMPLE CDIC CARD



1845

A HELICOPTER FLIGHT EVALUATION
OF A HEAD-UP DISPLAY
Curtain, J.G. & Emery, J.H.
Bell Helicopter
JANAIR Feb. 1966

Report #: D228-420-010
Contract #: Nonr 4429(00)

The purpose of the study was to determine the feasibility of using the Computing Devices of Canada, Ltd. Spectocom Head-Up Display in a helicopter for instrument landing approaches.

The study was performed in two phases. The first phase examined IFR landing approach performance with the display in the fixed-wing design configurations. No other flight displays were presented. The second phase examined the same maneuver with the display augmented with heading information.

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APPENDIX II

THE PROPOSED CLASSIFICATION SCHEME FOR DOCUMENT RETRIEVAL

This retrieval program is basically a numerical system, utilizing six digits to identify a particular article or group of articles. It is designed for quick reference without requiring a special knowledge of descriptors, etc., by providing arbitrary definitions of certain terms. If the user will accept the logic of the system and use the terms and breakdowns as they are defined, he should have no trouble locating a particular area for study or review. It is imperative that the user familiarize himself with the first three digits in the system, as these are the descriptors upon which the system is based. The following is an explanation of these first three digits.

FIRST DIGIT:

The first digit is the one which establishes the frame of reference the user is to employ in searching for an article.

1.....Systems
2.....Assemblies
3.....Subjective data

Thus, when the user is at the one (1) level, he may find information relative to systems, types of systems and types of system components. He can find types of vehicles, ground support equipment, missiles, aircraft, satellites, etc. He will not find information relative to that which makes up missiles, ground support equipment, etc. To find this information, he will have to enter the system at the two (2) level. Here he will find propulsion units, airframes, flight controls, displays, dydraulic systems, etc. The three (3) level is concerned only with subjective data and techniques. In other words, if the user is interested in performance of personnel, techniques for landing an aircraft, effects of environment on crews, etc., he will enter the system at the three level.

SECOND AND THIRD DIGITS:

The second and third digits are what may be properly called the prime descriptors. That is, they define the subject matter and operate independently of the first digit. Thus, if we arbitrarily use the numeral (2) as the second digit, and define it to mean "missile system", and the numeral (6) in the third digit to mean "silo", then we can talk about missile silos from a systems standpoint, from an assembly standpoint, or from a subjective standpoint.

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THE ZERO:

A word about the use of zeroes (0) in the system. Anytime a zero is used it signifies "no specific type," or "no further breakdown." Thus, the numbers 104XXX mean that you are discussing personnel at the systems level, but the personnel are not identified with any particular system.

One final point should be made in regard to the system. It is unfortunately true that many of the articles written do not fall neatly into a specific bin. Thus, in some cases, it will be necessary to duplicater certain articles. In other cases, articles which discuss units or systems at several levels, must be arbitrarily placed in the system. Thus, an article which concerns the interaction of ground-support equipment with real estate, etc., can be placed in the Aircraft Systems category, with a zero in the third digit to show that the article could not be placed in a particular category, or it could be placed in both categories.

SECOND DIGIT:

The second digit identifies the type of system:

0.....No particular system
1.....Aircraft system
2.....Missile system
3.....Space system
4.....Ground-based system
5.....Water-based system

THIRD DIGIT:

The third digit describes the basic units or components which make up any system:

0.....No particular component
1.....IPI (Item of Primary Interest) (aircraft, submarine, etc.)
2.....Support Equipment (GCA, ILS, etc.)
3.....Support Functions (maintenance, training)
4.....Personnel (aircrew, missile crew)
5.....Armament (guns, bombs, rockets)
6.....Real Estate (hangars, runways, etc.)
7.....Material (metals, coatings, etc.)
8.....Unused

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FOURTH.....Nth DIGITS:

The digits after the first three are all descriptors, and are not consistent. That is, a fourth digit numeral may be a hydraulic system, etc. They have meaning only within the frame of reference being utilized at the time, and thus, are not independent of the first three digits.

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103XXX SYSTEMS: SUPPORT

Operations 103100

Maintenance 103200

Logistics 103300

Training & Stan. 103400
- Flying safety 103410
- Ground Schools 103420
- Survival " 103430

Intelligence 103500

Meteorology 103600

Finance 103700

Administration 103800

104XXX SYSTEMS: PERSONNEL

Vehicle Crew 104100

Support Crew 104200

Operations 104300

Maintenance 104400

Intelligence 104500

Weather 104600

Science/Engineering 104700

Support 104800

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110XXX AIRCRAFT SYSTEMS

OFFENSIVE..... 110100
- 1 engine 110110
- 2 " 110120
- 3 " 110130
- 4 " 110140
- over 4 110150

DEFENSIVE..... 110200
- 1 engine..... 110210
- 2 " 110220
- 3 " 110230
- 4 " 110240
- over 4 110250

LOGISTICS..... 110300
- 1 engine 110310
- 2 " 110320
- 3 " 110330
- 4 " 110340
- over 4 110350

EXPERIMENTAL..... 110400
- 1 engine 110410
- 2 " 110420
- 3 " 110430
- 4 " 110440
- over 4 110450

TRAINER 110500
- 1 engine..... 110510
- 2 " 110520
- 3 " 110530
- 4 " 110540
- over 4 110550

INTELLIGENCE..... 110600
- 1 engine 110610
- 2 " 110620
- 3 " 110630
- 4 " 110640
- over 4 110550

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Appendix II con't.

111XXX AIRCRAFT SYSTEMS: AIRCRAFT

OFFENSIVE..... 111100
1 engine 111110
2 engine 111120
3 " 111130
4 " 111140
over 4 111150

DEFENSIVE..... 111200
1 engine 111210
2 " 111220
3 " 111230
4 " 111240
over 4.....111250

LOGISTICS 111300
1 engine..... 111310
2 " 111320
3 " 111330
4 " 111340
over 4 111350

EXPERIMENTAL 111400
1 engine 111410
2 " 111420
3 " 111430
4 " 111440
over 4 111450

TRAINER 111500
1 engine 111510
2 " 111520
3 " 111530
4 " 111540
over 4 111550

INTELLIGENCE.....111600
1 engine 111610
2 " 111620
3 " 111630
4 " 111640
over 4 111650

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112 XXX AIRCRAFT SYSTEMS: GROUND BASED EQUIPMENT

Vehicles 112100

Starting/Power units 112200

Guidance/Control 112300

Emergency Equip. 112400

Weather Equipment 112500

Simulators 112600

Computers 112700
Digital 112710
Analog 112720

113XXX AIRCRAFT SYSTEMS: SUPPORT

Operations 113100

Maintenance 113200

Logistics 113300

Training & Stan. 113400
Flying Safety See 3 113410
Ground Schools 113420
Survival 113430

Intelligence 113500

Meteorology 113600

Finance 113700

Administration 113800

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120XXX MISSILE SYSTEMS

Short Range.....120100

Medium Range.....120200

Long Range.....120300

Boosters.....120400

121XXX MISSILE SYSTEMS: MISSLE

Short Range.....121100

Medium Range.....121200

Long Range.....121300

Boosters.....121400

122XXX MISSILE SYSTEMS: GROUND SUPPORT EQUIPMENT

Vehicles..... 122100

Launchers.....122200

Gantries.....122300

Guidance /Control.....122400

Emergency equip. 122500

Simulators.....122600

Computers.....122700
Digital.....122710
Analog.....122712

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Appendix II con't.

114XXX AIRCRAFT SYSTEMS: PERSONNEL

Aircrew 114100

Ground crew..... 114200

Operations 114300

Maintenance..... 114400

Intelligence..... 114500

Weather..... 114600

Scientific/Engineer..... 114700

Support 114800

115XXX AIRCRAFT SYSTEMS: ARMAMENT

Guns..... 115100

Bombs 115200

Rockets 115300

116XXX AIRCRAFT SYSTEMS: REAL ESTATE

Hangars..... 116100

Runways 116200

Taxiways, Aprons..... 116300

Approaches..... 116400

Lighting Systems. 116500

Control Towers 116600

Weather Stations 116700

Explosive Ord. Dep. 116800

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123XXX MISSILE SYSTEMS: SUPPORT

Operations.....123100

Maintenance.....123200

Logistics.....123300

Training & Stan. 123400
Simulation.....123410
Flying Safety 123420
Ground Schools 123430
Survival.....123440

Intelligence.....123500

Meteorology.....123600

Finance.....123700

Administration.....123800

124XXX MISSILE SYSTEMS: PERSONNEL

Crew.....124100

Operations 124200

Maintenance.....124300

Support 124400

126XXX MISSILE SYSTEMS: REAL ESTATE

Launching Pads/Silos.....126100

Control Stations.....126200

130XXX SPACE SYSTEMS

Sub-Orbital.....130100

Orbital-unmanned 130200

Orbital-manned.....130300

Extra-orbital-unmanned.....130400

Extra-orbital-manned 130500

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131XXX SPACE SYSTEMS: VEHICLE

Sub-orbital..... 131100

Orbital-unmanned..... 131200

Orbital, manned..... 131300

Extra-orbital-unmanned 131400

Extra-orbital-manned 131500

132XXX SPACE SYSTEMS: GROUND SUPPORT EQUIPMENT

Communications..... 132100

Guidance/Control 132200

Simulators 132300

Computors 132400
Digital..... 132410
Analog..... 132420

133XXX SPACE SYSTEMS: SUPPORT

Operations..... 133100

Maintenance 133200

Logistics..... 133300

Training & Stan. 133400
Simulation 133410
Flying Safety..... 133420
Ground Schools 133430
Survival..... 133440

Intelligence 133500

Meteorology..... 133600

Finance 133700

Administration..... 133800

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136XXX SPACE SYSTEMS: REAL ESTATE

See 126000 category

201XXX IPI ASSEMBLIES

Frame.....201100

Propulsion 201200

Unused..... 201300

Controls 201400

Displays 201500

Electronic.....201600

Hydraulic.....201700

Fuel and Oil.....201800

Auxiliary 201900

221XXX MISSILE ASSEMBLIES

Frame.....221100

Propulsion 221200

Unused.....221300

Control/Guidance 221400

Unused 221500

Electronic 221600

Hydraulic.....221700

Fuel & Oil.....221800

Auxiliary.....221900

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231XXX SPACECRAFT ASSEMBLIES

- Spacecraft 231100
- Propulsion 231200
- Unused 231300
- Controls 231400
  - Flight 231410
    - Manual 231411
    - Automatic 231412
- Displays 231500
  - Sensors 231510
    - Pressure 231511
    - Temperature 231512
    - Flow 231513
    - Vacuum 231514
  - Indicators 231520
    - Earth Reference 231521
    - Airmass " 231522
    - Spacecraft " 231523
    - Celestial 231524
- Electronic 231600
- Hydraulic 231700
- Fuel & Oil 231800
- Auxiliary 231900

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301XXX SUBJECTIVE DATA: IPI

- Frame.....301100
- Propulsion.....301200
- Control/Display.....301300
- Controls.....301400
  - Flight.....301410
    - Manual.....301411
    - Automatic.....301412
  - Landing Gear.....301420
  - Flaps.....301430
  - Speed Brakes.....301440
- Displays.....301500
  - Sensors.....301510
    - Pressure.....301511
    - Temperature.....301512
    - Flow.....301513
    - Vacuum.....301514
    - Inertial Attitude.....301515
    - Inertial Accel.....301516
- Indicators.....301520
  - Earth Reference.....301521
  - Airmass Reference.....301522
  - Aircraft Reference.....301523
  - Celestial Reference.....301524
- Electronic.....301600
- Hydraulic.....301700
- Fuel & Oil.....301800
- Auxiliary.....301900

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Appendix II con't.

303XXX SUBJECTIVE DATA: SUPPORT

Operations.....303100

Maintenance.....303200

Logistics.....303300

Training & Stan. 303400
Safety.....303410
Schools 303420
Survival 303430

Intelligence 303500

Weather.....303600

Finance.....303700

Administration.....303800

304XXX SUBJECTIVE DATA: PERSONNEL

Manning.....304100

Performance Requirements 304200

Performance Evaluation.....304300

Psychological Effects.....304400

Physiological Effects.....304500

Man/Machine Interface 304600

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Appendix II con't.

310XXX SUBJECTIVE DATA: AIRCRAFT SYSTEMS

Start-Taxi.....310100

Take-Off.....310200

Climb.....310300

Cruise.....310400

SMRP.....310500

Descent.....310600

Landing.....310700

Emergency Conditions.....310800

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311XXX SUBJECTIVE DATA: AIRCRAFT SYSTEMS: AIRCRAFT

Airframe 311100

Propulsion 311200

Control/Display 311300

Controls 311400
- Flight 311410
  - Manual 311411
  - Automatic 311412
- Landing Gear 311420
- Flaps 311430
- Speed Brakes 311440

Displays 311500
- Sensors 311510
  - Pressure 311511
  - Temperature 311512
  - Flow 311513
  - Vacuum 311514
  - Inertial Attitude 311515
  - Inertial Acceleration 311516
- Indicators 311520
  - Earth Reference 311521
  - Airmass Reference 311522
  - Aircraft Reference 311523
  - Celestial Reference 311524

Electronic 311600

Hydraulic 311700

Fuel and Oil 311800

Auxiliary 311900

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313XXX SUBJECTIVE DATA: AIRCRAFT SYSTEMS: SUPPORT

Operations 313100

Maintenance..... 313200

Logistics 313300

Training & Stan. 313400
- Flying Safety 313410
- Schools..... 313420
- Survival..... 313430

Intelligence..... 313500

Weather 313600

Finance 313700

Administration..... 313800

314XXX SUBJECTIVE DATA: AIRCRAFT SYSTEMS: PERSONNEL

Manning..... 314100

Performance Requirements 314200

Performance Evaluation 314300

Psychological Effects..... 314400

Physiological Effects 314500

Man/Machine Interface 314600

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321XXX SUBJECTIVE DATA: MISSILE SYSTEMS: MISSILE

- Airframe.....321100
- Propulsion 321200
- Control/Display.....321300
- Controls 321400
  - Flight.....321410
    - Manual.....321411
    - Automatic 321412
  - Landing Gear 321420
  - Flaps 321430
  - Speed Brakes..... 321440
- Displays 321500
  - Sensors 321510
    - Pressure.....321511
    - Temperature.....321512
    - Flow.....321513
    - Vacuum 321514
    - Electro/Magnetic 321515
    - Electro/Optic 321516
    - Inertial 321517
  - Indicators 321520
    - Earth Reference 321521
    - Airmass Reference.....321522
    - Aircraft Reference 321523
    - Celestial Reference.....321524
- Electronic.....321600
- Hydraulic 321700
- Fuel & Oil.....321800
- Auxiliary.....321900

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323XXX SUBJECTIVE DATA: MISSILE SYSTEMS: SUPPORT

Operations 323100

Maintenance 323200

Logistics 323300

Training 323400

Intelligence 323500

Weather 323600

Finance 323700

Administration 323800

324XXX SUBJECTIVE DATA: MISSILE SYSTEMS: PERSONNEL

Manning 324100

Performance Requirements 324200

Performance Evaluation 324300

Psychological Effects 324400

Physiological Effects 324500

Man/Machine Interface 324600

330XXX SUBJECTIVE DATA: SPACE SYSTEMS

Launch 330100

Orbital Injection 330200

Orbital Nav. 330300

SMRP 330400

Reentry 330500

Nav. & Ldg. 330600

Emerg. 330700

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331XXX SUBJECTIVE DATA: SPACE SYSTEMS: VEHICLE

Airframe.....331100

Propulsion.....331200

Control/Display.....331300

Controls.....331400
- Flight.....331410
  - Manual.....331411
  - Automatic.....331412
- Landing Gear.....331420
- Flaps.....331430
- Speed Brakes.....331440

Displays.....331500
- Sensors.....331510
  - Pressure.....331511
  - Temperature.....331512
  - Flow.....331513
  - Vacuum.....331514
  - Electro/Magnetic.....331515
  - Electro/Optic.....331516
  - Inertial.....331517
- Indicators.....331520
  - Earth Reference.....331521
  - Airmass Reference.....331522
  - Aircraft Reference.....331523
  - Celestial Reference.....331524

Electronic.....331600

Hydraulic.....331700

Fuel & Oil.....331800

Auxiliary.....331900

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333XXX SUBJECTIVE DATA: SPACE SYSTEMS: SUPPORT

Operations 333100

Maintenance 333200

Logistics 333300

Training 333400
- Simulation 333410
- Safety 333420
- Schools 333430
- Survival 333440

Intelligence 333500

Weather 333600

Finance 333700

Administration 333800

334XXX SUBJECTIVE DATA: SPACE SYSTEMS: PERSONNEL

Manning 334100

Performance Requirements 334200

Performance Evaluation 334300

Psychological Effects 334400

Physiological Effects 334500

Man/Machine Interface 334600

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APPENDIX III

Master Word List and Thesaurus

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MASTER WORD LIST

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0001000 ACCELERATION

0002000 ACCELERATION CONTROL SYSTEMS

0003000 ACCURACY

0004000 AERODYNAMIC FLOW

0005000 AERODYNAMIC STABILITY

0006000 AEROSPACE MEDICINE

0007000 AIR TERMINAL

0008000 AIR TRAFFIC CONTROL

0009000 AIRBORNE FLIGHT EQUIPMENT

0010000 AIRBORNE SIMULATORS

0011000 AIRCRAFT

0012000 AIRCRAFT MANEUVERS

0013000 AIRSPEED

0013100 AIRSPEED INDICATORS

0014000 ALIGNMENT

0015000 ALL-WEATHER CONDITIONS

0016000 ALTIMETERS

0017000 ALTITUDE

0018000 ALTITUDE CONTROL SYSTEMS

0019000 ANALOG COMPUTERS

0020000 ANALOG SIMULATION SYSTEMS

0021000 ANALYSIS

0022000 ANGLE OF ATTACK

0023000 ANGULAR VELOCITY

0024000 APPROACH

0025000 ATTITUDE

0026000 ATTITUDE CONTROL SYSTEMS

0027000 AUGMENTED PILOT CONTROL

0028000 AUTOMATIC CONTROL

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0029000 AUTOMATIC SYSTEMS

0030000 BIBLIOGRAPHY

0031000 BLIND LANDING

0032000 CATASTROPHIC FAILURE

0033000 CATHODE RAY TUBES

0034000 CLIMB-OUT

0035000 CLOSED CIRCUIT SYSTEMS

0036000 COCKPIT DISPLAY

0037000 COCKPITS

0038000 COMMERCIAL AIRCRAFT

0038300 COMMUNICATIONS

0038800 COMPUTER PRINTOUT

0039000 COMPUTERS

0040000 CONFIGURATION

0041000 CONTACT ANALOG DISPLAY

0041600 CONTINUOUS OPERATIONS

0042000 CONTROL ANALYSIS

0043000 CONTROL AUTHORITY TRANSFER

0044000 CONTROL CHARACTERISTICS

0045000 CONTROL DEFICIENCIES

0046000 CONTROL DISPLAY

0047000 CONTROL-DISPLAY

0048000 CONTROL ELEMENTS

0049000 CONTROL POWER

0050000 CONTROL SETTINGS

0051000 CONTROL SURFACES

0052000 CONTROL SYSTEMS

0053000 CONTROLLING

0054000 CONVENTIONAL AIRCRAFT

0054600 COOPER RATING SYSTEM

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0055000 COURSE

0056000 CREW

0057000 CREW STATIONS

0057600 CRUISE

0058000 DAMPING

0059000 DATA

0060000 DATA PROCESSING

0061000 DEGREES OF FREEDOM

0062000 DESIGN

0062050 DESIGN DRAWINGS

0063000 DIAGRAMS

0064000 DIALS

0065000 DIGITAL COMPUTERS

0066000 DIMENSIONS

0066500 DISCRETE OPERATIONS

0067000 DISPLAY

0068000 DISPLAY COMPONENTS

0069000 DISTANCE

0070000 DOCUMENTATION

0071000 DRIFT

0072000 ELECTRICAL SYSTEM

0073000 EMERGENCY CONDITIONS

0074000 ENGINES

0075000 EQUIPMENT

0076000 ERRORS

0077000 EVALUATION

0077200 EXHAUST GASES

0077300 EXPERIMENTAL AIRCRAFT

0077350 EXPERIMENTAL DESIGN

0078000 FAIL-SAFE

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0079000 FAILURE

0080000 FAILURE ANALYSIS

0081000 FIGHTER AIRCRAFT

0082000 FIXED BASE SIMULATORS

0083000 FLIGHT

0084000 FLIGHT CHARACTERISTICS

0085000 FLIGHT DATA

0086000 FLIGHT INSTRUMENTS

0087000 FLIGHT MODE

0088000 FLIGHT MODE TRANSITION

0089000 FLIGHT PATH

0090000 FLIGHT PROCEDURES

0091000 FLIGHT REPORTS

0092000 FLIGHT TESTING

0093000 FLYING

0094000 FLYING AIDS

0095000 FOREIGN AIRCRAFT

0095300 FUEL CONSUMPTION

0095600 FUNCTIONAL ANALYSIS

0096000 GEOGRAPHIC DIRECTION

0097000 GLIDE

0098000 GROUND BASED FLIGHT EQUIPMENT

0099000 GROUND BASED FLIGHT OPERATIONS

0100000 GROUND BASED SIMULATORS

0100250 GROUND EFFECT

0101000 GUIDANCE SYSTEMS

0102000 GYROSCOPES

0103000 HELICOPTERS

0104000 HORIZON

0105000 HOVERING

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0106000	HUMAN ENGINEERING
0106100	HUMAN PERFORMANCE
0107000	IFR
0108000	IFR CONDITIONS
0109000	ILLUMINATION
0110000	IMAGES
0111000	INFORMATION
0112000	INFORMATION DISPLAY
0113000	INFORMATION PROCESSING
0114000	INFORMATION REQUIREMENTS
0115000	INSTALLATION
0116000	INSTRUCTOR
0117000	INSTRUMENT DISPLAY
0118000	INSTRUMENTATION
0119000	INSTRUMENTS
0120000	INTEGRATED SYSTEMS
0121000	INTERVIEW
0122000	JET AIRCRAFT
0123000	JET ENGINES
0124000	LANDING
0125000	LANDING SITES
0126000	LATERAL MODE
0127000	LENSES
0128000	LEVEL FLIGHT
0129000	LIFT
0130000	LIFT FAN
0131000	LONGITUDINAL MODE
0132000	LOW ALTITUDE
0133000	LOW SPEED
0134000	LUNAR EXCURSION MODULE

