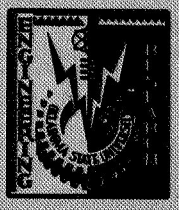

OFFICE OF ENGINEERING RESEARCH

OKLAHOMA STATE UNIVERSITY

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

QUARTERLY REPORT

TO

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

ER 68-I-3

MAY 31, 1968

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

QUARTERLY REPORT
March 1, 1968 through May 31, 1968

COLLEGE OF ENGINEERING
OKLAHOMA STATE UNIVERSITY
STILLWATER, OKLAHOMA

Administered under Contract Number NSR 37-002-045
of the
National Aeronautics and Space Administration

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QUARTERLY REPORT

A. Summary

From the efforts of the Monograph authors, sixteen Educational Monographs are now available for immediate distribution and four others are in the final stages of preparation. Tentative titles for six other Educational Monographs have been submitted. The emphasis on the requirements for evaluations of the Monographs by both engineering educators and engineers in industry has resulted in a large increase in the number of evaluations received during the quarter. Of the 64 Monograph evaluations received to date, 41 of them have been received during the quarter just completed.

The number of Visual Briefs ready for immediate distribution remains at 21. During the program there have been 249 requests for use of this visual material. There have been 75 evaluations received on the Visual Briefs. From the nature of this material, those who request them appear to use them and evaluate them much sooner and with greater percentages of completion than for the Monograph material.

An addition to the NASA Pilot Program made during the last quarter was to investigate industrial interest in Education Monographs to follow up the initial effort by the NASA Goddard Space Flight Center Technology Utilization Office. The response to the O.S.U. industrial investigation gave similar positive results to that of the initial investigation by NASA. There have been 17 Monograph evaluations already submitted by individual engineers from these industrial firms.

From an analysis of the responses from both universities and industries, the Educational Monograph concept has been evaluated to be a useful and desirable method of accelerating new technology into classroom instruction and presenting it in flexible form for curriculum planning in the educational process for engineers and engineering students. The only significant complaint has been that there should be more Monographs from which to choose for these educational purposes.

As the NASA Pilot Program nears completion, effort has been directed toward determining methods of continuing and expanding upon the positive results already demonstrated for the concepts developed in the program. During the discussion of a Preliminary Proposal for continuation with the National Science Foundation during which an in-house critique was given early in March, the office of the Undergraduate Science Curriculum Planning gave a favorable response and asked for a Final Proposal. The plan submitted is for a five-year program to allow sufficient time to prepare greater numbers of Monographs from a broader base of reports, to further evaluate the acceptance of Educational Monographs by both industry and university engineers, and to investigate and develop permanent means of financing the publication of the Monographs.

B. Monographs

Two Educational Monographs were completed for mailing during this quarter. They were: TD-5, "Computer Program for Thermodynamic Performance of Brayton Cycle Space Power Systems" by J. A. Wiebelt, Mechanical Engineering, Oklahoma State University and CS-2, "An Application of Root Locus Techniques to Lunar Vehicle Control" by William A. Blackwell and Leonard L. Grigsby, Electrical Engineering, Virginia Polytechnic Institute.

Sixteen Educational Monographs are available for immediate distribution to educators and industry. Another Monograph is ready for final reproduction. Two other Monographs have been written and mailed to the original authors for comment. Another Monograph has been written but requires additional development by the Monograph author. Abstracts for these 20 Educational Monographs are shown in Appendix VI. Other Educational Monographs are in various stages of research and preliminary writing. Tentative titles for the six of the additional Monographs under preparation are:

HT-9: The Grover Heat Pipe
HT-10: Thermal Modeling in a Simulated Space Environment
TD-7: Entropies and Enthalpies from Equations of State and Other Data
TD-9: High Temperature Enthalpies from Pressure and Flow-rate Measurements
CS-7: An Example of Central System Design by State Variable Feedback
CS-8: An Analog Study of the Human Ear

A total of 1,531 instructor copies and 5,245 student copies of Educational Monographs have been mailed to individuals who have requested them for review or use in a classroom situation. Appendix I shows the number of copies mailed to university educators while Appendix II tabulates the number of copies of Monographs requested by industrial organizations. An additional 1,182 instructor copies of Monographs have been distributed with letters designed to stimulate interest in the program; 615 copies of Monographs with the initial letters to industry (OSU Survey) and 567 copies with the initial letters to the Deans of Engineering. These additional copies are not included in the tabulations in Appendices I and II.

C. Visual Brief

The number of Visual Briefs ready for immediate distribution to universities and industry remain at 21. There have been received 249 requests for use of the technical films. All but 18 of the requests have been filled. The unfilled requests will be processed as soon as the appropriate Visual Briefs are returned from borrowing institutions. Visual Brief dissemination by Visual Brief number is tabulated in Appendix IX.

Mr. Carl Lindquist, NASA Western Support Office, forwarded all the Visual Brief material that had been filed in his office to Oklahoma State University for retention when the Western Support Office was closed.

D. Dissemination

1. General

There have been 238 professors at 102 universities located in 39 states of the United States of America and five foreign countries who have received Educational Monograph information for review or use in classroom situations. Monograph dissemination by university is tablulated in Appendix V.

In addition to sales promotions by mail, Dr. Kenneth A. McCollom appeared as a speaker at two meetings during the quarter. He made a presentation on the value of Educational Monographs in continuing education to the 10th Annual Thermodynamics Conference held by the School of Chemical Engineering, Oklahoma State University, on April 9, 1968.

A more complete discussion of the value of the NASA Pilot Program in improving the transfer of new technology to engineering education and practicing engineers was included in a paper presented at the 5th Space Congress held at Cocoa Beach, Florida, on March 12, 1968. Abstracts of Educational Monographs were made available to the attendees of both meetings.

An increased number of requests for Educational Monographs and Visual Briefs were received as a result of (1) letters to Deans (2) advertisement in the Journal of Engineering Education and (3) letters to industry.

2. Letters to Deans

The letters to the Deans of Engineering continue to stimulate interest in the NASA Pilot Program. The letters are apparently being circulated to the engineering faculty of many of the institutions. Obviously it takes several months for all of the faculty members to review the material in detail. There have been 165 professors at 67 universities who have requested Monographs and Visual Briefs as a result of these letters: one hundred seventeen professors requested Monograph material; 19 asked for Visual Briefs; and 29 requested both Monographs and Visual Briefs.

3. Advertisement

The full page advertisement describing Educational Monographs and Visual Briefs that was placed in the January, 1968 issue of the Journal of Engineering Education was successful. A total of 77 professors in the United States, Canada, England, Argentina and India have requested information on the NASA Pilot Program. A general letter describing Educational Monograph and Visual Brief material was mailed to each responder along with abstracts of both Monographs and Visual Briefs. Secondary responses to the letters are just now being received.

4. Industrial

The Goddard Space Flight Center survey was to determine the magnitude of interest industrial organizations might have in Educational Monographs. Under contract to the Goddard Space Flight Center Technology Utilization

Office, the Office of Industrial Applications of the University of Maryland distributed descriptive information on the Education Monograph program to corporate heads of 243 industrial organizations.

Four Education Briefs, one page abstracts of the Monographs, were mailed to the companies together with a cover letter explaining the potential of Educational Monographs. The companies were invited to write Goddard Space Flight Center requesting complete copies of the four Monographs to allow detailed evaluation.

The results of the Education Brief Survey was most encouraging. Eighty nine of the 243 companies responded; 62 of them indicated further positive interest in receiving the complete Monographs. The 62 companies were then mailed all four Educational Monographs after which seventeen companies again responded. This small percentage of secondary responses was not considered an indication of non-interest since response time for information of this nature within industrial organizations may be delayed or bypassed depending on the work load of the individuals in the organizations. The conclusions from the survey results were that the industrial community has an interest in the use of Educational Monographs.

Oklahoma State University instituted a follow-on survey for the Goddard survey. Follow-on letters were written to the seventeen organizations indicating secondary responses to the Goddard Space Flight Center survey. Two of the organizations have requested additional Educational Monographs. A second follow-on letter was mailed to the 45 companies that indicated an interest in the program but had not made a secondary response. (See Appendix VIII) We are awaiting answers to this latest effort.

Oklahoma State University initiated a companion survey which is complementary to the Goddard survey to determine industrial interest in Educational Monographs. Industrial membership in the American Society for Engineering Education was used as a source of dissemination. This group of 205 organizations was selected because of their indicated interest in engineering education. Perhaps more important is that many of the designated representatives are directly involved in the employment, in-house training or supervision of engineers and scientists.

A letter describing the Educational Monograph program was mailed to each of these organizations along with instructor's copies of Monographs CS-1, "An Example of Compensation Network Design"; HT-1, "Calculation of Radiant Heat Exchange by the Monte Carlo Method"; and TD-1, "Calculation of Complex Chemical Equilibria". Several copies of the abstracts of Monographs available for distribution were also attached.

The copies of Educational Monographs were included in the initial mailing to illustrate the format, simplicity of presentation and content. The recipient could immediately route the Monographs to appropriate engineers or scientists for review. Each recipient was asked to evaluate the Educational Monographs for application by industry--for either industrial seminars or for individual study.

Responses to the OSU survey have been gratifying. Of the 205 organizations contacted, 46 had responded by May 17, 1968 and additional

responses are expected. Seventy-eight percent of the responses (36 companies) were positive. The other 22% of the replies (10 companies) were considered negative responses. Of the 36 companies responding positively, representatives of 29 companies have requested additional monographs for review. Number of responses received each week are shown in Figure 1. The relationship of positive and negative responses is illustrated in Figure 1. A total of 283 instructor copies and 165 student copies of Educational Monographs have been mailed for industrial use. Individual company requests have ranged from one copy of one monograph to 66 copies of monographs for use by 21 different engineers.

A comparison of the results of the OSU survey, the Goddard Space Flight Center survey, and the NASA Office of Technology Utilization Tech Brief Mode III dissemination illustrates the acceptance of Educational Monographs by industry. In both the NASA Education Brief survey and the OSU survey responses to initial contact to industry exceeded the response to Tech Brief disseminations: NASA Tech Brief - 21.6% response; OSU Industrial Survey - 22.4% and NASA Education Brief - 36.6%. However, Figure 2 illustrates that the positive response of the Educational Monograph was twice as great as that experienced with the Tech Brief. The positive response on the OSU survey was 10% greater than the response to the NASA Educational Brief survey. This greater response is attributed to the selection of the management level to whom the material was mailed.

