A PILOT PROGRAM FOR SELECTING, EDITING, AND DISSEMINATING ENGINEERING AND SCIENTIFIC EDUCATIONAL SUBJECT MATTER FROM NASA TECHNICAL REPORTS

FINAL REPORT
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COLLEGE OF ENGINEERING
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NASA PILOT PROGRAM

FINAL REPORT

A. Summary

Engineering educators and practicing engineers alike have difficulty in keeping abreast of new technology with the rate at which it is being created in research and development laboratories throughout the world. If every individual had the time to search through research reports documenting the new technology and to glean for himself the information that he could use, there would be no problem. Not only is it physically impossible for each individual to review all documents being produced, but also it is a very inefficient use of the valuable time of engineers and teachers.

The NASA Pilot Program has been conducted at Oklahoma State University over a fifteen month period ending August 31, 1967, with an objective of providing up-to-date instructional material derived from current research as rapidly and as efficiently as possible to faculty members engaged in teaching. A senior author who is a recent textbook author or a recognized authority in his field has provided the guidance for a systematic search of the literature, a selection of appropriate material in his subject area for educational use, and a preparation of a written Monograph for use as supplementary material in the classroom. A total of 17 Monographs have been written in three different subject areas of heat transfer, thermodynamics, and control systems. These Monographs were prepared from research documents produced through NASA research efforts.

A Monograph is described as a technical paper primarily based on one or more NASA research reports and commonly supplemented by other material and is designed to supplement textbook and class note material in a course of instruction. The material is sufficiently complete to be used by the teacher in one to three class periods without undue reference work on his part. Where possible, the Monograph contains and develops only one central idea. An instructor's guide orients the instructor on how to use the Monograph and the prerequisites and technical significance to be expected.

A second facet of the NASA Pilot Program has been the evaluation of Visual Briefs generated in NASA research centers. The Visual Briefs add another dimension to the learning process by providing visual information not readily presented by written material alone. The visual materials used in the Visual Briefs usually were produced as a part of the analysis process in a research program and were thus available for use in an educational format as well. The NASA Pilot Program at Oklahoma State University obtained the assembled Visual Briefs from the NASA Western Support Office and then incorporated 21 of them into the same dissemination and evaluation program developed for testing the Monographs being generated at both Oklahoma State University and Virginia Polytechnic Institute.

The initial experience in producing and using Monographs to reduce the time between discovery of specific scientific and engineering information and its use in technological development (and perhaps prevent the loss of the material for further use altogether) has been most encouraging. A sufficient number of requests and evaluations of Monographs have been obtained from professors at 35 different universities to conclude that there is real value in this program. Although there were fewer requests for the use of the Visual Briefs involving professors at 19 different universities, most professors using the materials reported favorably on their benefit to the educational process. In these tests there were more exposures for the Monographs in the classroom while there were more exposures for the Visual Briefs in research seminars and graduate student research. These materials were not ready soon enough to allow faculty to adequately plan for their use during the regular academic year.

The efficiency with which the material can be selected and prepared in Monograph format depends on having a satisfactory mode of operation among a senior author, another experienced engineering educator as a writer and a graduate assistant for searching the literature. Several different modes of operation have been tried during the contract, and a number of satisfactory techniques have been developed depending on the desires of the senior author. Particularly desirable, economically, was the mode allowing the senior author to select material, to contract the writing out to an experienced engineering educator for writing as a consultant, and then to finally edit the material for final reproduction.

The extrapolation of a program of this type from the pilot stage to a comprehensive recovery of documents in many subject areas from the research laboratories throughout the world should be preceded by an expansion of these activities into other subject areas and from other laboratories outside of the NASA group to provide further tests of the techniques developed during this first stage of the NASA Pilot Program. The personnel of the NASA Pilot Program at Oklahoma State University have been convinced by the experience and results obtained under this contract that there probably is no better way than this technique to insure that scientific and technological developments from current research be retrieved and made available to the maximum extent for this nation's industrial and educational benefit.

B. Introduction

1. History of Program

On March 16, 1966, the College of Engineering at Oklahoma State University submitted an unsolicited proposal entitled "A Pilot Program for Selecting, Editing, and Disseminating Engineering and Scientific Educational Subject Matter from NASA Technical Reports" to the Office of Technology Utilization of the National Aeronautics and Space Administration. The objective of this proposal [redacted] was to systematically review NASA Technical Reports for information that would be of significant benefit to the engineering and physical sciences educational programs. The resulting information would be formulated as Monographs suitable for supplementary text materials in advanced undergraduate and graduate classes as well as in technical short courses and seminars.

The Office of Technology Utilization through its Western Support Office had already implemented a program to develop Visual Briefs with a similar purpose as proposed for the Monographs. Since the two programs were so closely related, they were combined into a single program with the Western Support Office preparing the Visual Briefs and Oklahoma State University providing for initial evaluation, reproduction, and dissemination and evaluation in various universities for trial use. In addition, Oklahoma State University would implement the program of Monograph preparation carrying through to a dissemination and evaluation along with the Visual Briefs. NASA Contract Number NSR 37-002-045 [redacted] with Oklahoma State University provides the Work Statement within which this program has been implemented.

The Virginia Polytechnic Institute became involved in the program through the participation of Dr. William A. Blackwell who participated in the early planning of the initial proposal from Oklahoma State University. Subsequently, Dr. Blackwell became Head of the Department of Electrical Engineering at Virginia Polytechnic Institute but retained his interest in the program. A subcontract with the Virginia Polytechnic Institute [redacted] was written to allow Dr. Blackwell to work as a senior author in the program.

2. Function of Program

A program objective is to provide up-to-date instructional material derived from current research as rapidly and as efficiently as possible to faculty members engaged in teaching. Information about new technology usually is published first as a research report and then tends to migrate through other forms of published material until it makes its way into textbooks. The time necessary for new technology to be included in the textbook typically can be five years. The textbook contains the majority of material possible for a professor to use in his course, and this busy person seldom has time to augment his material with many recent research results. In the meantime, new technology is being created at a faster and faster rate further aggrevating the situation of using outdated material in university classrooms. The preparation of a Monograph directly from the first research report would attempt to shortcut this time by perhaps several years. This preparation would conserve the time of many faculty members by having the search and writing done by a few with the resulting Monograph being made available to all.

The Visual Briefs attempt to add another dimension in the learning process by providing visual information not readily possible to be described by written material. During research programs there are times when the research participant cannot adequately analyze the results of his project without taking either still or motion pictures. Once the information has been obtained there is an excellent source of material for explaining the same phenomenon to the student in the classroom. This is the raw material from which Visual Briefs are prepared by the NASA Western Support Office for this program.

A program that systematically searches for new technology and prepares it for educational use may make available many new developments that otherwise might contribute only to the solution of a single problem. The inevitable result otherwise would be the reinvention or rediscovery of technology that would not otherwise have been necessary.

A more complete discussion of the relationship and value of the products of this program in improving the material available to an engineering professor is included in two papers presented at the Annual Meeting of the American Society for Engineering Education at Michigan State University during June 19-22, 1967. The papers [redacted] are entitled "Monographs Containing Source Material on New Technology", by Kenneth A. McCollom, an administrator of this program, and "Visual Briefs - Supplementary Teaching Aids" by Dick W. Orrick of the NASA Office of Technology Utilization.

C. Program Organization

1. Subject Areas Used

The subject areas of Heat Transfer, Thermodynamics, and Control Systems were selected from the one page summaries submitted by Oklahoma State University professors in the initial proposal (Appendix VII). Even though there would be no attempt to write Monographs to cover the complete range of these areas, the broad subject areas appeared desirable as a title. In Heat Transfer both radiation and convection heat transfer are treated. The Thermodynamics area is rather specialized in the Monographs prepared. In the Control System area a wide range of subjects are covered. The Monograph titles and abstracts generated during this program are listed under these three subject areas in Appendix VI of this report.

The Visual Briefs were selected without regard for subject areas and then were classified according to subject. These subject areas are somewhat more specific than for the Monographs. The Visual Briefs are listed according to the following categories in Appendix VII of this report: Convection Heat Transfer, Radiation Heat Transfer, Gas Dynamics, Machine Design, Reaction Kinetics, Aircraft Structures, Control Systems, Mechanical Metallurgy, and Bioelectronics.

The NASA research program generates certain specialized areas which are unique to NASA, but, in addition, nearly every standard technology is represented by use to a greater or lesser degree. Many subject areas could be developed into a Monograph program from NASA work as well as from other major research programs such as that of the Atomic Energy Commission.

2. Program Personnel

This program has been organized and administered by two administrators, Dr. Clark A. Dunn, Associate Dean of the College of Engineering, and Dr. Kenneth A. McCollom, Professor of the School of Electrical Engineering at Oklahoma State University.

During the course of the program there have been five professors who qualify as senior authors: Dr. John A. Wiebelt of the School of Mechanical Engineering; Dr. Kenneth J. Bell, Professor Wayne C. Edmister, and Dr. K. C. Chao of the School of Chemical Engineering; and Dr. William A. Blackwell of the School of Electrical Engineering at Virginia Polytechnic Institute. Others participating significantly in writing Monographs are Dr. Leonard L. Grigsby, Dr. H. F. VanLandingham, and Dr. A. Wayne Bennett of the School of Electrical Engineering at Virginia Polytechnic Institute; and Dr. Paul A. Miller of the School of Mechanical Engineering at Kansas State University.

D. Procedures for Producing Monographs

1. Modes of Operation

The mode of operation used to produce Monographs must be attractive to the senior author to gain his participation. He is the key person in the production of Monographs and is expected to have the following qualifications: an author of a recent textbook or a recognized authority in his field, an experienced and mature engineer in his field, and an experienced and knowledgeable teacher in engineering. In the process of producing Monographs he must be able to recognize new and significant material in his field; he must be able to develop a complete and accurate presentation of the new contribution to technology; and he must be able to write or edit the Monograph in such a way as to make it valuable as supplementary teaching material in his field. An individual with these qualifications has many places where he can fruitfully apply his labors, so a satisfactory mode of operation of the monograph program is important.

Two main modes of operation have been used for writing Monographs with a third mode being a slight modification of the second. In the first mode, the senior author does all of his own development of material and writing with only minor assistance from a graduate associate where desired. This mode uses a considerable amount of the senior author's time. In the second mode, an experienced engineering professor in the field takes the material selected by the senior author and prepares it as supplementary textbook material under the guidance of the senior author. In these two modes, both the senior author and the supporting experienced engineering professor have been regular participants in the program. The third mode modifies this procedure slightly by hiring the experienced engineering professor as a consultant at an appropriate hourly stipend to prepare the Monograph from the material selected by the senior author. The senior author then edits and prepares the material for final typing. The experience in this mode of operation was obtained under the guidance of Dr. John A. Wiebelt as senior author with Dr. Paul A. Miller of Kansas State University, who was a former student of Dr. Wiebelt's, doing the writing. This procedure is closely related to the writing arrangement textbook authors have with professional book publishers.

2. Selection of Material

The first task in preparing a Monograph is to obtain new material appropriate for use in the classroom. A graduate associate performs the initial search under the guidance of the senior author. The senior author orientates the Graduate Associate in the subject area in which he is to work, giving him key ideas of what to expect. The most productive place from which a graduate associate can find research reports from NASA Laboratories or NASA Contracts is the STAR abstracts, A Selected Listing of NASA Scientific and Technical Reports for 19--, and the AIAA, American Institute of Aerospace Abstracts, publications. The abstracts obtained in this manner are reviewed with the senior author who selects those for which the complete report should be obtained. The microfiche copies of the complete report are obtained quite rapidly from the closest NASA repository (in this case, the Technology Use Studies Center at Southeastern State College in Durant, Oklahoma). Similar repositories are distributed throughout the United States. The graduate associate reads the microfiche copy and presents those passing this analysis to the senior author to check. The senior author then has "hard copy" reproduced from the microfiche in local library facilities at Oklahoma State University if he wishes to use it for Monograph source material. Detailed guidance for the graduate associate in searching the abstracts is reproduced in Appendix V-1 of this report.

Two other techniques used to discover appropriate material for Monographs were computer oriented information retrieval programs and personal contacts and visits with known centers in the senior author's area. Initial use of the information retrieval through the Technology Utilization Division produced some peripheral reports of interest but otherwise rather useless material for this purpose. No further refinement of indexing was attempted at this time, since sufficient material was being discovered through the abstract searches. The NASA Information retrieval system known as SCAN, Selected Current Aerospace Notices, should be of great use in selecting material.

Since the senior author is acquainted with those contributing in his field, he is in a position to learn of material directly from centers doing this research. Several of the senior authors did visit some of the NASA research centers to develop such contacts with good results. One item discovered was the availability of internal reports which do not reach the open literature. Some of these external reports, particularly in design, appear to make significant contributions to new technology.