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0135000 MACH NUMBER

0136000 MAINTENANCE

0137000 MALFUNCTIONS

0138000 MAN-MACHINE SYSTEMS

0139000 MANUAL CONTROL

0140000 MANUFACTURING TECHNOLOGY

0141000 MAPS

0142000 MATHEMATICAL MODELS

0143000 MEASUREMENT

0144000 METROPOLITAN AREA

0145000 MILITARY AIRCRAFT

0146000 MIRRORS

0147000 MISSION

0148000 MODELS

0149000 MOON

0150000 MOTION

0151000 MOTION CUES

0152000 MOVIES

0153000 MOVING BASE SIMULATORS

0154000 NAVIGATION

0155000 NAVIGATOR

0156000 NORMAL CONDITIONS

0157000 OBSERVATION

0157400 ON-OFF CONTROL

0158000 OPTIMIZATION

0159000 OSCILLOGRAPHS

0160000 PANELS

0170000 PATTERNS

0171000 PAYLOAD

0172000 PERFORMANCE

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0173000	PERSONAL EVALUATION
0174000	PERSONNEL
0174100	PERTURBATION
0175000	PHOTOGRAPHY
0176000	PICTORIAL DISPLAY
0177000	PILOT
0178000	PILOT ERRORS
0179000	PITCH
0180000	POSITION
0181000	POWER
0182000	PROGRAMMED OPERATIONS
0182100	PROGRESS REPORT
0183000	PROJECTION DISPLAY
0184000	PROPELLER DRIVEN AIRCRAFT
0185000	PROPORTIONAL CONTROL
0185100	PROPOSAL
0186000	PROPULSION SYSTEMS
0187000	RADAR
0187200	RADIO
0188000	RADIO OPERATOR
0188200	RANGE
0189000	RATE
0189400	READABILITY
0190000	RELIABILITY
0191000	REPAIR
0192000	REQUIREMENTS
0193000	RESPONSE
0193200	RESPONSE TIME
0194000	ROLL
0195000	ROOT MEAN SQUARE CONTROL

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0196000 ROTATION

0197000 ROTOR BLADES

0198000 SAFETY

0199000 SAFETY EQUIPMENT

0200000 SCALES

0201000 SCALING

0202000 SCHEDULE

0203000 SEATING

0204000 SEMI-AUTOMATIC CONTROL

0205000 SERVO SYSTEMS

0206000 SHORT FIELD TAKE-OFF

0207000 SIGNALS

0208000 SIMULATION SYSTEMS

0209000 SPACE VEHICLES

0210000 STALLING

0211000 STATE-OF-THE-ART

0212000 STOL AIRCRAFT

0213000 SUBJECTIVE DATA

0214000 SUPERSONIC AIRCRAFT

0215000 SYMBOLS

0216000 SYMPOSIUM

0216700 TACTICAL AIRCRAFT

0216750 TACTILE CUES

0217000 TAIL ROTOR

0218000 TAKE-OFF

0219000 TASK ANALYSIS

0220000 TASKS

0221000 TELEVISION

0222000 TESTING

0223000 THEORETICAL ANALYSIS

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Contrails

0224000	THREE-DIMENSIONAL DISPLAY
0225000	THRUST
0226000	TILT WING AIRCRAFT
0227000	TIME LINE ANALYSIS
0228000	TRACKING
0229000	TRAINING
0230000	TRAINING EQUIPMENT
0231000	TRANSPARENT DISPLAY
0232000	TRANSPORT AIRCRAFT
0233000	TURBULENCE
0233533	VARIABLE STABILITY CONDITIONS
0234000	VECTORS
0235000	VELOCITY
0236000	VERTICAL FLIGHT
0237000	VERTICAL MANEUVERS
0238000	VERTICAL MODE
0239000	VFR
0240000	VFR CONDITIONS
0241000	VIBRATION
0242000	VISIBILITY
0243000	VISION
0244000	VISUAL CUES
0245000	V/STOL AIRCRAFT
0246000	VTOL AIRCRAFT
0247000	WEAPON SYSTEMS
0248000	WEIGHT
0249000	WIND
0250000	WIND TUNNELS
0251000	WORK LOAD
0252000	YAW

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Contrails

7019400	1940=1944
7019450	1945=1949
7019495	1950=1955
7019500	1950
701950	
7019510	1951
701951	
7019520	1952
701952	
7019530	1953
701953	
7019540	1954
7019545	1955=1959
701954	
7019550	1955
701955	
7019560	1956
701956	
7019570	1957
701957	
7019580	1958
701958	
7019590	1959
7019595	1960=1964
701959	
7019600	1960
7019610	1961
701961	
7019620	1962
701962	

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7019630	1963
701963	
7019640	1964
7019645	1965-1969
701964	
7019650	1965
701965	
7019660	1966
701966	
7019670	1967
701967	
7019680	1968
701968	
7019690	1969
701969	
701980	
7040100	JANUARY
7040200	FEBRUARY
7040300	MARCH
7040400	APRIL
7040500	MAY
7040600	JUNE
7040700	JULY
7040800	AUGUST
7040900	SEPTEMBER
7041000	OCTOBER
7041100	NOVEMBER
7041200	DECEMBER

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THESAURUS

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ABSOLUTE ALTITUDE * ALTITUDE 0017000 *

0001000 ACCELERATION
0002000 RT ACCELERATION CONTROL SYSTEMS

0002000 ACCELERATION CONTROL SYSTEMS
0052000 BT CONTROL SYSTEMS
0001000 RT ACCELERATION

0003000 ACCURACY
0044000 RT CONTROL CHARACTERISTICS
0071000 RT DRIFT
0076000 RT ERRORS
0119000 RT INSTRUMENTS
0143000 RT MEASUREMENT
0190000 RT RELIABILITY
0193000 RT RESPONSE

ACTIVE NAVIGATION * NAVIGATION 0154000 *

0004000 AERODYNAMIC FLOW
0005000 RT AERODYNAMIC STABILITY
0129000 RT LIFT
0233000 RT TURBULENCE

0005000 AERODYNAMIC STABILITY
0004000 RT AERODYNAMIC FLOW
0025000 RT ATTITUDE
0044000 RT CONTROL CHARACTERISTICS
0045000 RT CONTROL DEFICIENCIES
0050000 RT CONTROL SETTINGS
0053000 RT CONTROLLING
0084000 RT FLIGHT CHARACTERISTICS
0129000 RT LIFT
0179000 RT PITCH
0194000 RT ROLL
0233000 RT TURBULENCE
0233500 RT VARIABLE STABILITY CONDITIONS
0249000 RT WIND
0250000 RT WIND TUNNELS
0252000 RT YAW

AERODYNAMIC STABILIZATION * CONTROLLING 0053000 AND
AERODYNAMIC STABILITY 0005000 *

0006000 AEROSPACE MEDICINE
0056000 RT CREW

0007000 AIR TERMINAL
0008000 RT AIR TRAFFIC CONTROL
0099000 RT GROUND BASED FLIGHT OPERATIONS
0144000 RT METROPOLITAN AREA

0008000 AIR TRAFFIC CONTROL
0007000 RT AIR TERMINAL
0038300 RT COMMUNICATIONS
0053000 RT CONTROLLING
0090000 RT FLIGHT PROCEDURES
0099000 RT GROUND BASED FLIGHT OPERATIONS
0144000 RT METROPOLITAN AREA

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```
0009000   AIRBORNE FLIGHT EQUIPMENT
  0075000   BT  EQUIPMENT
  0086000   RT  FLIGHT INSTRUMENTS
  0098000   RT  GROUND BASED FLIGHT EQUIPMENT

0010000   AIRBORNE SIMULATORS
  0208000   BT  SIMULATION SYSTEMS
  0082000   RT  FIXED BASE SIMULATORS
  0100000   RT  GROUND BASED SIMULATORS
  0153000   RT  MOVING BASE SIMULATORS

0011000   AIRCRAFT
  0038000   NT  COMMERCIAL AIRCRAFT
  0054000   NT  CONVENTIONAL AIRCRAFT
  0077300   NT  EXPERIMENTAL AIRCRAFT
  0081000   NT  FIGHTER AIRCRAFT
  0095000   NT  FOREIGN AIRCRAFT
  0103000   NT  HELICOPTERS
  0122000   NT  JET AIRCRAFT
  0145000   NT  MILITARY AIRCRAFT
  0184000   NT  PROPELLER DRIVEN AIRCRAFT
  0212000   NT  STOL AIRCRAFT
  0214000   NT  SUPERSONIC AIRCRAFT
  0216700   NT  TACTICAL AIRCRAFT
  0226000   NT  TILT WING AIRCRAFT
  0232000   NT  TRANSPORT AIRCRAFT
  0245000   NT  V/STOL AIRCRAFT
  0246000   NT  VTOL AIRCRAFT

            AIRCRAFT HEADING  *    COURSE 0055000    *

0012000   AIRCRAFT MANEUVERS
  0024000   NT  APPROACH
  0031000   NT  BLIND LANDING
  0034000   NT  CLIMB-OUT
  0057600   NT  CRUISE
  0083000   NT  FLIGHT
  0087000   NT  FLIGHT MODE
  0088000   NT  FLIGHT MODE TRANSITION
  0097000   NT  GLIDE
  0105000   NT  HOVERING
  0124000   NT  LANDING
  0128000   NT  LEVEL FLIGHT
  0206000   NT  SHORT FIELD TAKE-OFF
  0218000   NT  TAKE-OFF
  0236000   NT  VERTICAL FLIGHT
  0237000   NT  VERTICAL MANEUVERS
  0050000   RT  CONTROL SETTINGS
  0051000   RT  CONTROL SURFACES
  0052000   RT  CONTROL SYSTEMS
  0053000   RT  CONTROLLING

            AIRCRAFT ORIENTATION  *    ATTITUDE 0025000    *

            AIRCRAFT WEIGHT  *    WEIGHT 0248000 AND AIRCRAFT 0011000  *

0013000   AIRSPEED
  0013100   RT  AIRSPEED INDICATORS
  0235000   RT  VELOCITY
```


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```
0013100   AIRSPEED INDICATORS
  0086000   BT  FLIGHT INSTRUMENTS
  0119000   BT  INSTRUMENTS
  0013000   RT  AIRSPEED

0014000   ALIGNMENT
  0050000   RT  CONTROL SETTINGS
  0053000   RT  CONTROLLING

0015000   ALL-WEATHER CONDITIONS
  0108000   RT  IFR CONDITIONS
  0240000   RT  VFR CONDITIONS
  0242000   RT  VISIBILITY

          ALL-WEATHER DISPLAY  *    ALL-WEATHER CONDITIONS 0015000
                    AND DISPLAY 0067000    *

          ALONG-COURSE ERROR  *    COURSE 0055000 AND ERRORS 0076000 *

0016000   ALTIMETERS
  0067000   BT  DISPLAY
  0068000   BT  DISPLAY COMPONENTS
  0086000   BT  FLIGHT INSTRUMENTS
  0119000   BT  INSTRUMENTS

0017000   ALTITUDE
  0069000   BT  DISTANCE
  0132000   NT  LOW ALTITUDE
  0016000   RT  ALTIMETERS
  0018000   RT  ALTITUDE CONTROL SYSTEM
  0180000   RT  POSITION

          ALTITUDE CHANGE  *    ALTITUDE 0017000    *

          ALTITUDE CONTROL  *    CONTROLLING 0053000 AND
                    ALTITUDE 0017000    *

0018000   ALTITUDE CONTROL SYSTEMS
  0052000   BT  CONTROL SYSTEMS

          ALTITUDE OVERSHOOT  *    ALTITUDE 0017000 AND ERRORS 0076000

          ALTITUDE RATE  *    ALTITUDE 0017000 AND RATE 0189000 AND/OR
                    VELOCITY 0235000    *

0019000   ANALOG COMPUTERS
  0039000   BT  COMPUTERS
  0020000   RT  ANALOG SIMULATION SYSTEMS
  0065000   RT  DIGITAL COMPUTERS
  0182000   RT  PROGRAMMED OPERATIONS
  0208000   RT  SIMULATION SYSTEMS

0020000   ANALOG SIMULATION SYSTEMS
  0208000   BT  SIMULATION SYSTEMS
  0019000   RT  ANALOG COMPUTERS

0021000   ANALYSIS
  0042000   NT  CONTROL ANALYSIS
  0080000   NT  FAILURE ANALYSIS
  0095600   NT  FUNCTIONAL ANALYSIS
```


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0219000 NT TASK ANALYSIS
0223000 NT THEORETICAL ANALYSIS
0227000 NT TIME LINE ANALYSIS
0062000 RT DESIGN
0077000 RT EVALUATION
0077300 RT EXPERIMENTAL DESIGN
0158000 RT OPTIMIZATION

0022000 ANGLE OF ATTACK
0005000 RT AERODYNAMIC STABILITY
0025000 RT ATTITUDE

0023000 ANGULAR VELOCITY
0235000 BT VELOCITY
0196000 RT ROTATION

0024000 APPROACH
0012000 BT AIRCRAFT MANEUVERS
0124000 RT LANDING

APPROACH PATHS * APPROACH 0024000 AND FLIGHT PATH 0083000 *

APPROACH PROFILES * APPROACH 0024000 *

ARM-SHOULDER CONTROL TECHNIQUE * MAN-MACHINE SYSTEMS 0138000 AND CONTROLLING 0053000 *

ATTACK AIRCRAFT * MILITARY AIRCRAFT 0145000 *

0025000 ATTITUDE
0022000 RT ANGLE OF ATTACK
0180000 RT POSITION

0026000 ATTITUDE CONTROL SYSTEMS
0052000 BT CONTROL SYSTEMS
0041600 RT CONTROLLING

ATTITUDE DISPLAY * ATTITUDE 0025000 AND DISPLAY 0067000*

0027000 AUGMENTED PILOT CONTROL
0053000 BT CONTROLLING
0008000 RT AIR TRAFFIC CONTROL
0094000 RT FLYING AIDS
0099000 RT GROUND BASED FLIGHT OPERATIONS
0111000 RT INFORMATION

AUSTERE LANDING SITES * LANDING SITES 0125000 *

0028000 AUTOMATIC CONTROL
0029000 BT AUTOMATIC SYSTEMS
0052000 BT CONTROL SYSTEMS
0053000 BT CONTROLLING
0039000 RT COMPUTERS
0048000 RT CONTROL ELEMENTS
0066500 RT DISCRETE OPERATIONS
0204000 RT SEMI-AUTOMATIC CONTROL

AUTOMATIC FLIGHT CONTROL * AUTOMATIC CONTROL 0028000 AND GUIDANCE SYSTEMS 0101000 AND FLIGHT 0083000 *

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AUTOMATIC HOVERING * HOVERING 0105000 AND AUTOMATIC CONTROL 0028000 *

AUTOMATIC LANDING * LANDING 0124000 AND AUTOMATIC CONTROL 0028000 *

AUTOMATIC MODE SWITCHING * AUTOMATIC CONTROL 0028000 AND FLIGHT MODE TRANSITION 0088000 *

AUTOMATIC STABILIZATION * AERODYNAMIC STABILITY 0005000 AND AUTOMATIC CONTROL 0028000 *

0029000 AUTOMATIC SYSTEMS
0028000 NT AUTOMATIC CONTROL

AUTOPILOT * AUTOMATIC CONTROL 0028000 AND GUIDANCE SYSTEMS 0101000 *

AUTOROTATION * ROTATION 0196000 *

BACKLASH * CONTROL DEFICIENCIES 0045000 *

BAROMETRIC ALTITUDE * ALTITUDE 0017000 *

0030000 BIBLIOGRAPHY
0070000 BT DOCUMENTATION

BLADE TIP * ROTOR BLADES 0197000 *

0031000 BLIND LANDING
0012000 BT AIRCRAFT MANEUVERS
0124000 BT LANDING
0107000 RT IFR
0242000 RT VISIBILITY

BLOCK DIAGRAM * DIAGRAMS 0063000 *

BLUEPRINTS * DESIGN DRAWINGS 0062050 *

BUFFETING * TURBULENCE 0233000 *

CAMERA TECHNIQUES * PHOTOGRAPHY 0175000 *

CARGO AIRCRAFT * TRANSPORT AIRCRAFT 0232000 *

0032000 CATASTROPHIC FAILURE
0079000 BT FAILURE
0073000 RT EMERGENCY CONDITIONS
0137000 RT MALFUNCTIONS
0190000 RT RELIABILITY

0033000 CATHODE RAY TUBES
0067000 RT DISPLAY
0110000 RT IMAGES
0221000 RT TELEVISION

CIRCULAR APPROACH * APPROACH 0024000 *

0034000 CLIMB-OUT
0012000 BT AIRCRAFT MANEUVERS

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CLOSE SUPPORT * MISSION 0147000 *

CLOSED CIRCUIT CRT * CATHODE RAY TUBES 0033000 AND CLOSED CIRCUIT SYSTEMS 0035000 *

0035000 CLOSED CIRCUIT SYSTEMS
0221000 RT TELEVISION

COCKPIT ARRANGEMENT * DESIGN 0062000 AND COCKPITS 0037000 *

COCKPIT CONFIGURATION * COCKPITS 0037000 AND CONFIGURATION 0040000 *

COCKPIT DEVELOPMENT * DESIGN 0062000 AND COCKPITS 0037000 *

0036000 COCKPIT DISPLAY
0067000 BT DISPLAY

COCKPIT LAYOUT * DESIGN 0062000 AND COCKPITS 0037000 *

COCKPIT MOCKUP * MODELS 0148000 AND COCKPITS 0037000 *

0037000 COCKPITS
0057000 BT CREW STATIONS

COLLECTIVE STICK * CONTROL ELEMENTS 0048000 AND CONTROL SYSTEMS 0052000 AND INTEGRATED SYSTEMS 0120000 *

COMBINED DISPLAY * DISPLAY 0067000 AND INTEGRATED SYSTEMS 0120000 *

0038000 COMMERCIAL AIRCRAFT
0011000 BT AIRCRAFT
0232000 RT TRANSPORT AIRCRAFT

COMMON CONTROLLER * CONTROL SYSTEMS 0052000 AND INTEGRATED SYSTEMS 0120000 *

0038300 COMMUNICATIONS
0008000 RT AIR TRAFFIC CONTROL
0070000 RT DOCUMENTATION
0187000 RT RADAR
0187200 RT RADIO
0188000 RT RADIO OPERATOR
0221000 RT TELEVISION