The positive response to both the NASA Survey and the OSU Survey is a good indication that Educational Monographs have a place in the continuing education of industrial employees provided a greater selection of material can be generated to encourage industry to use them frequently.

E. Evaluations

1. Monographs

There were 41 Educational Monograph evaluations received during the quarter raising the total evaluations returned by reviewers of the material to 64. Figure 3 shows the number of evaluations received each quarter of the operation of the NASA Pilot Program. A projection of the increase in receipt of Monograph evaluations indicates that more evaluation sheets should be received during the period June through August, 1968. A letter reminding the recipients of Educational Monographs of the need for candid evaluations of the material is being mailed to the individuals who received documents prior to April 1, 1968. A sample copy of the letter is shown in Appendix VII.

Two of the industrial organizations have already returned 19 Monograph evaluations. One company, Caterpillar Tractor Company, provided very positive, and enthusiastic, evaluations. One man evaluated seven Monographs. He stated "I believe the general idea of this type of Educational Monograph is excellent. It should also be very helpful to industry as well as universities. In my evaluation I tend to rate them all very good. Some of them are not pertinent to our areas of interest." Another Caterpillar Tractor Comapny representative said "I think the monograph would be quite useful in industry as a means of continuing education for

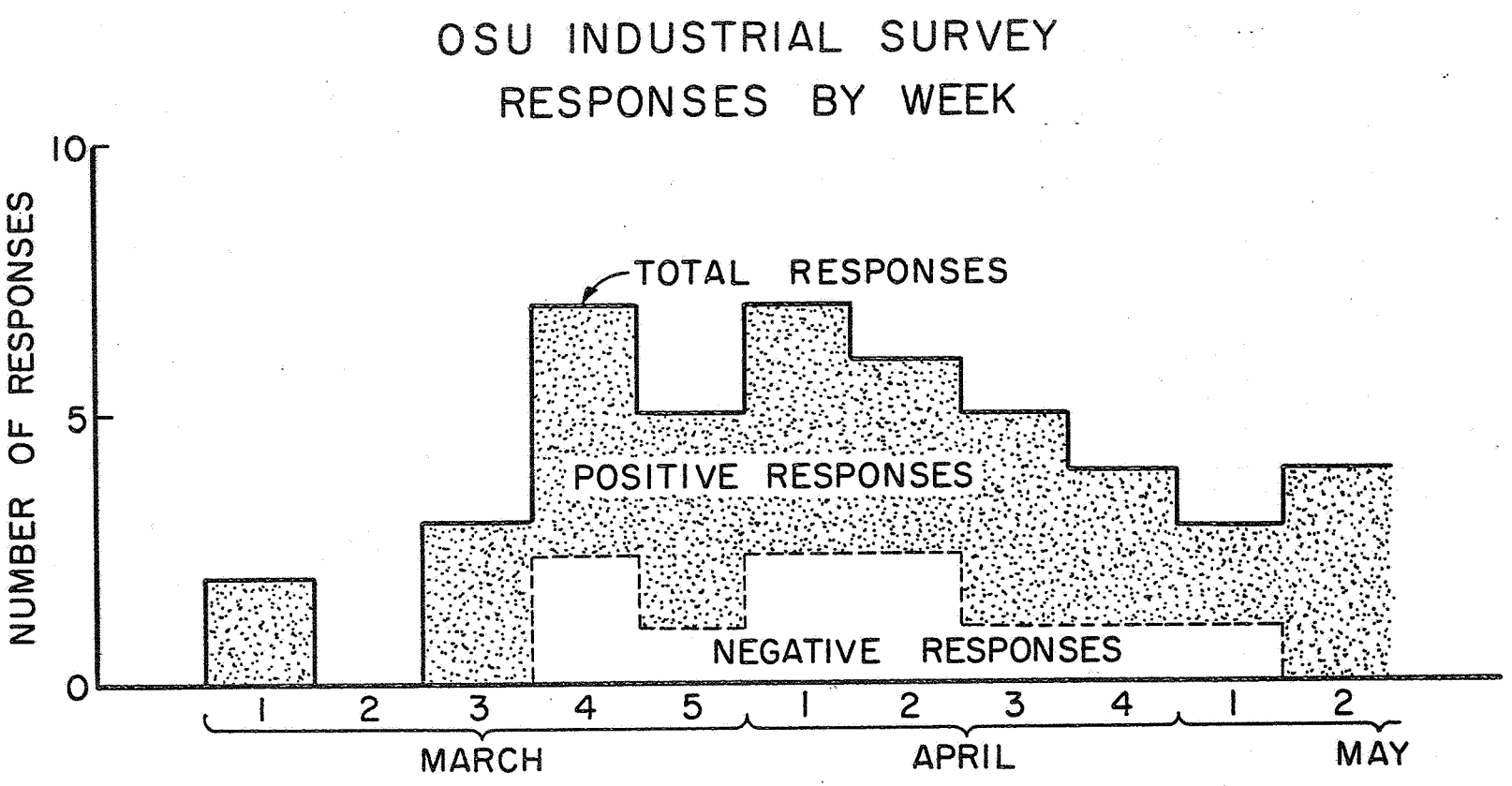
OSU INDUSTRIAL SURVEY
RESPONSES BY WEEK
NUMBER OF RESPONSES
10
5
0
TOTAL RESPONSES
POSITIVE RESPONSES
NEGATIVE RESPONSES
1 2 3 4 5 1 2 3 4 1 2
MARCH
APRIL
MAY

