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THE FLUID POWER INSTITUTES--A PILOT PROGRAM FOR INTRODUCING EMERGING TECHNOLOGIES.

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A PILOT PROGRAM CONDUCTED TO TRAIN TEACHERS OF VOCATIONAL, TECHNICAL, OR INDUSTRIAL EDUCATION IN FLUID POWER WAS DESIGNED TO EXPLORE AND TRY OUT THE TECHNIQUES OF INTRODUCING A NEW TECHNOLOGY INTO SCHOOLS. THE PROGRAM CONSISTED OF SEVEN SUMMER INSTITUTES OFFERED AT FIVE DIFFERENT INSTITUTIONS AND PROVIDING INITIAL PREPARATION FOR 168 INSERVICE TEACHING PERSONNEL FROM HIGH SCHOOLS, VOCATIONAL SCHOOLS, COMMUNITY AND JUNIOR COLLEGES, TECHNICAL INSTITUTES, AND TEACHER EDUCATION INSTITUTIONS. PARTICIPANTS WERE DIVIDED INTO TEAMS FOR CURRICULUM DEVELOPMENT. EACH TEAM DEVELOPED A RECOMMENDED CURRICULUM FOR THE EDUCATIONAL LEVEL OF PRIMARY INTEREST TO THAT TEAM (FOR EXAMPLE, HIGH SCHOOL, VOCATIONAL, POST-SECONDARY SCHOOL, AND TEACHER-PREPARATION). A UNIFORM FINAL EXAMINATION ADMINISTERED TO ALL PARTICIPANTS AT THE CONCLUSION OF THE INSTITUTES WAS USED TO COMPARE THE EFFECTIVENESS OF THE DIFFERENT KINDS OF INSTRUCTORS (GUEST LECTURERS, RESOURCE PERSONS, OR FULL-TIME INSTRUCTORS). SEMINARS WERE EFFECTIVE BECAUSE THEY PROVIDED THE PARTICIPANTS WITH MATERIALS NECESSARY FOR CONFERENCES WITH THEIR SCHOOL ADMINISTRATORS UPON THEIR RETURN TO THEIR TEACHING ASSIGNMENT. (TC)

THE FLUID POWER INSTITUTES— A PILOT PROGRAM FOR INTRODUCING EMERGING TECHNOLOGIES

1965
INSTITUTES

Vocational and Technical Education Grant Number OE-5-85-039,
Vocational Education Act of 1963, Section 4(c)

Gerald Baysinger
FLUID POWER SOCIETY
THIENSVILLE, WISCONSIN
1966

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Final Report
Project No. 5-0019

THE FLUID POWER INSTITUTES--A PILOT PROGRAM
FOR INTRODUCING EMERGING TECHNOLOGIES

ABSTRACT AND SUMMARY OF THE REPORT
ON THE 1965 INSTITUTES

Fluid Power emerged during World War II as a new technology. It is defined as the control and transmission of power by means of a pressurized fluid such as air or oil. Sometimes referred to as oil hydraulics and pneumatics, fluid power technology is based upon the laws and theorems that govern the behavior and flow of a fluid under pressure, and includes the design, installation, and maintenance of equipment used in fluid power systems.

For the most part, modern fluid power technology and the systems using it were born in the laboratories and on the drawing boards of factories and defense agencies during World War II. Consequently, and unlike many other technologies, there was little if any academic base. People who designed, maintained, and operated fluid power systems were trained by military agencies and manufacturers of the systems. But by the early 1960's, serious shortages of skilled workers and technicians in fluid power were reported throughout the United States.

Since only a half-dozen schools included fluid power in their curricula, and since no teacher-education institution in the country included fluid power in the curricula of students taking their degrees in vocational, technical, and industrial education, it was apparent that the first step necessary to solve manpower shortages was the development of teacher education programs.

To this end, the Fluid Power Society and the National Fluid Power Association sponsored, with the cooperation of Wayne State University, a Summer Institute on Fluid Power Education during 1964. Twenty carefully chosen college and university teachers attended. They were encouraged to organize, for the summer of 1965, similar institutes for secondary and vocational teachers.

The 1965 Institute plans were brought to the attention of the United States Office of Education, which recognized therein a unique pilot program which could offer solutions to teacher shortages in fluid power, expanded opportunities for employment for young people trained in fluid power, and encouragement to schools and colleges to increase offerings in fluid power. However, the most unique and challenging aspects of the pilot program were possible answers to this question:

<u>What kind of a program could be devised to accelerate the introduction of new technologies into school programs?</u>

The unabridged study, of which this is the abstract and summary, and which details the plans, operation, and evaluation of the 1965 Summer Institutes on Fluid Power Education, offers what is probably the most comprehensive review available. It includes not only the planning, operation, and evaluation results, but also the techniques of evaluation and the survey instruments. These techniques and procedures are readily adaptable to almost any other program whose primary objective is the introduction of a new technology into school programs.