0038800 COMPUTER PRINTOUT
0067000 RT DISPLAY

0039000 COMPUTERS
0019000 NT ANALOG COMPUTERS
0065000 NT DIGITAL COMPUTERS
0028000 RT AUTOMATIC CONTROL
0182000 RT PROGRAMMED OPERATIONS

CONFIGURATION: INDICATES A PARTICULAR TYPE, MODEL, NUMBER ARRANGEMENT OR SHAPE OF AN OBJECT, CREW OR SYSTEM

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```
0040000   CONFIGURATION
  0062000     RT  DESIGN
  0077300     RT  EXPERIMENTAL AIRCRAFT
  0148000     RT  MODELS

0041000   CONTACT ANALOG DISPLAY
  0067000     BT  DISPLAY

          CONTACT ANALOG PATTERN GENERATOR  *    CONTACT ANALOG
                DISPLAY 0041000 AND PATTERNS 0170000    *

          CONTINUOUS CONTROL ANALYSIS  *    CONTROL ANALYSIS 0042000
                AND CONTINUOUS OPERATIONS 00416000    *

          CONTINUOUS MEASUREMENT  *    MEASUREMENT 0143000 AND
                CONTINUOUS OPERATIONS 0041600    *

0041600   CONTINUOUS OPERATIONS
  0028000     RT  AUTOMATIC CONTROL
  0052000     RT  CONTROL SYSTEMS
  0053000     RT  CONTROLLING
  0066500     RT  DISCRETE OPERATIONS

          CONTROL  *    CONTROL SYSTEMS 0052000 OR CONTROLLING 0053000

0042000   CONTROL ANALYSIS
  0021000     BT  ANALYSIS
  0052000     RT  CONTROL SYSTEMS
  0062000     RT  DESIGN
  0095600     RT  FUNCTIONAL ANALYSIS
  0219000     RT  TASK ANALYSIS
  0220000     RT  TASKS

0043000   CONTROL AUTHORITY TRANSFER
  0090000     BT  FLIGHT PROCEDURES
  0099000     RT  GROUND BASED FLIGHT OPERATIONS

          CONTROL BUTTONS  *    CONTROL ELEMENTS 0048000    *

0044000   CONTROL CHARACTERISTICS
  0045000     NT  CONTROL DEFICIENCIES
  0049000     NT  CONTROL POWER
  0003000     RT  ACCURACY
  0050000     RT  CONTROL SETTINGS
  0053000     RT  CONTROLLING
  0061000     RT  DEGREES OF FREEDOM
  0071000     RT  DRIFT
  0084000     RT  FLIGHT CHARACTERISTICS
  0093000     RT  FLYING
  0138000     RT  MAN-MACHINE SYSTEMS
  0174100     RT  PERTURBATION
  0193000     RT  RESPONSE
  0216750     RT  TACTILE CUES
  0233000     RT  TURBULENCE
  0233500     RT  VARIABLE STABILITY CONDITIONS

0045000   CONTROL DEFICIENCIES
  0044000     BT  CONTROL CHARACTERISTICS
  0050000     BT  CONTROL SETTINGS
  0052000     BT  CONTROL SYSTEMS
```


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0053000 BT CONTROLLING
0071000 BT DRIFT
0179000 NT PITCH
0194000 NT ROLL
0252000 NT YAW
0005000 RT AERODYNAMIC STABILITY

0045600 COOPER RATING SYSTEM
0173000 BT PERSONAL EVALUATION

CONTROL DISPLAY * DISPLAY OF CONTROL ELEMENTS SUCH AS KNOBS, BUTTONS, PEDALS, ETC. *

0046000 CONTROL DISPLAY
0067000 BT DISPLAY
0048000 RT CONTROL ELEMENTS
0117000 RT INSTRUMENT DISPLAY
0160000 RT PANELS

CONTROL-DISPLAY * THE SCIENCE OF DETERMINING THE CONTROLS NECESSARY TO OPERATE A MACHINE AND THE INFORMATION TO BE DISPLAYED TO THE OPERATOR %PILOT□ WHO MANIPULATES THE CONTROLS

0047000 CONTROL-DISPLAY
0062000 BT DESIGN
0106000 BT HUMAN ENGINEERING
0052000 RT CONTROL SYSTEMS
0067000 RT DISPLAY
0138000 RT MAN-MACHINE SYSTEMS

CONTROL DISPLAY REQUIREMENTS * REQUIREMENTS 0192000 AND CONTROL DISPLAY 0046000 *

CONTROL-DISPLAY REQUIREMENTS * REQUIREMENTS 0192000 AND CONTROL-DISPLAY 0047000 *

CONTROL ELEMENTS = THOSE DEVICES WHICH INITIATE THE ACTUATION OF THE CONTROL SYSTEM. INCLUDED ARE CONTROL BUTTON, CONTROL KNOB, CONTROL STICK

0048000 CONTROL ELEMENTS
0028000 RT AUTOMATIC CONTROL
0046000 RT CONTROL DISPLAY
0138000 RT MAN-MACHINE SYSTEMS

CONTROL EQUATIONS * CONTROL ANALYSIS 0042000 *

CONTROL EQUIPMENT * CONTROL SYSTEMS 0052000 AND EQUIPMENT 0075000 *

CONTROL INFORMATION * CONTROLLING 0053000 AND/OR CONTROL SYSTEMS 0052000 AND INFORMATION 0111000 *

CONTROL KNOBS * CONTROL ELEMENTS 0048000 *

CONTROL LOCATION * DESIGN 0062000 AND CONTROL DISPLAY 0046000 *

CONTROL METHODS * CONTROLLING 0053000 *

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CONTROL OPERATION * CONTROLLING 0053000 *

CONTROL PANEL * CONTROL DISPLAY 0046000 AND/OR INSTRUMENT DISPLAY 0117000 AND PANELS 0160000 *

CONTROL PARAMETERS * CONTROL ANALYSIS 0042000 AND/OR CONTROL CHARACTERISTICS 0044000 *

0049000 CONTROL POWER
- 0044000 BT CONTROL CHARACTERISTICS
- 0181000 BT POWER
- 0052000 RT CONTROL SYSTEMS
- 0053000 RT CONTROLLING

CONTROL RESPONSE * CONTROLLING 0053000 AND/OR CONTROL CHARACTERISTICS 0044000 AND RESPONSE 0193000 *

CONTROL SCHEME * CONTROL SYSTEMS 0052000 *

CONTROL SENSITIVITY * CONTROL CHARACTERISTICS 0044000 *

0050000 CONTROL SETTINGS
- 0005000 RT AERODYNAMIC STABILITY
- 0012000 RT AIRCRAFT MANEUVERS
- 0014000 RT ALIGNMENT
- 0044000 RT CONTROL CHARACTERISTICS
- 0045000 RT CONTROL DEFICIENCIES
- 0052000 RT CONTROL SYSTEMS
- 0053000 RT CONTROLLING

CONTROL SIGNALS * SIGNALS 0207000 AND CONTROLLING 0053000 AND/OR CONTROL SYSTEMS 0052000 *

CONTROL STICK * CONTROL ELEMENTS 0048000 *

0051000 CONTROL SURFACES
- 0012000 RT AIRCRAFT MANEUVERS
- 0052000 RT CONTROL SYSTEMS
- 0160000 RT PANELS

0052000 CONTROL SYSTEMS
- 0002000 NT ACCELERATION CONTROL SYSTEMS
- 0026000 NT ATTITUDE CONTROL SYSTEMS
- 0028000 NT AUTOMATIC CONTROL
- 0101000 NT GUIDANCE SYSTEMS
- 0157400 NT OFF-ON CONTROL
- 0185000 NT PROPORTIONAL CONTROL
- 0195000 NT ROOT MEAN SQUARE CONTROL
- 0204000 NT SEMI-AUTOMATIC CONTROL
- 0005000 RT AERODYNAMIC STABILITY
- 0012000 RT AIRCRAFT MANEUVERS
- 0041600 RT CONTROLLING
- 0047000 RT CONTROL-DISPLAY
- 0053000 RT CONTROLLING
- 0061000 RT DEGREES OF FREEDOM
- 0066500 RT DISCRETE OPERATIONS
- 0120000 RT INTEGRATED SYSTEMS
- 0139000 RT MANUAL CONTROL

CONTROLLABILITY * CONTROL CHARACTERISTICS 0044000 *

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CONTROLLERS * AUTOMATIC CONTROL 0028000 *

0053000 CONTROLLING
0220000 BT TASKS
0028000 NT AUTOMATIC CONTROL
0093000 NT FLYING
0139000 NT MANUAL CONTROL
0204000 NT SEMI-AUTOMATIC CONTROL
0012000 RT AIRCRAFT MANEUVERS
0014000 RT ALIGNMENT
0041600 RT CONTROLLING
0050000 RT CONTROL SETTINGS
0061000 RT DEGREES OF FREEDOM
0066500 RT DISCRETE OPERATIONS
0138000 RT MAN-MACHINE SYSTEMS
0185000 RT PROPORTIONAL CONTROL
0193000 RT RESPONSE
0195000 RT ROOT MEAN SQUARE CONTROL
0216750 RT TACTILE CUES
0220000 RT TASKS
0293500 RT VARIABLE STABILITY CONDITIONS

CONTROLS * CONTROL ELEMENTS 0048000 OR
CONTROL SYSTEMS 0052000 *

0054000 CONVENTIONAL AIRCRAFT
0011000 BT AIRCRAFT

CONVENTIONAL LANDING * LANDING 0124000 *

CONVERSION * FLIGHT MODE TRANSITION 0088000 *

CONVERSION MANEUVER * FLIGHT MODE TRANSITION 0088000

0055000 COURSE
0089000 RT FLIGHT PATH
0096000 RT GEOGRAPHIC DIRECTION
0128000 RT LEVEL FLIGHT
0141000 RT MAPS
0154000 RT NAVIGATION
0180000 RT POSITION
0188200 RT RANGE

0056000 CREW
0174000 BT PERSONNEL
0155000 NT NAVIGATOR
0177000 NT PILOT
0188000 NT RADIO OPERATOR
0006000 RT AEROSPACE MEDICINE
0106000 RT HUMAN ENGINEERING
0106100 RT HUMAN PERFORMANCE
0139000 RT MANUAL CONTROL
0198000 RT SAFETY
0199000 RT SAFETY EQUIPMENT
0220000 RT TASKS

CREW OPERATION * TASKS 0220000 AND/OR FLIGHT PROCEDURES
0090000 AND/OR GROUND BASED FLIGHT OPERATIONS
0099000 *

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          CREW PERFORMANCE  *    CREW 0056000 AND PERFORMANCE 0172000*

0057000   CREW STATIONS
  0037000   NT  COCKPITS
  0106000   RT  HUMAN ENGINEERING
  0203000   RT  SEATING

          CRITICAL HEIGHT  *    ALTITUDE 0017000 AND CONTROL
                    CHARACTERISTICS 0044000    *

          CROSS-COURSE ERROR  *    COURSE 0055000 AND ERRORS 0076000*

          CROSS-GRID DISPLAY  *    PATTERNS 0170000 AND DISPLAY
                    0067000    *

          CRT  *    CATHODE RAY TUBES 0033000    *

0057600   CRUISE
  0000000   BT  AIRCRAFT MANEUVERS
  0087000   RT  FLIGHT MODE
  0128000   RT  LEVEL FLIGHT

          CYCLIC PITCH  *    PITCH 0179000    *

0058000   DAMPING
  0044000   RT  CONTROL CHARACTERISTICS
  0241000   RT  VIBRATION

0059000   DATA
  0085000   NT  FLIGHT DATA
  0213000   NT  SUBJECTIVE DATA
  0070000   RT  DOCUMENTATION
  0111000   RT  INFORMATION

0060000   DATA PROCESSING
  0113000   RT  INFORMATION PROCESSING

          DATA REDUCTION  *    DATA PROCESSING 0060000    *

          DATE OF DOCUMENT - SEE LAST PAGE

0061000   DEGREES OF FREEDOM
  0044000   RT  CONTROL CHARACTERISTICS
  0052000   RT  CONTROL SYSTEMS
  0053000   RT  CONTROLLING
  0062000   RT  DESIGN

0062000   DESIGN
  0062050   NT  DESIGN DRAWINGS
  0077350   NT  EXPERIMENTAL DESIGN
  0021000   RT  ANALYSIS
  0042000   RT  CONTROL ANALYSIS
  0061000   RT  DEGREES OF FREEDOM
  0063000   RT  DIAGRAMS
  0077300   RT  EXPERIMENTAL AIRCRAFT
  0095300   RT  FUEL CONSUMPTION
  0148000   RT  MODELS
  0158000   RT  OPTIMIZATION
  0201000   RT  SCALING
  0208000   RT  SIMULATION SYSTEMS
```


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0062050 DESIGN DRAWINGS
  0063000 AS DIAGRAMS
  0062000 BT DESIGN

DEVIATIONS * ERRORS 0076000 *

0063000 DIAGRAMS
  0062050 AS DESIGN DRAWINGS
  0062000 RT DESIGN
  0067000 RT DISPLAY
  0170000 RT PATTERNS
  0201000 RT SCALING
  0215000 RT SYMBOLS

0064000 DIALS
  0067000 BT DISPLAY
  0068000 BT DISPLAY COMPONENTS
  0109000 RT ILLUMINATION
  0112000 RT INFORMATION DISPLAY
  0189400 RT READABILITY

0065000 DIGITAL COMPUTERS
  0039000 BT COMPUTERS
  0182000 RT PROGRAMMED OPERATIONS

0066000 DIMENSIONS
  0171000 RT PAYLOAD
  0201000 RT SCALING
  0248000 RT WEIGHT

0066500 DISCRETE OPERATIONS
  0028000 RT AUTOMATIC CONTROL
  0041600 RT CONTINUOUS OPERATIONS
  0052000 RT CONTROL SYSTEMS
  0053000 RT CONTROLLING

0067000 DISPLAY
  0016000 NT ALTIMETERS
  0038800 NT COMPUTER PRINTOUT
  0046000 NT CONTROL DISPLAY
  0068000 NT DISPLAY COMPONENTS
  0110000 NT IMAGES
  0112000 NT INFORMATION DISPLAY
  0117000 NT INSTRUMENT DISPLAY
  0141000 NT MAPS
  0152000 NT MOVIES
  0176000 NT PICTORIAL DISPLAY
  0183000 NT PROJECTION DISPLAY
  0215000 NT SYMBOLS
  0224000 NT THREE-DIMENSIONAL DISPLAY
  0231000 NT TRANSPARENT DISPLAY
  0033000 RT CATHODE RAY TUBES
  0047000 RT CONTROL-DISPLAY
  0063000 RT DIAGRAMS
  0070000 RT DOCUMENTATION
  0090000 RT FLIGHT PROCEDURES
  0109000 RT ILLUMINATION
  0111000 RT INFORMATION
  0119000 RT INSTRUMENTS
  0148000 RT MODELS

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0189400   RT  READABILITY
0200000   RT  SCALES
0201000   RT  SCALING
0207000   RT  SIGNALS
0221000   RT  TELEVISION

          DISPLAY ARRANGEMENT  *    DISPLAY 0067000 AND DESIGN
                    0062000    *

0068000   DISPLAY COMPONENTS
  0067000   BT  DISPLAY
  0016000   NT  ALTIMETERS
  0064000   NT  DIALS
  0119000   RT  INSTRUMENTS
  0200000   RT  SCALES

          DISPLAY CONCEPTS  *    DISPLAY 0067000    *

          DISPLAY CONFIGURATION  *    CONFIGURATION 0040000 AND
                    DISPLAY 0067000    *

          DISPLAY-CONTROL  *    CONTROL-DISPLAY 0047000    *

          DISPLAY ILLUMINATION  *    DISPLAY 0067000 AND ILLUMINATION
                    0109000   *

          DISPLAY LAYOUT  *    DISPLAY 0067000 AND DESIGN 0062000    *

          DISPLAY PARAMETERS  *    DISPLAY 0067000 AND DESIGN 0062000*

          DISPLAY SYSTEM  *    DISPLAY 0067000    *

0069000   DISTANCE
  0017000   NT  ALTITUDE
  0132000   NT  LOW ALTITUDE

          DISTANCE MEASUREMENT  *    DISTANCE 0069000 AND
                    MEASUREMENT 0143000    *

          DISTURBANCES  *    PERTURBATION 0174100    *

0070000   DOCUMENTATION
  0030000   NT  BIBLIOGRAPHY
  0091000   NT  FLIGHT REPORTS
  0038300   RT  COMMUNICATIONS
  0059000   RT  DATA
  0067000   RT  DISPLAY
  0111000   RT  INFORMATION

          DOMESTIC AIRCRAFT  *    AIRCRAFT 0011000    *

          DOPPLER RADAR  *    RADAR 0187000    *

0071000   DRIFT
  0003000   RT  ACCURACY
  0044000   RT  CONTROL CHARACTERISTICS
  0045000   RT  CONTROL DEFICIENCIES
  0076000   RT  ERRORS
  0119000   RT  INSTRUMENTS
  0190000   RT  RELIABILITY
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          EFFICIENCY *    PERFORMANCE 0172000    *

          EJECTION SEATS *    SAFETY EQUIPMENT 0199000 AND
                    SEATING 0203000    *

0072000   ELECTRICAL SYSTEM

          ELECTROLUMINESCENT DISPLAY *    ILLUMINATION 0103000 AND
                    DISPLAY 0067000    *

0073000   EMERGENCY CONDITIONS
  0032000   RT  CATASTROPHIC FAILURE
  0078000   RT  FAIL-SAFE
  0079000   RT  FAILURE
  0156000   RT  NORMAL CONDITIONS
  0174100   RT  PERTURBATION
  0198000   RT  SAFETY
  0199000   RT  SAFETY EQUIPMENT
  0233500   RT  VARIABLE STABILITY CONDITIONS

          EMERGENCY FLIGHT MODE *    EMERGENCY CONDITIONS 0073000 AND
                    FLIGHT MODE 0087000    *

          ENGINE DATA *    ENGINES 0074000 AND DATA 0059000    *

          ENGINE INSTRUMENTATION *    ENGINES 0074000 AND
                    INSTRUMENTATION 0118000    *

          ENGINEERING DRAWINGS *    DESIGN DRAWINGS 0062050    *

0074000   ENGINES
  0123000   NT  JET ENGINES
  0077200   RT  EXHAUST GASES
  0095300   RT  FUEL CONSUMPTION
  0186000   RT  PROPULSION SYSTEM

0075000   EQUIPMENT
  0009000   NT  AIRBORNE FLIGHT EQUIPMENT
  0098000   NT  GROUND BASED FLIGHT EQUIPMENT
  0199000   NT  SAFETY EQUIPMENT
  0230000   NT  TRAINING EQUIPMENT

0076000   ERRORS
  0178000   NT  PILOT ERRORS
  0003000   RT  ACCURACY
  0071000   RT  DRIFT
  0079000   RT  FAILURE
  0137000   RT  MALFUNCTIONS

          ESSENTIAL CONFIGURATION *    CONFIGURATION 0040000    *

0077000   EVALUATION
  0173000   NT  PERSONAL EVALUATION
  0021000   RT  ANALYSIS
  0092000   RT  FLIGHT TESTING
  0121000   RT  INTERVIEW
  0143000   RT  MEASUREMENT
  0222000   RT  TESTING

0077200   EXHAUST GASES
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```
  0074000    RT  ENGINES
  0100250    RT  GROUND EFFECT
  0123000    RT  JET ENGINES
  0186000    RT  PROPULSION SYSTEMS
  0225000    RT  THRUST

0077300    EXPERIMENTAL AIRCRAFT
  0011000    BT  AIRCRAFT
  0040000    RT  CONFIGURATION
  0062000    RT  DESIGN
  0077300    RT  EXPERIMENTAL AIRCRAFT
  0092000    RT  FLIGHT TESTING

0077350    EXPERIMENTAL DESIGN
  0062000    BT  DESIGN
  0021000    RT  ANALYSIS
  0143000    RT  MEASUREMENT
  0222000    RT  TESTING