Figure 1

COMPARISON ON INDUSTRIAL RESPONSES

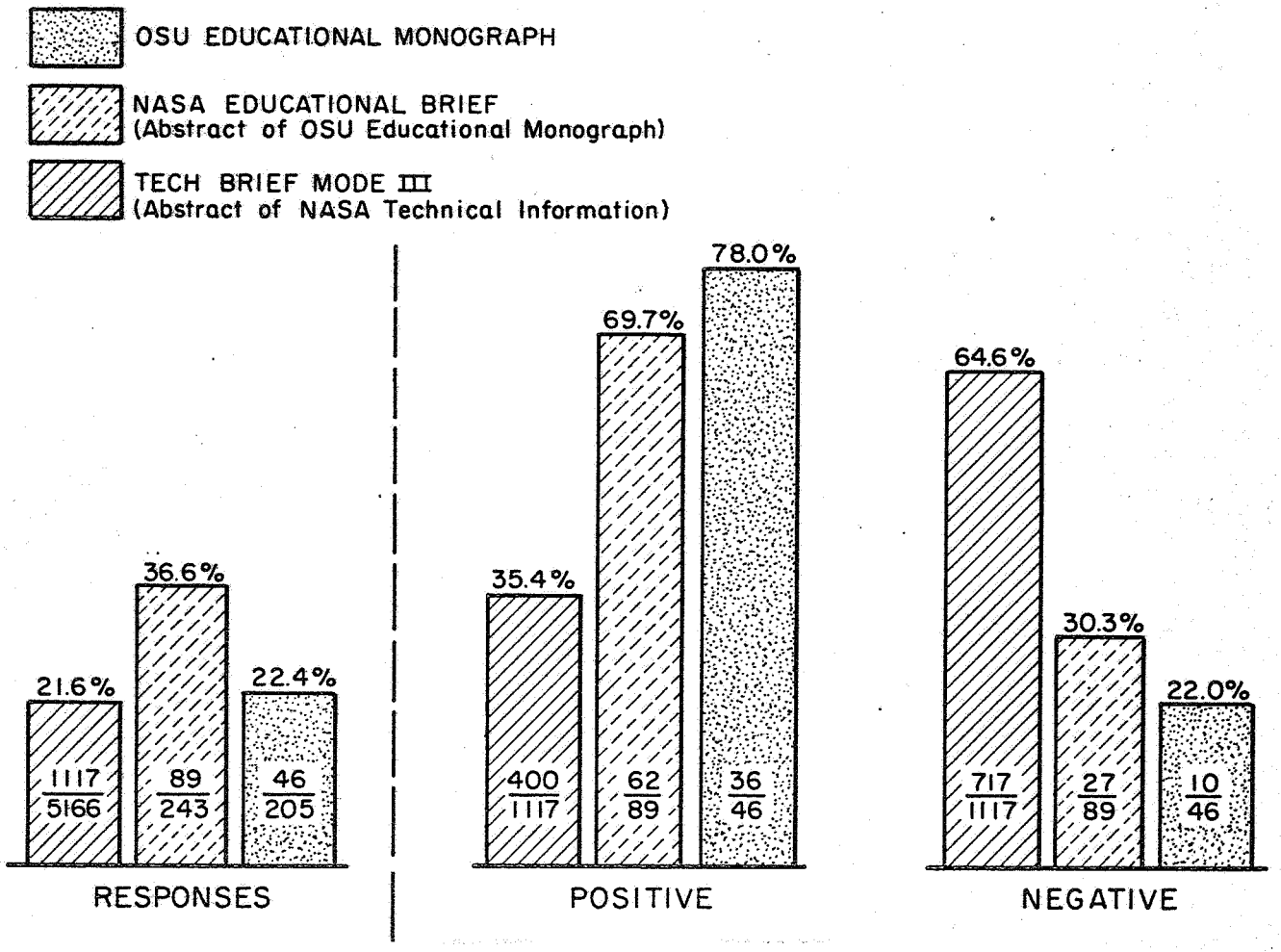

Figure 2

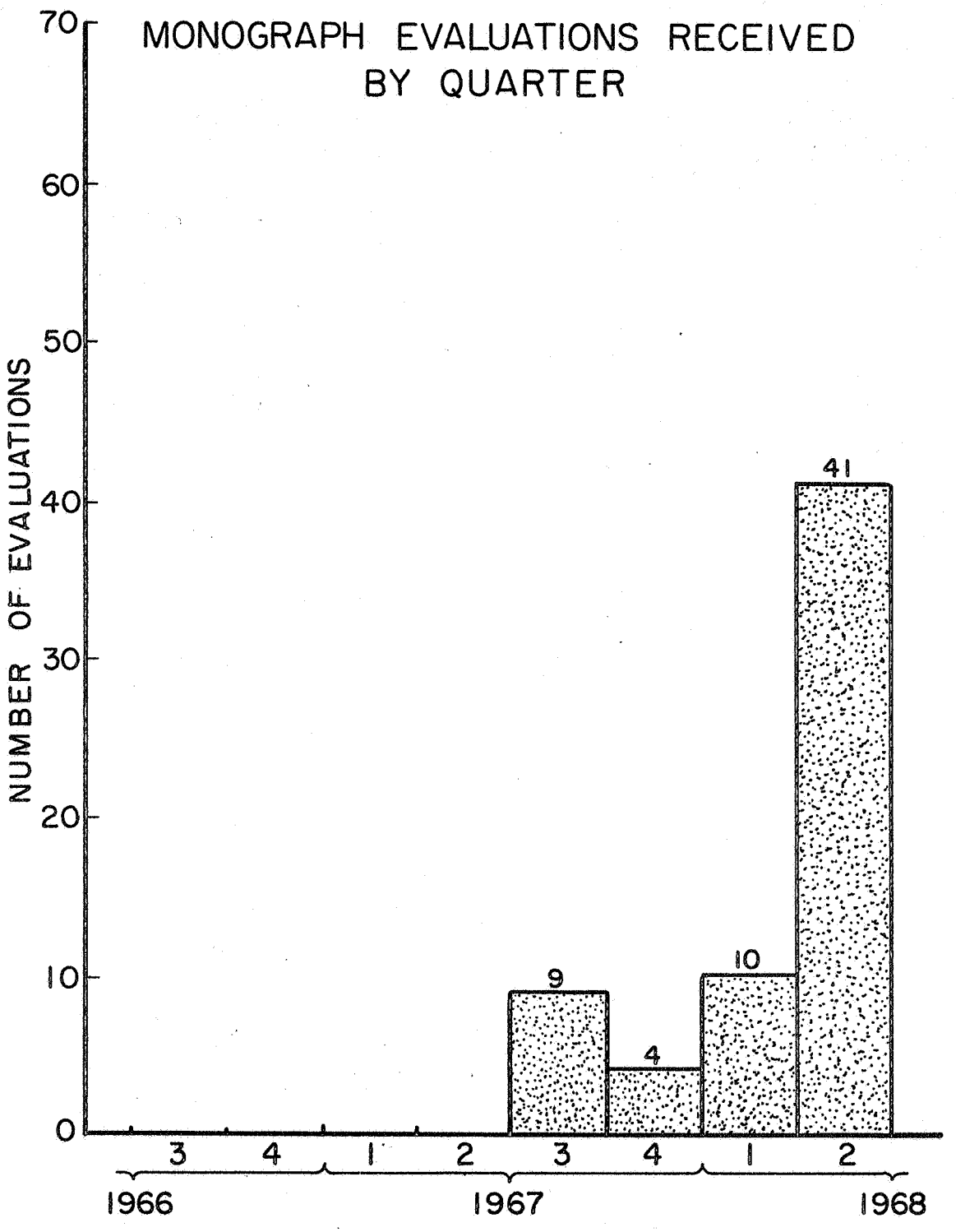
MONOGRAPH EVALUATIONS RECEIVED
BY QUARTER
NUMBER OF EVALUATIONS
70
60
50
40
30
20
10
0
9
4
10
41
3
4
1
2
3
4
1
2
1966
1967
1968

Figure 3

technical specialists. The material is well presented in a concise manner . . . . A wide variety of subjects would be necessary to be of general interest in industry. For use in classroom groups, however, they would have to be available to the students for a reasonable period of time (two months)."

A third evaluator stated "Very useful method for engineers in industry to improve or update their skills by self-study or study groups. This particular Monograph would be difficult to improve upon. Expansion of subject matter would undoubtedly create more interest. I had planned to organize a study group of interested persons, but the length of time allowed was insufficient for preparation of lectures. Frequent use would depend on permanent copies of Monographs--perhaps they should be purchased." Complete evaluations by engineers employed by Caterpillar Tractor Companies and other industrial companies are included in Appendix IV.

Another industrial organization which submitted evaluations was R. J. Reynolds Tobacco Company. Their evaluations are considered positive although they did have some negative comments regarding the applications of the specific Monographs they evaluated. Excerpts from these evaluations are shown below.

"This Monograph would be of particular value in the academic classroom since it allows the student to put theory into practice by solving actual problems. This would also be true in certain industrial classrooms where communication and data transmission is of principal importance."

"For engineers outside this specialized field of technology, this Monograph would be of doubtful value."

"If this material could be presented in a simplier, more detailed and better organized form, it could be an effective tool for disseminating technical material to the practicing engineer."

"The Instructional Monograph is an excellent method of disseminating the results of recent research and scientific technical information; however, if it is to be used by engineers in industry, I feel that it must be presented in a classroom by a qualified instructor or its use will probably be limited. The Monograph requires that the student have a general familiarity of chemical equilibria and advanced mathematics appreciably since their formal education, will be unable to follow the discussion in the Monograph without first reviewing the prerequisites."

"On this basis I feel that this Instructional Monograph will not find widespread use in industry. The engineer in industry can better continue his education by reviewing technical papers published by the ASME and other founder societies, studying programmed instructional courses through extension divisions of colleges and universities and taking other educational courses presented in formal classrooms or through television networks."

Two examples of responses which were classified as negative in the OSU Industrial survey were:

Consolidated Edison Company of New York, Inc. reports "We find that none of the subjects is applicable to our engineering problems and so it has not been possible for us to evaluate the Monographs as you requested."

Wisconsin Motor Corporation states "The Example Instruction Monograph was also reviewed to determine applicability. It was found that the examples are extremely theoretical in nature and do not apply to present requirements. In view of this, it is doubtful as to their usefulness to an organization such as ours as a tool, either educational or otherwise."

Figure 4 illustrates the number of evaluations received for each Educational Monograph. It is hoped that a minimum of ten evaluations for each of the Monographs distributed prior to May 1, 1968 can be obtained. Evaluations of the new Monographs released during the summer months will probably be received after their use in the fall semester. However, a few evaluations of the new documents are expected from industrial organizations during the summer--provided the vacation schedules do not delay their use.

The concept and format of the Monographs seem to be acceptable to educators and practicing engineers alike. A review of the evaluations in Appendices III and IV indicates an excellent acceptance of the Monograph material by both the education and industrial communities. Specific complaints seem to center on the need for a greater selection of Monographs in specific fields of interest and an expansion of the concept into fields other than control systems, thermodynamics and heat transfer.

A significant conclusion appears to be that this unique program of technology transfer should be continued and expanded to provide new engineering developments to industry and universities alike.

2. Visual Brief

A total of 75 evaluations of Visual Briefs have been received from users of the technical films. Evaluations of each film have been received with exception of VB-5. Figure 5 illustrates the number of evaluations received for each Visual Brief. Analysis of the responses on the evaluation sheets indicates Visual Briefs add to the further understanding of course material when used in classes. (Appendix X) However, a review of the general comments made on the Visual Brief Evaluation sheets indicates the Visual Briefs need modifying to be used effectively in educational situations.

Some of the general comments included in the evaluation sheets are:

"Too long for rather specialized material presented."

"Without reference documents the Visual Brief is of very little as no use. After previewing, it was decided not to use in class."

"Major limitation is each of time by students to dig into the (written) material."

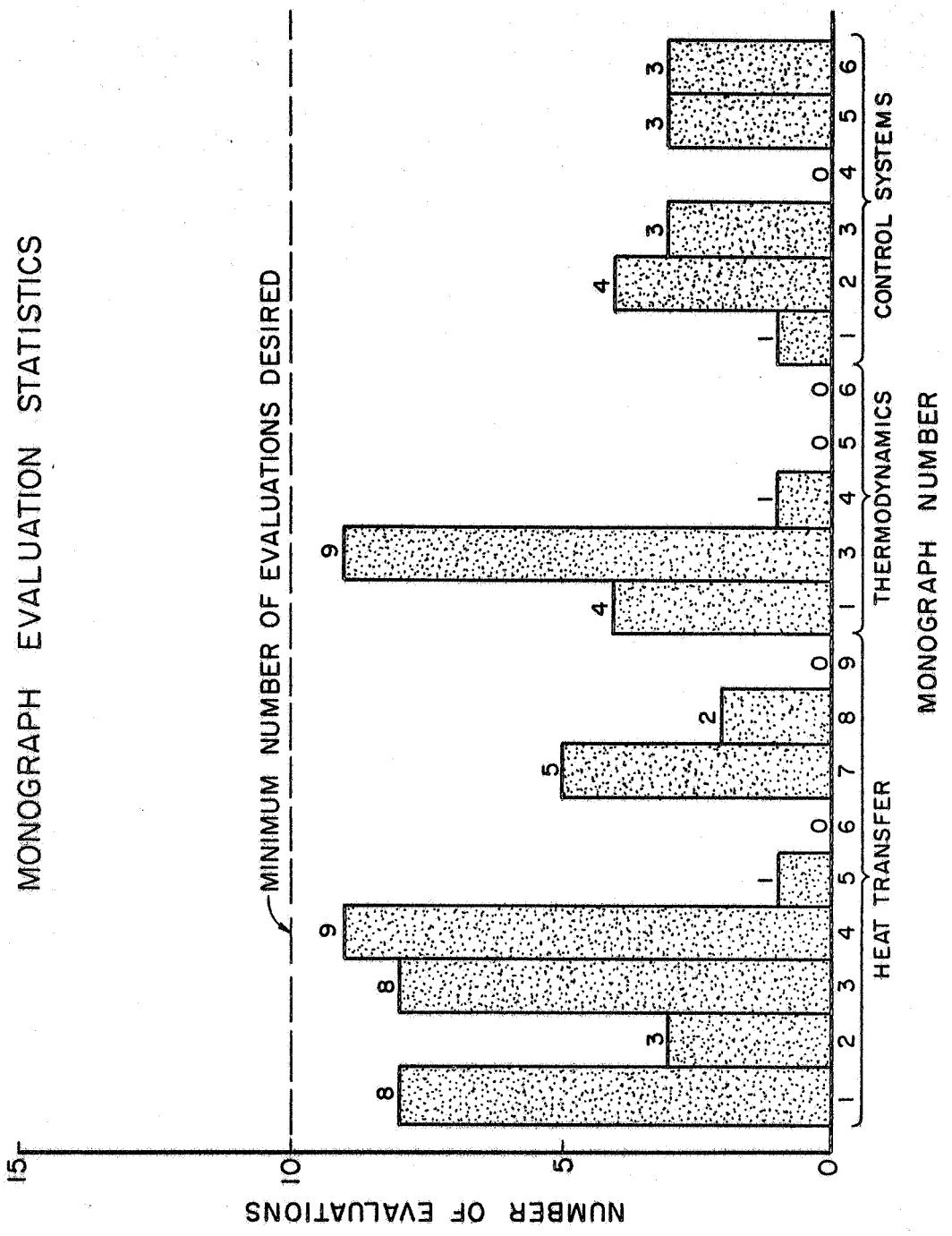
MONOGRAPH EVALUATION STATISTICS
MINIMUM NUMBER OF EVALUATIONS DESIRED
NUMBER OF EVALUATIONS
15
10
5
0
8
3
8
9
1
5
2
9
4
1
0
0
4
3
3
3
1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6
HEAT TRANSFER
THERMODYNAMICS
CONTROL SYSTEMS
MONOGRAPH NUMBER