3. Writing the Monographs

Varying degrees of effort are required to turn the information in a report or reports into a form appropriate as a Monograph. Much of the effort in the initial searches involved obtaining research reports which could be readily transformed from their present form to that of a Monograph. There have been some significant exceptions which indicate the variation in effort required. When more than one report serves as a basis for the Monograph significantly greater effort is required to produce a single Monograph. Even greater effort is required if the material in a report is new technology but is too limited or incomplete to serve as satisfactory educational material.

General guidance for the senior authors is provided for both the philosophy behind the Monograph concept and for the specific Monograph format expected, yet he is left with a great deal of flexibility in the actual writing of the Monograph. This guidance information is included in Appendix V-2 of this report. Following the writing of the Monograph, the graduate associate is again used to help design and work out a solution to a problem using the new technology discussed. Following editing of the Monograph, the home problem, and the home problem solution, final typing and drafting are accomplished and the Monograph is readied for multiple copy reproduction.

Prior to final reproduction, several copies of the Monograph are made which are sent to the authors of the original reports from which the Monograph was written. The objective is to get a critique of the technical content of the Monograph from one who is intimately acquainted with the work. This review is quite useful when it can be obtained. When this is not possible, the senior author usually will have a colleague who is also competent in the field to review the Monograph for technical content. The format and the presentation of the Monograph as educational material, of course, is the responsibility of the senior author as an experienced, competent engineering teacher in his field.

4. Reproduction

Following the technical review and any alterations found appropriate, the Monographs are typed onto multilith mats for reproduction which results in printed material similar to that of this report. There are two formats produced of each Monograph, an Instructor's Monograph and a Student's Monograph. They differ only in that the student's copy does not have front and back covers, the Instructor's Guide for Use of the Monograph, and the solution to any home problems in the Monograph. The usefulness to the student of a copy is similar to the usefulness of his textbook in providing him with basic technology.

E. Procedures for Handling Visual Briefs

1. Initial Evaluation

The Visual Briefs consisting of visual material and associated written material were received from NASA Western Support Office for initial evaluation for possible use as classroom, seminar, and technical meeting materials. Professors in fields related to the subject area reviewed these materials with an eventual selection of 21 of the 37 Visual Briefs provided. A listing of these 21 Visual Briefs together with abstracts describing them are given in Appendix VII of this report.

The usual initial evaluation of a Visual Brief was essentially as follows. The professor read the material supplied with the visual material to acquaint himself with the general background of the NASA research in which it was generated. The film was run for the first time. The professor attempted to select the important portion or portions of technology that were best explained or demonstrated in the film. If he felt that there were significant educational materials for particular group or groups of technical persons, the professor made this note along with any general comments concerning the film quality.

2. Guidance for Use of Visual Briefs

The visual materials for the Visual Briefs were prepared by each of the NASA research centers initially generating the related research. Although it is possible to edit the movie films, it is not possible to add material to the films in an attempt to improve the educational techniques. With this limitation in effect no attempt was made at Oklahoma State University to alter the visual material as received from the NASA Western Support Office.

For those who use the Visual Briefs, a general guide was prepared to bring to the user's attention possible educational uses. The guide suggests the types of information that might be involved in the films, the types of groups which might profitably use the Visual Brief, and the recommended procedure for preparation by the professor before using the Visual Brief in a group presentation. This "General Guide for Use of Visual Briefs" is shown attached as the first page of the abstracts of Visual Briefs in Appendix VII.

3. Reproduction

The visual material of the Visual Briefs occur as 16 mm moving picture film, 8 mm moving picture film in cartridges, and still photographs. The 16 mm films include both color and black and white in combination with both silent and sound tracks. The 8 mm film in cartridges is for use without sound with the Technicolor Instant Movie Projector Model 800. These cartridges together with the projector are very easy equipment to use and contain only short, meaningful moving pictures of key parts of a particular experiment. Two of the Visual Briefs VB-15 and VB-20 were supplied in this format by the NASA Western Support Office and the ten Model 800 projectors were purchased under this contract at Oklahoma State University for loan to possible users not equipped in this manner. One Visual Brief, VB- 5, provided photographs as the visual material.

The remaining Visual Briefs were 16 mm moving picture films. Nine copies of each film were made by one of two film processing firms, Hollywood Film Enterprises, Hollywood, California, and Byron Motion Pictures, Inc., Washington, D. C. The latter firm was used for reproduction of the four films from the Langley Research Center at their request. The remaining films were reproduced by the Hollywood Film Enterprises as the low bidder of three bids from film processing companies. Some of the color films were reproduced from the master film from the research centers known as A, B, and C rolls corresponding to pictures, fading and subtitles, and sound and some were reproduced from a good quality print. In either case, an internegative was produced from which additional color prints can be made as desired. These internegatives are in the possession of the NASA Western Support Office. The best quality prints, of course, are obtained from internegatives made from the masters, but the alternate method did prove satisfactory.

F. Procedures Used for Trial Dissemination

An objective of the program was to determine the effectiveness of the Monographs and Visual Briefs by dissemination into classrooms, seminars, and research programs in universities throughout the United States. The schedule of writing and reproducing Monographs and receiving and reproducing Visual Briefs was sufficiently tight to require personal contacts with prospective evaluators if a test were to be obtained during the second semester of the 1966-67 academic year. These contacts were made by the senior authors with known co-workers in his field at other universities and resulted in reasonably good response. Due to the longer time necessary to prepare a Monograph than that originally thought and due to the delays in reproduction of both the Monographs and Visual Briefs, only a few items were actually sent to professors for use during the second semester of 1966-67.

A second method of making the engineering educator aware of the program was through presentation of papers at professional meetings. Dr. McCollom presented a general paper describing the program for both the Monographs and the Visual Briefs at the educational session of the Fourth Space Congress held at Cocoa Beach, Florida, in April, 1967. A more effective presentation to engineering professors specifically was made through the papers referred to previously presented at the Annual Meeting of the American Society for Engineering Education by Dr. McCollom and Mr. D. W. Orrick [redacted] The reception by educators at both meetings was quite positive resulting in many more requests for both Monographs and Visual Briefs. In addition to the papers presented at A.S.E.E. there were two panel displays on Monographs and Visual Briefs placed at strategic places at the meeting and two of the Visual Briefs were included in a series of films shown three times during the meeting by the Office of Engineering Education.

At the time an individual professor expressed any interest in participating in evaluating Monographs and/or Visual Briefs he was sent a letter explaining the program and a set of abstracts of all Monographs and/or Visual Briefs (reproduced as Appendix VI and VII of this report, respectively). Then, when the professor made specific requests for those materials appropriate for his use, the materials were sent together with evaluation sheets (forms of which are reproduced in Appendix III-2 and IV-2 of this report) and with an indication of how important his evaluations would be to the success of the program.

G. Results from Program Implementation

During the period of this contract, 17 Monographs have been written most of which have been reproduced and 21 of 37 Visual Briefs have been selected and have been reproduced. The abstracts of the Monographs are shown in Appendix VI and those of the Visual Briefs selected are shown in Appendix VII. The procedures discussed in the previous three sections were those used to accomplish these results. The rest of this section will be used to summarize the accomplishments when these procedures were implemented.

1. Selection of Material for Monographs

The most productive method of obtaining reports for use in preparing Monographs was through the graduate associate. Under the guidance of the senior authors, the graduate associate systematically reviewed the STAR and AIAA abstracts using the techniques recorded in Appendix V-1. The second method of making a visit to specific laboratories doing research in his area was used a single time by each of three senior authors. These personal contacts with research personnel active in the individual areas produced a number of likely reports. The senior authors feel that this avenue would be very effective for obtaining material when properly developed. The third method of using informational retrieval techniques that are automated through the computer was used only one time. The very large number of inappropriate reports and very few desirable ones indicated that familiarity and proper indexing techniques would be necessary to take advantage of what will undoubtedly be a very valuable aid.

Some statistics on the effectiveness of the use of reviewing abstracts in the Control Systems area will give an indication of results of this method of seeking material. From the survey of the STAR abstracts over several recent years 146 reports were considered. Of these 146, 36 were reviewed extensively, some by two or more members of the group for a total of 64 reviews. Of those reviewed, 9 reports were chosen from which the 6 Monographs in the Control Systems area were written. Of the 27 reports remaining of those extensively reviewed, 15 additional reports were felt to have classroom applications. Of these, 5 seem best suited for Monograph preparation.

The amount of material available in each of the three subject areas of this program depends greatly on the breadth or narrowness of specialization of the professor involved. The subject areas themselves are quite broad. The narrower part of the Thermodynamics area worked by Dr. K. C. Chao, however, appears to be quite limited in the reports that were located. On the other hand, that part of the subject area of thermodynamics being developed by Wayne C. Edmister does not seem to be so limited.

There is a source of what appears to be useful material for Monographs which are not published in the open literature. They are referred to as "internal" reports. These are normally generated to provide for satisfactory operation of work being conducted at a particular research center, but, for some reason have not been published where they would be abstracted by STAR or AIAA.

2. Writing the Monographs

Once appropriate material has been selected by the senior authors a wide range of effort is still required to complete the writing of a Monograph. Some reports are in a format near enough to one useful in the educational process that a relatively few hours are required to finish the preparation. Monographs HT-7 and HT-8 are examples where approximately 40 and 24 hours, respectively, of actual writing time were required to make the conversion. Additional man-hours of time are required to prepare the Monographs for reproduction estimated here to be: approximately 10 hours to design and work a home problem; 5 hours of editing by senior author; and 25 hours for the rough draft and the final draft typing together with preparation of illustrations. For HT-7 this would total 45 man-hours of professional time and 35 man-hours of skilled time. Undoubtedly, this is the lower limit of the time necessary to prepare a Monograph following delineation of material.

The variables that have been found to increase the time necessary to complete a Monograph are numerous. If two or more reports are used, the preparation is more time consuming. When the subject area is covered inadequately, the professor may find it necessary to prepare additional information to make a complete topic. The computer has become a valued tool in many analytical techniques not previously solvable. Usually these computer programs are quite elaborate and need simplification for the learning process required in the classroom. Lastly, (as was found in CS-2) some improper assumptions on the part of the original author may lead to errors that the author must reconcile through further development and discussions with the original author. As an estimate, the professional man-hours could easily increase by a factor of four over the 45 man-hours established in the previous paragraph.

During this program, the majority of the writing effort of a professor was provided as a continuous 1/4 time. With the other 3/4 time assigned to other duties and with the many interruptions during the day, this mode of operation did not provide an efficient use of the professor's efforts. Writing technical material just cannot be done efficiently or effectively in two hour sections. During writing periods, at least 1/2 of the professor's time should be allotted. The minimum time established for the two Monographs, HT-7 and HT-8, was accomplished with full time assigned during the actual writing of the Monograph by the consultant, Dr. Paul A. Miller.

3. Dissemination of Monographs and Visual Briefs

The timing of the production of Monographs and Visual Briefs was supposed to be so that evaluations could be obtained from uses in the classroom during the second semester of the academic year starting the last of January, 1967. The timing could not be met, primarily because of the longer time necessary to write a Monograph over that originally expected. The last of the original 15 Monographs plus 2 additional Monographs in the Heat Transfer area were not completed until the end of the program on August 31, 1967. There was also a delay in receiving all of the materials making up the Visual Briefs until January, after which all of the reproduction had to be handled. The delays in obtaining the masters from the research centers involved and the actual processing in the commercial film laboratories did not make the Visual Briefs available until April, 1967. This delay made the time much too short for a professor to incorporate the material into a course in conjunction with his other material during the Spring semester.

Despite the lateness of availability, sufficient numbers of requests for the materials were received to conclude that there was both an interest in the material and that the methods of publicizing their existence were effective. In Table I-1 of Appendix I, the statistics on dissemination of Monographs listed by the Monograph Number is shown. The total number of instructor's copies, indicating individual professors making requests, ranged from 12 to 28 depending on the Monograph. The total requests for the 15 Monographs were 290 instructor's copies and 1,481 student's copies. These requests came through contacts made by the personal calls of the senior authors, the displays and papers at the meetings, and through word of mouth. The list in Table I-1 as being unfilled requests for Monographs results from not having the reproduction process completed on the particular ones.

Many of the Monograph requests were for just the instructor's copy for evaluation. The dissemination statistics were analyzed with this in mind and resulted in the two other tables in Appendix I designated Table I-2 and Table I-3. In Table I-2, the Monographs are listed by university and department where both an instructor's copy and additional student copies were requested, indicating a definite intent of use in the classroom. There are 13 different universities listed here. In Table I-3 the Monographs are listed by university department and professor for which just the instructor's copy was requested. There are 22 universities represented here from which it is expected to receive some requests for student copies.