0078000    FAIL-SAFE
  0079000    BT  FAILURE
  0198000    BT  SAFETY
  0062000    RT  DESIGN
  0073000    RT  EMERGENCY CONDITIONS
  0106000    RT  HUMAN ENGINEERING
  0137000    RT  MALFUNCTIONS

0079000    FAILURE
  0078000    NT  FAIL-SAFE
  0137000    NT  MALFUNCTIONS
  0076000    RT  ERRORS
  0080000    RT  FAILURE ANALYSIS
  0136000    RT  MAINTENANCE
  0190000    RT  RELIABILITY
  0198000    RT  SAFETY

0080000    FAILURE ANALYSIS
  0021000    BT  ANALYSIS
  0079000    RT  FAILURE

             FAN LIFT  *    LIFT 0129000 AND LIFT FAN 0130000    *

             FEASIBILITY  *    EVALUATION  0377000    *

0081000    FIGHTER AIRCRAFT
  0216700    AS  TACTICAL AIRCRAFT
  0011000    BT  AIRCRAFT
  0145000    BT  MILITARY AIRCRAFT

0082000    FIXED BASE SIMULATORS
  0208000    BT  SIMULATION SYSTEMS
  0010000    RT  AIRBORNE SIMULATORS

             FIXED WING AIRCRAFT  *    CONVENTIONAL AIRCRAFT 0054000    *

             FIXED WING VTOL  *    VTOL AIRCRAFT 0246000 AND
                      CONFIGURATION 0040000    *

0083000    FLIGHT
  0012000    BT  AIRCRAFT MANEUVERS
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```
  0128000   NT  LEVEL FLIGHT
  0236000   NT  VERTICAL FLIGHT
  0093000   RT  FLYING

0084000   FLIGHT CHARACTERISTICS
  0005000   RT  AERODYNAMIC STABILITY
  0044000   RT  CONTROL CHARACTERISTICS

          FLIGHT CONTROL  *    FLIGHT 0083000 AND CONTROLLING 0053000*

          FLIGHT CONTROLS  *    CONTROL ELEMENTS 0048000 AND/OR
                  CONTROL SYSTEMS 0052000 AND FLIGHT 0083000    *

0085000   FLIGHT DATA
  0059000   BT  DATA

          FLIGHT DEMONSTRATION  *    FLIGHT TESTING 0092000    *

          FLIGHT EVALUATION  *    FLIGHT 0083000 AND EVALUATION
                  0077000    *

0086000   FLIGHT INSTRUMENTS
  0119000   BT  INSTRUMENTS
  0016000   NT  ALTIMETERS
  0009000   RT  AIRBORNE FLIGHT EQUIPMENT

          FLIGHT METHODS  *    FLIGHT MODE 0087000    *

0087000   FLIGHT MODE
  0012000   BT  AIRCRAFT MANEUVERS
  0126000   NT  LATERAL MODE
  0128000   NT  LEVEL FLIGHT
  0131000   NT  LONGITUDINAL MODE
  0236000   NT  VERTICAL FLIGHT
  0057600   RT  CRUISE
  0237000   RT  VERTICAL MANEUVERS

0088000   FLIGHT MODE TRANSITION
  0012000   BT  AIRCRAFT MANEUVERS

          FLIGHT OPTIMIZATION  *    FLIGHT 0083000 AND OPTIMIZATION
                  0158000    *

0089000   FLIGHT PATH
  0055000   RT  COURSE
  0228000   RT  TRACKING

0090000   FLIGHT PROCEDURES
  0220000   BT  TASKS
  0107000   NT  IFR
  0239000   NT  VFR
  0008000   RT  AIR TRAFFIC CONTROL
  0099000   RT  GROUND BASED FLIGHT OPERATIONS

0091000   FLIGHT REPORTS
  0070000   BT  DOCUMENTATION
  0085000   RT  FLIGHT DATA

          FLIGHT TEST DATA  *    FLIGHT DATA 0085000 AND
                  FLIGHT TESTING 0092000    *
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0092000 FLIGHT TESTING
  0222000 BT TESTING
  0077000 RT EVALUATION
  0077300 RT EXPERIMENTAL AIRCRAFT
  0250000 RT WIND TUNNELS

0093000 FLYING
  0053000 BT CONTROLLING
  0220000 BT TASKS
  0044000 RT CONTROL CHARACTERISTICS
  0083000 RT FLIGHT
  0094000 RT FLYING AIDS
  0154000 RT NAVIGATION
  0177000 RT PILOT
  0244000 RT VISUAL CUES

0094000 FLYING AIDS
  0027000 RT AUGMENTED PILOT CONTROL
  0093000 RT FLYING
  0099000 RT GROUND BASED FLIGHT OPERATIONS
  0177000 RT PILOT

FLYING QUALITIES * FLIGHT CHARACTERISTICS 0084000 AND CONTROL CHARACTERISTICS 0044000 *

0095000 FOREIGN AIRCRAFT
  0011000 BT AIRCRAFT

FORWARD ACCELERATION * ACCELERATION 0010000 *

0095300 FUEL CONSUMPTION
  0062000 RT DESIGN
  0074000 RT ENGINES
  0172000 RT PERFORMANCE
  0188200 RT RANGE

FULL IFR CONDITIONS * IFR CONDITIONS 0108000 *

FULL VFR CONDITIONS * VFR CONDITIONS 024000 *

FUNCTIONAL ANALYSIS- THE ANALYSIS OF THOSE HUMAN AND OR EQUIPMENT FUNCTIONS REQUIRED TO PERFORM A GIVEN TASK OR OPERATION

0095600 FUNCTIONAL ANALYSIS
  0021000 BT ANALYSIS
  0042000 RT CONTROL ANALYSIS
  0106100 RT HUMAN PERFORMANCE
  0219000 RT TASK ANALYSIS
  0227000 RT TIME LINE ANALYSIS

GENERAL PURPOSE AIRCRAFT * AIRCRAFT 0011000 *

0096000 GEOGRAPHIC DIRECTION
  0055000 RT COURSE
  0141000 RT MAPS
  0154000 RT NAVIGATION
  0180000 RT POSITION

0097000 GLIDE

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0012000 BT AIRCRAFT MANEUVERS

GLIDE APPROACH * GLIDE 0097000 AND APPROACH 0024000 *

GLIDE SLOPE * FLIGHT PATH 0089000 AND GLIDE 0097000 *

GO-NO GO CONTROL * ON-OFF CONTROL 0157400 *

0098000 GROUND BASED FLIGHT EQUIPMENT
0075000 BT EQUIPMENT
0099000 RT GROUND BASED FLIGHT OPERATIONS

0099000 GROUND BASED FLIGHT OPERATIONS
0007000 RT AIR TERMINAL
0008000 RT AIR TRAFFIC CONTROL
0043000 RT CONTROL AUTHORITY TRANSFER
0090000 RT FLIGHT PROCEDURES
0094000 RT FLYING AIDS
0098000 RT GROUND BASED FLIGHT EQUIPMENT
0220000 RT TASKS

0100000 GROUND BASED SIMULATORS
0208000 BT SIMULATION SYSTEMS
0010000 RT AIRBORNE SIMULATORS
0082000 RT FIXED BASE SIMULATORS

GROUND CONTROL * CONTROLLING 0053000 AND GROUND BASED FLIGHT OPERATIONS 0099000 *

GROUND CONTROL EQUIPMENT * GROUND BASED FLIGHT EQUIPMENT 0098000 *

GROUND EFFECT- ANY EFFECT RESULTING FROM THE INTERACTION OF AIRBORNE VEHICLES OR THEIR EXHAUST GASES WITH THE GROUND. DUST CLOUDS RAISED BY A LANDING VTOL IS AN EXAMPLE

0100250 GROUND EFFECT
0077200 RT EXHAUST GASES
0129000 RT LIFT
0132000 RT LOW ALTITUDE
0225000 RT THRUST
0233000 RT TURBULENCE
0233500 RT VARIABLE STABILITY CONDITIONS

GROUND FACILITIES * GROUND BASED FLIGHT EQUIPMENT 0098000 *

GUIDANCE * GUIDANCE SYSTEMS 0101000 *

0101000 GUIDANCE SYSTEMS
0052000 BT CONTROL SYSTEMS
0154000 RT NAVIGATION

GYROS * GYROSCOPES *

0102000 GYROSCOPES
0086000 BT FLIGHT INSTRUMENTS
0119000 BT INSTRUMENTS
0101000 RT GUIDANCE SYSTEMS

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HANDLING * CONTROLLING 0053000 *

HANDLING QUALITIES * CONTROL CHARACTERISTICS 0044000 *

HEADING * COURSE 0055000 *

HEADING CONTROL * COURSE 005000 AND
GUIDANCE SYSTEMS 0101000 *

HEADING STABILITY * COURSE 0055000 AND
ERRORS 0076000 *

HEIGHT. DISTANCE OF AN OBJECT FROM THE GROUND AS A REFERENCE
PLANE * ALTITUDE 0017000 *

HEIGHT. VERTICAL DIMENSION OF AN OBJECT
* DIMENSIONS 0066000 *

0103000 HELICOPTERS
0011000 BT AIRCRAFT
0246000 BT VTOL AIRCRAFT

HIGH PERFORMANCE * PERFORMANCE 0172000 *

HIGH PERFORMANCE AIRCRAFT
* SUPERSONIC AIRCRAFT 0214000 *

HIGH SPEED CAPABILITY * PERFORMANCE 0172000 *

0104000 HORIZON
0244000 RT VISUAL CUES

HORIZON LINE * HORIZON 0104000 *

HORIZONTAL ATTITUDE * ATTITUDE 0025000 *

HORIZONTALITY * ATTITUDE 0025000 *

HOVER * HOVERING 0105000 *

HOVER DISPLAY * HOVERING 0105000 AND DISPLAY 0067000 *

0105000 HOVERING
0012000 BT AIRCRAFT MANEUVERS

HOVERING STABILITY * HOVERING 0105000 AND
AERODYNAMIC STABILITY 0005000 *

0106000 HUMAN ENGINEERING
0062000 BT DESIGN
0047000 NT CONTROL-DISPLAY
0056000 RT CREW
0057000 RT CREW STATIONS
0198000 RT MAN-MACHINE SYSTEMS
0174000 RT PERSONNEL
0203000 RT SEATING
0219000 RT TASK ANALYSIS
0220000 RT TASKS
0227000 RT TIME LINE ANALYSIS
0251000 RT WORK LOAD

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0106100   HUMAN PERFORMANCE
  0172000     BT  PERFORMANCE
  0056000     RT  CREW
  0095600     RT  FUNCTIONAL ANALYSIS
  0219000     RT  TASK ANALYSIS
  0220000     RT  TASKS

          HYBRID SIMULATION  *     SIMULATION SYSTEMS 0208000     *

          HYPERSONIC AIRCRAFT  *    SUPERSONIC AIRCRAFT 0214000     *

          IFR- INSTRUMENT FLYING RULES

0107000   IFR
  0090000     BT  FLIGHT PROCEDURES
  0031000     RT  BLIND LANDING

0108000   IFR CONDITIONS
  0015000     RT  ALL-WEATHER CONDITIONS
  0240000     RT  VFR CONDITIONS

          IFR POINT LANDINGS  *     IFR 0107000 AND LANDING 0124000    *

0109000   ILLUMINATION
  0064000     RT  DIALS
  0067000     RT  DISPLAY
  0189400     RT  READABILITY
  0242000     RT  VISIBILITY

          IMAGE DETAIL  *     IMAGES 0110000     *

          IMAGE GENERATION  *     IMAGES 0110000     *

0110000   IMAGES
  0067000     BT  DISPLAY
  0033000     RT  CATHODE RAY TUBES
  0063000     RT  DIAGRAMS
  0170000     RT  PATTERNS
  0176000     RT  PICTORIAL DISPLAY
  0215000     RT  SYMBOLS
  0221000     RT  TELEVISION

          INDEPENDENT VARIABLE-DEPENDENT VARIABLE TIME INTERVAL
                    *     RESPONSE TIME 0193200     *

          INDICATED AIRSPEED  *     AIRSPEED 0013000     *

          IN-FLIGHT EVALUATION  *     FLIGHT TESTING 0092000 AND
                    EVALUATION 0077000     *

0111000   INFORMATION
  0059000     RT  DATA
  0067000     RT  DISPLAY
  0070000     RT  DOCUMENTATION
  0094000     RT  FLYING AIDS
  0207000     RT  SIGNALS

          INFORMATION ANALYSIS  *     ANALYSIS 0021000 AND
                    INFORMATION 0111000     *
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Contrails

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0112000   INFORMATION DISPLAY
  0067000   BT  DISPLAY
  0064000   RT  DIALS
  0119000   RT  INSTRUMENTS
  0200000   RT  SCALES

0113000   INFORMATION PROCESSING
  0060000   RT  DATA PROCESSING

0114000   INFOR ATION REQUIREMENTS
  0192000   BT  REQUIREMENTS

0115000   INSTALLATION

0115000   INSTRUCTOR
  0174000   BT  PERSONNEL
  0220000   BT  TASKS
  0220000   RT  TASKS
  0229000   RT  TRAINING

          INSTRUCTOR PILOT  *    INSTRUCTOR 0116000  AND
                    PILOT 0177000    *

          INSTALLMENT  *     INSTALLATION 0115000    *

          INSTRUMENT DESIGN  *    DESIGN 0062000 AND
                    INSTRUMENTS 0119000    *

0116000   INSTRUCTOR
  0174000   BT  PERSONNEL
  0220000   RT  TASKS
  0229000   RT  TRAINING

          INSTRUMENT APPROACH  *    APPROACH 0024000 AND
                    IFR 0107000    *

0117000   INSTRUMENT DISPLAY
  0067000   BT  DISPLAY
  0046000   RT  CONTROL DISPLAY
  0160000   RT  PANELS

          INSTRUMENT FLIGHT  *    FLIGHT 0083000 AND IFR 0107000    *

          INSTRUMENT LANDING  *    LANDING 0124000 AND IFR 0107000

          INSTRUMENT OPERATION  *    INSTRUMENTS 0119000 AND
                    PERFORMANCE 0172000    *

          INSTRUMENT RESPONSE SPEED  *    INSTRUMENTS 0119000 AND
                    RESPONSE TIME 0193200    *

          INSTRUMENT SYSTEM  *    INSTRUMENTATION 0118000   *

          INSTRUMENT TRAINER  *    TRAINING EQUIPMENT 0230000 AND
                    INSTRUMENTS 0119000   *

0118000   INSTRUMENTATION
  0062000   RT  DESIGN
  0119000   RT  INSTRUMENTS
  0143000   RT  MEASUREMENT
```


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```
0119000   INSTRUMENTS
  0013100     NT  AIRSPEED INDICATORS
  0016000     NT  ALTIMETERS
  0086000     NT  FLIGHT INSTRUMENTS
  0187000     NT  RADAR
  0003000     RT  ACCURACY
  0067000     RT  DISPLAY
  0068000     RT  DISPLAY COMPONENTS
  0071000     RT  DRIFT
  0118000     RT  INSTRUMENTATION
  0143000     RT  MEASUREMENT
  0189400     RT  READABILITY
  0200000     RT  SCALES

            INTEGRATED CONTROLS  *    CONTROL SYSTEMS 0052000 AND
                      INTEGRATED SYSTEMS 0120000    *

            INTEGRATED DISPLAY  *    DISPLAY 0067000 AND INTEGRATED
                      SYSTEMS 0120000    *

0120000   INTEGRATED SYSTEMS
  0052000     RT  CONTROL SYSTEMS

            INTERMITTENT IFR CONDITIONS  *    IFR CONDITIONS 0108000
                      AND DISCRETE OPERATIONS 0066500    *

            INTERPRETATION TIME  *    INFORMATION PROCESSING 0113000 AND
                      RESPONSE TIME 0193200    *

0121000   INTERVIEW
  0077000     RT  EVALUATION
  0173000     RT  PERSONAL EVALUATION

0122000   JET AIRCRAFT
  0011000     RT  AIRCRAFT

0123000   JET ENGINES
  0074000     BT  ENGINES
  0077200     RT  EXHAUST GASES
  0186000     RT  PROPULSION SYSTEMS

            JET FIGHTER  *    JET AIRCRAFT 0122000 AND FIGHTER
                      AIRCRAFT 0081000    *

            JET LIFT  *    LIFT 0129000 AND JET ENGINES 0123000    *

            LABORATORY EVALUATION  *    EVALUATION 0077000    *

            LAG TIME  *    RESPONSE TIME 0193200    *

0124000   LANDING
  0012000     BT  AIRCRAFT MANEUVERS
  0024000     RT  APPROACH

            LANDING DISPLAY  *    LANDING 0124000 AND DISPLAY 0067000  *

0125000   LANDING SITES
  0124000     RT  LANDING

            LARGE AIRCRAFT  *    AIRCRAFT 0011000    *
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```
          LATERAL CONTROL  *    CONTROLLING 0053000 AND
                    LATERAL MODE 0126000    *
        0   0   LATERAL MODE
  0087000   BT  FLIGHT MODE
  0131000   RT  LONGITUDINAL MODE
  0238000   RT  VERTICAL MODE

          LATERAL TILT  *    ATTITUDE 0025000    *

0127000   LENSES
  0146000   RT  MIRRORS

0128000   LEVEL FLIGHT
  0012000   BT  AIRCRAFT MANEUVERS
  0083000   BT  FLIGHT
  0087000   BT  FLIGHT MODE
  0055000   RT  COURSE
  0057600   RT  CRUISE
  0131000   RT  LONGITUDINAL MODE

0129000   LIFT
  0004000   RT  AERODYNAMIC FLOW
  0005000   RT  AERODYNAMIC STABILITY
  0100250   RT  GROUND EFFECT
  0172000   RT  PERFORMANCE
  0206000   RT  SHORT FIELD TAKE-OFF
  0218000   RT  TAKE-OFF
  0225000   RT  THRUST
  0237000   RT  VERTICAL MANEUVERS

0130000   LIFT FAN
  0129000   RT  LIFT
  0197000   RT  ROTOR BLADES
  0246000   RT  VTOL AIRCRAFT

          LIFT-OFF  *    TAKE-OFF 0218000 AND VERTICAL
                    MANEUVERS 0237000    *

          LONGITUDINAL CONTROL  *    CONTROLLING 0053000 AND
                    LONGITUDINAL MODE 0131000    *

0131000   LONGITUDINAL MODE
  0087000   BT  FLIGHT MODE
  0126000   RT  LATERAL MODE
  0128000   RT  LEVEL FLIGHT
  0238000   RT  VERTICAL MODE

          LONGITUDINAL TILT  *    ATTITUDE 0025000 AND LONGITUDINAL
                    MODE 0131000    *

          LONGITUDINAL TRIM  *    CONTROL SETTINGS 0050000 AND
                    LONGITUDINAL MODE 0131000    *

          LOW ALTITUDE = 0 TO 200 FT

0132000   LOW ALTITUDE
  0017000   BT  ALTITUDE
  0069000   BT  DISTANCE
  0100250   RT  GROUND EFFECT
```


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LOW HOVERING * HOVERING 0105000 AND LOW ALTITUDE 0132000 *

LOW SPEED 0 - 100 MPH

0133000 LOW SPEED
0235000 BT VELOCITY

LOW SPEED MANEUVERING * AIRCRAFT MANEUVERS 0012000 AND LOW SPEED 0133000 *

0134000 LUNAR EXCURSION MODULE
0209000 BT SPACE VEHICLES
0149000 RT MOON

LUNAR LANDING * LANDING 0124000 AND MOON 0149000 *

0135000 MACH NUMBER
0214000 RT SUPERSONIC AIRCRAFT
0235000 RT VELOCITY

MAINTAINABILITY * MAINTENANCE 0136000 *

0136000 MAINTENANCE
0220000 BT TASKS
0137000 RT MALFUNCTIONS
0190000 RT RELIABILITY
0191000 RT REPAIR

MALFUNCTION DETECTION * MALFUNCTIONS 0137000 AND FAILURE ANALYSIS 0080000 *

MALFUNCTION DIAGNOSIS * MALFUNCTIONS 0137000 AND FAILURE ANALYSIS 0080000 *

0137000 MALFUNCTIONS
0032000 RT CATASTROPHIC FAILURE
0076000 RT ERRORS
0078000 RT FAIL-SAFE
0079000 RT FAILURE
0136000 RT MAINTENANCE
0178000 RT PILOT ERRORS
0191000 RT REPAIR
0198000 RT SAFETY