The following summary is confined to the more important conclusions which resulted from the analysis of the operation and evaluation of the Institutes:

The Summer Institute as a Vehicle for Introducing the Technology

The summer institute *per se* can be a most effective vehicle for introducing a new technology to teachers, since it offers a controlled environment and the efficient means for bringing together, (1) industrial and technological authorities, (2) educational authorities on educational subject matter and curriculum planning, and (3) teachers who are motivated to develop new competencies.

Administering an Institute Pilot Program

The responsibility for planning, administering, and evaluating the Summer Institutes was the primary responsibility of the Fluid Power

Society. It sub-contracted with five institutions to provide the facilities and instruction: Trenton State College (New Jersey), Tuskegee Institute (Alabama), Wayne State University (Michigan), University of Minnesota-Duluth, and California State College at Los Angeles. Administration was judged to be effective.

Conclusion: A new technology should work through the professional society which represents it as the chief coordinating agency of pilot programs involving multiple summer institutes. The professional society can effectively act as the unifying agency in activities involving cooperating educational institutions and participants.

Selection of Participating Institutions

In making the contract grant to the Fluid Power Society, the United States Office of Education allowed the Society wide latitude in selecting those institutions to receive a sub-contract for the Summer Institutes. Aside from meeting the general conditions qualifying them for federal grants and contracts, these criteria guided the Society in selecting the five sub-contractors:

1. A 1964 Summer Institute participant was available to direct the program.

2. The institution gave evidence of interest in fluid power education.

3. Institutions were geographically located to serve all areas of the country.

4. Personnel were available from local industry to serve as guest lecturers and counselors.

Staffing of the Pilot Program

The Fluid Power Society provided the following "overseers" of the institute program: The Principal Investigator who was the Executive Vice President of the Fluid Power Society and chief administrator of the program; the Coordinator who provided liaison between the Society and the five participating institutions; and a Consultant who directed the design of the evaluation instruments and who directed the evaluation.

Each Institute provided a Director. All but one Institute also provided one or more staff instructors. All but one of the Institutes used guest lecturers, mostly from industry, for a significant portion of the instruction.

Conclusion: The more ideal situation was found to exist where the Director had no instructional duties, and where a staff instructor was responsible for the majority of the instruction and academic content. The least ideal situation was found to be where there was no staff instructor, and where all of the instruction was provided by guest lecturers from industry and other institutions.

Selection of Participants

Participants were required to be (1) teachers of vocational, technical, or industrial education subject matter, and (2) now offering, or planning to offer, a unit or course in fluid power at his home institution. No restrictions were placed on level of insturction. A total of 167 participants were admitted into the Institutes, representing 35 states. Seventy-one per cent were secondary school teachers; 15 per cent were post-secondary level teachers; 12 per cent were four-year college level teachers; and 1 per cent involved teachers not otherwise classified.

Institute Content

Each institute was required to have a minimum of 175 contact hours distributed as follows:

Lecture-Demonstrations	35 hours
Laboratory Work	66
Seminars (Curriculum Development)	7

Examination	3 hours
Field Trips	14
TOTAL	175 hours

One of the stipulations agreed upon by the United States Office of Education and the Society was an evaluation, during the Institutes, of the four commercially-available teaching fluid power demonstration devices on the market. This was accomplished by the use of uniform assignments and evaluation forms provided by the Society, and through participant-team activity under the direction of each Institute director.

In addition to the regular day institute program, each institute provided professional-social activities, including informal meetings with local chapters of the Fluid Power Society, and planned social events. Weekly evening workshops were also held for review of content and for self-help of participants with the cooperation of the instructors and guest lecturers.

Participants were divided into teams for curriculum development. Each team developed a recommended curriculum for the educational level of primary interest to each team (for example, high school, vocational, post secondary school, and teacher-preparation).

A uniform final examination was administered to all participants at the conclusion of the institutes. The results of the final examination were used as a method of discovering which kinds of instructors (guest lecturers, resource persons, or full-time instructor) were most effective.

Conclusions: Commercially available teaching-demonstration units were effective, and provided valuable laboratory experiences. Further, the teacher newly introduced to a technology should not be expected to design such equipment for his own school, but should initially depend on pre-tested devices.

An unexpected benefit resulted from the evaluation of the teaching-demonstration devices. Recommendations for improving the devices were relayed to the manufacturers; subsequently, each manufacturer incorporated improvements into new models.

Seminars were effective because they provided the participants with materials necessary for conferences with their school administrators upon their return to their teaching assignments.

Since participants were offered maintenance allowances for dependents, many were accompanied by their families, and lived "off campus." More of their time was required for family activities than for those participants who left their families at home. Since the introduction of a new technology requires intensive exposure during an institute, results appear to be best when participants leave their families at home, and live together in campus facilities.

Finally, institute programs of this nature should carry graduate credit, and arrangements should be made whereby participants may earn such credit. The more ideal situation exists where the participant may earn credit without the payment of additional tuition.

Participant Maintenance

Participants were provided with maintenance allowances of $75.00 per week plus $15.00 per week for each dependent to a maximum of four. They also were eligible to receive $.08 per mile for a maximum of 400 miles, representing the round trip distance between their homes and the Institute location.