Similar information to that accumulated on Monograph dissemination and shown in Appendix I has been developed for Visual Briefs and is shown in Appendix II. In Table II-1, the number of requests can be seen to range from 0 to 5 depending on the Visual Brief. The total number of requests for the 21 Visual Briefs come to 74 at the time of the completion of the contract. The unfilled requests for the Visual Briefs are for use by professors who want the Visual Brief for a particular time during the Fall Semester of the academic year starting September, 1967. The analyses of dissemination statistics on Visual Briefs was made according to whether the use was in the classroom, shown in Table II-2, or the use was for some other purpose, shown in Table II-3. There were 16 different universities where the expectation is for use in the classroom and 3 organizations for miscellaneous purposes.

The effectiveness of dissemination appears to be reasonably good for the Monographs and not so good for the Visual Briefs. All of the Monographs have 12 or more professors involved. Although a fairly wide range of universities are involved, none of the Visual Briefs have more than 5 requests and VB-5 has had no requests. This is far from the original goal of 10 or more tests of each Visual Brief. This appears to reinforce an impression obtained early in the program of more reluctance to use moving pictures as supplementary educational material compared to that of the specially prepared written material for the Monograph. The professors who did use the Visual Briefs, in general, felt that obtaining projection equipment was not a particular nuisance or problem. On the other hand, the Monographs and the Visual Briefs had essentially the same exposure to professors, yet, the Monographs were requested 5.5 times as often as the Visual Briefs at the completion of the contract on August 31, 1967.

4. Monograph Evaluations from Professors

More evaluations from professors have been received for use of the Visual Briefs than for use of the Monographs. The Visual Briefs are being used more in research seminars while the Monographs are being used almost entirely in classroom lectures. Monographs were not available in time for any significant use in spring classes and there were not many classes conducted during the summer in most universities. On the other hand, the research programs do flourish in the summer possibly accounting for the large number of evaluations for the Visual Briefs. Further discussion on the evaluation of Visual Briefs will be made in the next section.

Only 5 of the 15 Monographs have been used by professors and corresponding evaluation sheets returned. They are HT-1, HT-3, HT-4, TD-3, and CS-5 as shown in the statistics collected from the evaluation sheets in Appendix III. Some selected responses from the evaluation sheets have been tabulated by Monograph in Table III-1. There are so few samples, 10 in all, that perhaps the most significant information in the table are the totals tabulated on the right for each response. The totals of all responses for each check space on the Monograph evaluation sheet have been made and entered on a Monograph evaluation Form in Section III-2 of Appendix III. The written comments made by any professor on the evaluation sheets are listed for each Monograph in Section III-3 of Appendix III.

From these evaluations some general conclusions can be made. The number of samples is so small that any positive conclusions would be premature. The Monographs were mostly used in the classroom rather than in other applications, and none were used in research as such. Although the material was familiar to most of the instructors, the formulation of the material in this form was found suitable for use. Perhaps a disappointing thing in the early returns was the number of times the instructor did not require the student to work the home problems. The format and the amount of material seemed appropriate for the professors involved, and references were used in most cases. The general observation of the professors submitting the evaluations is that all thought they were of some use and half of them felt that Monographs would be of great assistance in the classroom use. It is interesting to note that the Monographs were used almost entirely in context with closely related material in course presentation, whereas the majority did not use the Visual Briefs in conjunction with closely related material. From the written comments in Section II-3, the feelings appear to be that the Monograph concept is interesting and useful. Other comments include some specific suggestions on Monograph format and the level in the technical content for which the particular Monographs might be used.

The number of evaluations is small, but there appears to be no reason why the Monograph would not be an acceptable and desirable supplementary aid in the classroom. Additional evaluations in classrooms by professors will certainly contribute to refinements that will make the Monographs even more effective in their uses.

5. Visual Brief Evaluations from Professors

Some of the statistics on the use and evaluation of Visual Briefs which were primarily obtained from the Visual Brief Evaluation Sheets are shown in Appendix IV. As was done for the Monograph tabulations, some selected information from the evaluation sheets is given by Visual Brief number in Table IV-1. This table is divided into part (A) on specific recommendations for Visual Briefs and part (B) on some general recommendations for Visual Briefs. The totaled responses from all evaluation sheets of all checked spaces are summarized on one of the Visual Brief Evaluation Sheets as part IV-2 of Appendix IV. And finally, in part IV-3, are a tabulation of all of the comments written in by the professor on the evaluation sheets tabulated according to Visual Brief. There are a reasonable number of these comments which appear to be meaningful. The discrepancy between the total copies sent being 42 as shown in Table IV-1, Comment 1, and the total evaluations received being 27 as shown in Table II-1 is caused by the professor who has not yet completed his evaluation. Although some of them may not return their evaluations, many will, but they were not available at the end of the contract period.

From these evaluations some general conclusions can be made, again with the reservation that there are not enough samples to make conclusions with great confidence. There appears to be more reluctance by professors to use the Visual Briefs as compared to the Monographs as supplementary classroom material. The Visual Briefs are used much more often for purposes outside the lecture classroom than the Monographs are. Predominantly, they were used for graduate students in research work. Those who used the Visual Briefs found them suitable material that contributed to understanding and felt that the material could not have been presented by any other communication form as well. The length and format appeared to be appropriate, and, although only half of the professors responding read the supplementary material, they did not feel that special preparation of written material (such as a supplementary Monograph) would be especially useful. There were several written comments that disagree with this (See for instance VB-33, Comment Number 2, Section IV-3 of Appendix IV). Except for some obvious exceptions, the Visual Briefs were felt to be too advanced for undergraduates. The Visual Briefs without sound were felt to be much less effective than those with sound. Some comments also indicated that a better description of what was happening and why should have been included in those that did have sound.

Although the number of samples involved here is small, the conclusions drawn above appear to be logical and should provide a profitable direction for future planning of such Visual Briefs. The only further comment that might be made at this time is that no one appears to be interested in the 8 mm systems. Whether the professor does not like the material, does not like the cartridge film system without sound, or whether the system has not been adequately sold is not known.

6. "Education Briefs" to Industry

The NASA Technology Utilization Division has in operation a method of sending one page "Tech Briefs" to industry on subjects generated in NASA research that might be applicable there. As a corollary to this program, Mr. Kenneth T. Jacobs of the Technology Utilization Office of the Goddard Space Flight Center produced one page "Education Briefs" from the abstracts of four of the Monographs, three in Heat Transfer and one in Thermodynamics. Mr. Jacobs routed these to the industrial companies normally receiving the "Tech Briefs" and obtained a very favorable response compared to the ratings normally obtained for such exposures. There were 243 approaches of which 36 per cent responded. Of those responding 70 per cent were positive, 14 per cent were negative and 14 per cent were other responses. This response by industry to the Monographs gives a significant support to the requirement of getting new technology as rapidly as possible into use through special preparation of educational materials.

H. Some Cost Figures from Program Implementation

This program in producing and testing written and visual materials as supplementary aid in engineering education has been a research program in that the techniques and formats were developed as well as actual products produced. In analyzing the cost figures necessary to be able to provide a probable unit cost in a continuing program of this type, it is difficult to separate the development costs from the production costs in the original program. Nevertheless, any estimate of the cost allotment from the original program might be helpful in making some initial estimates of cost of production. In the following sections, these costs have been divided according to some major budget areas.

1. Preparation of Monographs

The costs listed below by Monograph numbers are divided by senior author. The costs included were the author's, the graduate associate's, the secretary's, and the special service's time necessary to search for materials, establish procedures, write the Monographs, obtain technical approvals from original authors, and make corrections required for the Monographs listed.

John A. Wiebelt	
HT-1, HT-3, HT-4	$12,000
HT-7, HT-8	1,700
Kenneth J. Bell	
HT-2, HT-5, HT-6	$11,400
Wayne Edmister	
TD-3, TD-4	$10,500
K. C. Chao	
TD-1, TD-2 (not completed)	$6,800
William A. Blackwell	
CS-1, CS-2, CS-3, CS-4, CS-5, CS-6	$19,800

These figures include the standard overhead, vacation, personnel benefits, etc., normally required for these persons but does not include the costs of the Program Administrator's office. The average cost then turns out to be about $3,700 per Monograph with a low of $850 per Monograph and a high of about $5,000 per Monograph.

2. Reproduction of Monographs

Following the typing of the final Monograph on multilith mats the reproduction costs per Monograph can be determined quite accurately. The total cost of drafting services, art services, and production of the front and back covers for the first 15 Monographs came to $1,094. The cost of running the reproduction process, assembling, and binding came to $1,177 for the first 9 Monographs. These figures result in averages of $73 and $130 per Monograph, respectively or a total of $203 per Monograph for the average. This resulted in 100 Instructor's copies and 400 Student's copies of each Monograph.

3. Review and Selection of Visual Briefs

An estimate of the total time used by the staff in reviewing and selecting the Visual Briefs together with an estimate of equipment and operator costs results in an estimate of about $2,200 for this service. This figure was much greater than this in the proposed budget at the start of this program. The difference resulted from the decision to make no alterations to the Visual Briefs and to prepare no detailed instructor's guide but rather a general instructor's guide for their use by the professors.

4. Reproduction of Visual Briefs

The unit cost per foot for the various stages of reproducing color and black and white film are given from the low bidder, Hollywood Film Enterprises.

Eastmancolor, Sound

1 - Internegative from A and B roll original	$.27/ft.
1 - Optical sound track from magnetic tape	.125/ft.
1 - First trial Eastman Color Answer Print	.11/ft.
9 - Eastmancolor release prints	.075/ft.

Eastmancolor, Silent

1 - Internegative from A and B roll original	$.27/ft.
1 - First trial Eastmancolor silent answer print	.10/ft.
9 - Eastmancolor release prints	.065/ft.

Black and White, Silent

1 - Black and white dupe negative from reversal original	$.125/ft.
9 - Black and white release prints	.0392/ft.

There were a total of 11 Visual Briefs reproduced under these cost figures with Hollywood Film Enterprises for a total cost figure of $5,763. There were four Visual Briefs from Langley Research Center that were reproduced at Byron Motion Pictures, Inc., for a total cost of $2,233. Thus, the total cost for reproduction of 15 Visual Briefs paid for from this contract was $7,996. The rest of the 6 Visual Briefs used in the evaluation program were supplied in the appropriate number of copies by the NASA Western Support Office.

I. Conclusions and Recommendations

The initial objective of the NASA Pilot Program at Oklahoma State University was to reduce the time between discovery of specific scientific and engineering information and its use in technological development. Our initial experience in producing and using Monographs created for supplementary use in the classroom leads us to believe that we have produced a mechanism for reaching this objective. The Monographs are useful as supplementary educational material and have reduced the time between development of a technological achievement and its introduction to engineering students and practicing engineers. They provide an appropriate method to get information of this type to individuals in industry as was shown through the "Education Brief" experiment. Perhaps more important, the same document used in the classroom provides the information with a multiplicative effect by exposure to students who soon are the practicing engineers in industry who will have the new technology with which to work. The use of Visual Briefs created in NASA research centers are perhaps more difficult to design for specific classroom use than the Monographs are but they provide a visual extension of presenting material that cannot be easily presented otherwise through just the written form.

The concepts developed in the NASA Pilot Program are obviously applicable to research and development documents reporting on the creation of new technology from any organization. There are special problems in seeking appropriate material and choosing subject areas, but a mode of operation developed for the NASA generated material could be placed into operation in the Atomic Energy Commission, the Department of Defense, or any industrial laboratory producing appropriate documents. A significant amount of progress has been made in determining an effective and efficient means of producing Monographs useful in the classroom during the contract. The most satisfactory technique is not unique, since it varies with senior authors and subject matter. The sources of information even from just the NASA organizations have not been investigated sufficiently to establish the needed confidence in the results from literature searches. Finally, the Monographs and the Visual Briefs need further use in the field with evaluations by the users as to their effectiveness to confirm the initial conclusions and allow refining of these supplementary educational aids resulting.

In addition to the refinement of the searching techniques and the modes of operation desirable in the NASA program, working in other areas of technology than those generated by NASA is of most importance. The NASA organization is ahead of other federally sponsored organizations in the use of technology "to insure that developments from NASA's scientific and technological programs be retrieved and made available to the maximum extent for the nation's industrial benefit in the shortest possible time . . .", (Quoting NASA Administrator James E. Webb in his definition of the Technology Utilization Program). To allow a large comprehensive recovery of much of the technology throughout federally sponsored programs, for instance, further experience is most desirable in creating Monographs from materials resulting from searches in each of the sponsoring organizations. We are convinced that the educational procedure investigated under the NASA Pilot Program has as good as, or a better opportunity of insuring Administrator Webb's goal for the Technology Utilization Program as any technique yet devised.