0138000 MAN-MACHINE SYSTEMS
0053000 RT CONTROLLING
0056000 RT CREW
0106000 RT HUMAN ENGINEERING
0155000 RT NAVIGATOR
0174000 RT PERSONNEL
0177000 RT PILOT
0188000 RT RADIO OPERATOR
0220000 RT TASKS

MANEUVERS * AIRCRAFT MANEUVERS 0012000 *

0139000 MANUAL CONTROL
0053000 BT CONTROLLING
0220000 BT TASKS

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```
  0028000   RT  AUTOMATIC CONTROL
  0052000   RT  CONTROL SYSTEMS
  0056000   RT  CREW
  0138000   RT  MAN-MACHINE SYSTEMS
  0204000   RT  SEMI-AUTOMATIC CONTROL

          MANUAL FLIGHT MODE  *    FLYING 0093000 AND
                    MANUAL CONTROL 0139000    *

0140000   MANUFACTURING TECHNOLOGY
  0211000   RT  STATE-OF-THE-ART

0141000   MAPS
  0067000   BT  DISPLAY
  0055000   RT  COURSE
  0096000   RT  GEOGRAPHIC DIRECTION
  0215000   RT  SYMBOLS

0142000   MATHEMATICAL MODELS
  0148000   BT  MODELS
  0208000   RT  SIMULATION SYSTEMS
  0223000   RT  THEORETICAL ANALYSIS

0143000   MEASUREMENT
  0003000   RT  ACCURACY
  0077000   RT  EVALUATION
  0077300   RT  EXPERIMENTAL DESIGN
  0222000   RT  TESTING

          MECHANICAL CONTROL  *    AUTOMATIC CONTROL 0028000 ANDSOR
                    CONTROL SYSTEMS 0052000    *

          MEDICAL ASPECTS OF FLYING  *    AEROSPACE MEDICINE 0006000 *

0144000   METROPOLITAN AREA
  0007000   RT  AIR TERMINAL
  0008000   RT  AIR TRAFFIC CONTROL

0145000   MILITARY AIRCRAFT
  0011000   BT  AIRCRAFT
  0081000   NT  FIGHTER AIRCRAFT
  0216700   NT  TACTICAL AIRCRAFT

0146000   MIRRORS
  0127000   RT  LENSES

0147000   MISSION
  0188200   RT  RANGE
  0202000   RT  SCHEDULE
  0247000   RT  WEAPON SYSTEMS

          MISSION ANALYSIS  *    ANALYSIS 0021000 AND MISSION 0147000*

          MOCKUP  *    SCALING 0201000 AND MODELS 0148000    *

0148000   MODELS
  0142000   NT  MATHEMATICAL MODELS
  0040000   RT  CONFIGURATION
  0062000   RT  DESIGN
  0201000   RT  SCALING
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```
  0208000   RT  SIMULATION SYSTEMS
  0223000   RT  THEORETICAL ANALYSIS

0149000   MOON
  0134000   RT  LUNAR EXCURSION MODULE

0150000   MOTION
  0196000   NT  ROTATION
  0189000   RT  RATE

            MOVIE SCRIPT  *    MOVIES 0152000    *

0151000   MOTION CUES
  0216750   RT  TACTILE CUES
  0244000   RT  VISUAL CUES

            MOTION PICTURES  *    MOVIES 0152000    *

            MOTION SIMULATORS  *    MOTION 0150000 AND SIMULATION
                      SYSTEMS 0208000    *

            MOVEMENT  *    MOTION 0150000    *

0152000   MOVIES
  0067000   BT  DISPLAY

0153000   MOVING BASE SIMULATORS
  0208000   BT  SIMULATION SYSTEMS

            MULTI-CREW SIMULATOR  *    SIMULATION SYSTEMS 0208000 AND
                      CREW 0056000    *

0154000   NAVIGATION
  0220000   BT  TASKS
  0055000   RT  COURSE
  0093000   RT  FLYING
  0096000   RT  GEOGRAPHIC DIRECTION
  0155000   RT  NAVIGATOR
  0180000   RT  POSITION

            NAVIGATION AIDS  *    FLYING AIDS 0094000 AND NAVIGATION
                      0154000    *

0155000   NAVIGATOR
  0056000   BT  CREW
  0174000   BT  PERSONNEL
  0220000   RT  TASKS

0156000   NORMAL CONDITIONS
  0073000   RT  EMERGENCY CONDITIONS

0157000   OBSERVATION
  0220000   BT  TASKS
  0242000   RT  VISIBILITY
  0243000   RT  VISION
  0244000   RT  VISUAL CUES

            OFF-ON CONTROL  *    ON-OFF CONTROL 0157400    *

0157400   ON-OFF CONTROL
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```
  0052000   BT  CONTROL SYSTEMS
  0185000   RT  PROPORTIONAL CONTROL
  0195000   RT  ROOT MEAN SQUARE CONTROL

          OPERATOR CONTROL ACTIVITIES  *    CONTROLLING 0053000    *

          OPINION STUDY  *    PERSONAL EVALUATION 0173000 AND
                    ANALYSIS 0021000    *

          OPINIONS  *    PERSONAL EVALUATION 0173000    *

0158000   OPTIMIZATION
  0021000   RT  ANALYSIS
  0062000   RT  DESIGN
  0077000   RT  EVALUATION

          OSCILLATION  *    VIBRATION 0241000    *

          OSCILLOGRAPHIC RECORDS  *    OSCILLOGRAPHS 0159000 AND
                    DOCUMENTATION 0070000    *

0159000   OSCILLOGRAPHS
  0119000   BT  INSTRUMENTS

          OUT-OF-WINDOW VIEWING  *    OBSERVATION 0157000    *

          OVERSHOOT  *    ERRORS 0076000    *

0160000   PANELS
  0046000   RT  CONTROL DISPLAY
  0051000   RT  CONTROL SURFACES
  0067000   RT  DISPLAY
  0117000   RT  INSTRUMENT DISPLAY

          PASSIVE NAVIGATION  *    NAVIGATION 0154000    *

0170000   PATTERNS
  0067000   BT  DISPLAY
  0063000   RT  DIAGRAMS
  0110000   RT  IMAGES
  0148000   RT  MODELS
  0215000   RT  SYMBOLS

0171000   PAYLOAD
  0066000   RT  DIMENSIONS
  0248000   RT  WEIGHT

0172000   PERFORMANCE
  0106100   NT  HUMAN PERFORMANCE
  0056000   RT  CREW
  0095300   RT  FUEL CONSUMPTION
  0129000   RT  LIFT
  0181000   RT  POWER
  0188200   RT  RANGE
  0220000   RT  TASKS

0173000   PERSONAL EVALUATION
  0077000   BT  EVALUATION
  0054600   NT  COOPER RATING SYSTEM
  0106000   RT  HUMAN ENGINEERING
```


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0121000 RT INTERVIEW
0138000 RT MAN-MACHINE SYSTEMS
0213000 RT SUBJECTIVE DATA

0174000 PERSONNEL
0056000 NT CREW
0116000 NT INSTRUCTOR
0155000 NT NAVIGATOR
0177000 NT PILOT
0188000 NT RADIO OPERATOR
0044000 RT CONTROL CHARACTERISTICS
0106000 RT HUMAN ENGINEERING
0119000 RT TASK ANALYSIS
0138000 RT MAN-MACHINE SYSTEMS
0233000 RT TURBULENCE

0174100 PERTURBATION
0073000 RT EMERGENCY CONDITIONS
0233500 RT VARIABLE STABILITY CONDITIONS

0175000 PHOTOGRAPHY

0176000 PICTORIAL DISPLAY
0067000 BT DISPLAY
0110000 RT IMAGES

0177000 PILOT
0056000 BT CREW
0093000 RT FLYING
0094000 RT FLYING AIDS
0138000 RT MAN-MACHINE SYSTEMS
0220000 RT TASKS

PILOT COMMENTS * PILOT 0177000 AND PERSONAL EVALUATION 0173000 *

PILOT-CONTROLLER INTEGRATION * PILOT 0177000, AUTOMATIC CONTROL 0028000 AND INTEGRATED SYSTEMS 0120000 *

PILOT OPINIONS * PILOT 0177000 AND PERSONAL EVALUATION 0173000 *

PILOT PERFORMANCE * HUMAN PERFORMANCE AND PILOT 0177000 *

PILOT PREPARATION * PILOT 0177000 AND TRAINING 0229000 *

PILOT RATINGS * PILOT 0177000 AND PERSONAL EVALUATION 0173000 *

PILOT TRAINING * PILOT 0177000 AND TRAINING 0229000 *

0178000 PILOT ERRORS
0076000 BT ERRORS
0137000 RT MALFUNCTIONS

0179000 PITCH
0044000 BT CONTROL CHARACTERISTICS
0045000 BT CONTROL DEFICIENCIES
0005000 RT AERODYNAMIC STABILITY

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Contrails

0194000 RT ROLL
0252000 RT YAW

PITCHING MOMENTS * PITCH 0179000 *

POSITION= LOCATION OF AN OBJECT,REPRESENTATION OR PERSON
RELATIVE TO A REFERENCE POINT OR PLANE

0180000 POSITION
0017000 RT ALTITUDE
0025000 RT ATTITUDE
0055000 RT COURSE
0090000 RT GEOGRAPHIC DIRECTION
0154000 RT NAVIGATION
0187000 RT RADAR
0228000 RT TRACKING

0181000 POWER
0049000 NT CONTROL POWER
0074000 RT ENGINES
0172000 RT PERFORMANCE
0186000 RT PROPULSION SYSTEMS
0225000 RT THRUST

PRECISION * ACCURACY 0003000 AND/OR RELIABILITY 0190000*

PRODUCTION * MANUFACTURING TECHNOLOGY 0140000 *

0182000 PROGRAMMED OPERATIONS
0019000 RT ANALOG COMPUTERS
0028000 RT AUTOMATIC CONTROL
0065000 RT DIGITAL COMPUTERS
0208000 RT SIMULATION SYSTEMS

0182100 PROGRESS REPORT

0183000 PROJECTION DISPLAY
0067000 BT DISPLAY

0184000 PROPELLER DRIVEN AIRCRAFT
0011000 BT AIRCRAFT

0185000 PROPORTIONAL CONTROL
0052000 BT CONTROL SYSTEMS
0053000 RT CONTROLLING
0157400 RT OFF-ON CONTROL
0195000 RT ROOT MEAN SQUARE CONTROL

0185100 PROPOSAL

0186000 PROPULSION SYSTEMS
0074000 RT ENGINES
0077200 RT EXHAUST GASES
0123000 RT JET ENGINES
0181000 RT POWER

PROTOTYPE AIRCRAFT * EXPERIMENTAL AIRCRAFT 0077300 *

PROTOTYPE DISPLAY * DISPLAY 0067000 AND MODELS 0148000 *

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PUBLICATION DATE OF DOCUMENT: SEE LAST PAGE

0187000 RADAR
- 0119000 BT INSTRUMENTS
- 0038300 RT COMMUNICATIONS
- 0180000 RT POSITION
- 0187200 RT RADIO
- 0228000 RT TRACKING

0187200 RADIO
- 0038300 RT COMMUNICATIONS
- 0187000 RT RADAR
- 0188000 RT RADIO OPERATOR
- 0221000 RT TELEVISION

0188000 RADIO OPERATOR
- 0056000 BT CREW
- 0038300 RT COMMUNICATIONS
- 0187200 RT RADIO
- 0220000 RT TASKS

0188200 RANGE
- 0055000 RT COURSE
- 0095300 RT FUEL CONSUMPTION
- 0147000 RT MISSION
- 0172000 RT PERFORMANCE
- 0188200 RT RANGE

0189000 RATE
- 0151000 RT MOTION
- 0193200 RT RESPONSE TIME
- 0235000 RT VELOCITY

RATINGS * PERSONAL EVALUATION 0173000 *

0189400 READABILITY
- 0064000 RT DIALS
- 0067000 RT DISPLAY
- 0109000 RT ILLUMINATION
- 0119000 RT INSTRUMENTS
- 0242000 RT VISIBILITY

RECORDS * DOCUMENTATION 0070000 *

RECTANGULAR APPROACH * APPROACH 0024000 *

0190000 RELIABILITY
- 0003000 RT ACCURACY
- 0032000 RT CATASTROPHIC FAILURE
- 0078000 RT FAIL-SAFE
- 0079000 RT FAILURE
- 0136000 RT MAINTENANCE
- 0172000 RT PERFORMANCE
- 0191000 RT REPAIR

0191000 REPAIR
- 0220000 BT TASKS
- 0136000 RT MAINTENANCE
- 0190000 RT RELIABILITY

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0192000   REQUIREMENTS
  0114000     NT  INFORMATION REQUIREMENTS

            RESEARCH AIRCRAFT  *    EXPERIMENTAL AIRCRAFT 0077300    *

0193000   RESPONSE
  0003000     RT  ACCURACY
  0044000     RT  CONTROL CHARACTERISTICS
  0053000     RT  CONTROLLING
  0071000     RT  DRIFT
  0084000     RT  FLIGHT CHARACTERISTICS
  0193200     RT  RESPONSE TIME

0193200   RESPONSE TIME
  0189000     RT  RATE
  0193000     RT  RESPONSE

0194000   ROLL
  0044000     BT  CONTROL CHARACTERISTICS
  0045000     BT  CONTROL DEFICIENCIES
  0005000     RT  AERODYNAMIC STABILITY
  0179000     RT  PITCH
  0252000     RT  YAW

            ROLL OSCILLATION  *    ROLL 0194000 AND VIBRATION 0241000  *

0195000   ROOT MEAN SQUARE CONTROL
  0052000     BT  CONTROL SYSTEMS
  0053000     RT  CONTROLLING
  0157400     RT  OFF-ON CONTROL
  0185000     RT  PROPORTIONAL CONTROL

            ROTATING COCKPITS  *    ROTATION 0196000 AND COCKPITS
                  0037000    *

0196000   ROTATION
  0151000     BT  MOTION
  0023000     RT  ANGULAR VELOCITY

0197000   ROTOR BLADES
  0217000     NT  TAIL ROTOR
  0103000     RT  HELICOPTERS

            ROUTE  *    COURSE 0055000    *

            ROUTE ADJUSTMENT  *    COURSE 0055000 AND GUIDANCE
                  SYSTEMS 0101000    *

            ROUTE CONTROL  *    COURSE 0055000 AND GUIDANCE SYSTEMS
                  0101000    *

            ROUTE DESIGN  *    DESIGN 0062000 AND COURSE 0055000    *

0198000   SAFETY
  0078000     NT  FAIL-SAFE
  0079000     RT  FAILURE
  0106000     RT  HUMAN ENGINEERING
  0137000     RT  MALFUNCTIONS
  0199000     RT  SAFETY EQUIPMENT
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0199000   SAFETY EQUIPMENT
  0075000   BT  EQUIPMENT
  0056000   RT  CREW

          SCALE DISPLAY  *    DISPLAY 0067000 AND SCALES 0200000    *

          SCALE MODELS  *    MODELS 0148000 AND SCALING 0201000    *

0200000   SCALES
  0067000   RT  DISPLAY
  0068000   RT  DISPLAY COMPONENTS
  0112000   RT  INFORMATION DISPLAY
  0119000   RT  INSTRUMENTS

          SCALING- DETERMINATION OF SCALES TO BE USED IN MEASURING A
                   PARAMETER  *    SCALES 0200000 AND
                   DESIGN 0062000    *

          SCALING- INCREASING OR DECREASING THE DIMENSIONS OF OBJECTS
                   OR REPRESENTATIONS PROPORTIONALLY

0201000   SCALING
  0062000   RT  DESIGN
  0063000   RT  DIAGRAMS
  0066000   RT  DIMENSIONS
  0067000   RT  DISPLAY
  0148000   RT  MODELS
  0208000   RT  SIMULATION SYSTEMS

0202000   SCHEDULE
  0147000   RT  MISSION

0203000   SEATING
  0057000   RT  CREW STATIONS
  0106000   RT  HUMAN ENGINEERING

0204000   SEMI-AUTOMATIC CONTROL
  0052000   BT  CONTROL SYSTEMS
  0053000   BT  CONTROLLING
  0028000   RT  AUTOMATIC CONTROL
  0139000   RT  MANUAL CONTROL

          SENSING REQUIREMENTS  *    REQUIREMENTS 0192000 AND
                   INSTRUMENTATION 0118000    *

          SERVICING  *    MAINTENANCE 0136000    *

          SERVO CONTROL  *    SERVO SYSTEMS 0205000 AND
                   CONTROL SYSTEMS 0052000    *

          SERVO ENGINEERING  *    SERVO SYSTEMS 0205000 AND
                   DESIGN 0062000    *

          SERVO SYSTEM INTEGRATION  *    SERVO SYSTEMS 0205000 AND
                   INTEGRATED SYSTEMS 0120000    *

0205000   SERVO SYSTEMS
  0028000   RT  AUTOMATIC CONTROL

0206000   SHORT FIELD TAKE-OFF
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0012000 BT AIRCRAFT MANEUVERS
0129000 RT LIFT
0212000 RT STOL AIRCRAFT
0245000 RT V/STOL AIRCRAFT

SIDE-BY-SIDE SEATING * SEATING 0203000 AND CONFIGURATION 3340000 *

SIDE-SLIP ANGLE * DRIFT 0071000 *

0207000 SIGNALS
0067000 RT DISPLAY
0068000 RT DISPLAY COMPONENTS
0111000 RT INFORMATION

SIMULATED RESPONSE * SIMULATION SYSTEMS 0203000 AND RESPONSE 0193000 *

SIMULATION * SIMULATION SYSTEMS 0208000 *

SIMULATION CONDITIONS * SIMULATION SYSTEMS 0203000 AND REQUIREMENTS 0192000 *

0208000 SIMULATION SYSTEMS
0010000 NT AIRBORNE SIMULATORS
0020000 NT ANALOG SIMULATION SYSTEMS
0082000 NT FIXED BASE SIMULATORS
0100000 NT GROUND BASED SIMULATORS
0153000 NT MOVING BASE SIMULATORS
0062000 RT DESIGN
0142000 RT MATHEMATICAL MODELS
0148000 RT MODELS
0182000 RT PROGRAMMED OPERATIONS
0201000 RT SCALING
0222000 RT TESTING
0223000 RT THEORETICAL ANALYSIS
0230000 RT TRAINING EQUIPMENT
0250000 RT WIND TUNNELS

SIMULATORS * SIMULATION SYSTEMS 0208000 *

SIMULTANEOUS OPERATIONS * INTEGRATED SYSTEMS 0120000 *

SIZE * DIMENSIONS 0066000 *

SONIC ALTIMETER * ALTIMETERS 0016000 *

0209000 SPACE VEHICLES
0134000 NT LUNAR EXCURSION MODULE
0011000 RT AIRCRAFT

STABILITY ANALYSIS * ANALYSIS 0021000 AND AERODYNAMIC STABILITY 0005000 *

STABILITY AUGMENTATION * AERODYNAMIC STABILITY 0005000 AND CONTROL SYSTEMS 0052000 *

STABILITY EQUATIONS * AERODYNAMIC STABILITY 0005000 AND THEORETICAL ANALYSIS 0223000 AND/OR MATHEMATICAL MODELS 0142000 *

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STABILIZATION * AERODYNAMIC STABILITY 0005000 *

STABILIZATION SYSTEM * CONTROL SYSTEMS 0052000 AND
AERODYNAMIC STABILITY 0005000 *

0210000 STALLING
0005000 RT AERODYNAMIC STABILITY
0172000 RT PERFORMANCE

0211000 STATE-OF-THE-ART
0140000 RT MANUFACTURING TECHNOLOGY
0216000 RT SYMPOSIUM

STICK POSITION * CONTROL SETTINGS 0050000 AND
CONTROL ELEMENTS 0048000 *

0212000 STOL AIRCRAFT
0245000 AS V/STOL AIRCRAFT
0011000 BT AIRCRAFT
0245000 RT V/STOL AIRCRAFT
0246000 RT VTOL AIRCRAFT

STRAIGHT-IN APPROACH * APPROACH 0024000 *

0213000 SUBJECTIVE DATA
0059000 BT DATA
0173000 RT PERSONAL EVALUATION

SUBJECTIVE EVALUATION * PERSONAL EVALUATION 0173000 *

0214000 SUPERSONIC AIRCRAFT
0011000 BT AIRCRAFT
0135000 RT MACH NUMBER

SUPERSONIC TRANSPORT * SUPERSONIC AIRCRAFT 0214000 AND
TRANSPORT AIRCRAFT 0232000 *

SYMBOL-FIXED MAP * MAPS 0141000 AND SYMBOLS 0215000 *

SYMBOLIC DISPLAY * SYMBOLS 0215000 AND DISPLAY 0067000 *

0215000 SYMBOLS
0067000 BT DISPLAY
0063000 RT DIAGRAMS
0110000 RT IMAGES
0141000 RT MAPS
0170000 RT PATTERNS
0234000 RT VECTORS

0216000 SYMPOSIUM
0211000 RT STATE-OF-THE-ART

SYSTEM DESIGN * DESIGN 0062000 AND APPROPRIATE SYSTEM
E.G. CONTROL SYSTEMS 0052000 *

SYSTEM INTEGRATION * INTEGRATED SYSTEMS 0120000 *

0216700 TACTICAL AIRCRAFT
0081000 AS FIGHTER AIRCRAFT
0011000 BT AIRCRAFT

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```
  0145000   BT  MILITARY AIRCRAFT

0216750   TACTILE CUES
  0044000   RT  CONTROL CHARACTERISTICS
  0053000   RT  CONTROLLING
  0093000   RT  FLYING
  0151000   RT  MOTION CUES
  0244000   RT  VISUAL CUES

0217000   TAIL ROTOR
  0197000   BT  ROTOR BLADES

0218000   TAKE-OFF
  0012000   BT  AIRCRAFT MANEUVERS
  0206000   NT  SHORT FIELD TAKE-OFF
  0129000   RT  LIFT

          TAKE-OFF ROTATION  *    TAKE-OFF 0218000 AND AIR TRAFFIC
                CONTROL 0008000    *

0219000   TASK ANALYSIS
  0021000   BT  ANALYSIS
  0227000   NT  TIME LINE ANALYSIS
  0042000   RT  CONTROL ANALYSIS
  0095600   RT  FUNCTIONAL ANALYSIS
  0106000   RT  HUMAN ENGINEERING
  0106100   RT  HUMAN PERFORMANCE
  0174000   RT  PERSONNEL
  0220000   RT  TASKS
  0251000   RT  WORK LOAD

0220000   TASKS
  0053000   NT  CONTROLLING
  0090000   NT  FLIGHT PROCEDURES
  0093000   NT  FLYING
  0107000   NT  IFR
  0115000   NT  INSTALLATION
  0136000   NT  MAINTENANCE
  0139000   NT  MANUAL CONTROL
  0154000   NT  NAVIGATION
  0157000   NT  OBSERVATION
  0191000   NT  REPAIR
  0229000   NT  TRAINING
  0239000   NT  VFR
  0042000   RT  CONTROL ANALYSIS
  0056000   RT  CREW
  0099000   RT  GROUND BASED FLIGHT OPERATIONS
  0106000   RT  HUMAN ENGINEERING
  0106100   RT  HUMAN PERFORMANCE
  0116000   RT  INSTRUCTOR
  0138000   RT  MAN-MACHINE SYSTEMS
  0155000   RT  NAVIGATOR
  0177000   RT  PILOT
  0188000   RT  RADIO OPERATOR
  0251000   RT  WORK LOAD

0221000   TELEVISION
  0033000   RT  CATHODE RAY TUBES
  0035000   RT  CLOSED CIRCUIT SYSTEMS
  0038300   RT  COMMUNICATIONS
```