Figure 4

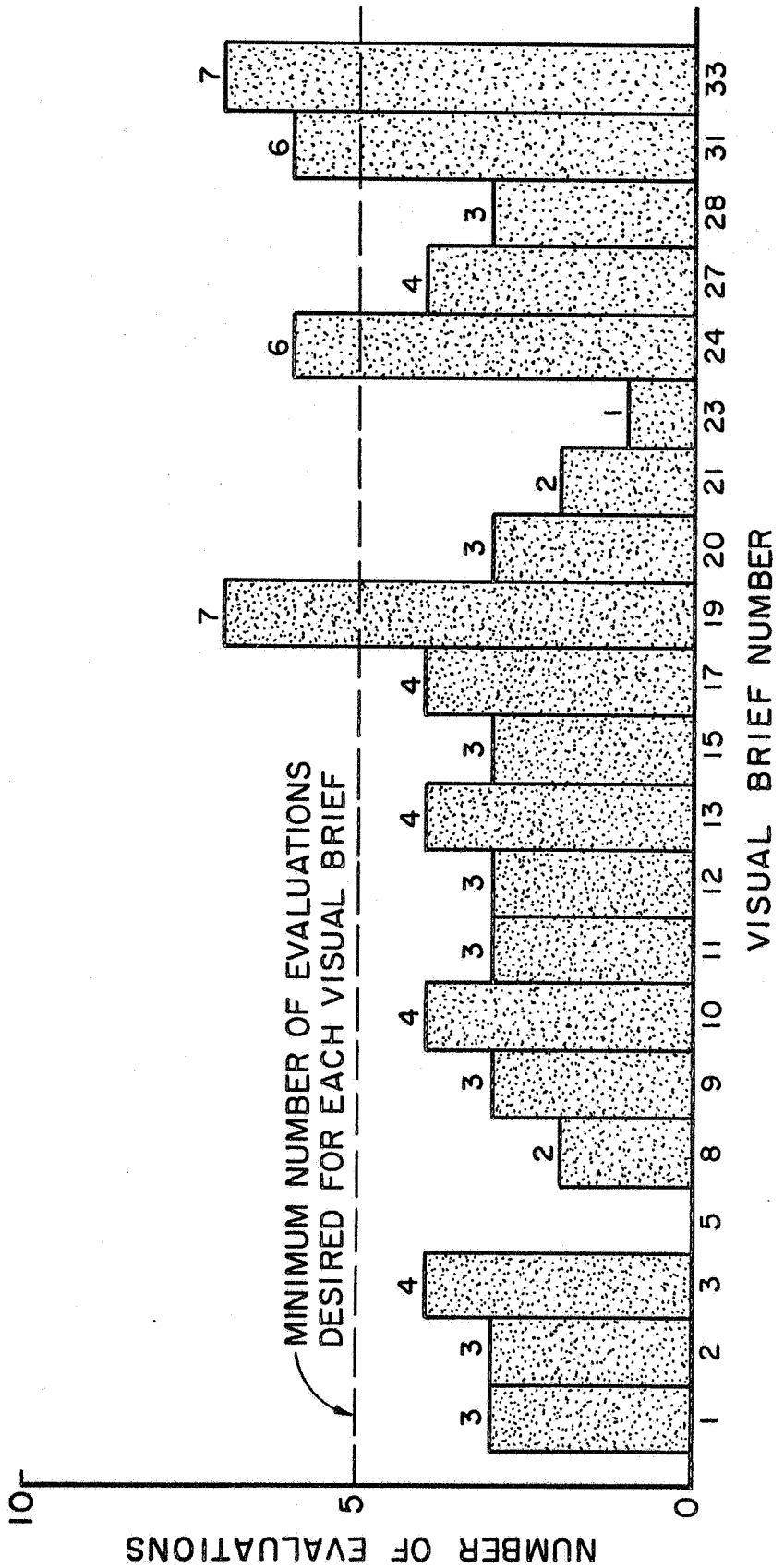
VISUAL BRIEF EVALUATION STATISTICS
NUMBER OF EVALUATIONS
10
5
0
MINIMUM NUMBER OF EVALUATIONS
DESIRED FOR EACH VISUAL BRIEF
VISUAL BRIEF NUMBER
1 2 3 4 5 6 7 8 9 10 11 12 13 15 17 19 20 21 23 24 27 28 31 33
3 3 4 3 2 4 3 3 4 3 3 4 3 4 7 3 2 1 6 4 3 6 7

Figure 5

"The quality of the photograph was not the best. The initial library scenes add little."

"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."

Other comments are included in Appendix XI.

The difficulty of modifying Visual Briefs for educational purposes is discouraging when the above comments are considered. If Visual Briefs are to be effective in a program of this type, the educational specialist in the subject area must be involved during the making of the film throughout the research program. Otherwise, only deletions can be made in editing for classroom or seminar use.

F. Program Support

A preliminary proposal for the continuation and expansion of the NASA Pilot Program was submitted to the National Science Foundation. On March 12, 1968, Drs. Borg, Dane and Foster of the National Science Foundation, met with Dr. McCollom and Dr. Dunn, Mr. Overton and Mr. Carpenter, Oklahoma State University, to discuss the preliminary proposal. Topics of discussion of the conference centered on establishing the need for the Monograph concept in technology transfer as opposed to present techniques such as textbooks, technical journals and research reports. The rationale for the Monograph concept and the organizational structure of the proposed developmental program were apparently acceptable to Dr. Borg and his colleagues as they requested the submission of a final proposal for their consideration.

Proposal ER68-T-144, entitled "A Center for Creating Educational Monographs in Engineering" was submitted to the National Science Foundation on April 26, 1968, by the College of Engineering, Oklahoma State University. The Center's activities are proposed as an extension of the NASA Pilot Program presently funded by the Technology Utilization Office of NASA. The activities of the Center for Creating Educational Monographs in Engineering would be expanded in the areas of heat transfer, thermodynamics, and control systems before extension of the concept to other subject areas.

A five-year plan has been proposed by the Center administrative personnel to evaluate more specifically the impact of Educational Monographs on the continuing education of engineers and scientists and to broaden the base of preparing Monographs to many professors at a large number of universities. The five-year plan would allow sufficient time to (1) prepare a greater number of Monographs by a large number of professors at many different universities, (2) evaluate the acceptance of Monographs by educators and industry, (3) develop refined procedures for the preparation of Monographs in larger quantities, thereby reducing the unit costs of individual documents, and (4) investigate and develop permanent means of financing the publication of the Monographs.

Support of $359,263 was requested for the first two years of the development program. Additional support of $560,106 will be requested for the third, fourth and fifth years as the progress of the program warrants.

A copy of the proposal submitted to the National Science Foundation also was forwarded to Mr. D. W. Orrich, Jr., Technology Utilization Office, National Aeronautics and Space Administration.

APPENDICES

APPENDIX I

UNIVERSITY MONOGRAPH DISSEMINATION STATISTICS THROUGH MAY 31, 1968

Dissemination Summary by Monograph Number

Monograph Number	Instructor's Copies Sent	Student's Copies Sent	Unfilled Requests		Evaluations Received
			Instructor's	Student's	
CS-1	60	218	0	0	1
CS-2	74	491	0	0	3
CS-3	70	431	0	0	2
CS-4	0	0	88	377	0
CS-5	94	358	0	0	2
CS-6	101	427	0	0	2
HT-1	122	488	0	0	8
HT-2	78	179	0	0	3
HT-3	106	526	0	0	8
HT-4	96	484	0	0	9
HT-5	82	176	0	0	0
HT-6	0	0	86	201	0
HT-7	78	174	0	0	0
HT-8	63	325	0	0	1
TD-1	78	338	0	0	3
TD-3	92	327	0	0	5
TD-4	47	138	0	0	1
TD-5	8	0	0	0	0
Totals	1249	5080	174	578	47

APPENDIX II

INDUSTRIAL MONOGRAPH DISSEMINATION STATISTICS THROUGH MAY 31, 1968

Dissemination Summary by Monograph Number

Monograph Number	Instructor's Copies Sent	Student's Copies Sent	Unfilled Requests		Evaluations Received
			Instructor's	Student's	
CS-1	16	0	0	0	0
CS-2	14	0	0	0	1
CS-3	12	0	0	0	1
CS-4	0	0	18	0	0
CS-5	16	0	0	0	1
CS-6	19	15	0	0	1
HT-1	21	15	0	0	0
HT-2	13	15	0	0	0
HT-3	20	15	0	0	0
HT-4	16	15	0	0	0
HT-5	12	15	0	0	1
HT-6	0	0	15	15	0
HT-7	26	15	0	0	5
HT-8	13	15	0	0	1
TD-1	20	15	0	0	1
TD-3	40	15	0	0	6
TD-4	17	0	0	0	0
TD-5	7	15	0	0	0
Totals	282	165	33	15	17

APPENDIX III

Totaled Responses on a Monograph Evaluation Sheet

Comments on Monograph from Classroom Use

1. The Monograph (was 13 , was not 2) used in a classroom situation.

2. The Monograph (was 13 , was not 1) used in context with closely related material in the course presentation.

3. The Monograph (was 7 , was not 4) used for the course described in the "Instructor's Guide for Monographs."

4. The Monograph (was 11 , was not 2) found suitable for the course in which it was used.

5. The technical information presented in the Monograph was (new to me 4 , well known to me 9) and (new to my students 11, well known to my students 0).