APPENDIX I

MONOGRAPH DISSEMINATION STATISTICS
THROUGH AUGUST 31, 1967

APPENDIX I

TABLE I-1

MONOGRAPH DISSEMINATION STATISCS
THROUGH AUGUST 31, 1967

Dissemination Summary by Monograph Number

Monograph Number	Instructor's Copies Sent	Student's Copies Sent	Unfilled Requests Instructor's	Unfilled Requests Student's	Evaluations Received
CS-1	12	25	1	0	0
CS-2	0	0	14	56	0
CS-3	0	0	13	56	0
CS-4	0	0	15	57	0
CS-5	21	81	0	0	1
CS-6	24	82	0	0	0
HT-1	28	173	0	0	4
HT-2	14	72	0	0	0
HT-3	28	200	0	0	1
HT-4	23	200	0	0	2
HT-5	0	0	16	62	0
HT-6	0	0	24	131	0
TD-1	19	101	1	22	0
TD-3	25	98	0	0	1
TD-4	12	65	0	0	0
Totals	206	1,097	84	384	9

TABLE I-2

MONOGRAPH DISSEMINATION SUMMARY BY UNIVERSITY
FOR CLASSROOM USE

University	Department	Monograph Numbers	Instructor's Copies	Student Copies	Evaluations Received
1. Auburn University	Mechanical Engineering	CS-1	1	5	
		CS-2	1	5	
		CS-3	1	5	
		CS-4	1	5	
		CS-5	1	5	
		CS-6	1	5	
		HT-1	1	5	
		HT-2	1	5	
		HT-3	1	5	
		HT-4	1	5	
		HT-5	1	5	
		HT-6	1	5	
		TD-3	1	5	
2. Michigan State University	Chemical Engineering	HT-1	1	10	
		HT-4	1	10	
		HT-5	1	10	
		HT-6	1	10	
		TD-1	1	10	
3. Pennsylvania State University	Mechanical Engineering	HT-1	1	12	
		HT-2	1	12	
		HT-3	1	12	
		HT-4	1	12	
		HT-5	1	12	
		HT-6	1	12	
		TD-1	1	22	
4. Southern Methodist University	Institute of Technology	CS-1	1	20	
		CS-2	1	20	
		CS-3	1	20	
		CS-4	1	20	
		CS-5	1	20	
		CS-6	1	20	

TABLE I-2 (Continued)

University	Department	Monograph Numbers	Instructor's Copies	Student Copies	Evaluations Received
5. Tulane University		CS-2	1	31	
		CS-3	1	31	
		CS-4	1	32	
		CS-5	1	31	
		CS-6	1	32	
		HT-1	1	31	
		HT-3	1	33	
		HT-4	1	33	
		HT-5	1	5	
		HT-6	1	4	
		TD-1	1	31	
		TD-3	1	5	
		TD-4	1	2	
6. United States Naval Academy		HT-3	1	20	
		HT-4	1	20	Yes
7. University of Arizona	Chemical Engineering	HT-1	1	5	
		HT-3	1	5	
		HT-4	1	50	
		HT-6	1	50	
8. University of Cincinnati	Aerospace Engineering	HT-1	1	15	
		HT-2	1	15	
		HT-3	1	15	
		HT-4	1	15	
		TD-1	1	30	
		TD-3	1	30	
9. University of Michigan	Chemical Engineering and Petroleum Engineering	CS-4	1	25	
		CS-5	1	25	
		CS-6	1	25	
		HT-1	1	25	
		HT-2	1	25	
		HT-3	1	25	
		HT-4	1	25	
		HT-6	1	25	
	Chemical and Metallurgical Engineering	TD-1	1	15	
		TD-3	1	15	
		TD-4	1	15	

TABLE I-2 (Continued)

	University	Department	Monograph Numbers	Instructor's Copies	Student Copies	Evaluations Received
10.	University of Nebraska	Mechanical Engineering	HT-1	2	15	
			HT-2	2	15	Yes
			HT-3	2	15	
			TD-1	2	15	
			TD-3	2	15	
11.	University of Southern California	Chemical Engineering	TD-3	1	18	Yes
12.	University of Tennessee	Electrical Engineering	HT-1	3	60	Yes
			HT-3	3	60	Yes
			HT-4	3	60	Yes
13.	University of Virginia	Mechanical Engineering	HT-3	1	10	
			HT-4	1	10	

TABLE I-3

MONOGRAPH DISSEMINATION SUMMARY BY UNIVERSITY
FOR REVIEW BY PROFESSOR

	University	Department	Professor	Monograph Number
1.	Cornell University	Chemical Engineering	Victor H. Edwards	CS-4 CS-5 CS-6
2.	City University of New York	Chemical Engineering	Robert A. Graff	CS-5 CS-6 HT-4 HT-5 HT-6 TD-1 TD-3 TD-4
3.	Kansas State University	Mechanical Engineering	P. L. Miller	CS-1 CS-2 CS-4 CS-6 HT-2 HT-5 HT-6
4.	Massachusetts Institute of Technology		Y. T. Li	CS-1 CS-5 CS-6 HT-1 HT-3 HT-4 TD-1 TD-3
5.	Michigan State University	Electrical Engineering	Gerald Park	CS-2 CS-4 CS-5 CS-6
6.	Oklahoma University	Chemical Engineering and Materials Science	C. P. Colver	HT-2 HT-5 HT-6

TABLE I-3 (Continued)

	University	Department	Professor	Monograph Number
7.	Pennsylvania State University	Mechanical Engineering	D. R. Olson	CS-5
				HT-6
				TD-2
			C. Birnie, Jr.	HT-1
				HT-3
				HT-4
			F. W. Schmidt	HT-5
				HT-6
			J. L. L. Baker	HT-1
				HT-2
				HT-3
				HT-4
				HT-5
				HT-6
			J. A. Brighton	TD-3
			D. A. Bowlus	TD-1
				TD-2
				TD-3
			J. L. Shearer	TD-3
8.	Saint Louis University	Aerospace Engineering	Benjamin H. Ulrich	CS-2
				CS-3
				CS-4
				CS-5
				CS-6
				HT-1
				HT-3
				HT-4
				TD-1
				TD-3
			John A. George	TD-1
				TD-3
9.	Southern Methodist University	Institute of Technology	J. C. Denton	CS-1
				CS-2
				CS-3
				CS-4
				CS-5
				CS-6
				HT-1
				HT-2
				HT-3
				HT-4

TABLE I-3 (Continued)

	University	Department	Professor	Monograph Number
				HT-5 HT-6 TD-1 TD-3 TD-4
			Andrew S. Page	CS-1 CS-5 CS-6
			F. W. Tatum	HT-6
10.	University of Arizona	Aerospace and Mechanical Engineering	Harvey Christensen	CS-1 CS-5 CS-6 HT-1 HT-3 HT-4 TD-1 TD-3
			H. C. Perkins	HT-1 HT-5 HT-6
11.	University of Cincinnati	Aerospace Engineering	Widen Tabakoff	CS-1 CS-2 CS-3 CS-4 CS-5 CS-6 HT-5 HT-6 TD-4
12.	University of Denver	Electrical Engineering	M. L. Moe	CS-1 CS-2 CS-3 CS-4 CS-5 CS-6
13.	University of Florida	Chemical Engineering	A. D. Randolph	CS-1 CS-2 CS-3

TABLE I-3 (Continued)

	University	Department	Professor	Monograph Number
				CS-4
				CS-5
				CS-6
				HT-1
				HT-2
				HT-3
				HT-4
				HT-5
				HT-6
				TD-1
				TD-3
				TD-4
14.	University of Houston	Chemical and Petroleum Engineering	W. I. Honeywell	CS-5
				CS-6
				HT-3
				HT-6
				TD-1
				TD-3
				TD-4
15.	University of Michigan	Chemical Engineering and Metallurgical Engineering	Dan Luss	HT-1
			S. W. Churchill	HT-1
				HT-3
				HT-4
				HT-6
16.	University of Nebraska		D. R. Haworth	CS-2
				CS-3
				HT-5
				HT-6
				TD-4
17.	University of Tennessee	Electrical Engineering	J. C. Hung	CS-6
18.	University of Texas		J. J. McKetta	CS-1
				CS-2
				CS-3
				CS-4
				CS-5
				CS-6

TABLE I-3 (Continued)

	University	Department	Professor	Monograph Number
				HT-1 HT-2 HT-3 HT-4 HT-5 HT-6 TD-3
19.	University of Virginia	Mechanical Engineering	James W. Moore	CS-2 CS-3 CS-4 CS-5 CS-6
20.	Utah State University	Mechanical Engineering	R. M. Holdredge	HT-1 HT-2 HT-3 HT-4
21.	West Virginia University	Engineering Experiment Station	J. F. Parmer	HT-1 HT-2 HT-3 HT-4 HT-5 HT-6
22.	Yale University		Barnett F. Dodge	TD-1 TD-3 TD-4

APPENDIX II

VISUAL BRIEF DISSEMINATION STATISTICS
THROUGH AUGUST 31, 1967

APPENDIX II

TABLE II-1

VISUAL BRIEF DISSEMINATION STATISTICS THROUGH AUGUST 31, 1967

Dissemination Summary by Visual Brief Number

Visual Brief Number	Number Sent	Unfilled Requests	Evaluations Received
VB-1	2	0	0
VB-2	0	1	0
VB-4	4	3	3
VB-5	0	0	0
VB-8	4	0	1
VB-9	3	2	2
VB-10	3	2	1
VB-11	1	0	1
VB-12	3	2	2
VB-13	4	3	2
VB-15	3	2	2
VB-17	3	0	1
VB-19	2	0	1
VB-20	2	0	1
VB-21	2	0	1
VB-23	0	1	0
VB-24	5	0	2
VB-27	3	1	2
VB-28	2	1	0
VB-31	4	0	1
VB-33	4	2	4
Totals	54	20	27

TABLE II-2

VISUAL BRIEF DISSEMINATION SUMMARY BY UNIVERSITY
FOR CLASSROOM USE

	University	Department	Professor	Visual Brief Number
1.	Auburn University	Mechanical Engineering	R. I. Vachon	VB-10 VB-13 VB-28
2.	Michigan State University	Electrical Engineering	Gerald Park	VB-8
3.	Oklahoma University	Chemical Engineering and Materials Science	C. Phillip Colver	VB-4 VB-9 VB-12 VB-13 VB-15
4.	Pennsylvania State University	Mechanical Engineering	J. L. Shearer	VB-8
			F. W. Schmidt	VB-4 VB-9 VB-12 VB-13 VB-15
			J. A. Brighton	VB-17
			D. R. Olson	VB-27
			C. Birnie, Jr.	VB-28
			A. D. Brickman	VB-31
5.	Rutgers, The State University	Mechanical and Aerospace Engineering	Robert H. Page	VB-17 VB-33
6.	United States Naval Academy		James A. Adams	VB-33
7.	University of California at Los Angeles		T. H. K. Frederking	VB-4 VB-9 VB-13 VB-15 VB-20
8.	University of Cincinnati	Chemical Engineering	Robert Lemlich	VB-27

TABLE II-2 (Continued)

	University	Department	Professor	Visual Brief Number
9.	University of Florida	Chemical Engineering	A. D. Randolph R. D. Walker	VB-13 VB-2 VB-4 VB-9 VB-10 VB-13 VB-15 VB-27 VB-28 VB-33
			T. M. Reed	VB-10 VB-33
10.	University of Houston	Chemical and Petroleum Engineering	W. I. Honeywell	VB-10
11.	University of Illinois	Chemistry and Chemical Engineering	R. A. Schmitz	VB-10 VB-27
12.	University of Pittsburgh	Civil Engineering	Joel I. Abrams	VB-19 VB-24
13.	University of Tennessee	University of Tennessee Space Institute	R. L. Young	VB-33
14.	University of Virginia	Mechanical Engineering	James W. Moore	VB-8 VB-11 VB-20 VB-21 VB-24
15.	Utah State University	Mechanical Engineering	R. M. Holdredge	VB-4 VB-12 VB-33
16.	Virginia Polytechnic Institute	Industrial Engineering	W. George Devens	VB-1 VB-8 VB-19 VB-21 VB-24 VB-31

TABLE II-3

VISUAL BRIEF DISSEMINATION SUMMARY
MISCELLANEOUS REVIEWS

	Organization	Reviewer	Purpose	Visual Brief Number
1.	Project Genus, Cape Kennedy	Paul D. Arthur	To establish a list of appropriate movies, visual aids, and various other topics involving aeronautics or astronautical engineering.	VB-1 VB-17 VB-24 VB-31
2.	University of Tennessee	R. L. Young	To be used in the Radiation Short Course	VB-33
3.	University of Texas	William R. Cox	For review by graduate students and faculty for NASA research on impact of space vehicles on soils	VB-24 VB-31