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```
  0067000   RT  DISPLAY
  0110000   RT  IMAGES
  0187200   RT  RADIO

          TERMINAL  *    AIR TERMINAL 0007000    *

0222000   TESTING
  0092000   NT  FLIGHT TESTING
  0077000   RT  EVALUATION
  0077350   RT  EXPERIMENTAL DESIGN
  0143000   RT  MEASUREMENT
  0208000   RT  SIMULATION SYSTEMS

0223000   THEORETICAL ANALYSIS
  0021000   BT  ANALYSIS
  0148000   RT  MODELS
  0208000   RT  SIMULATION SYSTEMS

          THEORETICAL MODELS  *    THEORETICAL ANALYSIS 0223000 AND/OR
                    MATHEMATICAL MODELS 0142000    *

0224000   THREE-DIMENSIONAL DISPLAY
  0067000   BT  DISPLAY

0225000   THRUST
  0077200   RT  EXHAUST GASES
  0100250   RT  GROUND EFFECT
  0129000   RT  LIFT
  0181000   RT  POWER

          THRUST-WEIGHT RATIO  *    THRUST 0225000 AND
                    WEIGHT 0248000    *

0226000   TILT WING AIRCRAFT
  0011000   BT  AIRCRAFT
  0245000   RT  V/STOL AIRCRAFT
  0246000   RT  VTOL AIRCRAFT

          TIME DELAY  *    RESPONSE TIME 0193200    *

          TIME LAG  *    RESPONSE TIME 0193200    *

0227000   TIME LINE ANALYSIS
  0021000   BT  ANALYSIS
  0219000   BT  TASK ANALYSIS
  0095600   RT  FUNCTIONAL ANALYSIS
  0106000   RT  HUMAN ENGINEERING

          TOUCHDOWN ACCURACY  *    LANDING 0124000 AND
                    ACCURACY 0003000    *

0228000   TRACKING
  0089000   RT  FLIGHT PATH
  0180000   RT  POSITION
  0187000   RT  RADAR

          TRADE-OFF  *    OPTIMIZATION 0158000    *

          TRAFFIC PATTERN  *    PATTERNS 0170000 AND
                    AIR TRAFFIC CONTROL 0008000    *
```


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```
          TRAINER= PERSON  *    INSTRUCTOR  0116000    *

0229000   TRAINING
  0220000   BT  TASKS
  0116000   RT  INSTRUCTOR
  0230000   RT  TRAINING EQUIPMENT

0230000   TRAINING EQUIPMENT
  0075000   BT  EQUIPMENT
  0208000   RT  SIMULATION SYSTEMS
  0229000   RT  TRAINING

          TRANSITION  *    FLIGHT MODE TRANSITION 0088000    *

0231000   TRANSPARENT DISPLAY
  0067000   BT  DISPLAY

0232000   TRANSPORT AIRCRAFT
  0011000   BT  AIRCRAFT

          TRIM  *    CONTROL SETTINGS 0050000 AND/OR
                    ATTITUDE 002500)    *

          TRUE AIRSPEED  *    AIRSPEED 0013000    *

0233000   TURBULENCE
  0004000   RT  AERODYNAMIC FLOW
  0005000   RT  AERODYNAMIC STABILITY
  0044000   RT  CONTROL CHARACTERISTICS
  0100250   RT  GROUND EFFECT
  0174100   RT  PERTURBATION
  0233500   RT  VARIABLE STABILITY CONDITIONS
  0249000   RT  WIND

          TWO-PLACE AIRCRAFT  *    AIRCRAFT 0011000 AND CREW 005600
                    AND CONFIGURATION 0040000    *

0233500   VARIABLE STABILITY CONDITIONS
  0005000   RT  AERODYNAMIC STABILITY
  0044000   RT  CONTROL CHARACTERISTICS
  0053000   RT  CONTROLLING
  0073000   RT  EMERGENCY CONDITIONS
  0100250   RT  GROUND EFFECT
  0174100   RT  PERTURBATION
  0233000   RT  TURBULENCE

          VECTORED THRUST  *    VECTORS 0234000 AND THRUST 022500)    *

0234000   VECTORS
  0062000   RT  DESIGN
  0067000   RT  DISPLAY
  0215000   RT  SYMBOLS

0235000   VELOCITY
  0023000   NT  ANGULAR VELOCITY
  0133000   NT  LOW SPEED
  0001000   RT  ACCELERATION
  0135000   RT  MACH NUMBER
  0189000   RT  RATE
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VERTICAL CONTROL * VERTICAL MANEUVERS 0237000 AND CONTROL SYSTEMS 0052000 *

VERTICAL DISPLAY * VERTICAL MANEUVERS 0237000 AND DISPLAY 0067000 *

0236000 VERTICAL FLIGHT
0012000 BT AIRCRAFT MANEUVERS
0083000 BT FLIGHT
0237000 BT VERTICAL MANEUVERS

VERTICAL LANDING * LANDING 0124000 AND VERTICAL MANEUVERS 0237000 *

0237000 VERTICAL MANEUVERS
0012000 BT AIRCRAFT MANEUVERS
0236000 NT VERTICAL FLIGHT
0087000 RT FLIGHT MODE
0238000 RT VERTICAL MODE

0238000 VERTICAL MODE
0087000 BT FLIGHT MODE
0126000 RT LATERAL MODE
0131000 RT LONGITUDINAL MODE
0237000 RT VERTICAL MANEUVERS

VERTICAL TAKE-OFF * TAKE-OFF 0218000 AND VERTICAL MANEUVERS 0237000 *

VERTICAL-TO-LEVEL TRANSITION * FLIGHT MODE TRANSITION 0088000 *

VFR = VISUAL FLYING RULES

0239000 VFR
0090000 BT FLIGHT PROCEDURES
0242000 RT VISIBILITY
0244000 RT VISUAL CUES

0240000 VFR CONDITIONS
0045000 RT ALL-WEATHER CONDITIONS
0107000 RT IFR CONDITIONS

0241000 VIBRATION
0058000 RT DAMPING

VIRTUAL IMAGE DISPLAY * IMAGES 0110000 *

0242000 VISIBILITY
0015000 RT ALL-WEATHER CONDITIONS
0107000 RT IFR CONDITIONS
0109000 RT ILLUMINATION
0157000 RT OBSERVATION
0189400 RT READABILITY
0240000 RT VFR CONDITIONS
0243000 RT VISION
0244000 RT VISUAL CUES

0243000 VISION
0157000 RT OBSERVATION

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```
  0242000   RT  VISIBILITY
  0244000   RT  VISUAL CUES

          V/STOL  *    V/STOL AIRCRAFT 0245000    *

0244000   VISUAL CUES
  0093000   RT  FLYING
  0104000   RT  HORIZON
  0151000   RT  MOTION CUES
  0157000   RT  OBSERVATION
  0216750   RT  TACTILE CUES
  0239000   RT  VFR
  0242000   RT  VISIBILITY
  0243000   RT  VISION

          VISUAL DISPLAY  *    DISPLAY 0067000 AND VISUAL
                    CUES 0244000    *

0245000   V/STOL AIRCRAFT
  0212000   AS  STOL AIRCRAFT
  0246000   AS  VTOL AIRCRAFT
  0011000   BT  AIRCRAFT
  0206000   RT  SHORT FIELD TAKE-OFF
  0212000   RT  STOL AIRCRAFT
  0226000   RT  TILT WING AIRCRAFT
  0246000   RT  VTOL AIRCRAFT

0246000   VTOL AIRCRAFT
  0245000   AS  V/STOL AIRCRAFT
  0011000   BT  AIRCRAFT
  0103000   NT  HELICOPTERS
  0130000   RT  LIFT FAN
  0212000   RT  STOL AIRCRAFT
  0226000   RT  TILT WING AIRCRAFT
  0245000   RT  V/STOL AIRCRAFT

0247000   WEAPON SYSTEMS
  0147000   RT  MISSION

0248000   WEIGHT
  0066000   RT  DIMENSIONS
  0171000   RT  PAYLOAD

          WIDE-ANGLE VIEWING  *    OBSERVATION 0157000    *

0249000   WIND
  0005000   RT  AERODYNAMIC STABILITY
  0293000   RT  TURBULENCE

          WIND CHANGES  *    WIND 0249000    *

0250000   WIND TUNNELS
  0005000   RT  AERODYNAMIC STABILITY
  0092000   RT  FLIGHT TESTING
  0208000   RT  SIMULATION SYSTEMS

0251000   WORK LOAD
  0106000   RT  HUMAN ENGINEERING
  0219000   RT  TASK ANALYSIS
  0220000   RT  TASKS
```


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XV-5A * EXPERIMENTAL AIRCRAFT 0077300 *

0252000 YAW
0044000 BT CONTROL CHARACTERISTICS
0045000 BT CONTROL DEFICIENCIES
0005000 RT AERODYNAMIC STABILITY
0179000 RT PITCH
0194000 RT ROLL

YEAR IN WHICH DOCUMENT WAS ISSUED - SEE LAST PAGES

ZERO-ZERO CONDITIONS * ALL-WEATHER CONDITIONS 0015000 *

DATE OF DOCUMENT - COORDINATE MONTH AND YEAR TO OBTAIN DATE OF DOCUMENT ISSUE E.G. MAY,1960 IS OBTAINED BY COORDINATING MAY WITH 1960

7019400 1940-1944

7019450 1945-1949

7019495 1950-1954
7019500 NT 1950
7019510 NT 1951
7019520 NT 1952
7019530 NT 1953
7019540 NT 1954

7019500 1950
7019465 BT 1950-1954

7019510 1951
7019465 BT 1950-1954

7019520 1952
7019465 BT 1950-1954

7019530 1953
7019465 BT 1950-1954

7019540 1954
7019465 BT 1950-1954

7019545 1955-1959
7019550 NT 1955
7019560 NT 1956
7019570 NT 1957
7019580 NT 1958
7019590 NT 1959

7019550 1955
7019545 BT 1955-1959

7019560 1956
7019545 BT 1955-1959

7019570 1957
7019545 BT 1955-1959

7019580 1958

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  7019545    BT   1955=1959

7019590    1959
  7019545    BT   1955=1959

7019595    1960=1964
  7019600    NT   1960
  7019610    NT   1961
  7019620    NT   1962
  7019630    NT   1963
  7019640    NT   1964

7019600    1960
  7019595    BT   1960=1964

7019610    1961
  7019595    BT   1960=1964

7019620    1962
  7019595    BT   1960=1964

7019630    1963
  7019595    BT   1960=1964

7019640    1964
  7019595    BT   1960=1964

7019645    1965=1969
  7019650    NT   1965
  7019660    NT   1966
  7019670    NT   1967
  7019680    NT   1968
  7019690    NT   1969

7019650    1965
  7019645    BT   1965=1969

7019660    1966
  7019645    BT   1965=1969

7019670    1967
  7019645    BT   1965=1969

7040100    JANUARY

7040200    FEBRUARY

7040300    MARCH

7040400    APRIL

7040500    MAY

7040600    JUNE

7040700    JULY

7040800    AUGUST

7040900    SEPTEMBER
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APPENDIX IV

Posting Index

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						1686		518	
0013100	AIRSPEED INDICATORS								
		1682				1686		518	
0014000	ALIGNMENT								
								518	
0015000	ALL-WEATHER CONDITIONS								
	2561	1232	713	1204	2185	2176	767		1899
0016000	ALTIMETERS								
		1682					2567		
0017000	ALTITUDE								
1890	1901		1953	1874	2785	1686		2658	2169
2130				2004		2166			
				2134					
0019000	ANALOG COMPUTERS								
	1951		113	1204					
			1713						
			2183						
0020000	ANALOG SIMULATION SYSTEMS								
			2183						
0021000	ANALYSIS								
2070		1232	1833	1894	2095	606	1497	1338	1089
2170		1892	2073	2184	2785	796	2067	2068	2069
			2133			1606	2147	2128	
							2267		
0022000	ANGLE OF ATTACK								
1880	1721	1882	1833	1484	1865	606	1497	198	479
1890	1901	1892	1913	1824	1885	1606	1877	1878	1879
2130	2451			1874	2095	1686	2067	1888	1889
2180	2561			1904		2266	2147	2068	2069
				2004			2657	2258	2149
				2134				2658	
0023000	ANGULAR VELOCITY								
			2163	1824					
0024000	APPROACH								
	1881	1882	713	1884	1845		2147		1899
	2561			2264	1895				
				2524					
0025000	ATTITUDE								
			1913	2184		1686		1338	479
			2163						1229
0026000	ATTITUDE CONTROL SYSTEMS								
									1229
0027000	AUGMENTED PILOT CONTROL								

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				1484					
0028000	AUTOMATIC CONTROL								
2170	2451	2162	1963	1904	1865	1686	2177	198	479
				2524	2185		2267	2128	1229
								2158	
								2558	
								2658	
0029000	AUTOMATIC SYSTEMS								
2170	2451	2162	1963	1904	1865	1686	2177	198	479
				2524	2185		2267	2128	1229
								2158	1899
								2558	
								2658	
0030000	BIBLIOGRAPHY								
	1951	2112	1873	1904				1338	1889
0031000	BLIND LANDING								
	2561				1865				
0033000	CATHODE RAY TUBES								
					315	2166			1889
					1865				2179
0034000	CLIMB-OUT								
								1888	
0035000	CLOSED CIRCUIT SYSTEMS								
									2179
0036000	COCKPIT DISPLAY								
			113		1865				1879
0037000	COCKPITS								
	1891	1892	113	1884	1685	1606	1877		
				1894					
0038000	COMMERCIAL AIRCRAFT								
			1873		2785				119
0038300	COMMUNICATIONS								
					2785				
0038800	COMPUTER PRINTOUT								
							1497		
0039000	COMPUTERS								
2070	1951		113	1204	1865		1087		
			1713						
			2183						
0040000	CONFIGURATION								
	1891	1882	1873	1824	1685	316	1497		2169
	1951		1963	2064	1845	1606			
	2071					1686			

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2130	2561		2163	1904	2175		2177	2158	1889
2170				2004	2185		2267	2258	2069
2180				2064			2657	2558	2149
				2134				2658	
				2524					
0053000	CONTROLLING								
1880	1721	1882	1883	1484	1865	606	1497	198	479
1890	1901	1892	1913	1824	1885	1606	1877	1878	1229
2130	2451	2162	1963	1874	2095	1686	2067	2068	1879
2170	2561			1904	2185	2266	2147	2128	1889
2180				2004			2177	2158	2069
				2134			2267	2258	2149
				2524			2657	2558	
								2658	
0054000	CONVENTIONAL AIRCRAFT								
	1881	1682		2524	1845			1878	
0054600	COOPER RATING SYSTEM								
				2134					
0055000	COURSE								
		2142		2524	1845		2147		
					2175		2267		
					2785		2567		
0056000	CREW								
1890		1892	113	1884	2095	606	1497	1878	2149
2130		2142	1883	2004		1606	1877	1888	
2170				2064			2147	2128	
				2184					
0057000	CREW STATIONS								
	1891	1892	113	1884	1685	1606	1877		
				1894					
0057600	CRUISE								
						1686			
0058000	DAMPING								
1890			2163	1484					
2130				1824					
				1904					
				2004					
				2134					
0059000	DATA								
1090	1721				1845	1686	767		
					1885		1877		
0060000	DATA PROCESSING								
								2168	
0061000	DEGREES OF FREEDOM								
							2067		2069
									2149

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1890						1877	2128	
0074000	ENGINES							
1880	1091		2264		2176			
	1721							
0075000	EQUIPMENT							
2180		1873		1865	606	1087	2068	
				2095				
0076000	ERRORS							
	2561		2134	2175				
				2785				
0077000	EVALUATION							
1890	701	1882	113	1824	1845	316	1087	518	1089
2130	1891		713	2184			1877	1878	2039
			1713	2264			2147	1888	2149
			1883						2669
			2163						
0077200	EXHAUST GASES							
			2004					
0077300	EXPERIMENTAL AIRCRAFT							
2180			2004	2095			2168	2669
0077350	EXPERIMENTAL DESIGN							
	2142					2067		2149
0079000	FAILURE							
1890								
0080000	FAILURE ANALYSIS							
					606			
0081000	FIGHTER AIRCRAFT							
					1606	1497		
					2176	2177		
0082000	FIXED BASE SIMULATORS							
1890		713			1686	1217		2069
0083000	FLIGHT							
	1721	713	1204	1885	796	2177	1338	1229
		1713	2004	2095	1686	2267	2658	2069
			2064			2657		2669
			2184					
0084000	FLIGHT CHARACTERISTICS							
1880	1951	113	1824					2039
		713						
		2163						
0085000	FLIGHT DATA							
1090	1721			1845	1686	767		
				1885				