6. The technical information in the Monograph (did 12 , did not 3) contribute to further understanding of the course material by the students in this course.

7. The home problems in the Monograph (were 5 , were not 8) assigned to the students in the course.

8. The home problems in the Monograph were (useful 9 , too complex 1 , 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 11, shorter 1) to have maximum effectiveness in class.

11. The reference bibliography (was 7 , was not 6) used and (was 4 , was not 5) a necessary requirement to gain additional information on Monograph subject.

Recommendations on Monographs in General

1. Monographs of technical literature such as this could be of (great 4 , some 10 , little 0) use to me in my course presentation.

2. Monographs should include (more 3 , less 0 , no change in 11) material over that given here.

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

4. The format of the Monograph is considered (good 12 , could be better 3 , poor 0 , completely incorrect 0) for use as an insertion in a course in engineering.

Totaled Responses on a Revised Monograph Evaluation Sheet

General Information on Monographs:

Was the technical information covered in the Monograph of value in course presentation: --Good 41, Some ____, Little 4

Should the Monographs include more information than was presented? --More 14, Same 24, Less ____

Is the format of the Monographs appropriate for use in engineering courses? ---Good 32, Fair 7, Poor 1, Incorrect ____

Comments on Monograph from Classroom Use:

Was the Monograph used in a classroom situation? ----------Yes 16, No 14

Was the Monograph used in context with closely related material in the course presentation? ---Yes 16, No 14

Did the technical information in the Monograph contribute to the further understanding of the course material by the students in the course? -----Great 7, Some 17, Little 1, None ____

Were the home problems in the Monograph too complex? ----------Not used 10, Too complex ____, Useful 16, Too simple 3, Unnecessary ____

How many hours of classroom lecture time should be allocated for presentation of this Monograph? Average of 2

Would you use the Monograph if you taught the course again?----------Yes 15, No 19

APPENDIX IV

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 this 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)

2. One advantage of using monographs should be found in the manner in which basic heat transfer theory is related to current practical applications. Problems should be written which deal with current and future aerospace and outerspace hardware. The theory presented in the monograph should be better illustrated and applied, via the problems. Even though the problem, and its solution, would remain basically the same, student motivation would be greatly increased if the problems were rewritten. In addition to relating the problems to specific hardware, a statement of difficulties and history which led to the problem (such as a practicing engineer might encounter) would stimulate the teaching and learning process. (United States Naval Academy)

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)

2. Much too specific to be useful. The formulas given apply only to very special situations and are not generally applicable. (Kansas State University)

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)

Comments to Questions Asked on Revised Monograph Evaluation Sheet

IN YOUR OPINION, ARE MONOGRAPHS A USEFUL METHOD OF PRESENTING NEW TECHNICAL INFORMATION IN THE CLASSROOM UNTIL THE MATERIAL CAN BE INCLUDED IN A TEXTBOOK?

CS-2

Yes (Southern Illinois University)

Not good for presenting new material before text coverage. (University of Massachusetts)

Yes (Rose Polytechnic Institute)

HT-1

Yes (Auburn University)

HT-2

Yes (Auburn University)

HT-3

They are of definite value. They would be more complete if all the basic material, the fundamentals, were included. (University of Kentucky)

Yes (University of Virginia)

Yes (Auburn University)

HT-4

Yes (University of Virginia)

HT-7

These Monographs are useful. They seem to strike a balance between too much and too little information although in the case of HT-7-67, I felt a little more detail would be useful. (Caterpillar Tractor Company)

Monographs could be extremely useful in industry as well as the classroom for keeping engineers abreast of current developments in their field. (Caterpillar Tractor Company)

Yes, a method of presenting recent developments to those interested in the field. (Caterpillar Tractor Company)

I think the Monograph would be quite useful in industry as a means of continuing education for technical specialists. (Caterpillar Tractor Company)

Monographs are an important source of "updated" material for graduate courses. Frequently government publications are of little value because they are poorly presented, too concise and do not bother to specify the application or limitations of the material. (Caterpillar Tractor Company)

HT-8

They are of definite value. They would be more complete if all the basic material, the fundamentals were included. (University of Kentucky)

TD-1

This should be useful in my graduate seminar. It does not fit in with the more elementary treatment we use in our undergraduate courses. (University of Michigan)

I think the idea of the Monographs are excellent as they bring the latest in technical developments to the attention of the students. As a practicing engineer, I think they are excellent. Also, I would appreciate receiving any other ones OSU publishes in the field of Chemical Engineering. (Lummus Company)

TD-3

I believe the Monograph a very useful method of presenting technical information especially in an industrial situation. (Caterpillar Tractor Company)

Yes (Auburn University)

Very useful method for engineers in industry to improve or update their skills by self-study or study groups. This particular Monograph would be difficult to improve upon. (Caterpillar Tractor)

Yes, they are useful and could be quite helpful in conjunction with advanced fluid dynamics courses. (Caterpillar Tractor Company)

Yes, these Monographs are useful. (Caterpillar Tractor Company)

In general, Monographs are a useful method. However, the content of a Monograph will, by purpose, usually delve deeper into a particular area than a person (student) can absorb or appreciate in a one-hour lecture. This Monograph, in particular, would be of much more value to an engineer experienced in the field of mass flow measurements than to a student being introduced to the subject. (Arnold Research Organization, Inc.)

This is a fairly useful method of supplementing fundamental material, although the time needed for students to assimilate everything in this Monograph may be greater than the importance of the specific detailed subject warrants. Each teacher uses his own scheme, however, and one who chooses this subject for elaboration on principles will have a convenient source of material. (University of Michigan)

TD-4

I have found this Monograph interesting reading. I can only assume the student will find it both interesting and useful when I am in a position to introduce it into a course. (University of Michigan)

WHAT ARE THE GOOD POINTS?

CS-2

It points out to the students that the theory they are learning has applications. (Southern Illinois University)

Very good as a practical example. Main advantage is that the problem discussed seems very typical of a real engineering problem not just an academic example. (University of Massachusetts)

Very Excellent. (Caterpillar Tractor Company)

CS-3

Excellent. (Caterpillar Tractor Company)

CS-5

Excellent (Caterpillar Tractor Company)

HT-1

Good Points: Provided sufficient numbers of Monographs are available, the instructor can be selective to the extent that he presents topics which complement his course outline. New materials of this form should confront students with a segment of the current literature which should be helpful in stimulating research ideas. (University of Virginia)

It includes current information ready for distribution to students. (Auburn University)

HT-2

It presents current material. (Auburn University)

HT-3

Students get acquainted with the real analysis of problems which are confronting engineers who are active now. (University of Virginia)

HT-4

Monographs can discuss specific problems and specific methods which a textbook cannot cover completely.
Monographs enable presentation of a specific information in fairly detailed manner which a textbook cannot due to the limitation placed on the number of pages.
Monographs may be developed to supplement textbook and expound informations newly developed.
Monographs may be written for laboratory courses to explain and inform the techniques, procedures, etc., with examples. (Rose Polytechnic Institute)

Students observe analysis of real problems like ones that one might experience. (University of Virginia)

HT-5

Good (Caterpillar Tractor Company)

HT-7

The good points were: (1) The mathematical derivations and manipulations were complete enough to follow--no gaping holes. (2) The background information for iteration procedures and numerical integration was complete enough that the reader need not refer to other texts. (3) The presentation was complete in itself. One could follow the development of the procedure to its conclusion and then use it. (Caterpillar Tractor Company)

The material is well presented in a concise manner. (Caterpillar Tractor Company)

TD-1

I think the idea of the Monographs are excellent as they bring the latest in technical developments to the attention of the students. As a practicing engineer, I think they are excellent. Also, I would appreciate receiving any other ones OSU publishes in the field of Chemical Engineering. (Lummus Company)

TD-3

This particular Monograph TD-3-67 contained enough information to obtain a thorough understanding of the material presented without several reference volumes. The material was initially outlined in sufficient detail, and there presented in an orderly fashion that was easy to follow. The example and home problems helped demonstrate the calculation procedures involved. (Caterpillar Tractor Company)

Very good. (Caterpillar Tractor Company)

Monographs can discuss specific problems and specific methods which a textbook cannot cover completely.
Monographs enable presentation of a specific information in fairly detailed manner which a textbook cannot due to limitation placed on the number of pages.
Monographs may be developed to supplement textbook and expound informations newly developed.
Monographs may be written for laboratory courses to explain and inform the techniques, procedures, etc., with examples. (Rose Polytechnic Institute)

ANY IMPROVEMENTS NEEDED?

CS-2

For my particular use, I feel that a photograph of the actual steering mechanism and the individual components would be useful. I also feel that picutres of the response of the system before and after compensation would emphasize the importance of compensation techniques. (Southern Illinois University)

No. (Rose Polytechnic Institute)

CS-3

CS-3-67 should be expanded. (Caterpillar Tractor Company)

CS-5

CS-5-67 should be expanded. (Caterpillar Tractor Company)

HT-2

No. (Auburn University)

I would like to see more area covered in a similar Monograph. (University of Cincinnati)

HT-3

Have more Monographs so that the instructor can be more selective. (University of Virginia)

HT-4

Have more Monographs so the instructor can be selective. (University of Virginia)

HT-7

This particular Monograph would have been a little clearer with a simple graph (Temp. vs. Distance) in conjunction with the discussion of the method (pgs. 2-3). (Caterpillar Tractor Company)

TD-1

We would have appreciated greater detail at the level (senior undergrad) of the present course - but for grad student use this is o.k. Most of my students also consulted the original TN. (Pennsylvania State University)

TD-3

Yes (Auburn University)

An example problem would be a helpful improvement. (Caterpillar Tractor Company)

A teaching Monograph on mass flow measurements should treat the problems of: (1) perfect fluid mass flow, (2) areas of pressure and temperature where real gas relations are important, (3) approximate real gas corrections, and (4) the exact detailed real gas corrections as outlined in the subject Monograph. (Arnold Research Organization, Inc.)