APPENDIX III

MONOGRAPH EVALUATIONS

TABLE III-1

SOME SUMMARY EVALUATIONS
BY MONOGRAPH

	Monograph No.		HT-1	HT-3	HT-4	TD-3	CS-5	Total
1.	Copies Sent for Evaluation		4	2	2	1	1	10
2.	Used for purposes outside classroom or research		1	0	1	0	1	3
3.	Used in classroom		3	2	1	1	0	7
4.	Used for students in research seminar		0	0	0	0	0	0
5.	Found suitable for use		4	1	2	1	1	9
6.	Found unsuitable for use		0	1	0	0	0	1
7.	Material new to instructor		1	1	0	0	0	2
8.	Material well known to instructor		2	1	1	1	0	5
9.	Students worked home problems		1	0	0	1	0	2
10.	Students did not work home problems		3	2	1	0	0	6
11.	Average hours of classroom lecture required		1.1	0.8	1.0	3.0	--	--
12.	Amount of material should be	Greater	2	0	0	0	0	2
		Same	2	2	1	0	0	5
		Less	0	0	0	1	0	1
13.	References Used	Yes	3	1	1	0	0	5
		No	1	1	0	0	0	2
14.	Monograph Usefulness Could Be	Great	2	1	1	1	0	5
		Some	2	1	1	0	1	5
		Little	0	0	0	0	0	0
15.	Monograph Format	Good	4	2	2	1	1	10
		Poor	0	0	0	0	0	0

APPENDIX III-2

Totaled Responses on a Monograph Evaluation Sheet

Comments on Monograph from Classroom Use

1. The Monograph (was 7 , was not 2) used in a classroom situation.

2. The Monograph (was 8 , was not 1) used in context with closely related material in the course presentation.

3. The Monograph (was 4 , was not 1) used for the course described in the "Instructor's Guide for Monographs".

4. The Monograph (was 6 , was not* 1) found suitable for the course in which it was used.

5. The technical information presented in the Monograph was (new to me 2 , well known to me 5) and (new to my students 7 , well known to my students 0).

6. The technical information in the Monograph (did 7 , did not* 2) contribute to further understanding of the course material by the students in this course.

7. The home problems in the Monograph (were 2 , were not 5) assigned to the students in the course.

8. The home problems in the Monograph were (useful 5 , too complex 0 , too simple 0 , unnecessary 0).

9. The amount of material for the Monograph was found to be suitable for presentation in (--) hours of classroom lecture.

10. The amount of material for this Monograph should be made (longer 2 , same 5 , shorter 1) to have maximum effectiveness in class.

11. The reference bibliography (was 5 , was not 2) used and (was 3 , was not 1) a necessary requirement to gain additional information on Monograph subject.

12. *Additional Information on classroom use of Monograph:

Recommendations on Monographs in General

1. Monographs of technical literature such as this could be of (great 3 , some 5 , little* 0) use to me in my course presentation.

2. Monographs should include (more* 3 , less* 0 , no change in 5) material over that given here.

3. The general reference bibliography (should 6 , should not 0) include information as to what is available in each reference.

4. The format of the Monograph is considered (good 8 , could be better* 1 , poor* 0 , completely incorrect* 0) for use as an insert in a course in engineering.

5. *Additional general recommendations on Monographs:

APPENDIX III-3

Comments on Monographs from Professor Evaluators

HT-1: Calculation of Radiant Heat Exchange by the Monte Carlo Method

1. I did not require the students to program and operate the technique (as a result their knowledge of it is somewhat superficial). I asked them for a flow chart of the program to be written. This might be sufficient for some, but not the majority. (University of Florida)

2. I received the Monograph too late in the school year for proper usage. I will use it next year. (University of Nebraska)

HT-3: Method of Estimating Ratio of Absorptance to Emittance

1. Material is elementary and I fail to see its technical value for radiant heat transfer. (University of Arizona)

HT-4: Formulas for Radiant Heat Transfer Between Non-gray Parallel Plates of Polished Refractory Materials

1. A paragraph of introduction is needed before the analysis section. It would aid the incentive and understanding of the students to introduce them to the problem with information such as why the research was necessary, how it was conducted, and how the results have been used in specific space applications. On the whole I feel that these monographs will serve a useful purpose. (United States Naval Academy)

CS-5: Controller Design for Nonlinear and Time-Varying Plants

1. Since the monograph arrived in the summer there has not been an opportunity to evaluate it in a classroom situation, but I do have some comments to make on it. I think the idea and general format of the Monograph is good. This particular Monograph presents an interesting and useful approach. . . . I am interested in the Monograph series and would appreciate being put on the mailing list for all Monographs dealing with control systems. (University of Texas)

TD-3: Critical Flow of Real Gases Through Nozzles

1. We used the Monograph . . . at the end of our year's course in Thermodynamics for undergraduates. Only one hour was devoted to this and this is admittedly too little to give the Monograph full treatment. Also, clearly this material is more suitable for first year graduate students. My own opinion of this Monograph is that it is an excellent discussion of various ways to determine critical flow conditions. I think it is something graduate students should have available to them. It should probably be used for graduate study as a textbook supplement. For undergraduates, the Monograph proceeds too rapidly. . . . Reiterating, I think this is a nice report but a little too sophisticated for seniors. . . . Thanks for the opportunity to use this program. I hope to have the privilege of using another one this coming fall. (University of Southern California)

APPENDIX IV

VISUAL BRIEF EVALUATIONS

TABLE IV-1

SOME SUMMARY EVALUATIONS
BY VISUAL BRIEF

A. Specific Recommendations for
Visual Briefs

Research Center Where Produced	Langley Research Center				Lewis Research Center									Ames Research Center			Manned Spacecraft Center		Jet Propulsion Laboratory	The Boeing Company	Marshall Space Flight Center	
VISUAL BRIEF NO.	1	17	19	21	2	4	9	10	12	13	15	23	28	8	11	31	24	27	20	5	33	Totals
1. Copies sent for evaluation.	0	1	1	3	0	4	3	1	3	3	2	0	0	3	3	4	3	2	1	1	4	42
2. Used for purposes outside of class and research.	0	0	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	3
3. Used in the classroom.	0	0	1	1	0	1	0	0	0	0	0	0	0	0	0	1	1	0	0	0	2	7
4. Used for students in research seminars.	0	1	0	1	0	2	2	1	1	2	2	0	0	0	0	0	1	2	1	0	1	17
5. Found suitable for use.	0	1	1	1	0	3	2	1	1	2	2	0	0	0	0	1	0	0	1	0	2	18
6. Found unsuitable for use.	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	0	0	0	3
7. Material new to instructor.	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
8. Material well known to instructor.	0	1	0	0	0	2	1	1	2	1	1	0	0	0	0	1	0	2	0	0	2	14
9. Material contributed to understanding.	0	1	1	1	0	2	1	1	1	1	1	0	0	0	0	1	0	1	0	0	2	14
10. Material did not contribute to understanding.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11. Instructor read documents before using Visual Brief.	0	1	1	1	0	0	0	1	0	0	0	0	0	0	0	1	0	2	0	0	2	9
12. Instructor did not read documents before using.	0	0	0	0	0	2	1	0	2	1	0	0	0	0	0	0	0	0	0	0	2	8
13. Material could have been presented as well orally.	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2
14. Material could not have been presented as well orally.	0	1	1	1	0	1	1	1	1	1	1	0	0	0	0	1	0	2	0	0	3	15

TABLE IV-1 (Continued)

B. Some General Recommendations or Visual Briefs

Research Center Where Produced		Langley Research Center				Lewis Research Center									Ames Research Center			Manned Spacecraft Center		Jet Propulsion Laboratory	The Boeing Company	Marshall Space Flight Center	
VISUAL BRIEF No.		1	17	19	21	2	4	9	10	12	13	15	23	28	8	11	31	24	27	20	5	33	Totals
1. Usefulness of Visual Briefs.	Great	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	2	4
	Some	0	1	0	1	0	2	1	1	2	1	1	0	0	0	0	1	0	2	0	0	2	15
	Little	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2. Adequacy of amount of material.	Too Little	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
	Too Much	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
	Alright	0	1	1	1	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	3	9
3. More suitable outside the classroom.	Probably	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	2	0	0	1	9
	Prob. Not	0	0	1	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	3	7
4. Usefulness with specially written material added.	More	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	3
	Same	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	2
	Less	0	0	1	0	0	1	1	0	1	1	1	0	0	0	0	0	0	1	0	0	1	8
5. Usefulness if less film, let professor talk.	More	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0	0	1	4
	Less	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3
	Same	0	0	1	0	0	1	1	1	1	1	1	0	0	0	0	0	0	1	0	0	0	8
6. Does arranging for a projector affect.	Does	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	2
	Does Not	0	1	1	1	0	2	1	1	2	1	1	0	0	0	0	0	0	1	0	0	4	16

APPENDIX IV-2

Totaled Responses on a Visual Brief Evaluation Sheet

Comments on Visual Brief from Classroom Use

1. The Visual Brief (was 9, was not 10) used in a classroom lecture situation.

2. The Visual Brief (was 7, was not 12) used in context with closely related material in the course presentation.

3. The Visual Brief (was 15, was not* 2) found suitable for the course in which it was used.

4. The Visual Brief (would 6, would not 7) have been as suitable for another course. If so, what course? ____________

5. The technical information displayed in the Visual Brief (was new to me 4, new to my students 14, well known to me 8, well known to my students 0).

6. The information displayed in the Visual Brief (did 15, did not* 1) contribute to further understanding of the course material by the students in the course.

7. The visual material (did 15, did not* 3) present the effect well that was described in the accompanying documentary material.

8. The instructor (did 9, did not 8) read the documents accompanying the visual material prior to presentation in class.

9. Material observed in the Visual Brief of particular value other than that described in the documentary summary accompanying the brief is ____________

10. The subject matter (could 3, could not 14) have been as easily presented to the students without the visual material.

11. Other types of visual aids (would 2, would not 5) have been as effective as presenting the subject material. If so, what type? ____________

12. The amount of material presented in the Visual Brief was (more* 3, alright 12, less* 1) than necessary to adequately present the technical material there.

13. The Visual Brief required (little 7, some 9, much* 0) additional information from the instructor to properly present the subject to the class.

14. It was of (little 3 , some 12, great 2) help to have the reference documents accompanying the Visual Brief for effective classroom presentation.

15. *Additional Information on classroom use of Visual Briefs:

Recommendations on Visual Briefs in General

1. Visual Briefs on technical subjects such as this could be of (great 4 , some 15, little* 0) use to me in my course presentation.

2. Visual Briefs should include (more* 1 , less* 2 , no change in 10) material over that given here.

3. Visual Briefs would (probably 8 , probably not 7) be more suitable for educational purposes outside of the classroom lecture.

4. Visual Briefs would be (more 3 , same 2 , less 7) useful if the report material had been prepared specifically for one classroom lecture.

5. I would use technical movies (more 4 , same 9 , less 5) if amount of material shown in the film were reduced to bare technical essentials and let me do the talking.

6. The inconvenience of obtaining the projector arrangement for classroom lecture (does 2 , does not 15) significantly affect how often I use technical movies.