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0086000	FLIGHT INSTRUMENTS 2071	1682	113 2263			1686	2567	198 518 768 1888	
0087000	FLIGHT MODE	1882	713 1713 1833	1484 1824	1845		2657	1878 2128	479 2069 2149
0088000 1880	FLIGHT MODE TRANSITION 1721 1901		713 1713 1833 1963	1204 1904 2004 2184 2264		1686	2177	1338 1878 2168 2558	1089
0089000	FLIGHT PATH 2561	1882				1686			2669
0090000 1880	FLIGHT PROCEDURES 1881		713 1833 2163	1874 1884 1904 2004 2064 2524	1845 1895 2185 2785	1686	2147	1878	1889 1899
0091000	FLIGHT REPORTS			2184					
0092000	FLIGHT TESTING	2072		1824 1874	1375 1845 2095	316	1877	518 1878 2168	2669
0093000	FLYING 2451			2004			2657	1878	
0094000	FLYING AIDS 2561			2524	1865				1899
0095000	FOREIGN AIRCRAFT								119
0095300	FUEL CONSUMPTION 1881								
0095600	FUNCTIONAL ANALYSIS			1884 2064		1606	1087	1338	
0097000	GLIDE	1882	713			1686			
0098000	GROUND BASED FLIGHT EQUIPMENT								

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				1873		1865		1087	
0099000	GROUND BASED FLIGHT OPERATIONS								
	2451	1882		2524				1087	
0100000	GROUND BASED SIMULATORS								
				2064					
0100250	GROUND EFFECT								
1880				1904					479
				2004					2169
				2134					
0101000	GUIDANCE SYSTEMS								
	2561			2524	1885	1686	2177	198	2069
					2185		2267	2158	
								2658	
0102000	GYROSCOPES								
							2567		
0103000	HELICOPTERS								
	701	1232	1913	764	315	316	767	198	479
	1881	1682	2133	1824	1375	606	2147	518	769
	1951	1882		2064	1845		2657	768	2669
	2561	2072		2524	2175			2168	
		2142			2785			2258	
								2558	
0104000	HORIZON								
									2669
0105000	HOVERING								
2130	701	2112	713	1204		1686	2147	198	769
	1721	2142	1713	1484			2177	1338	1089
	1901		1953	1874			2657	2168	2149
				1904					2179
				2004					
				2064					
				2134					
				2264					
0106000	HUMAN ENGINEERING								
	1901			1884	2145				
				2184					
0106100	HUMAN PERFORMANCE								
2170		2142			2185				1889
		2162							
0107000	IFR								
1880	1881		713	1884	1845	1686			1889
				2064	1895				1899
				2524	2185				
					2785				
0108000	IFR CONDITIONS								

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2180	1881		2524	1845	1686	767		1879
	2451			1895		2177		1899
								2179
0109000	ILLUMINATION							
			2264	2195				2179
0110000	IMAGES							
					2166			
0111000	INFORMATION							
	1892			1865			2128	
0112000	INFORMATION DISPLAY							
2170								
0113000	INFORMATION PROCESSING							
2170							198	
0114000	INFORMATION REQUIREMENTS							
2170		1913			1606	1497		1879
								2179
0115000	INSTALLATION							
				315			518	
0116000	INSTRUCTOR							
					606			
0117000	INSTRUMENT DISPLAY							
	1881	113					198	
							2068	
0118000	INSTRUMENTATION							
1090	2561 1682		1904	315		1087	198	
				1895		2567	518	
				2175			1888	
							2168	
0119000	INSTRUMENTS							
	1881 1682	113	764	2175	606	2567	198	1879
	2071	2253	1904				768	
	2561		2004				1878	
			2264				1888	
0120000	INTEGRATED SYSTEMS							
2170	1682	2253	764	315		767	518	119
			2004			1087	1888	
			2064			2177	2068	
			2524				2128	
							2258	
0121000	INTERVIEW							
					606			
0122000	JET AIRCRAFT							
1880		113	1484		1606	1497		1899

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			1963	2184					
0123000	JET ENGINES								
1880						2176			
0124000	LANDING								
1880	2561	1892	1873	1204	1845	1686	2147	1878	1889
2180		2112	2163	1904	1865		2177		1899
				2184	1895		2657		2179
				2264	2185				
				2524					
0125000	LANDING SITES								
					2185				
0126000	LATERAL MODE								
			1713	1824	1845				479
0127000	LENSES								
						2166			
0128000	LEVEL FLIGHT								
			1713				2657		
0129000	LIFT								
1880					2095	1686			1089
						2176			2169
0130000	LIFT FAN								
1880			713	2004	2095	796		1878	1089
0131000	LONGITUDINAL MODE								
			1713	1824					479
			1833						
0132000	LOW ALTITUDE								
				2004		2166			
0133000	LOW SPEED								
	2451		1963	1874					2149
				1884					
				1904					
0134000	LUNAR EXCURSION MODULE								
			1913						
0135000	MACH NUMBER								
						1686			
0136000	MAINTENANCE								
				1204	315				
0137000	MALFUNCTIONS								
						606			
0138000	MAN-MACHINE SYSTEMS								
				2134					

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1889
2669

0181000 POWER
1890 2451 2162 1963 2145 2176 2147 1878 479
2130 2153

0182000 PROGRAMMED OPERATIONS
1865

0182100 PROGRESS REPORT
1090 2071 2072 2073 764 1375 767 768 769
2070 1087 2068 2069
2267

0183000 PROJECTION DISPLAY
316 2567

0184000 PROPELLER DRIVEN AIRCRAFT
1953

0185000 PROPORTIONAL CONTROL
2153

0185100 PROPOSAL
2170 1881 1873 2264 1865 767 2128 1229
1913 1885 1217
2253 2177

0186000 PROPULSION SYSTEMS
1904 2095
2004

0187000 RADAR
1682 764 2567 198

0187200 RADIO
2785

0188000 RADIO OPERATOR
1497

0189000 RATE
2253 1484 1686 1888 1889
2258
2558
2658

0189400 READABILITY
2004 2195

0190000 RELIABILITY
1204

0192000 REQUIREMENTS
2070 1091 1232 113 1204 1685 1606 1087 1338 1879
2170 1721 1682 1913 1884 2175 1656 1497 2068 2179

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0208000	SIMULATION SYSTEMS								
1890	1951	2072	113	1204	1375	606	1217	1338	1889
2130	2071	2142	713	1874	2095	796	2067	1888	1899
2180		2162	1713	1884	2175	1686	2147	2558	2069
			2133	2064		2166			2149
				2134		2176			2169
				2264					2179
				2524					
0209000	SPACE VEHICLES								
			1913						2179
			2153						
0210000	STALLING								
			1883						479
0211000	STATE-OF-THE-ART								
	1881		1873				1087	168	119
									1089
									2179
0212000	STOL AIRCRAFT								
	1901							2128	
0213000	SUBJECTIVE DATA								
							1877		
0214000	SUPERSONIC AIRCRAFT								
1090	2451	1232		1894				1888	119
		2072							1879
0215000	SYMBOLS								
		2142							
0216000	SYMPOSIUM								
				1874	2095				1889
0216700	TACTICAL AIRCRAFT								
	1721	1892	2073	2264	1685	1606	1497	2068	1879
	2071	2072							
0216750	TACTILE CUES								
						606			
0217000	TAIL ROTOR								
							2657		
0218000	TAKE-OFF								
		1892	1873	1884			2177	1338	
				1904			2657	1878	
				2184				1888	
0219000	TASK ANALYSIS								
2070		1892				1606	1497	1338	1089
								2068	
								2128	

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0220000	TASKS 701 2451	1892	113	764 1204 1484 1904 2004 2184 2524	315 1865 2785	2166	767 1087 2657	198 518 768 1878 2128	769 1229
0221000	TELEVISION								2669
0222000 1890	TESTING	2072	1833	1824 1874	1375 1845 2095	316	1877	518 1878 2168	2069 2669
0223000	THEORETICAL ANALYSIS		2133		2785		2147	1338	
0224000	THREE-DIMENSIONAL DISPLAY		1913						
0225000	THRUST 1901	1892		2004 2134	1685				1089
0226000	TILT WING AIRCRAFT		1713						2149
0227000 2070	TIME LINE ANALYSIS	1892				1606	1497	2068	1089
0228000	TRACKING							1338	
0229000	TRAINING		1883	2184	2095	606 796			
0230000	TRAINING EQUIPMENT					606			
0231000	TRANSPARENT DISPLAY				315	2166			
0232000	TRANSPORT AIRCRAFT		1873				1877	1888	
0233000	TURBULENCE		713 2153	2004 2134			2147		
0233533	VARIABLE STABILITY CONDITIONS		2153	1484 1874			2147		

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					2785				
0247000	WEAPON SYSTEMS								
2070	2071	2072	2073		1685			2068	
0248000	WEIGHT								
				2134	1685		2147		
0249000	WIND								
				2004					
0250000	WIND TUNNELS								
						2176			2169
0251000	WORK LOAD								
								2128	1889
0252000	YAW								
					2185		2147		
7019450	1945-1949								
					2195				
7019500	1950								
					2145				
7019545	1955-1959								
	701		113	764		316	767	198	479
	1901		1963	2184		606		768	769
						2266			
7019570	1957								
							767	768	479
7019580	1958								
	701		113	764					
7019590	1959								
	1901		1963	2184	315	316			769
						606			
						2266			
7019595	1960-1964								
1090	1721	1232	1713	1204	1375	2176	1087	518	119
1880	1881	1682	1873	1884	1885		1217	1338	1089
1890	2071	1882	1833	1904			2067	1888	1229
2070	2561	2072	1913	2134			2267	2068	1879
2130		2142	2073	2524				2128	1899
2180			2133					2658	2039
									2069
7019600	1960								
			1713	1204			1217		
7019610	1961								
		2142	1873					1888	1229
			1833						

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7019620	1962								
1890	2561	1882		2134				518	2039
				2524					
7019630	1963								
				1884			1087	1338	119
							2267		1089
7019640	1964								
1090	1721	1232	1913	1894	1375	2176	2067	2068	1879
1880	1881	1682	2073	1904	1885			2128	1899
2070	1951	2072	2133					2658	2069
2130	2071								
2180									
7019645	1965-1969								
2170	1891	1892	2163	1484	1685	1606	1497	1878	1889
	2451	2162	2253	1824	1845	1686	1877	2168	2149
				2004	1895	2166	2147	2258	2169
				2064	2095		2177	2558	2179
				2264	2175				2669
					2185				
					2785				
7019650	1965								
2170	1891	2112		1484	1685	1606	1497	1878	2149
				1874	1895	1686	1877	2168	
					2095	2166	2147		
7019660	1966								
	2451	1892	2163	1824	1845		2177	2258	1889
		2162	2253	2004	1865			2558	2169
				2064	2175				2669
				2264	2785				
7040100	JANUARY								
		1892	1873		1865		1877	1878	
7040200	FEBRUARY								
1090			2253	1884	1685	1686	1217		1229
1890					1845		2177		2669
7040300	MARCH								
			113	1484		606	767		
			1833			1606	2267		
			1913						
7040400	APRIL								
1880	1721	2072	2163		2175			1338	2169
2170		2162						2258	
2180								2558	
7040500	MAY								
	1901		1963	2064	2145	316		768	1889
			2133	2264					
7040600	JUNE								

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	701	1232 2112	1713 2073	2004 2524					479 769
7040700	JULY					2176			1879 2149
7040800 2070 2130	AUGUST 1891				315		2067		
7040900	SEPTEMBER 2451	2142		764 1824 1894 2184	2785		1087 2147	518 2658	
7041000	OCTOBER 1881	1882		2134	188E		1497	2068 2128	119 1899 2039 2069
7041100	NOVEMBER 2561			1874	1375 1895 209E	2166 2266		1888 2168	
7041200	DECEMBER 1951 2071	1682		1204 1904	2195				1089

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APPENDIX V

Users (Subjects)

Engineers:

Sam Bordonaro. Technical Editor on Technical Staff of Link Contract in support of Project 6190 at Wright Field.

Lt. Bruce Bertram, U. S. Air Force. Electrical Engineer. Task Engineer for Task 619009 at Wright Field.

George Berbert. Electrical-Mechanical Engineer at Ritchie and Associates, Dayton, Ohio.

Robert Yost. Electrical Engineer at the National Cash Register Company, Dayton, Ohio.

Capt. James Lee, U. S. Air Force. Aeronautical Engineer. Task Engineer for Task 683 E at Wright Field.

Charles Shoals. Systems Analysis Engineer. Task Engineer for Task 619012.

Psychologists:

Dr. Malcom Ritchie. Experimental Psychologist. Director of Ritchie and Associates, Dayton, Ohio.

William Welde. Experimental Psychologist at Ritchie and Associates, Dayton, Ohio. Enrolled in the Graduate School at the University of Dayton.

Fred Oberman. General-Experimental Psychologist on Technical Staff of Bunker-Ramo Corporation in support of Project 6190, Wright Field.

William M yers. General Experimental Psychologist on Technical Staff of Bunker-Ramo Corporation in support of Project 6190, Wright Field. Enrolled in Graduate School at the University of Dayton.

Warren Williams. Experimental Psychologist at Ritchie and Associates, Dayton, Ohio. Enrolled in Graduate School at the University of Dayton.

Dr. Gerald Rabideau. Experimental Psychologist at Ritchie and Associates, Dayton, Ohio.

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APPENDIX VI

INSTRUCTIONS

INSTRUCTIONS X

1. Use thesaurus to state search question in keywords or index terms. The unnumbered terms are reference terms and show how to express concepts in system terminology. AS=also see; BT=broader term; NT=narrower term; RT=related term.

2. Having determined the keywords, formulate a search strategy. This means how to combine terms to obtain your results.

3. Apply the search strategy to the posting index which contains the access numbers associated with each index term. Use more than one posting index.

4. Record "hits" and obtain documents for review.

5. Example: find the "hits" between DESIGN and INSTRUMENTS or INSTRUMENTATION (search strategy).

Posting Index #1

DESIGN

20✓ 21✓ 32 (3)
30 (51) 72 33
(70) 81 (92)✓
90✓

Posting Index #2

INSTRUMENTS

10 11 62 (3)
40 31 82 83
(70) (51) (92)
80

INSTRUMENTATION

20✓ 21✓ 12 13
90✓ 42 63
92✓ 83

6. Record hits.

20 21 92 3
70 51
90

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INSTRUCTION Y

The basic principle of a coordinate index document retrieval system is that documents can be indexed by recording technically meaningful words or phrases called index terms which describe the technical content of the documents. These documents can be retrieved on demand by searching under one or more of these index terms in various combinations.

There are two tools which are provided to help one retrieve documents, the thesaurus and the posting index. The posting index is an inverted file of all the documents in the system, that is, index terms are listed in alphabetical order with the document access numbers presented under the term. The presence of an access number under a term means that that particular document was indexed by that term. It should be noted that the access numbers appear in numerical order within columns. Each column represents a terminal digit. The first column represents terminal digit 0; therefore access number 1810 would appear in the first column. Access number 719 would appear in the last column. The purpose of sorting the documents in this way is so that access numbers under different terms can be more readily compared. A "hit" occurs when the same access number appears under the terms being compared e.g. 1879 appears under both CONTROL SYSTEMS and INFORMATION REQUIREMENTS.

The thesaurus constitutes a reference to the posting index which is the actual retrieval tool. The thesaurus indicates the index terms and their relationships to other index terms in the system. Furthermore, concepts which

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are not index terms are displayed and the expression of these concepts in index term language is indicated. For example, the concept "hovering stability" is expressed by coordinating the terms HOVERING and AERODYNAMIC STABILITY. There are definitions provided where necessary or helpful to guide the user. For example, LOW ALTITUDE is an index term. Its meaning is shown immediately above the index term LOW ALTITUDE - 0 to 200 ft. It should be noted that actual index terms always have their corresponding term number displayed adjacent to the term. Concepts which are not actual index terms do not have term numbers displayed, e.g. "Hovering stability".

The symbols which appear under the main term or header term are as follows: AS (also see); BT (broader term); NT (narrower term); RT (related term). AS indicates a near synonymous relationship with the main term, thus VTOL AIRCRAFT AS V/STOL AIRCRAFT means that if one were referring to VTOL AIRCRAFT, it is strongly suggested that V/STOL AIRCRAFT be considered as well. BT represents a higher order generic relationship, e.g. SAFETY EQUIPMENT belongs to the larger class EQUIPMENT which includes other types of equipment in addition to safety equipment. Conversely NT represents a lower order generic relationship, e.g. EQUIPMENT NT SAFETY EQUIPMENT. RT stands for related terms and indicates an unspecified relationship between the terms. Its primary function is to alert the user to the existence of other index terms which he should perhaps consider instead of or in addition to the main term. For instance, suppose the user refers to the term INTERVIEW. There he finds INTERVIEW RT SUBJECTIVE DATA. For his purpose,

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SUBJECTIVE DATA is really a better term so he would enter the posting index under the term SUBJECTIVE DATA.

Now let us concern ourselves with using the system. There should be two posting indexes so that coordinations can be accomplished readily. To coordinate terms, one opens the first posting index to one of the terms and the other posting index to the other term. The matches of access numbers or "hits" are found and recorded, preferably in terminal digit columns as displayed in the posting index. This permits an easy second coordination with a third term if desired. In this way all access numbers which "hit" under DESIGN and INSTRUMENTS and LANDING can be found. To include more than one term in a group, a composite list can be recorded, again preferably in terminal digit columns. In this way all access numbers which appear under INSTRUMENTS or INSTRUMENTATION can be obtained by simply recording the sum total of the document access numbers found under the two terms.

It should always be kept in mind that the more coordinations which are made, the fewer number of documents will be retrieved, but the more relevant they should be. Conversely, the fewer coordinations made, the more documents will be retireved, but their probability of relevancy declines correspondingly. The user must optimize his own retrievals according to his particular needs.

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INSTRUCTION Z

The best way to provide instructions on how to use a document retrieval system based on coordinate indexing is to go through an actual example, showing the various steps the user should go through to obtain document references. Let us postulate the following search topic: What documents are contained in the system which deal with the design of instruments to assist the pilot in approach and landing of VTOL aircraft?

First, the user refers to the thesaurus to aid him in formulating search strategy. Being a coordinate index system, document access numbers are located under certain keywords or index terms. The user must select combinations of index terms to provide access numbers relevant to his search topic. The user writes down various key concepts relating to his search topic. For instance, INSTRUMENTS, PILOT ASSISTS, DESIGN, APPROACH, LANDING, and VTOL AIRCRAFT might be listed. Referring to the thesaurus under INSTRUMENTS, one finds that it is an index term. This is verified by the fact that the term number appears adjacent to the term. Under INSTRUMENTS one finds the following:

INSTRUMENTS
- NT AIRSPEED INDICATORS
- NT ALTIMETERS
- NT FLIGHT INSTRUMENTS
- NT RADAR
- RT ACCURACY
- RT DISPLAY
- RT DRIFT
- RT INSTRUMENTATION
- RT MEASUREMENT
- RT SCALES

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The NT designation denotes "narrower term" which means that any such term is a member of the broader class INSTRUMENTS. The RT denotes "related term" which suggests an unspecified relationship between the main term and the term to which it is related. The primary purpose of an RT is to alert the user to the existence of other and/or better index terms to be considered in the search. For the search topic under consideration, the user recognizes the terms DISPLAY and INSTRUMENTATION as being closely related to the search topic and these keywords are recorded.

Next the concept PILOT ASSISTS is looked for in the thesaurus. There is no such term. The user must then try to find another expression for the concept. PILOT AIDS does not exist. There are, however, several concepts listed with "pilot" as part of the concept. These "terms" are called reference terms because they refer the user to the active index term(s) which express the concept. For example, PILOT COMMENTS * PILOT 0177000 AND PERSONAL EVALUATION 0173000 * means that the concept "pilot comments" is expressed by coordinating the terms PILOT and PERSONAL EVALUATION. More about coordination of terms later. None of the listed concepts i.e. reference terms starting with "pilot" apply to PILOT ASSISTS. The user then looks under the term PILOT to see if any help can be found here. Under PILOT one finds the following:

PILOT
- BT CREW
- RT FLYING
- RT FLYING AIDS
- RT MAN-MACHINE SYSTEMS
- RT TASKS

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The RT FLYING AIDS is apparent as the term which embodies the concept PILOT ASSISTS, and this term is recorded.

The term DESIGN is found next. The several related terms to design do not suggest any better or alternate terms to be used. The search strategy will require DESIGN to be a keyword or term for retrieval.