Conclusion: Since teachers seek fellowship support (such as NSF Institutes) or summer employment, it is necessary to offer some type of participant maintenance to attract qualified candidates. However, both the participant and his home school benefit from Institute attendance, and an attempt should be made to encourage schools to share in participant maintenance.

The Use of Advisory and Evaluation Committees

Initial planning of the Summer Institutes was accomplished with the help of the Council on Fluid Power Education. This group includes representatives of the following organizations: Fluid Power Society, National Fluid Power Association, National Association of Industrial Teacher Educators, American Vocational Association, American Society for Engineering Education, and the American Technical Education Association. Thus, a broad representative base of support was obtained.

Further advisory groups included the Education Committee of the Fluid Power Society and the Education Board of the National Fluid Power Association. These groups provided valuable counsel in the determination of the Institute curriculum.

The evaluation was conducted under the direction of an Evaluation Committee, made up of representatives of State vocational education departments, teacher education institutions, technical institutes, and industry. This Committee met during the month of October following the close of the 1965 Summer Institutes and reviewed all of the data secured through evaluation procedures. Its analysis and recommendations are incorporated in this report.

Conclusion: The use of existing committees in planning Institute activities was proved to be most effective in eliciting support and advice from authorities and national organizations who share interest in the Institutes. The Evaluation Committee functioned unusually effectively. Expense for its meetings and activities were a part of the supporting contract and rightly so, for evaluation is an essential part of an educational activity.

Evaluation Procedures

Six aspects of the Institutes were evaluated; these were:

1. Suitability of laboratory and demonstration devices, workbooks and laboratory manuals.
2. Quality of instructional program.
3. Cooperation of industry.
4. Qualification of participants.
5. Follow-up of participants.
6. Available audio-visual materials.

Uniform evaluation forms were prepared and distributed to the Institute Directors. Both the Directors and participants filled out the various forms. Results were tabulated for the consideration of the Evaluation Committee and for inclusion in detail in this report.

A further evaluation was made by individual members of the Evaluation Committee. Three individual visits to each Institute were made by members of the Committee. They, too, used uniform evaluation forms which were tabulated and the results summarized in this report. Travel and related expenses for the evaluation visits were a part of the supporting contract.

During the Institutes each participant was asked to select up to 17 follow-up activities which he hoped to accomplish when he returned to his home school, ranging from the organization of a curriculum advisory committee to the introduction of courses and curricula in fluid power. The participants named 727 specific activities, an average of 6 or 7 per participant.

In June of 1966 the participants were polled again to ascertain accomplishments. A total of 303 of the initial plans were accomplished; 230 were in the planning stage; 68 had been scheduled for the coming year, and 55 were dropped.

Conclusions: Evaluation is necessary in any effort to introduce a new technology. It must be carefully planned, and uniformly applied. It should include evaluation by the participants themselves, by the

Institute directors, by an Evaluation Committee, and through evaluation visits by members of the Committee to each Institute. A follow-up of participants is essential.

Cooperation of Industry

Through the National Fluid Power Association, which represents the fluid power industry in the United States, manufacturers of fluid power equipment were asked to provide guest lecturers for the Institutes; and to provide technical manuals, laboratory equipment, and training aids.

Industry provided 82 guest lecturers, who lectured a total of 285 contact hours.

Forty-four companies contributed the following materials for use by the Institutes and participants: 14,252 catalogs; 6,335 manuals; 275 components such as cylinders, valves, or pumps; 637 demonstration models; 92 cutaway models; and 32 films.

It is significant that in no way whatsoever did industry attempt to dictate or control the institute activity. Caliber of guest lecturers was high, and their participation created a noticeable esprit-de-corps between participants and the industry.

Conclusions: Industry involved in a new technology should be asked to cooperate and contribute toward educational activities which will be of benefit to it. In the case of the fluid power industry, its response was overwhelmingly generous. In terms of manpower contributions (guest lecturers), the dollar value of time contributed is estimated at a minimum of $100.00 per lecturer, or $8,200.00. The value of catalogs, manuals and training aids contributed is estimated at $40,000.00.

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Fluid Power Society
Thiensville, Wisconsin
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FOREWORD

The 1965 Summer Institute Program on Fluid Power was a pilot program and, hence,an experimental one. New and largely untried were the planning and administration by a professional society, the offering of seven institutes during one summer requiring both co-ordination and supervision, the planned use of guest-lecturers for much of the instruction, co-operation of the industry in providing instructional materials that had not yet been made available to schools, evaluation of the quality of the instruction, a follow-up study of the participants, and even this report itself.

In this report of the prime contractor, the Fluid Power Society, Chapters I and II briefly describe some of the problems introduced by new technologies, report activities previous to the contract program, and describe planning and co-ordinating activities.

The work of the Evaluation Committee is reported in Chapters III, IV, and V and sections of the Appendix.

Conclusions and Recommendations, Chapter VI, represent the judgments of the Institute Staff based both upon the data and findings reported in the previous chapters and upon cut-and-try experiences. As such, they are not necessarily the opinions of the Institute Directors nor those of the Evaluation Committee, neither of whom have had opportunity to review the total report before duplication.