7. *Additional general recommendations on Visual Briefs:

APPENDIX IV-3

Comments on Visual Briefs from Professor Evaluators

VB-4: Bubble Dynamics for Nucleate Boiling in Reduced Gravity

1. No classroom use, but laboratory presentation has been helpful to students and stimulated discussion of related problems. (University of California at Los Angeles)

2. This brief is quite good. (Utah State University)

3. Too narrow in scope to be of much value to undergraduate students. Could prove quite useful for graduate students with special interest in research area. (Pennsylvania State University)

VB-5: Polarized Light Photography to Resolve Fatigue, Cyclic, and Sustained Stress Crack Propagation Zones in Metals

1. This brief was reviewed by our Metallurgy Department and they feel it would be extremely useful for a graduate student undertaking research in this area. However, they foresee no room for this in any courses presently offered here. (Virginia Polytechnic Institute)

VB-8: Flight-measured Control Power and Damping Required for VTOL Aircraft

1. All Visual Briefs should have sound film. (University of Virginia)

2. The inclusion of root locus or other stability information would make this an excellent film for a course in control system stability and operation. Each new flight sequence should be preceded by a listing of the pertinent data for the flight sequence. It might also be advisable to precede this film with a brief summary of VTOL Aircraft. (Virginia Polytechnic Institute)

VB-9: Pool Heating of Liquid Hydrogen Over a Range of Accelerations

1. No classroom use, but laboratory presentation has been helpful to students and stimulated discussion of related problems. (University of California at Los Angeles)

2. Too narrow in scope to be of much value to undergraduate students. Could prove quite useful for graduate students with special interest in research area. (Pennsylvania State University)

VB-11: Transonic Buffeting of Hammerhead Launch Vehicles

1. To the untrained eye, the test film is just many shots of the same thing. (Implication is that there are insufficient differences except for very careful delineations.) (Virginia Polytechnic Institute)

VB-12: Experimental Observations of Transient Boiling in Subcooled Water and Alcohol

1. More effective presentation of the subject material would have been accomplished with better film. After previewing it was decided the film was not what was needed and was not shown to the class. (Utah State University)

2. Too narrow in scope to be of much value to undergraduate students. Could prove quite useful for graduate students with special interest in research area. (Pennsylvania State University)

VB-13: A Visual Study of Two Phase Flow in a Vertical Tube with Heat Addition

1. No classroom use, but laboratory presentation has been helpful to graduate students involved in research and stimulated discussion of related problems. (University of California at Los Angeles)

VB-15: A Visual Study of Velocity and Buoyancy Effects on Boiling Nitrogen

1. No classroom use, but laboratory presentation has been helpful to graduate students involved in research and stimulated discussion of related problems. (University of California at Los Angeles)

2. Too narrow in scope to be of much value to undergraduate students. Could prove quite useful for graduate students with special interest in research area. (Pennsylvania State University)

VB-20: Magnetically Supported Superconducting Spherical Gyro

1. No classroom use, but laboratory presentation has been helpful to graduate students involved in research and stimulated discussion of related problems. (University of California at Los Angeles)

VB-21: The Supersonic Transport in the Air Traffic Control System

1. Prefer sound track with all briefs. (University of Virginia)

2. Visual Brief was also shown to Civil Air Patrol audience. (University of Virginia)

3. We feel that this film could have two possible uses: (1) in a freshman-level motivation-oriented course, and (2) in an analog simulation course as an introduction to a typical problem. Some NASA "sales pitch" and emphasis on highly placed NASA officials is objectionable. (Virginia Polytechnic Institute)

4. Movie does not show results or trends. Good movie for design classes and classes interested in an overall system approach. (Virginia Polytechnic Institute)

VB-24: Spacecraft Landing Dynamics

1. All Visual Briefs should have sound. (University of Virginia)

2. Received only VB-24A and not VB-24B so incomplete use. (Ed. Note: This is when we discovered that VB-24 came to us incomplete.) (University of Pittsburgh)

VB-27: Flammability of Surfaces in Zero Gravity

1. Showing of the same phenomena for different pressures, compositions, etc., is unnecessary. Added nothing to the basic phenomena being presented. (University of Pittsburgh)

VB-31: Human Tolerance to Acceleration

1. This appears to be an excellent film for technical society meetings and other general science oriented meetings. It might also be used as one lecture in a course in bio-medical electronics. The instrumentation is of interest and the film might be of use in an instrumentation course; however, it is felt that it would require extensive editing before being used in this manner. (Virginia Polytechnic Institute)

2. A technical film which should be shown to people familiar with the terminology of human behavior. Primary emphasis is on breathing and oxygen content of blood. Not a good film for general studies although it serves to make students more aware of problem. (Virginia Polytechnic Institute)

VB-33: Saturn Radiation and Convection Base Heating

1. Sound track could have provided the general information together with more information about nature of the film, calculations, etc. Was used as introduction to space age need for radiation heat transfer. (University of Virginia)

2. Without reference documents the Visual Brief is of very little or no use. After previewing, it was decided not to use in class. (Utah State University)

3. Major limitation is lack of time by the students to dig into the (written) material. (University of Florida)

4. This Visual Brief would probably be more for educational purposes outside the classroom lecture. (Rutgers)

APPENDIX V

PROCEDURES USED IN CREATING MONOGRAPHS

APPENDIX V-1

Technique for Locating Reports by Graduate Associates

The reports suitable for use in originating Monographs may be found through literature searches by Graduate Associates in STAR and AIAA listings. The following procedure for doing this is recommended:

(1) A survey of the NASA STAR report abstracts, A Selected Listing of NASA Scientific and Technical Reports for 19-- and/or the AIAA abstracts of NASA work can be initiated by a graduate student or similar type help. For assistance in the use of STAR refer to the booklet issued by NASA entitled "How to use NASA's Scientific and Technical Information System."

(2) Although all technical literature is eligible for inclusion, the primary source or sources from which a Monograph is prepared should be technical reports or papers prepared by NASA personnel or under a NASA contract.

(3) The project author should discuss with these assistants the type of articles desired and how they are to be used.

(4) The project author then needs to identify for his assistants as many key words related to the subject area as possible, from which the assistant may proceed.

(5) Using this list of key words as a guide, consult the Subject Index of the report abstracts.

(6) From this Subject Index, record the titles of reports which appear applicable to the objective. Do not forget to record the research number, abstract number and any other information given with the title.

(7) Be alert for other key words in titles. If any are found, repeat steps 4 and 5.

(8) After listing the title of each report, locate the abstract and read it carefully. (It is expected the assistant will be highly enough qualified in the area, that he will be able to make a preliminary selection of material from the abstracts.)

(9) If, from the abstract, the report appears to be of some value, write the titles of these by subject classification. Include all information necessary to locate the report.

(10) Do not overlook the possibility of a rejected report being a good reference. Keep a list of good references for bibliographies.

(11) Make any notes relevant to the report, including its qualifications or limitations.

(12) Study the titles of other research papers written by the authors of your selection. The Author Index has a list of these. Read the abstracts of possibilities.

(13) Read the bibliographies of available NASA reports on the subject area. Locate and read the abstracts of any report that appears of value.

(14) The project author should then read each of the abstracts selected by the assistant. A consultation between the project author and his assistant should follow, in which they can arrive at a group of reports to be ordered through the NASA STAR documents or other sources.

(15) At the same time the reports are ordered, the assistant should investigate the possibility of a report having been condensed in a technical paper. A list of technical papers presented at technical society meetings can often be obtained from the main offices of these societies. Another source of obtaining condensed versions of a report may be by contacting the author of the research report.

(16) Discussions of technical papers published in journals can sometimes be found in later issues. Often these discussions contribute appreciably to the paper; however, these should be carefully scrutinized.

(17) After the receipt of the reports, the assistant should compare these with a prepared check list. This check list should indicate the advisability of further consideration of the report.

(18) After the selection of the reports read by the assistant, these reports should be discussed between the author and the assistant. This discussion should result in a few reports to be used for Monographs.

APPENDIX V-2

Guidance to Author for Preparing Monographs

A. General Philosophy for the Preparation of Monographs

A Monograph is a technical paper primarily based on one or more NASA research reports and commonly supplemented by other material and is designed to supplement textbook and class note material in a course of instruction. The author of the Monograph must keep in mind the usefulness of the Monograph in a class. It is desirable to keep the amount of material to a minimum and yet the material should be sufficiently complete for the use of the teacher in the class without undue reference work on his part. Where possible, the Monograph should contain and develop only one central idea. It is important that the Monograph be written for the student at the proper level. Use of a Monograph should acquaint the student with the format and purpose of a technical paper as well as contribute some technical information to his course.

B. Description of Monograph Content

(1) Abstract of the Monograph

The abstract should contain the kernel of what the Monograph is about and why it will be useful. The abstract should follow the usual procedure for abstracting a technical article.

(2) Main Body of the Monograph

The main body of the Monograph should consist of material that can be used in a class with a minimum amount of extra preparation and explanation to the class. The material should be written on a level corresponding to the level of the student to which the Monograph is addressed. It would seem important that figures be prepared in such a way that transparencies or slides could be easily made and successfully projected in the classroom. In general the Monograph should be made to cover some integral number of class periods. In particular, it is expected that the Monograph will be used in units of single class period sessions. However, if material is such that its importance justifies more than one class period, then up to three class periods might be considered.

(3) References

The references should be pertinent and should be chosen carefully to serve some well-defined purpose. Avoid long lists of bibliographical material unless such a list is needed for a specific purpose. The reference information should be given with some indication of what will be found in each individual reference. If only a single short item is to be included in this reference material, it should be placed in the Monograph instead of being referenced.

(4) Supporting Material

Whenever possible the author should indicate in the Monograph an example of the use of the material in the report from which the Monograph has been taken. It would also be desirable for the author to prepare an example or home problem to be assigned by the instructor. These home problems should also be accompanied by solutions attached to the Instructor's Monograph.

(5) Instructor's Guide for Monographs

A guide for the instructor for the use of the material in the Monograph should be included in each Monograph and where possible kept to a minimum of one page. The information to be presented in this guide is listed below:

(a) Educational level of the Monograph
(b) Prerequisite course material
(c) Estimated number of lecture periods required
(d) Technical significance of the Monograph
(e) New concepts or unusual concepts illustrated
(f) Suggestions on how the Monographs can best be used
(g) Other literature, Briefs, or Monographs of interest to this subject
(h) Other reports reviewed by the editor in preparing this Monograph
(i) Who should be contacted for further information
(j) General subject areas available in other Briefs or Monographs

(6) Format of Monographs

There will be two different forms of Monograph prepared for each Monograph written. One will be for the use of the instructor and the other will be for the use of the student. The general content of the Monograph for the instructor is listed below in the order recommended for assembling the Monograph. In order to discriminate between the two, the student's Monograph and the Instructor's Monograph will have different colored covers or the student's Monograph will be an unbound paper. The following order is suggested for the Monograph:

* Front
* Title Page
* Foreword on NASA Pilot Program
* Report or reports from which this Monograph was primarily taken
Instructor's Guide
* Abstract
* Main Body
* Summary
* References, Specific and General
* Illustrative problem
Solution to Illustrative problem
Transparencies of figures

* Contained in a student Monograph

Those pages in the instructor's Monograph not included in the student's Monograph will be printed on different colored paper than the common material. This will make the instructor immediately aware of the information available to the student.

APPENDIX VI

ABSTRACTS OF MONOGRAPHS PRODUCED

APPENDIX VI

Monograph Abstract

		Page
HT-1	Calculation of Radiant Heat Exchange by the Monte Carlo Method	2
HT-2	A Generalized Correlation of Vaporization Times of Drops in Boiling Film Boiling on a Flat Plate	2
HT-3	Method for Estimating Ratio of Absorptance to Emittance	2
HT-4	Formulas for Radiant Heat Transfer Between Nongray Parallel Plates of Polished Refractory Metals	3
HT-5	Pool Boiling Heat Transfer at Reduced Gravity	3
HT-6	Condensation of Liquid Metals	3
HT-7	The Method of Zones for the Calculation of Temperature Distribution	4
HT-8	Heat Pipes and Vapor Chambers for Thermal Control of Spacecraft	4
TD-1	Calculation of Complex Chemical Equilibria	4
TD-3	Critical Flow of Real Gases Through Nozzles	5
TD-4	Thermodynamic Consistency of Vapor-Liquid Solubility Data	5
CS-1	An Example of Compensation Network Design	5
CS-2	An Application of Root Locus Techniques to Lunar Vehicle Control	5
CS-3	An Example of Nuclear Rocket Control Design	6
CS-4	An Example of Bang-Bang Control System Design	6
CS-5	Controller Design for Nonlinear and Time-Varying Plants	6
CS-6	An Example of Optimal Control Design	6

MONOGRAPH HT-1

ABSTRACT

Title: Calculation of Radiant Heat Exchange by the Monte Carlo Method

The Monte Carlo Method of solving radiant heat transfer problems basically consists of following groups of photons around through a system until they are either absorbed or lost. By using a large number of photon groups the statistical behavior of the large group will approach the behavior of an actual system. This Monograph discusses the technique required to select photon groups, such that a given statistical distribution will be achieved. An example problem is included, which shows how the Monte Carlo technique can be used to solve problems where energy is emitted and reflected in a non-diffuse or non-specular method. In particular it is assumed that the Fresnel type surface is present. The Fresnel surface distribution is used as an example problem.

MONOGRAPH HT-2

ABSTRACT

Title: A Generalized Correlation of Vaporization Times of Drops in Boiling Film Boiling on a Flat Plate

A dimensionless correlation for the vaporization times of discrete liquid masses in the Leidenfrost state is obtained and verified with experimental data in the literature. The correlation is presented as a single curve relating a dimensionless vaporization time to a dimensionless initial liquid volume. The correlation works well for the entire range of initial liquid volumes from spherical drops to large pancaked blobs.