The material is presented good but it is too simple for graduate students. I would like to see more complicated problems presented in similar form. (University of Cincinnati)

SHOULD A PROGRAM OF PREPARING MONOGRAPHS BE EXPANDED TO COVER A WIDE VARIETY OF SUBJECT AREAS?

CS-2

Yes (Southern Illinois University)

I should like to see others of this same general type. (University of Massachusetts)

HT-1

Yes (University of Virginia)

HT-2

Yes (Auburn University)

Yes (University of Cincinnati)

HT-3

Yes (University of Virginia)

Yes (Auburn University)

Yes. I think the fact of the Monographs coming from actual engineering research make the material more interesting to the student. They see the work they are doing in class is directly related to current technology. (University of Kentucky)

HT-4

Yes (Rose Polytechnic Institute)

Yes (University of Virginia)

I think so. The Monograph technique if used by the instructor is an excellent way of promulgating recent technical information. (Auburn University)

HT-7

Yes. These Monographs may be quite useful in industry where very short courses on specific topics would be better attended and probably retain higher interest. (Caterpillar Tractor Company)

Yes (Caterpillar Tractor Company)

Yes (Caterpillar Tractor Company)

A wide variety of subjects would be necessary to be of general interest in industry. For use in classroom groups, however, they would have to be available to the students for a reasonable period of time (two months). (Caterpillar Tractor Company)

Monographs for other subject areas would probably be well accepted. The material should be presented such that it would also be of value to practicing engineers. This would probably entail greater detail and certainly more bibliography references. (Caterpillar Tractor Company)

HT-8

Yes. I think that the fact of the Monographs coming from actual engineering research make the material more interesting to the student. They see the work they are doing in class is directly related to current technology. (University of Kentucky)

TD-1

Yes. (University of Virginia)

Yes (Auburn University)

Yes - particularly some of the NASA cascade data and information on turbomachinery, nozzles, etc. (Pennsylvania State University)

TD-3

This type of presentation would lend itself very easily to an industrial self-study or group study situation. New technical information or older information in which a new interest has arisen would be presented by this method of Monographs covering a variety of subjects available. (Caterpillar Tractor Company)

Expansion of subject matter would undoubtedly create more interest. I had planned to organize a study group of interested persons, but the length of time allowed was insufficient for preparation of lectures. (Caterpillar Tractor Company)

Yes, they should be expanded. This appears to be a fairly comprehensive short course for working engineers to "keep up" in their technical knowledge. (Caterpillar Tractor Company)

Yes (Auburn University)

Yes. These Monographs will be helpful in industry in small study groups where very short courses with attendance tailored to the topic would be preferable to long and ultimately unworkable groups. (Caterpillar Tractor Company)

I doubt that Monographs which are intended for undergraduate courses could add to a well-selected textbook or set of well-prepared lecture notes. As an instructor, I would use the Monograph as reference for preparing the lectures. However, a Monograph would be very helpful and instructive to a graduate student, research assistant, or engineer who has already been introduced to a specific problem area and wishes to proceed in greater depth than is readily available from textbooks. If I taught a class only in mass flow measurements, then the subject Monograph would be of use, otherwise not. (Arnold Research Organization, Inc.)

Yes (Rose Polytechnic Institute)

Yes (University of Cincinnati)

WOULD YOU USE THEM FREQUENTLY IF YOU TAUGHT CLASSES IN THE SUBJECT AREAS?

CS-2

The introductory course I have been teaching does not permit the use of this particular Monograph due to the time limitation. (Rose Polytechnic Institute)

Yes (Southern Illinois University)

Yes (University of Massachusetts)

In the undergraduate area it is doubtful. (Rose Polytechnic Institute)

CS-3

In the introductory course I have been teaching time does not permit the use of this particular Monograph. (Rose Polytechnic Institute)

CS-6

The introductory course I have been teaching does not permit the use of this particular Monograph due to the time limitation. (Rose Polytechnic Institute)

HT-1

I feel that such Monographs could help the course become more "current research problem" oriented, and this is good. I feel that about four Monographs (with homework problems) would be the most I could use in my radiation heat transfer course. . . unless there is a major modification of the outline. (University of Virginia)

Yes. (Auburn University)

HT-2

Yes. (Auburn University)

Yes (University of Cincinnati)

Occasionally (University of Michigan)

HT-3

Yes. (University of Virginia)

Yes (Auburn University)

HT-4

Yes. (University of Virginia)

Yes (Rose Polytechnic Institute)

HT-7

Yes. (Caterpillar Tractor Company)

Yes. (Caterpillar Tractor Company)

Yes (Caterpillar Tractor Company)

HT-8

Yes (University of Kentucky)

TD-1

Depends on the level. Doubtful for undergrads. (University of Michigan)

TD-3

Frequent use would depend on permanent copies of Monographs - perhaps they should be purchased. (Caterpillar Tractor Company)

Yes (Rose Polytechnic Institue)

Probably not frequently, but occastionally for the special subjects I may wish to expand upon. (University of Michigan)

Yes (University of Cincinnati)

Yes (Auburn University)

ADDITIONAL COMMENTS ON MONOGRAPHS BY EVALUATORS

CS-1

This Monograph represents a small band in the very broad spectrum of electronics. More specifically it deals with the specialized field of design for compensation networks to compensate for signal distortion within networks. Such networks are frequently found in communication, data transmission, and associated facilities.

This Monograph would be of particular value in the academic classroom since it allows the student to put theory into practice by solving actual problems. This would also be true in certain industrial classrooms where communication and data transmission is of principal importance.

For engineers outside this specialized field of technology, this Monograph would be of doubtful value. This opinion is based on the premise that although an engineer's progress is related to his continuing education and study, there should be priorities in his program of continuing education. So it seems reasonable to assume that an engineer's first priority would be to study and upgrade himself in his principal area of responsibility. (R. J. Reynolds Tobacco Company)

HT-1

This particular Monograph deals with the Monte Carlo method for solving problems in which energy is emitted and reflected such as that occurring in radiant heat transfer problems. In these problems, the happenings at a given location are mathematically described, but the equations of the interaction between locations are extremely difficult to solve. The Monte Carlo method effects a solution to this type problem through use, between defined limits, of random numbers as variables in a sequence of inter-dependent calculations. Since this necessitates many repetitive calculations, use of a computer is required.

The author assumes the reader has a good working knowledge of the theories and mathematics involved and takes simplifying shortcuts which could be difficult to follow. Unless the reader is familiar with this particular field, I feel this Monograph, as written, would be of little benefit to the average engineer in industry. If this material could be presented in a simpler, more detailed and better organized form, it could possibly be an effective tool for disseminating technical material to the practicing engineer. (R. J. Reynolds Tobacco Company)

HT-4

I think the Monograph idea is a very good one and commend your office for the work you are doing in instigating it. I think the extra effort required by the faculty in preparing for the lectures on the Monograph subjects is a good investment also. (University of Virginia)

TD-1

The Instructional Monograph is an excellent method of disseminating the results of recent research and scientific technical information; however, if it is to be used by engineers in industry, I feel that it must be presented in a classroom by a qualified instructor or its use will probably be limited. The Monograph requires that the student have a general familiarity of chemical equilibria and advanced mathematics - differential equations and numerical analysis. Engineers in industry who have not been concerned with chemical equilibrium thermodynamics on a daily basis or who have not used advanced mathematics appreciably since their formal education, will be unable to follow the discussion in the Monograph without first reviewing the prerequisites.

On this basis I feel that this Instructional Monograph will not find widespread use in industry. The engineer in industry can better continue his education by reviewing technical papers published by the ASME and other founder societies, studying programmed instructional courses through extension divisions of colleges and universities and taking other educational courses presented in formal classrooms or through television networks. (R. J. Reynolds Tobacco Company)

APPENDIX V

MONOGRAPH DISSEMINATION BY UNIVERSITY

Professors who have requested and received one or more Monographs for review and for use in an engineering classroom are listed below

University	Professor
Arizona State University	H. H. Young
Auburn University	R. I. Vachon
Brigham Young University	John M. Simonsen Bill J. Pope
California Institute of Technology	R. H. Sabersky
California State College at Long Beach	Ali Eshett
California State College at Los Angeles	Phillip Gold George Mann Dan R. Rankin
Case Western Reserve University	H. K. Wiskind
City College of the City University of New York	Robert M. Graff Latif M. Jiji Reuel Shinnar
Clemson University	J. C. Mullins Duane F. Bruley
Cleveland State University	George V. Parmelee
Colorado School of Mines	Frank Stermole
Columbia University of the City of New York	Harold G. Elrod
Cornell University	Victor H. Edwards
Dartmouth College	A. O. Converse
Harvey Mudd College	Taghi Mirsepassi
Hudson Valley Community College	R. M. Frinks

Iowa State University	Donald C. Scouten Bion L. Pierson
Kansas State Univesity	P. L. Miller C. L. Hawns P. E. McNall, Jr.
Lake Superior State College	D. L. Carsteus
Lehigh University	Luis Pujol Benjamin E. Nevis
Louisiana Polytechnic Institute	Buck F. Brown
Louisiana State University	Dupree Maples Ralph W. Pike
Massachusetts Institute of Technology	Y. T. Li
Michigan State University	George Coalman Gerald Park
Michigan Technological Institute	S. Winnikow R. D. Audi
Mississippi Research and Development Center	Kenneth Wagner
New York University	John R. Ragazzini John Happel
North Carolina State University	W. C. Peterson
North Dakota State University	Kam Wu Li Karl G. Maurer Lampert P. Vogel Phillip C. Pfister
Northwestern University	Professor Walker Professor Larson William E. Schmitendorf
Ohio University	R. S. Mayer
Ohio Northern University	Robert J. Glass
Ohio State University	E. O. Doebelin
Oklahoma State University	Charles M. Bacon Paul A. McCollum John B. West Rao Yarlagadda K. C. Chao W. C. Edmister