Errors either in fact or judgment are, therefore those of the author.

In all of these activities, the willingness to be of service by representatives of the industry, by Directors of the Institutes, and by members of the Evaluation Committee has been notable and inspiring. Hopefully, this report records the results of the excellent work which these men have done; their assistance is gratefully acknowledged.

Special mention is made of the work of William D. Wolansky and Leslie H. Cochran who carefully compiled and tabulated the extensive data on Laboratory Manuals and Workbooks, and Demonstration and Laboratory Devices; and the data and its interpretation from the Participants' Evaluation of the Instructional Program.

Gerald Baysinger

CHAPTER I

INTRODUCTION

Descri   of the Problem

What kind of a program could be devised to accelerate the introduction of new technologies into school programs?

The rate of development and use of new technologies in industry has out-paced the normal rate of introduction of new programs in secondary and post-secondary schools preparing young people for jobs in industry, and in colleges preparing teachers for these schools. In addition, the new technologies have made many of the present school programs obsolete.

As a result of education's inability to keep pace, industry has resorted to more on-the-job training, expanded their in-plant training and, in some cases, established its own schools. But industry feels that basic education should not be a production cost, looks to the schools for this service, and frequently offers help in establishing the needed programs.

Then too, the new technologies are not simply refinements or extensions of older processes and procedures by which needed technical competencies could be developed by longer training programs, but are in fact new. In a dramatic way, the skill of the craftsman has been converted into punched tape which transports and positions materials, directs and controls the pre-scheduled manufacturing processes, eliminates human error, corrects its own errors, and maintains such control of production that manufacturing costs are reduced.

In what has been called the third industrial revolution, fluid power plans a major role; it is one of three basic technologies in the transmission and application of power by which work is done; manufacturing, mining, agriculture, marine, aero-space, construction, and others.

But outside of a few isolated instances, fluid power has not yet been taught in schools or colleges. Moreover, colleges preparing teachers do not have faculty who have the needed technical competencies, nor the laboratories required. In addition, costs of curriculum research and development, and costs of building the needed laboratory equipment and training simulators cannot be met by colleges alone. Clearly, the help of the Federal Government is needed.

Pilot Program

The summer institute has become an established device for modifying present educational programs and introducing new ones. Grant funds provide faculty time for thorough planning and for necessary instructional materials not otherwise available; participants are given allowances for living expenses.for themselves and dependents, and for travel. Without this support, the key teachers in the school or school system, for whom the institute has been planned, could not participate. Evaluation of institute programs attest to the efficiency of the summer institute as a device for implementing change.

But the summer institute has been, until early in 1966, concerned primarily with academic areas. Then too, each institute has been complete in itself, unrelated to others being offered at the same time at other institutions, and having therefore some variations in content and emphasis.

For introducing a new technology, the present pattern of summer institutes would appear to require modification to meet demands which such a task would necessarily impose. First, Fluid Power is a technology rather than a subject matter discipline and its existence is in industry rather than schools; it has had little curriculum organization and few textbooks have been written. Next, Fluid Power is found in industry from coast to coast but applications differ by industry and by geographical location. Examples are concentrations of mining, aero-space, and basic-material processing. Finally, Fluid Power Education is new and the development and availability of the needed laboratory equipment for teaching purposes is just now taking place. Clearly, a different type of summer institute program is needed. The objective of this project, therefore, is to develop and evaluate a pilot program--which could be used for introducing other new and emerging technologies.

Background

In 1962, the Fluid Power Society conducted a survey to determine manpower needs, if any, and found shortages in all personnel classifications; shortages of operators, and service and maintenance men, were most critical.

In 1963, representatives of the Fluid Power Society and interested teacher educators met at Wayne State University, examined the problem, formed the Council for Fluid Power Education, and selected for initial programming the preparation of teachers for secondary and vocational schools.

Later that year, the Council requested a grant to conduct a summer institute for teacher educators from the National Science Foundation. This was rejected because fluid power was considered to be an applied rather than a pure science.

In 1964, the Council with the help of members and chapters of the Fluid Power Society, and with financial help of the National Fluid Power Association, conducted a summer institute at Wayne State University for teacher educators selected to represent various areas of the United States. The objectives were: one, to provide technical competencies needed to introduce Fluid Power in institutions preparing teachers; two, to develop an outline for a basic course in Fluid Power; and three, to encourage participants to offer summer institutes the following year at their own institutions for secondary and vocational school teachers. The Council also prepared and conducted a professional program, consisting of three meetings, at the Annual Meeting of the American Vocational Association in Minneapolis. At that time, ten institutions announced plans to conduct summer institutes in 1965.

In 1965, funds were made available by the Office of Education for seven institutes to be conducted at five institutions: University of California at Los Angeles, University of Minnesota-Duluth, Wayne State University, Trenton State College, and Tuskegee Institute. In addition, Georgia Southern College and Bradley University conducted institutes with only institutional support.