MONOGRAPH HT-3

ABSTRACT

Title: Method for Estimating Ratio of Absorptance to Emittance

A graphical method is presented for estimating the values of the ratio of absorptance to emittance α/ε that can be achieved with surfaces having a high degree of spectral selectivity. The ratio of emitting source to absorbing surface temperature is the parameter in the graphs. In principle, the results of the calculations presented are general and apply for any source or surface temperature. In practice, the ratios of absorptance to emittance so estimated can be used in radiant heat transfer calculations involving space vehicles. In this case α becomes α_s the total normal absorptance of a surface to solar radiation, and ε the total hemispherical emittance.

MONOGRAPH HT-4

ABSTRACT

Title: Formulas for Radiant Heat Transfer Between Nongray Parallel Plates of Polished Refractory Metals

Hemispherical emittance, both total and normal, were calculated from normal spectral-emittance data. The metals evaluated were clean polished tungsten, molybdenum, and tantalum, each of which exhibits spectral emittances that vary considerably with temperature and wavelength.

Net radiant heat flow between two parallel infinite plates was computed by summing the monochromatic energy exchange. The evaluation was made for all nine possible combinations obtained by interchanging metals on the two surfaces. The results are graphically presented as a function of temperatures of the two surfaces. Equations of the form

$$q = a(T_1^b - T_2^b)\left(\frac{T_2}{T_1}\right)^c$$

were fitted to each of the nine sets of heat flux calculations, where q is the heat transfer rate, and T_1 and T_2 are the temperatures of the hotter and cooler surfaces, respectively. Values of the constants, a, b, and c are presented along with contour plots showing the temperature regions in which the equations are accurate. A comparison with conventional calculation techniques is presented.

MONOGRAPH HT-5

ABSTRACT

Title: Pool Boiling Heat Transfer at Reduced Gravity

The role of gravity in the theory of nucleate and film pool boiling mechanisms is examined and compared to experimental results. Particular attention is given to the critical heat flux and interface stability. Bubble growth and dynamics in reduced gravity fields are also considered.

MONOGRAPH HT-6

ABSTRACT

Title: Condensation of Liquid Metals

The theory of condensation of liquid metal vapor on a cool vertical surface both with and without forced convection of the vapor is discussed. Experimental results are presented to show the probable existence of a resistance to heat transfer at the vapor-liquid interface. An approximate analytical treatment of interfacial resistance effects is included.

MONOGRAPH HT-7

ABSTRACT

Title: The Method of Zones for the Calculation of Temperature Distribution

The method of zones is an improved method for obtaining approximate solutions to certain partial differential equations. The application of this method to heat transfer problems is discussed in detail. The method of zones assumes the temperature in the zone of interest varies parabolically with the space coordinates. Volume integrated mean temperatures are used as the "zone temperature" and area integrated mean temperatures are used as the "surface temperatures" at the boundaries of the zone. The higher order of approximation of the method permits a complicated system to be divided into fewer parts than is necessary when conventional linear approximation methods are used.

The heat flow equation is integrated over the volume of the zone to give an instantaneous heat balance equation which involves the fluxes over the boundaries of the zone and the rate of change of the volumetric mean temperature of the zone. Approximate formulas, which are based on the parabolic assumption, are derived which express the boundary heat flow rates in terms of the volumetric mean temperature of the zone and the mean temperatures over the zone boundaries. These simultaneous equations in temperature, one for the zone and one for each boundary, are integrated numerically to obtain the temperature as functions of time.

The integration is a two-point integration involving an integration parameter. Rules for choosing this parameter to insure stability and accuracy are given. A rule is also given for selecting the time increment, and methods for selecting the zone size are discussed.

MONOGRAPH HT-8

ABSTRACT

Title: Heat Pipes and Vapor Chambers for Thermal Control of Spacecraft

This Monograph reviews the basic theory and application of devices that transfers heat by evaporation of liquid from heated areas and condensation on cold areas, with continuous return of the condensate to the heating area by capillary action. Computed examples are presented to indicate possible applications to the solution of thermal control problems and to illustrate the principles and methods of analysis. Items discussed include wicks and associated capillary structures for optimum transfer of heat and minimum resistance to fluid flow.

MONOGRAPH TD-1

ABSTRACT

Title: Calculation of Complex Chemical Equilibria

Calculation of chemical equilibria in a complex reaction system is carried out in an iterative manner on computers. For this purpose the basic equations

expressing the equilibrium conditions are arranged systematically. The equations are linearized. The linearized equations are applied first to the case of a homogeneous ideal gas mixture and then extended to more complex situations.

MONOGRAPH TD-3

ABSTRACT

Title: Critical Flow of Real Gases Through Nozzles

Methods for calculating the mass flow of real gases through critical-flow nozzles are presented by: (1) equation derivations, (2) tabulations of thermodynamic properties for critical flow conditions of steam, (3) problem on application of tabulated data in thrust calculation, and (4) problem on evaluation of critical flow thermodynamic properties of a fluid represented by the Redlich-Kwong equation of state.

MONOGRAPH TD-4

ABSTRACT

Title: Thermodynamic Consistency of Vapor-Liquid Solubility Data

Methods for testing the thermodynamic consistency of vapor-liquid solubility data with other properties are presented for binary systems. Derivations of the equations for testing isothermal solubility data with densities of the coexisting phases are given, as are the equations for testing isobaric data with enthalpies of the coexisting phases. The isothermal case is illustrated for the Hydrogen-Helium system.

MONOGRAPH CS-1

ABSTRACT

Title: An Example of Compensation Network Design

This Monograph gives the design criteria for wide-band phase realization. The design of lattice phase equalizers, all-pass networks that correct the phase response of a system without affecting its amplitude response, are introduced. These equalizers are used to obtain particular phase vs. frequency characteristics which are desirable for phase correction in a wide variety of systems.

MONOGRAPH CS-2

ABSTRACT

Title: An Application of Root Locus Techniques to Lunar Vehicle Control

This Monograph illustrates the use of the root locus technique as an aid to the design of a portion of the control complex of the steering mechanism of

a 4-wheel lunar-surface vehicle. Examples of root loci for different steering control systems are presented and compared as to suitability for use in the lunar-surface vehicle with a human operator.

MONOGRAPH CS-3

ABSTRACT

Title: An Example of Nuclear Rocket Control Design

A technique which provides a practical compromise between system complexity and speed of response for a large class of systems is discussed in this Monograph. The method is illustrated by an example of its application to a nuclear rocket control problem.

MONOGRAPH CS-4

ABSTRACT

Title: An Example of Bang-Bang Control System Design

This Monograph discusses a technique for the synthesis of a Bang-Bang Control system. The technique employs linear switching logic and uses time-dependent gains to eliminate endpoints. For illustrative purposes, the technique is applied to the attitude control of a spinning space vehicle.

MONOGRAPH CS-5

ABSTRACT

Title: Controller Design for Nonlinear and Time-Varying Plants

This Monograph discusses a technique to generate a control signal which forces the state of a nonlinear plant to be close to the state of a reference model. The method is suitable for a broad class of nonlinear plants. Special emphasis is placed on the time response to perturbations from equilibrium.

MONOGRAPH CS-6

ABSTRACT

Title: An Example of Optimal Control Design

This Monograph discusses a technique for the design of minimum energy discrete-data control system. The "derived" matrix is used to determine a control sequence that will take the state of the plant from some initial state to a desired final state in N sampling periods. The cost function is a time weighted function of the control energy.

APPENDIX VII

ABSTRACTS OF VISUAL BRIEFS SELECTED

APPENDIX VII

ABSTRACTS OF VISUAL BRIEFS SELECTED

General Guidance for Use of Visual Briefs

I. Types of Information potentially involved in each film

A. Useful subject matter in several fields
B. Demonstration of experimental technique
C. Identification of data gathering means
  1. By instrumentation
  2. Through visual observation

II. Types of Groups where the Visual Brief may be used

A. Undergraduate courses
B. Graduate courses
C. Undergraduate seminars
D. Graduate seminars
E. Faculty - Technical Discussion Groups
F. Student organizations
G. Non-technical groups

III. Probable preparation needed before use

A. Read material accompanying film - run film
B. Prepare background information
C. Identify the points of interest and announce them before demonstration
D. Call attention to important points while film is being projected

Subject Areas for Selected Visual Briefs

		Page
I. Convection Heat Transfer		
VB-4	Bubble Dynamics for Nucleate Boiling in Reduced Gravity Source: NASA Lewis Research Center	1
VB-9	Pool Heating of Liquid Hydrogen Over a Range of Accelerations Source: NASA Lewis Research Center	1
VB-12	Experimental Observations of Transient Boiling in Subcooled Water and Alcohol Source: NASA Lewis Research Center	1
VB-13	A Visual Study of two phase flow in a Vertical Tube with Heat Addition Source: NASA Lewis Research Center	1
VB-15	A Visual Study of Velocity and Buoyancy Effects on Boiling Nitrogen Source: NASA Lewis Research Center	2
VB-27	Flammability of Surfaces in Zero Gravity Source: Manned Spacecraft Center	2
II. Radiation Heat Transfer		
VB-33	Saturn Radiation and Convection Base Heating Source: Marshall Space Flight Center	2
III. Gas Dynamics		
VB-17	Expansion Tube Hypersonic Test Facility Source: NASA Langley Research Center	3
IV. Machine Design		
VB-2	Hydrodynamic Rotating Shaft Seals Source: NASA Lewis Research Center	3
VB-28	Journal Bearings in Laminar and Turbulent Regimes Source: NASA Lewis Research Center	3
V. Reaction Kinetics		
VB-10	Visualization Studies of Combustion Instability in a Hydrogen-Oxygen Model Combustor Source: NASA Lewis Research Center	4
VB-23	Hypergolic Propellant Research Source: NASA Lewis Research Center	4

VI. Aircraft Structures | Page

VB-1 Smoke Trail Wind Shear Measurements — 4
Source: NASA Langley Research Center

VB-19 Experimental Research in Aerospace Structural Dynamics — 5
Source: NASA Langley Research Center

VB-24 Spacecraft Landing Dynamics — 5
Source: Manned Spacecraft Center

VII. Control Systems

VB-8 Flight Measured Control Power and Damping Required for Vtol Aircraft — 5
Source: NASA Ames Research Center

VB-11 Transonic Buffeting of Hammerhead Launch Vehicles — 6
Source: NASA Ames Research Center

VB-20 Magnetically Supported Superconducting Spherical Gyro — 6
Source: Jet Propulsion Laboratory

VB-21 The Supersonic Transport in the Air Traffic Control System — 6
Source: NASA Langley Research Center

VIII. Mechanical Metallurgy

VB-5 Polarized Light Photography to Resolve Fatigue Cracked Zones in Metals — 7
Source: The Boeing Company

IX. Bioelectronics

VB-31 Human Tolerance to Acceleration — 7
Source: NASA Ames Research Center

ABSTRACTS

Title: Bubble Dynamics for Nucleate Boiling in Reduced Gravity
Number: VB-4
Source: NASA Lewis Research Center
Area: Convection Heat Transfer Time Duration: 19 Minutes

The formation and dynamic behavior of bubbles in nucleate boiling directly influence heat transfer rates and hence the performance of boilers and other heat transfer systems in which boiling conditions prevail. The effect of gravity on bubble growth and departure characteristics is pronounced with some liquids, including water, and of little significance with others. Studies of bubble characteristics for different fluids and for different gravitational fields and temperature differences at saturation are leading to an improved understanding of the mechanism of heat transfer in nucleate boiling.

Title: Pool Heating of Liquid Hydrogen Over a Range of Accelerations
Number: VB-9
Source: NASA Lewis Research Center
Area: Convection Heat Transfer Time Duration: 9 Minutes

Storage and handling of cryogenic fluids can create circumstances involving high heat transfer rates at boiling or near boiling conditions. Liquid hydrogen is less well understood in this regime than are other cryogenic fluids. With an increasing number of applications of liquid hydrogen in view, recent investigations have explored heat transfer phenomena in both the subcritical and supercritical pressure regimes, including subcritical nucleate and film boiling. Increased understanding has been sought of film boiling, supercritical heating, and the role of evaporation in the attainment of nucleate boiling high heat transfer rates.

Title: Experimental Observations of Transient Boiling in Subcooled Water and Alcohol
Number: VB-12
Source: NASA Lewis Research Center
Area: Convection Heat Transfer Time Duration: 10 Minutes

Information on transient heating to the onset of boiling in subcooled liquids has been found to be important in the design of certain heat exchange equipment. Very rapid changes can occur in the rate of heat generation in nuclear reactors and regeneratively cooled rocket engine combustion chambers and nearly as rapid temperature rise times can occur in the thin walled structures associated with such equipment. The sharp rate of change in wall temperature and steep temperature gradients in the liquid produce momentary heat transfer coefficients materially different from those of either nucleate boiling or ordinary convection heating. Additionally, studies of heat transfer in this regime have proved to be quite useful in contributing to an understanding of the nucleate boiling process itself.