Oregon State University	Carl G. Downing J. R. Welty
Pennsylvania Military Colleges	Anthony J. Calise
Pennsylvania State University	J. L. L. Baker C. Birnie, Jr. D. A. Bowlus J. A. Brighton G. M Faeth D. R. Olson F. W. Schmidt J. L. Shearer
Princeton University	James B. Anderson Ronald P. Andres Ernest F. Johnson Richard K. Toner John C. Whitwell
Purdue University	Paul E. Stanley
Rensselaer Polytechnic Institute	H. J. Sneck Euan F. C. Somerscales
Rose Polytechnic Institute	Thomas Hutchinson Stan S. Thomas
Rutgers, the State University	Robert H. Page Marvin L. Granstrom
Saint Louis University	Benjamin H. Ulrich, Jr. John A. George
San Jose State College	Robert F. Clothier
Southern Methodist University	James L. Melsa Andrew S. Page J. C. Denton Donald C. Price
Stanford University	H. C. Perkins
State University of New York	Chi-Tsong Chen
Stevens Institute of Technology	Kenneth Tompetrine Leo Rosentha H. W. Phair
Tatung Institute of Technology	T. S. Lin
Tennessee Technological University	Cecil O. Alford John P. Wallace James Seay Brown

Tulane University	Robert C. Weaver John R. O'Loughlin Chester A. Peyronnin Harold H. Sogin Robert G. Watts Robert P. Chambers
United States Air Force Academy	Myron D. Harnly
United States Naval Academy	James A. Adams
University of Alabama	C. H. T. Wilkins
University of Arizona	H. C. Perkins Harvey Christensen Donald M. McEligot N. D. Cox Lynn Weaver
University of Arkansas	William J. Buche Stanley E. Stephenson
University of California, Berkleley	H. A. Johnson L. S. Caretto R. Greif Y. Taitel C. Tien L. Farbar R. F. Sawyer E. D. Howe P. B. Stewart R. J. Bollard
University of Cincinnati	James F. Thorpe Widen Tabakoff Marvin English R. D. Zerkle
University of Denver	M. L. Moe
University of Detroit	Leon Kowalcyzk C. O. Smith
University of Florida	J. S. Gilbert R. K. Irey Calvin C. Oliver A. D. Randolph Joseph Mahig R. D. Walker J. P. O'Connell
University of Hawaii	R. M. Fan J. S. Fox H. C. Chai

University of Houston	Dan Luss W. I. Honeywell
University of Illinois	R. G. Hering
University of Iowa	Earl Eyman
University of Kentucky	Clifford J. Cremers Ronald D. Bonnell
University of Maine	Walter W. Turner David B. Young Richard C. Gibson Richard C. Hill
University of Massachusetts	Richard V. Monopoli W. L. Short Donald E. Scott Professor Herchenreder Lawrence L. Ambs
University of Michigan	S. W. Churchill Robert B. Keller J. J. Martin Richard A. Matula George S. Springer
University of Minnesota	E. R. Eckert K. Ogata E. M. Sparrow Richard J. Goldstein
University of Mississippi	F. A. Anderson R. E. Aven H. Bostian H. T. Huddleston
University of Missouri at Rolla	J. C. McBrayer
University of Nebraska	D. R. Haworth
University of New Hampshire	David H. Chittenden S. S. S. T. Fan
University of New Mexico	A. V. Houghton K. T. Feldman Charles Gilbert Richards
University of North Dakota	Milton B. Larson C. P. Naismith
University of Notre Dame	Edward W. Jerger J. C. Hogan J. L. Novotny

University of Oklahoma	C. Phillip Colver Tom J. Love Michael L. McGuire Kenneth E. Sterling
University of Pittsburgh	G. E. Geiger
University of Portland	George F. Babits
University of Santa Clara	Richard C. Dorf
University of Southern California	John M. Lenoir
University of Tennessee Space Institute	R. L. Young
University of Texas	R. A. Halfinstine J. J. McKetta B. E. Short H. A. Walls C. W. Jiles W. R. Upthegrove
University of Utah	E. B. Christiansen Otto C. Davidson Dietrich K. Gehmlich Wayne S. Brown Fabio R. Goldschmied Arlo F. Johnson Gary M. Sandquist J. D. Seader Noel de Nevers Forrest L. Staffanson
University of Virginia	J. Taylor Beard Herbert Goller James W. Moore Robert Smoak
University of Washington	Creighton A. Depew
University of Wisconsin	Edward Obert Charles G. Hill C. A. Coberly Howard L. Harrison David R. Poirer John W. Mitchell W. A. Beachman
University of Wyoming	William D. Batton
Utah State University	R. M Holdredge Jack Keller
Valparaiso University	Leslie M. Zoss

Vanderbilt University	John W. Williamson
Villanova University	Joseph Goldberg
Washington University	Albert W. Black J. C. Georgian William J. Murphy
Washington State University	I. M. Yeyinmen
West Virginia University	Barnett F. Dodge J. F. Parmer
Ecole Centrale des Arts and Manufactures, Paris, France	R. Kling
Ecole Polytechnique, Montreal, Quebec, Canada	Michel Rigaud
Instituto Politecnio Nacional, Mexico	Morris S. Ojalvo Paul Alper
University of Calgary, Calgary, Alberto Canada	J. E. Venart
University of Waterloo, Waterloo, Ontario, Canada	George D. Gulford D. C. T. Pei G. F. Pearce F. A. Dullien
University of Windsor, Windsor, Ontario, Canada	J. Gordon Parr

APPENDIX VI

Monograph Abstract

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

HT-2 A Generalized Correlation of Vaporization Times of Drops in Film Boiling on a Flat Plate

HT-3 Method for Estimating Ratio of Absorptance to Emittance

HT-4 Formulas for Radiant Heat Transfer Between Nongray Parallel Plates of Polished Refractory Metals

HT-5 Pool Boiling Heat Transfer at Reduced Gravity

HT-6 Condensation of Liquid Metals

HT-7 The Method of Zones for the Calculation of Temperature Distribution

HT-8 Heat Pipes and Vapor Chambers for Thermal Control of Spacecraft

TD-1 Calculation of Complex Chemical Equilibria

TD-3 Critical Flow of Real Gases Through Nozzles

TD-4 Thermodynamic Consistency of Vapor-Liquid Solubility Data

TD-5 Computer Program for Thermodynamic Performance of Brayton Cycle Space Power Systems

TD-6 Enthalpies of Co-existing Equilibrium Vapor and Liquid Mixtures from Solubility Data and Equation of State Calculations

TD-8 Thermodynamics of Space Flight

CS-1 An Example of Compensation Network Design

CS-2 An Application of Root Locus Techniques to Lunar Vehicle Control

CS-3 An Example of Nuclear Rocket Control Design

CS-4 An Example of Bang-Bang Control System Design

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

CS-6 An Example of Optimal Control Design

MONOGRAPH HT-1

ABSTRACT

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

By: John A. Wiebelt, Mechanical Engineering, Oklahoma State University

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 Film Boiling on a Flat Plate

By: Kenneth J. Bell, Chemical Engineering, Oklahoma State University

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

By: John A. Wiebelt, Mechanical Engineering, Oklahoma State University

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

By: John A. Wiebelt, Mechanical Engineering, Oklahoma State University

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 monchromatic 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

By: Kenneth J. Bell, Chemical Engineering, Oklahoma State University

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

By: Kenneth J. Bell, Chemical Engineering, Oklahoma State University

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

By: Paul L. Miller, Mechanical Engineering, Kansas State University
John A. Wiebelt, Mechanical Engineering, Oklahoma State University

The method of zones is an improved method for obtaining approximate solutions to certain partial differential equations. The application of this method of 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

By: Paul L. Miller, Mechanical Engineering, Kansas State University
John A. Wiebelt, Mechanical Engineering, Oklahoma State University

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

By: K. C. Chao, Chemical Engineering, Oklahoma State University

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

By: Wayne C. Edmister, Chemical Engineering, Oklahoma State University

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

By: Wayne C. Edmister, Chemical Engineering, Oklahoma State University

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 TD-5

ABSTRACT

Title: Computer Program for Thermodynamic Performance of Brayton Cycle Space Power Systems

By: J. A. Wiebelt, Mechanical Engineering, Oklahoma State University

This Monograph presents a computer program to be used in the calculation of the thermodynamic performance of one and two shaft Brayton cycle space power systems. The systems which can be analyzed include those with or without reheating, with or without intercooling and with or without turbine coolant flow.

Inputs required for the program include the component performance parameters and cycle temperature variables. Output from the program includes cycle efficiency and prime radiator area, and other cycle parameters.

MONOGRAPH TD-6

ABSTRACT

Title: Enthalpies of Co-existing Equilibrium Vapor and Liquid Mixtures from Solubility Data and Equation of State Calculations

By: Wayne C. Edmister, Chemical Engineering, Oklahoma State University

Methods for calculating the enthalpies of the saturated vapor and liquid phases of mixtures are presented theoretically and illustrated on the helium-hydrogen system, using previously published pressure-temperature-composition experimental data for the coexisting equilibrium vapor and liquid phases. An enthalpy-composition diagram is prepared for the helium-hydrogen binary at 400 psia using the results obtained in this example. Differential and integral forms of the isobaric Gibbs-Duhem equation were two of the methods used with the experimental temperature composition data for the binary mixture.

MONOGRAPH TD-8

ABSTRACT

Title: Thermodynamics of Space Flight (Heat Transfer Phenomena in Space)

By: P. L. Miller, Mechanical Engineering, Kansas State University
J. A. Wiebelt, Mechanical Engineering, Oklahoma State University

The analysis used in determining energy gains or losses to spacecraft in orbit is discussed. This is the basic environment parameter type approach without detailed discussion of the heat transfer problem. The Monograph discusses some practical as well as theoretical aspects.

MONOGRAPH CS-1

ABSTRACT

Title: An Example of Compensation Network Design

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
Leonard L. Grigsby, Electrical Engineering, Virginia Polytechnic Institute

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

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
Leonard L. Grigsby, Electrical Engineering, Virginia Polytechnic Institute

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

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
H.F. vanLandingham, Electrical Engineering, Virginia Polytechnic Institute

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

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
A. Wayne Bennet, Electrical Engineering, Virginia Polytechnic Institute

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

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
H.F. vanLandingham, Electrical Engineering, Virginia Polytechnic Institute

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 for equilibrium.