CHAPTER II

ARRANGEMENTS

Background

During the first Fluid Power Institute, held in the Summer of 1964, participants were encouraged to plan and conduct institutes the following summer at their own institutions. All but three of the 1964 participants were teaching in institutions which prepared teachers of Industrial Education, and were originally selected with this possibility as one criterion. At the Annual Convention of the American Vocational Association, held in Minneapolis that year, ten participants reported that, at their institutions, plans were underway for summer institutes.

Meanwhile, the Office of Education had become interested in the program through Mr. George Carlson of the Minnesota Rubber Company, and invited the Fluid Power Society to explore possibilities with the Contract Office.

Some funds were still available for pilot programs, and it was suggested that such a multiple project might best be funded and administered through a single contract with the Fluid Power Society acting as prime contractor, with sub-contracts made with the various institutions. Due to the late start, and the problems encountered in planning and obtaining approval for a pilot program, the contract was not completed until August.

Administration

With the Fluid Power Society, an incorporated, non-profit, educational organization, acting as prime contractor, Mr. Theodore Pearce, Executive Vice President, logically became the Principal Investigator. He then appointed as Program Coordinator Fred Lamb, a participant in the 1964 Institute and Instructor in Fluid Power at Flint Junior Community College; and as Consultant, Gerald Baysinger, Chairman of the Education Committee, Fluid Power Society; director of the 1964 Summer Institute; and Associate Professor, Wayne State University. The three men named comprised the staff responsible for planning and conducting the 1965 Institutes.

Selection of Institutions

Funds made available for this pilot program were insufficient to conduct institutes at all ten institutions which had started planning and made some commitments; however, it was possible to offer only five institutes. Criteria for selection of these were:

1. A 1964 Summer Institute Participant was available to direct the program.
2. The extent of pre-planning, and the nature and number of commitments made by the various institutions which were judged as indicators of need for and interest in Fluid Power Education.
3. Location of institutions, the geographical areas which each might service, and the commercial applications of Fluid Power represented; e.g., agriculture, aero-space, manufacturing, mining, marine, construction.
4. Availability of personnel from the local Fluid Power industry who could serve as guest lecturers.

While all four criteria were applied, area representation was considered most critical. It was hoped that by adequate area representation all states would be represented by at least one participant.

As a result of careful study, the following institutions were selected:

1. California State College at Los Angeles.
2. Trenton State College--New Jersey
3. Tuskegee Institute--Alabama
4. University of Minnesota at Duluth
5. Wayne State University--Michigan

To provide for as many participants as possible in the Mid-West, which has a concentration of manufacturing and industry, University of Minnesota and Wayne State University were asked to conduct two institutes each.

Instructional Staff

At each of the institutions selected a faculty member was available to serve as director who had participated in the 1964 Summer Institute and, thereby, had previous institute experience and a working knowledge of Fluid Power. Each director chose his own instructor from the same institution or a neighboring one. If he had difficulty in obtaining a qualified instructor, however, the Institute Staff assisted him.

In addition to an instructor, the directors planned to use guest-lecturers recruited from the fluid power industry as was done during the 1964 Institute.

For each of the Institutes, names of staff members are listed below:

California State College at Los Angeles

Director: Ray E. Fausel
Instructor: Angus McDonald

University of Minnesota at Duluth

Director and instructor: Martin L. Mattson

Trenton State College

Director: John Koenig
Assistant Director: Vincent Dresser
Instructor: Frank L. Mackin

Tuskegee Institute

Director: Austell O. Sherard
Instructor: Dudley Pease

Wayne State University

Director: Gerald Baysinger
Instructor: William F. Gayde
Conan E. Fisher

Program Planning

With the institutions selected, the institute directors met in Milwaukee on May 17 and 18 at the request of the Institute Staff. At this meeting, the content of the instructional program was discussed and agreement was reached on the topics to be included in each of the institute programs. These are listed for both Hydraulics and Pneumatics:

Hydraulics

Basic Laws
Language: Symbols, Terms
Fluids
Fluid Conditioners

Hydraulics (continued)

Pumps
Pressure-Control Valves
Directional Valves
Flow-Control Valves
Actuators-Motors
Boosters-Accumulators
Conductors
Circuits

Pneumatics

Basic Laws
Language: Symbols, Terms
Pumps
Conditioners
F.R.L.
Valves
Actuators
Conductors
Circuits

Next, the number of clock-hours to be included in the program was studied and discussed, and agreement was reached to provide 175 hours distributed among the following activities as shown below:

Lecture-Demonstration	
Hydraulics	55 hours
Pneumatics	30
Disassembly-Assembly of Components	36
Laboratory	30
Seminar	7
Examination	3
Field Trips	14
Total	175 hours

The number of class hours, generally 50 minutes in length, was 204 obtained by the following arithmetic operations:

$$175 + \left(\frac{175 \times 10}{60} \right) = 204$$

This number of class hours is in excess of those generally required for a 6 semester-hour laboratory program (16 x 2 x 6 = 192), and for an 8 quarter-hour laboratory program (11 x 2 x 8 = 176).