Title: A Visual Study of Two Phase Flow in a Vertical Tube with Heat Addition
Number: VB-13
Source: NASA Lewis Research Center
Area: Convection Heat Transfer Time Duration: 14 Minutes

Wide differences in heat transfer coefficients prevail in different regimes of two-phase flow in tubes. These along with flow dynamics problems, create a need for knowledge of effects of heat flux, flow velocity, tube length, and bubble nucleation and growth characteristics. While there is a considerable amount of work on this subject reported in the literature, most has been performed primarily on adiabatic two-component flow (liquid plus gas) in simulation of the boiling condition. Heat fluxes sufficient to produce boiling create two phase flow characteristics differing from those determined for adiabatic two-component flow.

Title: A Visual Study of Velocity and Buoyancy Effects on Boiling Nitrogen
Number: VB-15
Source: NASA Lewis Research Center
Area: Convection Heat Transfer — Time Duration: 16 Minutes

Differences in the acceleration of gravity have been shown to influence bubble dynamics and boiling heat transfer characteristics of both pool-type and tube-type boilers. Effects in tube boilers, with the tubes oriented vertically, are most pronounced at low flow velocity and with flow moving in a downward direction. Under these conditions, vapor bubbles tend to rise in opposition to the direction of flow and to dwell longer near the point of their origin. Both nucleate and film boiling heat transfer rates are then affected by the congestion of vapor and its resulting concentration at the hot surface. Upward flow in tubes produces no such effect because the fluid motion and the gravity forces on the vapor bubbles are both in the same direction.

Title: Flammability of Surfaces in Zero Gravity
Number: VB-27
Source: NASA Manned Spacecraft Center
Area: Convection Heat Transfer — Time Duration: 10 Minutes

The use of pure oxygen for life sustaining purposes in manned spacecraft programs has naturally created concern about fire safety. The film and references of this Visual Brief deal primarily with flammability under zero gravity condition of various substances much used in spacecraft, and with paraffin, a simple hydrocarbon used as a "control." Zero gravity state, to simulate space flight, was obtained through use of a military-type C-131 aircraft flying Keplerian trajectories and maintained for approximately 10 seconds for each test. Flame characteristics under zero gravity conditions are shown to be grossly different than under one g. Information was obtained which will permit a better understanding of the fire hazard in space flight; however, additional investigation is required.

Title: Saturn Radiation and Convection Base Heating
Number: VB-33
Source: NASA Marshall Space Flight Center
Area: Radiation Heat Transfer — Time Duration: 7 1/2 Minutes

The base region thermal environments of stages with clustered engines present a variety of engine/vehicle interaction problems. Components and structures in the base region, including the rocket engines, depend for survival in the radiant and convective heating environment upon such devices as protective insulation, shielding, airscooping, and proper disposal of the fuel-rich turbine exhaust gases. In general it can be stated that, at low altitude, the primary source of heating will normally be radiation. As altitude is increased, convective heating increases in importance. Different thermal protection concepts evolve for booster and upper stages due to the differences in ground altitude, and high altitude heating mechanisms.

Title: Hypergolic Propellant Research
Number: VB-23
Source: NASA Manned Spacecraft Center
Area: Reaction Kinetics Time Duration: 11 Minutes

The hypergolic and storable properties of the propellants N_2O_4 and hydrazine have made them attractive for missile and space applications. The high reactivity of N_2O_4 with members of the hydrazine family appears actually to lead to a degradation of combustion efficiency under some conditions. This has led to intensive research on injectors and also to some study of means of varying propellant properties. The film contains excerpts from three experimental investigations of the behavior of N_2O_4 and hydrazine under different test conditions.

Title: Visualization Studies of Combustion Instability in a Hydrogen-Oxygen Model Combustor
Number: VB-10
Source: NASA Lewis Research Center
Area: Reaction Kinetics Time Duration: 14 Minutes

High frequency (acoustic) modes of unstable operation in rocket engine combustors have been extensively studied to define the parameters affecting coupling between the acoustic oscillations and energy release from the combustion process. Harmonic oscillations in the gas velocity, pressure and density modulate the combustion energy release through cyclic changes created in propellant injection, atomization, evaporation and burning. These process changes and the coupling between energy release and acoustic oscillations have received extensive analytical study. Careful observation of combustion processes using high-speed photography is one method used to substantiate and expand the analytical descriptions which model the unstable combustor and can prescribe stability criteria.

Title: Smoke Trail Wind Shear Measurements
Number: VB-1
Source: NASA Langley Research Center
Area: Aircraft Structures Time Duration: 9 1/2 Minutes

The variation of horizontal wind velocity with altitude, especially in the altitude range where maximum dynamic pressures occur, can have a major effect on the flight loads experienced by launch vehicles. The structural deflections which result can also have an important effect on the output of sensors which perform important functions in the vehicle guidance and control systems.

The severity of these effects depend to a large degree on the fine detail of the wind profile. By means of the rocket smoke trail method, measurements of the wind profile can be obtained in greater detail and with greater accuracy than previous methods used, such as sounding balloons. In addition to providing more accurate data for loads and dynamic response calculations, repeated measurements of the fine detail provide valuable data for the study of the statistical nature of the phenomenon which, in time, should provide a more fundamental understanding of its causes.

Title: Expansion Tube Hypersonic Test Facility
Number: VB-17
Source: NASA Langley Research Center
Area: Gas Dynamics — Time Duration: 5 1/2 Minutes

A number of experimental laboratory facilities have been developed, based on several different operating principles, to simulate the reentry environment of interplanetary spacecraft. Practical problems have prevented completely satisfactory simulation, especially of the critical heating portion of the reentry trajectory. The expansion tube, which is a device utilizing both unsteady shock waves and expansion waves in its operating cycle, was conceived to provide the improved performance and testing capability not available in existing facilities.

Title: Journal Bearings in Laminar and Turbulent Regimes
Number: VB-28
Source: NASA Lewis Research Center
Area: Machine Design — Time Duration: 18 Minutes

In the design of certain types of turbomachinery for space vehicle applications, it is desirable or perhaps necessary to use the working fluid for bearing lubrication and to operate at high rotational speeds. These conditions result in fluid flow Reynolds Numbers in the bearings higher than critical, so that laminar flow, which ordinarily is present in conventional bearings lubricated by high viscosity oils, does not exist. The research which is the subject of this Brief is a theoretical and experimental investigation of the dynamic properties and fluid film phenomena in journal bearings operating in this non-laminar flow region. Depending on the geometry and operating conditions, the transition from laminar flow occurs at different Reynolds Numbers and the results in either a vortex flow or a turbulent flow. The visual aid contains motion pictures of tests in a device developed to provide a flow-visualization of the fluid phenomena within a journal bearing over the relevant range of Reynolds Numbers, lubricant viscosities and shaft and bearing eccentricities. These pictures plus the data presented in the reference reports provide new understanding of bearing performance in the non-laminar operating region.

Title: Hydrodynamic Rotating Shaft Seals
Number: VB-2
Source: NASA Lewis Research Center
Area: Machine Design — Time Duration: 14 Minutes

Long lifed hydrodynamic seals employ liquid viscous and centrifugal forces to establish a liquid-vapor or liquid-gas interface, often in the presence of considerable design pressure drop across the seal. Slinger-type hydrodynamic seals use centrifugal force to maintain a liquid-vapor interface radially around the face of a disk normal to a shaft. Viscoseals use liquid viscous forces generated by helical grooves in either a shaft or its concentric housing to develop a pressure drop axially along the seal and a stable liquid-vapor or liquid-gas interface. Both types of seals are demonstrated in the film.

Title: Experimental Research in Aerospace Structural Dynamics
Number: VB-19
Source: NASA Langley Research Center
Area: Aircraft Structures Time Duration: 16 1/2 Minutes

The complexity of large aerospace structures and the difficulty of defining exactly the environment in which they operate and the critical loads to which they are exposed makes it difficult, if not impossible, to handle design problems and structural analysis with sufficient accuracy on a theoretical basis, especially under dynamic conditions. Therefore, experimental techniques are essential for producing reliable, efficient and lightweight aerospace structures. The use of dynamically similar models, scaled properly elastically, aerodynamically and inertially, is a particularly useful experimental tool in structural dynamics and is the subject of this Brief. The motion picture visual aid gives an overview of the various different vehicles and structural dynamics problems which have been handled satisfactorily by this technique. The references, together with the reports cited therein, provide a detailed technical treatment of structural dynamics and experimental model techniques, with emphasis on recent NASA work related to large launch vehicle structures.

Title: Spacecraft Landing Dynamics
Number: VB-24
Source: NASA Manned Spacecraft Center
Area: Aircraft Structures Time Duration: 4 Minutes

Landing systems for manned spacecraft must be designed to limit landing impact below levels that exceed human acceleration-tolerance levels, and must not add excessive weight to the spacecraft. Since it is difficult to handle completely the many interacting factors in an analysis of vehicle landing dynamics, experimental techniques are usually necessary to verify the analysis and refine the design. An experimental technique, which has provided much useful data, is the utilization of dynamic models which are scaled so that the motions and forces can be accurately interpreted in terms of the full-scale vehicle.

This Brief summarizes a number of these studies. Vehicle configurations included are parachute and paraglider supported ballistic bodies, lifting bodies and lunar landing vehicles. Both water and land impacts in earth gravitation in addition to impacts in the reduced lunar gravitation are included in the studies. Among the various impact attenuation devices studied are hydraulic struts, material deformation systems (crushable honeycomb and strain straps), and landing rockets. In certain of the studies, data from model tests and full-scale tests are compared.

Title: Flight Measured Control Power and Damping Required for Vtol Aircraft
Number: VB-8
Source: NASA Ames Research Center
Area: Control Systems Time Duration: 6 Minutes

The capability of VTOL aircraft of fulfilling a more widespread transportation role is dependent on a number of economic and technical factors. Considerable effort has been expended in the field of stability, control and handling qualities in recent years. The technique of investigating these factors in flight using a variable stability and control research aircraft, a research method originally developed and used successfully on conventional aircraft, has been of value also for VTOL types. With this technique, investigations of a general nature into these factors can be carried out by varying the stability and control parameters over a wide range, or the particular stability and control characteristics of a specific vehicle or proposed design can be simulated. The results of the handling qualities evaluation are ordinarily presented in terms of pilots opinions, expressed in terms of some accepted rating system such as the Cooper scale.

Title: Transonic Buffeting of Hammerhead Launch Vehicles
Number: VB-11
Source: NASA Ames Research Center
Area: Control Systems Time Duration: 8 Minutes

In order to adapt certain large diameter payloads to existing launch vehicles, hammerhead aerodynamic shrouds have been designed to accommodate the payload and match the smaller diameter final stage of the launch vehicle. During the launch trajectory, as the vehicle accelerates through the transonic speed range, it can be subjected to large structural loads depending on its dynamic response to the transonic buffeting. It has been found that certain of the hammerhead configurations, having particular combinations of nose shape and boattail angle, can experience fluctuating loads under these conditions severe enough to cause catastrophic failure. For research into problems of this nature, a particularly useful experimental technique is the testing in a transonic wind tunnel of models which are properly scaled both aerodynamically and structurally.

Title: Magnetically Supported Superconducting Spherical Gyro
Number: VB-20
Source: Jet Propulsion Laboratory
Area: Control Systems Time Duration: 4 Minutes

For long duration space flights, reliable, high performance gyros are required for attitude reference. To avoid the necessity of frequent resetting or compensation, very low drift rates are desirable, which, of course, is also of importance in applications other than for space flight. For these reasons research has been carried out in advanced gyro techniques in recent years. One approach that shows promise is the magnetically supported superconducting spherical gyro. The spherical rotor configuration has the advantage of all-attitude capability. The use of superconducting materials has the advantage of low, if not zero, power consumption. In addition to the reduction of the frictional losses to a minimum, the magnetically suspended, superconducting configuration promises certain suspension stability advantages, as well.

This Brief is predominantly concerned with the fundamentals related to the suspension, or levitation, of spherical superconducting rotors and the analysis of the stability of these configurations in the presence of various disturbances. The advanced theoretical techniques used in the analysis involve the consideration of the superconductivity phenomenon, the electromagnetic interactions and the inertial characteristics simultaneously.

Title: The Supersonic Transport in the Air Traffic Control System
Number: VB-21
Source: NASA Langley Research Center
Area: Control Systems Time Duration: 18 Minutes

Because of the magnitude of the program, among other reasons, the Federal Government has participated to a greater extent in the Supersonic Transport (SST)