MONOGRAPH CS-6

ABSTRACT

Title: An Example of Optimal Control Design

By: William A. Blackwell, Electrical Engineering, Virginia Polytechnic Institute
A. Wayne Bennett, Electrical Engineering, Virginia Polytechnic Institute

This Monograph discusses a technique for the design of minimum energy descrete-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.

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College of Engineering, Office of the Dean 74074
Frontier 2-6211, Ext. 7551

May 28, 1968

APPENDIX VII

Mr. E. R. G. Eckert
Regents' Professor and Director
Thermodynamics and Heat Transfer
Department of Mechanical Engineering
University of Minnesota
Minneapolis, Minnesota 55455

Dear Mr. Eckert:

During recent months you have received Educational Monographs prepared under the NASA Pilot Program for your review or use in your engineering classes. As you will recall, these Monographs were provided to you free of charge except that we asked you to give us an evaluation of the material as a tool for engineering education.

We plan to analyze the evaluations of the Monographs during June and would appreciate receiving your comments. Your appraisal of the material would be most helpful to us in planning the future operation of A CENTER FOR CREATING EDUCATIONAL MONOGRAPHS IN ENGINEERING. Several evaluation forms are enclosed for your use in making comments on each Educational Monograph that you have reviewed or used in a classroom.

Thank you for your interest in the program.

Sincerely,

Robert L. Overton

Robert L. Overton, P. E.
Deputy Administrator
NASA Pilot Program

RLO/clc

Enclosures

OKLAHOMA STATE UNIVERSITY · STILLWATER

College of Engineering, Office of the Dean 74074
Frontier 2-6211, Ext. 7551

May 28, 1968

APPENDIX VIII

Mr. P. H. Horstmann
Engineering Manager
Coppus Engineering Corporation
344 Park Avenue
Worcester, Massachusetts 01610

Dear Mr. Horstmann:

Several months ago you requested copies of Educational Monographs from the Goddard Space Flight Center for your review of their application as an educational tool for practicing engineers within your organization.

As you may recall, Educational Monographs are technical papers prepared as instructional material from one or more research reports, by recognized authorities in three selected areas: Heat Transfer, Thermodynamics, and Control Systems. The material is sufficiently complete to be used in one to three hours of study by groups or individuals.

Since your initial contact with the Goddard Space Flight Center, additional Monographs have been completed. Oklahoma State University is preparing these Educational Monographs under a NASA supported program. We have initiated a follow-on program to inform industrial organizations of the new monographs and to determine the effectiveness of these documents in providing industry with new technological developments that have resulted from recent research.

The initial objective of this program was to develop supplementary text material for universitiy classrooms. However, we believed the material had potential use in industry. Companies that have reviewed the documents have confirmed this belief. The firms have reported that the Monographs are an excellent method of providing practicing engineers with new engineering developments within their fields of interest.

Copies of three recently prepared Monographs are enclosed for your review.

Abstracts of 20 monographs are also enclosed for your review and distribution to interested people in your organization. Monographs are furnished to individuals or organizations who will provide us with an evaluation of their application as an educational tool. An evaluation sheet is provided with each Monograph; the completion of the evaluation sheet would be of

considerable benefit in the future planning and expansion of the program. If the concept of Educational Monographs does provide significant technological information to industry, it is planned to prepare additional documents thereby providing a greater selection of material.

Additional Monographs can be obtained by sending me the following information: Monograph number, name and mailing address of the person(s) who will use them, number of copies and approximate date desired for use.

As rapidly as technology is changing, there is a need for practicing engineers to keep abreast of new educational material in their field of interest. We believe Educational Monographs provide a new and high quality approach to continuing engineering education.

Sincerely,

Robert L. Overton

Robert L. Overton, P. E.
Deputy Administrator
NASA Pilot Program

RLO/clc

Enclosures

APPENDIX IX

VISUAL BRIEF DISSEMINATION STATISTICS
THROUGH MAY 31, 1968

Dissemination Summary by Visual Brief Number

Visual Brief Number	Number Sent	Unfilled Requests	Evaluations Received
VB-1	9	0	3
VB-2	4	0	3
VB-4	17	3	4
VB-5	10	0	0
VB-8	13	5	2
VB-9	9	1	3
VB-10	16	1	4
VB-11	8	0	3
VB-12	14	2	3
VB-13	18	4	4
VB-15	9	1	3
VB-17	9	0	4
VB-19	16	0	7
VB-20	9	0	3
VB-21	9	1	2
VB-23	4	0	1
VB-24	14	0	6
VB-27	9	0	4
VB-28	8	0	3
VB-31	13	0	6
VB-33	13	0	7
TOTALS	231	18	75

APPENDIX X

Totaled Responses on a Revised Visual Brief Evaluation Sheet

General Information on Visual Briefs:

Was the technical information covered in the Visual Brief of value in course presentation?	Yes	18
	No	3
Should the Visual Brief include more information than was presented?	More	13
	Same	10
	Less	1
Would the Visual Brief be more useful if the accompanying report material had been prepared specifically for a classroom lecture?	More	14
	Same	9
	Less	1
Would the material shown on the film be more effective if edited and condensed?	Yes	5
	No	17
Does the inconvenience of obtaining a projector for a classroom lecture affect the frequent use of technical movies?	Yes	2
	No	20

Comments on Use of Visual Briefs:

In what situation was the Visual Brief used? _____

Did the instructor read the documents accompanying the Visual Briefs before the film was used?	Yes	14
	No	6
Was the Visual Brief used in context with closely related material?	Yes	13
	No	8
Did the Visual Brief present the effect well and contribute to the further understanding of the participants?	Well	9
	Fair	8
	Poor	2
Would the Visual Brief be more useful for educational purposes outside the classroom?	Yes	7
	No	12
Could the subject matter have been as easily presented without the visual matter?	Yes	3
	No	18
Would you use this visual Brief again in an educational situation?	Yes	17
	No	5

APPENDIX XI

Comments on Questions Asked on Revised Visual Brief Evaluation Sheet

IN YOUR OPINION, ARE VISUAL BRIEFS A USEFUL AND DESIRABLE METHOD OF PRESENTING NEW TECHNICAL INFORMATION IN THE CLASSROOM?

VB-2: Hydrodynamic Rotating Shaft Seals

Helpful to those familiar with the basic subject matter. Well prepared. (Ingersoll Rand Co.)

The film was not shown to a class but was reviewed for possible future classroom use. However, since we have demonstration units of the type shown in the film, we do not need this particular film for classroom use. As a matter of interest--we had demonstration units of the type shown in the film long before the filmed units were conceived. (University of California at Berkeley)

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

Visual Briefs are helpful for special lectures. This film was off the topic but was useable. (North Dakota State University)

VB-10: Visualization Studies of Combustion Instability in a Hydrogen-Oxyen Model Combustor

It is very useful to use movies on technical material such as this Visual Brief. Often universities cannot afford to obtain all the necessary equipment for research or class experiments in a particular subject, and the movies can aid the student in visualizing material presented in class. (University of Texas)

VB-11: Transonic Buffeting of Hammerhead Launch Vehicles

Visual Briefs are a useful and desirable method of presenting new technical information in the classroom because more information is presented in the brief time that the film takes to run. By reading the accompanying documents that were sent with the brief it was possible to prepare the students for what they saw in the film. (Tennessee Technological Institute)

Yes. The visual brief is good enough for the information of the movies in consideration, however, the documentary material should be more complete and more comprehensive. (West Virginia University)

VB-13: A Visual Study of two phase flow in a Vertical Tube with Head Addition

Very good. (University of Pittsburgh)

VB-17: Expansion Tube Hypersonic Test Facility

Yes, classroom is good place as any. (Rose Polytechnic Institute)

Comments on Questions Asked on Revised Visual Brief Evaluation Sheet (continued)

VB-19: Experimental Research in Aerospace Structural Dynamics

Very useful when supplemented by addition comments by instructor. (North Dakota State University)

Yes. The Visual Brief is good enough for the information of the movies in consideration, however, the documentary material should be more complete and more comprehensive. (West Virginia University)

Yes. Generally superior to other techniques. (University of Oklahoma)

VB-20: Magnetically Supported Superconducting Spherical Gyro

Yes (Hudson Valley Community College)

Visual Briefs are a useful and desirable method of presenting new and technical information in the classroom; however this brief was too advanced for the intended audience and projected upside down and backwards. (Tennessee Technological Institute)

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

Yes. The current nature and extensiveness of the problem presented expands student outlook. He gains a realization of the complexity of modern day problems which are hard to get across during a lecture. (Oregon State University)

VB-23: Hypergolic Propellant Research

This was a difficult phenomena to show on a movie. (University of West Virginia)

VB-27: Flammability of Surface in Zero Gravity

Sound would be desirable for this presentation. (North Dakota State University)

VB-28: Journal Bearings in Laminar and Turbulent Regimes

Yes, they are a good idea. This was too brief, in the sense that explanation of phenomena and parameters was inadequate. Sound films in which the material is competently discussed and commented upon are, in my opinion, much more effective. (University of Pennsylvania)

VB-33: Saturn Radiation and Convection Base Heating

Very good, but too advanced. (University of Calgary)

These films would be better with sound on the track and more explanation on the film. (West Virginia University)

This particular brief was not useful. A sound track and audio description is a must. (U. S. Naval Academy)

Comments on Questions Asked on Revised Visual Brief Evaluation Sheet (continued)

HOW DOES IT COMPARE WITH DOCUMENTARY MATERIAL OR OTHER VISUAL AIDS?

VB-11: Transonic Buffeting of Hammerhead Launch Vehicles

It is superior to a series of slides because the motion in the film could not be depicted with slides or documentary material. (Tennessee Technological Institute)

VB-20: Magnetically Supported Superconducting Spherical Gyro

It is better than other documentary material and visual aids because it presents motion and color which has a greater impact on the mind than the dry chalkboard lecture. (Tennessee Technological Institute)