In planning for class-hours in excess of those required, the Directors and Institute Staff agreed that it was better to exceed institutional requirements and, thereby, avoid any possible criticism which might be given to an experimental program.

With instructional content and time allocations agreed upon, the Institute Staff then worked with each Director in establishing beginning and ending dates for the Institute; these are listed below:

California State College at Los Angeles

August 2 - September 3

Trenton State College

July 6 - August 6

Tuskegee Institute

June 28 - August 7

University of Minnesota - Duluth

I. June 14 - July 18

II. July 19 - August 20

Wayne State University

I. June 28 - August 2

II. August 2 - September 3

At the conclusion of the meeting, the Principal Investigator, Theodore Pearce, reported on the status of contract negotiations, and reviewed various provisions which were expected to be included in the contract.

One, each institution would be asked to prepare and submit a budget; this would be reviewed and changes, if any, would be made. When the contract was signed, the Fluid Power Society would then sub-contract with each institution. Until then, the Fluid Power Society would send each institution a letter of intent so that plans and committments for the institute could be made.

Two, amount of support for participants will be the same as provided in N.D.E.A. institutes: \$75 per week, plus \$15 per week for each dependent. Support for dependents would be provided for only those dependents whom the participant brought to the campus with him. Mileage to campus and back home was to be provided, however, because the institutes were few in number and it was felt that teachers who lived at a distance may not be able to finance their transportation.

Finally, one each of four different instructional devices, with laboratory manuals recently introduced by school supply organizations, will be provided each institute. Being new and designed for a new instructional program, the devices were largely untried. It was felt that their use in the institutes with teachers would have two important results: participants would have experience with all four and, in equipping a laboratory for Fluid Power for a particular level of instruction, would have a basis for making a selection; and use by teachers themselves, under the controlled conditions of the institute program, would reveal strengths and weaknesses helpful in further improving the devices for instructional programs in public schools.

Selection of Participants

With previous requests for help in setting up programs in Fluid Power from high schools, vocational schools, community colleges and technical institutes, and teacher education institutions, the Institute Staff felt that criteria for selection of participants should not restrict approval to any one school-level but should be open to all. Then too, the instructional program emphasized basic theory and applications which would be appropriate and suitable for a first course for teachers regardless of the school level at which they may be teaching.

The Staff did feel, however, that an important criterion was a need for instruction in Fluid Power, and that the institute program should first service those who are now teaching a unit or course and those who have been asked or expected to introduce Fluid Power the following year.

Other criteria were considered such as age, length of service, industrial experience, academic preparation, and others. After thorough discussion, the Staff agreed that applying these might defeat the purpose of the institute program, and that such criteria might be interpreted as recommendations for selection and preparation of teachers for this new technology.

As a result of careful study, the Staff agreed that criteria for selection would be limited to one: The applicant is now teaching a unit or course in Fluid Power, or will begin teaching such a unit or course in the Fall of 1965. It was further decided that the application include a statement to that effect signed by the appropriate school official.

Notices concerning the institute program presented a problem due to time for it was too late to place news items or advertisements in technical or professional journals. After exploring various possibilities, the Staff chose direct mailing to teachers of such subjects as Manufacturing Processes, Power Mechanics, Machine Metal Working, and Electronics and who may be teaching a unit or course in Fluid Power or would know a colleague who was. Names and addresses of this selected group of teachers were obtained from the publishers of School Shop, Ann Arbor, Michigan.

Again, due to lack of time, direct mailing was limited to a brief mimeographed announcement, and an application form. Completed forms were returned directly to the various institutions, and each Director processed the applications and notified those selected. Applications of those accepted were later examined by the Coordinator, Fred Lamb, who found that in every case the participant had met the selection criteria.

Participants at each of the institutions selected, the states, and types of schools represented are reported in the following tables:A to E. The data in these tables are summarized in tables F and G.

TABLE A

PARTICIPANT REPRESENTATION BY STATE AND SCHOOL LEVEL AT CALIFORNIA STATE COLLEGE-LOS ANGELES

State	Number	Type of School	Number
California	12	High School	9
Utah	3	Technical High School	1
Oregon	2	Vocational School	0
Arizona	1	Area Vocational School	0
Idaho	1	Technical Institute	2
Nevada	1	Community College	4
Washington	1		
		4-Year Technical	0
		Teacher Education	5
Total	21		21

TABLE B

PARTICIPANT REPRESENTATION BY STATE AND SCHOOL LEVEL
AT UNIVERSITY OF MINNESOTA-DULUTH

State	Number	Type of School	Number
Minnesota	43	High School	29
Wisconsin	13	Technical High School	0
Michigan	4	Vocational School	11
Iowa	3	Area Vocational School	7
North Dakota	1		
		Technical Institute	5
		Community College	3
		4-Year Technical	1
		Teacher Education	8
Total	64		64