APPROACH and LANDING are both index terms. APPROACH appears in the thesaurus as follows:

APPROACH
BT AIRCRAFT MANEUVERS
RT LANDING

The BT designation means "broader term" which means that this term is broader in scope than the main term and includes the main term as a member of the class term AIRCRAFT MANEUVERS. It would be possible to use the broader term if, for instance, documents on any aircraft maneuvers would be of interest. But for the postulated search topic we will restrict ourselves to LANDING and/or APPROACH.

Finally, the term VTOL AIRCRAFT is found as an index term. Under VTOL AIRCRAFT is the notation AS V/STOL AIRCRAFT and AS VTOL AIRCRAFT. AS means "also see" and strongly suggests consideration of the term in the search, as it is nearly synonomous with the keyword. For this particular search, V/STOL AIRCRAFT is quite close to VTOL AIRCRAFT, so this term is recorded.

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We now have the basic terminology for formulating a search strategy. Our worksheet now looks something like that shown in Figure 1. Verbalizing our search strategy, we definitely want the term DESIGN in the search. Next we want one or more of the following three terms to coordinate with DESIGN: INSTRUMENTS, INSTRUMENTATION, DISPLAY. We are interested in VTOL or V/STOL AIRCRAFT, so we would want one or both of these terms to coordinate with the previous coordination between DESIGN and one of the three terms indicated. We specifically desire APPROACH or LANDING, so either or both of these two terms should be coordinated with the just previous coordination. Finally we would be interested in FLYING AIDS coordinated with the result of the above coordinations. Writing this strategy in Boolean AND/OR logic our search would appear as follows:

AND	DESIGN
AND	INSTRUMENTS
OR	DISPLAY
OR	INSTRUMENTATION
AND	VTOL AIRCRAFT
OR	V/STOL AIRCRAFT
AND	APPROACH
OR	LANDING
AND	FLYING AIDS

We are now ready to go to the posting index and retrieve access numbers. The posting index consists of a listing of terms and the access numbers which were assigned these terms in indexing. The access numbers are listed in columns such that the terminal digit of the access number corresponds to the appropriate column. This allows for easier coordination. Using hypothetical numbers, let us apply our search strategy which was just formulated. For

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Figure 1

What documents on design of instruments to assist pilot in approach and landing VTOL aircraft?

Concepts	Terms
INSTRUMENTS	INSTRUMENTS
PILOT ASSISTS	INSTRUMENTATION
DESIGN	DISPLAY
APPROACH	
LANDING	FLYING AIDS
VTOL AIRCRAFT	
	DESIGN
	APPROACH
	LANDING
	VTOL AIRCRAFT
	V/STOL AIRCRAFT

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brevity this example will include only terminal digits 0-3. There should be two copies of the posting index from which to work.

1. Look up the term DESIGN in one posting index
2. Look up the term INSTRUMENTS in the other posting index and record common numbers in terminal digit columns

Posting Index #1

DESIGN

410	511	612	413
1620	721	1322	2003
1950	841	1552	
2170			

Posting Index #2

INSTRUMENTS

410	21	432	23
1730	71	552	653
1880	511	612	1133
1960	801	1082	1983
2170	921	1322	2003
	1001	1592	2123
		1712	

Our Worksheet

DESIGN and INSTRUMENTS

410	511	612	2003
2170		1322	

3. Look up the term INSTRUMENTATION in the other posting index and record common numbers

DESIGN

410	511	612	413
1620	721	1322	2003
1950	841	1552	
2170			

INSTRUMENTATION

100	11	52	83
270	81	732	833
410	101	1322	1933
1950	721	1482	
2000	1111	1552	
2140	2881		

Our Worksheet

DESIGN and INSTRUMENTS or INSTRUMENTATION

410✓	511	612	2003
2170	721	1322✓	
		1552	

✓indicates "hit" with both INSTRUMENTS and INSTRUMENTATION

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4. Look up the term DISPLAY in the other posting index and record common numbers

Posting Index #1

DESIGN

410	511	612	413
1650	721	1322	2003
1950	841	1552	
2170			

Posting Index #2

DISPLAY

10	71	32	83
50	101	412	193
330	191	1322	413
440	441	1462	2123
1260	720	2002	
1320	2021		
1620			
2200			

Our Worksheet

410✓✗	511	612	2003
2170	721✗	1322✓✗	
1620		1552	

✗ indicates hit with INSTRUMENTS or INSTRUMENTATION and DISPLAY

5. Look up the term VTOL AIRCRAFT in one posting index and find common numbers with our worksheet

Our Worksheet

410(vtol)	511	612(vtol)	2003
2170	721(vtol)	1322	
1620		1552(vtol)	

Posting Index #1
VTOL AIRCRAFT

200	411	392	803
370	721	612	1043
410	881	1292	1333
2220	1041	1482	2143
		1552	
		1702	

6. Look up V/STOL AIRCRAFT and find common numbers with our worksheet

Our Worksheet

410(vtol)	511	612(v/stol)(vtol)	2003(v/stol)
2170	721(vtol)	1322	
1620(v/stol)		1552(vtol)	

Posting Index #1
V/STOL AIRCRAFT

600	731	612	813
1590	951	1402	2003
1620	2281	1552	2153
2300			

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7. Separate out the group which coordinates throughout to this point

Our Worksheet

410(vtol)	511	612(v/stol vtol)	2003(v/stol)
2170	721(vtol)	1322	
1620(v/stol)		1552(vtol)	

410	721	612	2003
1620		1552	

8. Look up the term APPROACH and find common numbers with our revised worksheet

Our revised Worksheet

410	721(a)	612	2003
1620(a)		1552(a)	

Posting Index #1
APPROACH

20	471	502	113
70	721	1022	683
530	1431	1552	943
1520		1892	1353
1620			2143
1990			

9. Look up the term LANDING and find common numbers with our revised worksheet

Our revised Worksheet

410(l)	721(a, l)	612	20031
1620(a, l)		1552(a, l)	

LANDING

300	111	602	1013
410	221	1372	1943
1510	461	1552	2003
1520	721	2092	2163
1620	1011		
1710			

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10. Separate out the group which coordinates throughout to this point

410(1) 721(a, 1) 612 2003(1)
1620(a, 1) 1552(a, 1)

410 721 1552 2003
1620

11. Look up the term FLYING AIDS and find common numbers with our re-revised worksheet

Our re-revised Worksheet

410(fa) 721 1552 2003(fa)
1620

Posting Index #1
FLYING AIDS

110	331	1482	1913
410	561	1592	2003
1790	891		2113

12. Separate out the group which coordinates through

Our final Worksheet

410 2003

Document numbers 410 and 2003 should specifically answer our search topic. However, we have accumulated valuable data as we've gone. To obtain more documents we can refer to the previous worksheets and look at these access numbers. Note that we get documents which are nominally less relevant the further back we look, but there is an excellent chance that a revelant document may appear in one of the earlier groups. This is due to variation in indexing, shades of meaning differences, etc. The individual user must determine for himself the optimal search level depending on his search topic and the intended degree of coverage.

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Appendix VII

Experimental Directions

In this experiment we are attempting to evaluate a coordinate indexing system. A series of 3 questions will be provided and your task is to retrieve relevant documents needed to answer the questions. Conceive of your task as obtaining the information required to write a technical report.

You will be given a set of directions which describes the procedures for manipulating the indexing system. After reading the directions, formulate a search strategy. List the concepts under which you search. A secretary will obtain the documents for you when you are ready.

After retrieving the documents, hand to the experimenter the ones which you deem relevant in providing the necessary information to answer the questions.

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Appendix VIII

Tasks (Questions)

A. Find reports dealing with panel configurations for rotary-winged aircraft.

B. Get me some information on control-display requirements for IFR approach and landing in VTOL aircraft.

C. I'd like some data on recent (1963-on) inflight studies of VTOL Transition maneuvers.

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Appendix IX

Panel of Judges

Dr. Anthony Debons. Experimental Psychologist. Chairman of Department of Psychology. University of Dayton.

Dr. Lewis Hanes. Experimental Psychologist. Senior Scientist (Human Factors) at the National Cash Register Company, Dayton, Ohio.

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APPENDIX X

Raw Data and Computed Data for Users (Subjects)

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Professional Categories		Sessions 1			2			3		
Z	P_1	2660	A	3	555	C	3	862	B	0
		5	4	3	2	9	4	6	0	0
	P_2	2376	B	3	933	A	1	1024	C	3
		4	4	3	5	9	4	4	7	3
	E_1	5920	B	17	1797	C	4	1241	A	7
		7	23	19	8	32	18	3	26	24
	E_2	5624	C	2	1312	B	11	715	A	3
		9	17	8	4	15	5	2	3	2
Y	P_3	2760	C	4	900	A	3	720	B	4
		16	13	5	4	7	4	5	7	5
	P_4	3429	A	7	1780	B	4	2099	C	5
		8	11	9	8	4	2	17	11	5
	E_3	2630	A	3	862	B	3	720	C	1
		5	3	0	5	4	3	3	4	1
	E_4	1315	B	19	245	A	1	609	C	8
		5	40	14	2	11	0	1	54	6
X	P_5	4835	B	9	978	C	2	1230	A	1
		8	9	9	3	2	2	4	2	2
	P_6	2074	A	3	1471	C	0	930	B	3
		5	15	5	4	2	2	5	3	3
	E_5	1248	C	3	1366	A	2	1238	B	0
		3	3	2	6	2	1	5	0	0
	E_6	2425	C	2	1030	B	4	573	A	6
		4	2	2	4	7	5	5	18	1

Table 21: Raw Data for the Experiment. The entry in the upper-left hand corner of the cell in the Request Time in Seconds and in the lower-left hand corner is the Number of Concepts Employed The number of Documents Returned is listed in the middle. In the upper right-hand corner is the number of Relevant Documents Returned and in the lower-right-hand corner is the number of Retrieved Documents Judged Relevant by Subject.

Instructions

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Z

Y

X

163 Instructions

Professional Categories	Sessions 1		2		3	
P_1	12.00	100.00	16.67	133.33	00.00	00.00
	A		C		B	
	75.00	75.00	33.33	44.44	00.00	00.00
P_2	6.25	100.00	4.00	400.00	16.67	100.00
	B		B		C	
	75.00	75.00	11.11	44.44	42.86	42.86
E_1	35.42	111.76	22.22	450.00	28.00	385.71
	B		C		A	
	73.91	82.61	12.50	56.25	26.92	92.31
E_2	11.11	400.00	22.92	45.45	12.00	66.67
	C		B		A	
	11.76	47.06	73.33	33.33	100.00	66.67
P_3	22.22	125.00	12.00	133.33	8.33	125.00
	C		A		B	
	30.77	38.46	42.86	57.14	57.14	71.48
P_4	28.00	128.57	8.33	50.00	27.78	100.00
	A		B		C	
	63.64	81.82	100.00	50.00	45.45	45.45
E_3	12.00	.0000	6.25	100.00	5.56	100.00
	A		B		C	
	100.00	.0000	75.00	75.00	25.00	25.00
E_4	39.58	73.68	4.00	00.00	44.44	75.00
	B		A		C	
	47.50	35.00	9.09	00.00	14.81	11.11
P_5	18.75	100.00	11.11	100.00	4.00	200.00
	B		C		A	
	100.00	100.00	100.00	100.00	50.00	100.00
P_6	12.00	166.67	00.00	00.00	6.25	100.00
	A		C		B	
	20.00	33.33	00.00	100.00	100.00	100.00
E_5	16.67	66.67	8.00	50.00	00.00	00.00
	C		A		B	
	100.00	66.67	100.00	50.00	00.00	00.00
E_6	11.11	100.00	8.33	125.00	24.00	16.67
	C		B		A	
	100.00	100.00	57.14	71.43	33.33	5.56

Table 22: Computed Measures for the Experiment The Entry in the upper left-hand corner is the Recall score and the lower left is the General Relevance score. The entry in the upper right hand corner is the Comparative Relevance and in the lower right-hand corner is the Subjective Relevance The number of Relevant Documents for Question A was 25 for Question B 48, and for Question C 18

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APPENDIX XI

Concepts (Index/Retrieval Terms) Used in Searching

Table 23. The Concepts Searched and the Frequency of Usage for Question A.

CONCEPTS	FREQUENCY
1. DISPLAY	6
2. INSTRUMENTS	3
3. VTOL AIRCRAFT	5
4. EXPERIMENTAL AIRCRAFT	1
*5. PANELS	7
*6. AIRCRAFT	1
7. V/STOL AIRCRAFT	3
8. CONTROL DISPLAY	5
9. HELICOPTERS	8
10. INSTRUMENT DISPLAY	5
11. INSTRUMENTATION	2
*12. CONFIGURATION	3
13. TILT WING AIRCRAFT	1
14. DESIGN	2
15. COCKPITS	1

Table 24. The Concepts Searched and the Frequency of Usage for Question B.

CONCEPTS	FREQUENCY
*1. CONTROL DISPLAY	10
*2. REQUIREMENTS	4
3. V/STOL AIRCRAFT	2
*4. VTOL AIRCRAFT	10
*5. IFR	8
6. IFR CONDITIONS	1
*7. APPROACH	8
*8. LANDING	9
*9. DISPLAY COMPONENTS	1
*10. DISPLAY	2
*11. INSTRUMENT DISPLAY	2
12. FLIGHT	1
13. VERTICAL FLIGHT	1
14. HUMAN ENGINEERING	1
15. DESIGN	1
16. BLIND LANDING	1
17. CONTROL SYSTEMS	2
18. AIRCRAFT MANEUVERS	1
19. ALL-WEATHER CONDITIONS	1
20. REQUIREMENTS	1
21. AUTOMATIC CONTROL	1

* concepts named in question

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Table 25. Concepts Searched and Frequency of Usage for Question C.

CONCEPTS	FREQUENCY
1. EVALUATION	6
2. V/STOL AIRCRAFT	4
3. TILT WING AIRCRAFT	2
4. DATA	1
5. DOCUMENTATION	1
6. AIRCRAFT MANEUVERS	4
*7. VTOL AIRCRAFT	10
8. FLIGHT TESTING	9
9. ANALYSIS	2
10. SHORT FIELD TAKE-OFF	1
11. VERTICAL FLIGHT	1
12. VERTICAL MANEUVERS	2
13. FLIGHT MODE TRANSITION	10
*14. 1963-1967	4
*15. INFLIGHT	2
16. HELICOPTERS	2
17. LIFT FAN	1
18. FLIGHT DATA	2
19. FLIGHT CHARACTERISTICS	1
20. FLIGHT PROCEDURES	2
21. FLIGHT REPORTS	2
22. FLYING	1
23. FLIGHT MEASUREMENT DATA	1
24. AIRCRAFT MANEUVERS	1
25. FLIGHT MODE	1
26. VERTICAL MODE	1
27. PATTERNS	1
28. LONGITUDINAL MODE	1
29. LANDING	1
30. CONTROLLING	1
31. CONTROL ELEMENTS	1
32. APPROACH	1

* concepts named in question

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Table 26. Concepts Searched by the Psychologists and the Frequency of Usage for Question A.

	CONCEPT	FREQUENCY
1.	V/STOL AIRCRAFT	1
2.	PANELS	5
3.	VTOL AIRCRAFT	2
4.	INSTRUMENT DISPLAY	4
5.	TILT WING AIRCRAFT	1
6.	DISPLAY	3
7.	CONFIGURATION	2
8.	HELICOPTERS	6
9.	CONTROL DISPLAY	2
10.	INSTRUMENTS	1
11.	INSTRUMENTATION	1
12.	DISPLAY ARRANGEMENT	1
13.	DESIGN	2
14.	COCKPITS	

Table 27. Concepts Searched by the Psychologists and the Frequency of Usage for Question B.

	CONCEPT	FREQUENCY
1.	CONTROL DISPLAY	6
2.	REQUIREMENTS	3
3.	V/STOL AIRCRAFT	1
4.	VTOL AIRCRAFT	5
5.	IFR	5
6.	IFR CONDITIONS	1
7.	APPROACH	5
8.	LANDING	4
9.	DISPLAY COMPONENTS	1
10.	DISPLAY	1
11.	INSTRUMENT DISPLAY	1
12.	FLIGHT	1
13.	VFR	1
14.	CONTROL SYSTEMS	1
15.	HUMAN ENGINEERING	1

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Table 28. Concepts Searched by the Psychologists and Frequency of Usage for Question C.

	CONCEPTS	FREQUENCY
1.	VTOL AIRCRAFT	4
2.	HELICOPTERS	2
3.	LIFT FAN	1
4.	TILT WING AIRCRAFT	1
5.	FLIGHT DATA	2
6.	FLIGHT CHARACTERISTICS	1
7.	FLIGHT PROCEDURES	2
8.	FLIGHT REPORTS	2
9.	FLIGHT MODE TRANSITION	5
10.	FLIGHT TESTING	5
11.	FLYING	1
12.	EVALUATION	2
13.	V/STOL AIRCRAFT	2
14.	FLIGHT MEASUREMENT DATA	1
15.	AIRCRAFT MANUEVERS	1
16.	FLIGHT MODE	1
17.	1963 - 1967	3
18.	VERTICAL MODE	1
19.	PATTERNS	1
20.	VERTICAL MANEUVERS	1
21.	LONGITUDINAL MODE	1
22.	LANDING	1
23.	CONTROLLING	1
24.	CONTROL ELEMENTS	1
25.	APPROACH	1
26.	TRANSITION	1

Table 29. Concepts Searched by the Engineers and the Frequency of Usage for Question A.

	CONCEPTS	FREQUENCY
1.	DISPLAY	3
2.	INSTRUMENTS	2
3.	VTOL AIRCRAFT	3
4.	EXPERIMENTAL AIRCRAFT	1
5.	PANELS	2
6.	AIRCRAFT	1
7.	V/STOL AIRCRAFT	2
8.	CONTROL DISPLAY	3
9.	HELICOPTERS	2
10.	INSTRUMENT DISPLAY	1
11.	INSTRUMENTATION	1
12.	CONFIGURATION	1

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Table 30. Concepts Searched by Engineers and the Frequency of Usage for Question B.

	CONCEPTS	FREQUENCY
1.	DISPLAY	1
2.	DESIGN	1
3.	BLIND LANDING	1
4.	INSTRUMENT DISPLAY	5
5.	LANDING	4
6.	CONTROL DISPLAY	1
7.	CONTROL SYSTEMS	3
8.	IFR	3
9.	APPROACH	5
10.	VTOL AIRCRAFT	2
11.	REQUIREMENTS	1
12.	AIRCRAFT MANEUVERS	1
13.	AUTOMATIC LANDING	1
14.	V/STOL AIRCRAFT	1
15.	ALL-WEATHER CONDITIONS	1
16.	AUTOMATIC CONTROL	1

Table 31. Concepts Searched by the Engineers and the Frequency of Usage for Question C.

	CONCEPTS	FREQUENCY
1.	EVALUATION	4
2.	V/STOL AIRCRAFT	2
3.	TILT WING AIRCRAFT	1
4.	DATA	1
5.	DOCUMENTATION	1
6.	AIRCRAFT MANEUVERS	3
7.	VTOL AIRCRAFT	5
8.	FLIGHT TESTING	4
9.	ANALYSIS	2
10.	SHORT FIELD TAKE-OFF	1
11.	VERTICAL FLIGHT	1
12.	VERTICAL MANEUVERS	1
13.	FLIGHT MODE TRANSITION	3
14.	1963 - 1967	1

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13. ABSTRACT

A proposed classification system was studied to determine its efficacy to the Air Force Control-Display Area. Based on negative outcomes from a logical assessment of the proposed system, an alternate system was proposed to include the coordinate index concept. Upon development of a thesaurus and an index system on 106 documents in the VSTOL/VTOL area, an experiment was conducted to determine the acceptance and effectiveness of the system on professional workers using the system. Findings revealed that the coordinate system was acceptable to the user and that it provided for the retrieval of relevant documents beyond that expected by chance. The study suggests that the coordinate index system and the present measures used to study its effectiveness provide a rationale for further experimentation which can expand the base of the system to meet the need of the control-display area.

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	ROLE	WT	ROLE	WT	ROLE	WT
Evaluation						
Experimental Design						
Models						
Information Retrieval						
Document Retrieval Systems						
Information Systems						
Analysis of Variance						
Searching						
Personnel						
Control-Display						
V/STOL Aircraft						

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