TABLE C

PARTICIPANT REPRESENTATION BY STATE AND SCHOOL LEVEL
AT TRENTON STATE COLLEGE-NEW JERSEY

State	Number	Type of School	Number
New Jersey	6	High School	6
New York	4	Technical High School	2
Massachusetts	2	Area Vocational School	0
Maryland	2		
		Technical Institute	3
Delaware	1		
		Community College	1
Maine	1		
Rhode Island	1	4-Year Technical	0
North Carolina	1	Teacher Education	1
Connecticut	1		
Pennsylvania	1		
Total	20		20

TABLE D

PARTICIPANT REPRESENTATION BY STATE AND SCHOOL LEVEL AT TUSKEGEE INSTITUTE-ALABAMA

State	Number	Type of School	Number
Alabama	4	High School	12
Mississippi	4	Technical High School	0
Florida	2	Vocational School	0
Texas	1	Area Vocational School	0
Michigan	1		
Ohio	1	Technical Institute	0
North Carolina	1	Community College	0
South Carolina	1	4-Year Technical	4
Georgia	1	Teacher Education	0
Total	16		16

TABLE E

PARTICIPANT REPRESENTATION BY STATE AND SCHOOL LEVEL
AT WAYNE STATE UNIVERSITY-MICHIGAN

State	Number	Type of School	Number
Michigan	33	High School	26
Illinois	3	Technical High School	3
Arizona	1	Vocational School	3
Kentucky	1	Area Vocational School	3
Missouri	1		
		Technical Institute	3
Oregon	1		
		Community College	5
California	1		
Idaho	1	4-Year Technical	0
Indiana	1	Teacher Education	2
Louisiana	1		
		Other	2
Ohio	1		
Pennsylvania	1		
West Virginia	1		
Total	47		47

It will be noted in Table F, that 35 States were represented in the institute program, leaving 15 without representation. The States from which the largest number of participants came were, with the exception of Wisconsin, those in which institute programs were offered. For this, several factors appear to be responsible: One, amount of local interest in fluid power and number of existing programs in a State; two, the level of development of vocational-technical education in the various States; and three, distance from the participant's school to the institution, and the influence which the institution may have beyond the borders of the State in which it is located.

Representation by school level is summarized in Table G. It will be noted that the largest number of participants, approximately one-half of the total, were teaching in general or comprehensive high schools. Area vocational schools may offer education at both the secondary and post-secondary levels but, in grouping these with other secondary schools, the number of participants teaching in these and other types of secondary schools was 119 or 71 per cent.

Participants from schools offering work two or more years, but less than four, beyond high school numbered 26

TABLE F

PARTICIPANT REPRESENTATION BY STATE

State	Number
Michigan	58
Minnesota	43
California	13
Wisconsin	13
New Jersey	6
Alabama	4
Mississippi	4
New York	4
Utah	3
Oregon	3
Iowa	3
Illinois	3
Arizona	2
Florida	2
Idaho	2
Ohio	2
North Carolina	2
Massachusetts	2
Maryland	2
Pennsylvania	2
Connecticut	1
Delaware	1
Georgia	1
Indiana	1
Kentucky	1
Louisiana	1
Maine	1
Missouri	1
Nevada	1
North Dakota	1
Rhode Island	1
South Carolina	1
Texas	1
Washington	1
West Virginia	1
Totals States: 35	168

TABLE G

PARTICIPANT REPRESENTATION BY SCHOOL LEVEL

Type of School	Number	Total	Per Cent
High School	82		
Technical High School	6		
Vocational High School	21		
Area Vocational School	10		
Secondary Level		119	71%
Technical Institute	13		
Community College	13		
Post-Secondary Level		26	15%
Four Year Technology Program	5		
Teacher Education	16		
Four-Year College Level		21	12%
Other	2	2	1%
Total	168	168	100%

or 15 per cent. And those teaching in four-year technology programs and teacher education totalled 21 or 12 per cent.

The two participants not classified by school level were Naval Personnel accepted into the program upon the request of the Department of the Navy.

Evaluation

During the planning of the institute program, the staff worked closely with personnel in the Office of Education who, incidentally, were highly interested in fluid power as a new technology, and in the pilot program as a promising technique for introducing a new technology into schools. The most helpful was Howard Hogan who had previously attended meetings of the Council for Fluid Power Education, and was acquainted with the total problem. In addition, he had done considerable work in introducing new welding techniques and instrumentation into schools.

As planning and arrangements progressed, the need for evaluating the total program became apparent. As a result of many meetings, it was decided to evaluate six aspects of the program:

1. Suitability of Laboratory and Demonstration Devices Workbooks and Laboratory Manuals
2. Quality of the Instructional Program

3. Extent of the Cooperation of the Fluid Power Industry

4. Qualifications of Participants and Teachers

5. Follow-up Study of Participants

6. Available Audio-Visual Materials

With the evaluation defined, it was decided to have the evaluation planned and supervised by a committee selected for that purpose which would be representative of both education and industry. Accordingly, the following people were invited to serve in this capacity:

Dr. Robert Worthington (Chairman)
Assistant Commissioner for Vocational Education
State of New Jersey
Trenton, New Jersey

Frederick W. Lamb (Executive Secretary)
Coordinator of the Institutes
Instructor in Fluid Power
Flint Community College
Flint, Michigan

Howard K. Hogan (Consultant)
U.S. Office of Education
Washington, D.C.

George Altland
Manager of Customer Training
Vickers Inc.
Detroit, Michigan

George Carlson
Chairman of the Board
Minnesota Rubber Company
Minneapolis, Minnesota

J. L. Fisher, Jr.
Vice President-Engineering
Bellows-Valvair
Akron, Ohio

Jack Harris
Trade and Industrial Education
State Department of Public Instruction
State of Michigan
Lansing, Michigan

George Kinsler
Supervisor: Vocational, Technical, and Adult Education
State of Wisconsin
Madison, Wisconsin

James Neff
Vice President
MAC Valves, Inc.
Detroit, Michigan

John Plenke
Department of Vocational Education
State of Wisconsin
Madison, Wisconsin

John J. Pippenger
Vice President
Racine Hydraulic Development Corporation
Racine, Wisconsin

William C. Richards, Jr.
Bellows-Valvair
P.O. Box 631
Akron, Ohio

Philip W. Ruehl
Professor
Stout State University
Menomonie, Wisconsin

G. Harold Silvius
Professor and Chairman
Department of Industrial Education
Wayne State University
Detroit, Michigan

Edwin J. Taibl
Associate Faculty Counselor
Milwaukee Institute of Technology
Milwaukee, Wisconsin

Carl Turnquist
Director of Vocational Education
Detroit Public Schools
Detroit, Michigan

Ex-Officio Members

Gerald Baysinger
Chairman Educational Committee
Fluid Power Society
Department of Industrial Education
Wayne State University
Detroit, Michigan

Max Covert
Past President
Fluid Power Society
Ford Motor Company
Dearborn, Michigan

Theodore Pearce
Executive Vice President
Fluid Power Society
P.O. Box 49
Thiensville, Wisconsin

Dudley A. Pease, President
Fluid Power Society
Kenosha Technical Institute
Kenosha, Wisconsin

Meanwhile, the Institute Staff developed tentative procedures and data-collecting instruments for the use of the Evaluation Committee so that the best use could be made of the available time. At the first meeting of the Committee, held in Detroit on June 4 and 5, the procedures and instruments were reviewed and various changes and additions were made. Copies of the revised materials were then made available to the Coordinator and Directors for their use.

At the conclusion of each of the various institutes, the data-collecting instruments were assembled and mailed to the Coordinator who, with other members of the Staff, tabulated the available data and prepared tentative summaries, findings, and conclusions. These materials were then duplicated for use of the Evaluation Committee.

The Evaluation Committee met in Milwaukee, October 14-15, with the institute directors. They reviewed the data, summaries, findings, and conclusions prepared by the Staff, made such changes as they felt were desirable, and approved the final and corrected draft.

Not included in the Committee's deliberations were some data which had not yet been all tabulated, and the follow-up study which was to be conducted later in the year. Added to the evaluation originally planned, however, were recommendations of the institute directors.

CHAPTER III

RESULTS

Laboratory Manuals and Workbooks, and Demonstration and Laboratory Devices

Following the recent introduction of Fluid Power in education, school supply companies developed various demonstration and laboratory devices, and prepared the necessary student workbooks and teacher's manuals. Each of the devices, which were available in the Spring of 1965, differed from others and, of course, varied in price. It became desirable, therefore, to examine these objectively, and to form some judgment regarding their value and suitability for school use.

Accordingly, each college or university offering an institute in Fluid Power was provided with one each of the four devices, and with the necessary manuals and workbooks. In addition, directions for using and evaluating the devices and workbooks were provided institute directors and instructors; copies may be found in the Appendix.

General Estimate

At each of the institutes, participants were assigned to one of four laboratory groups. Depending upon the number of participants in each institute, group membership varied from four to seven with five as the most common size.

Next, the instructor selected and assigned certain experiments or demonstrations to be done by the participants as a group, and to be done with each of the four devices. In the instructional outline, 30 hours were allotted for this activity which permitted each group to work with each device for approximately 7 hours.

Finally, the participants were asked to provide the information requested on Checklists I-A, I-B-1, I-B-2, and I-C. See Appendix A.

For each institute, the general estimate of each of the groups for each of the four devices and accompanying workbooks and manuals was recorded and summarized.

This was done by first tabulating the ratings, obtaining means of the ratings, and then determining rank positions using the mean ratings. These data are shown in Tables 1, 2, 3, 4, 5, 6, 7, which may be found in Appendix A.

Finally, the ratings for the devices and workbooks from all of the institutes were combined, mean ratings were calculated, and ranks were assigned. These data are shown in Table 8.

When examining these tables, it will be noted that some demonstration and laboratory devices provide for experiments and demonstrations in both hydraulics and pneumatics, and some do not. For this reason, ratings were obtained, means calculated, and rank positions assigned for the device as a hydraulics unit and as a pneumatics unit, and for the accompanying workbooks and manuals. By so doing, it was possible to obtain rank positions for each device as a hydraulics unit and as a pneumatics unit, and for each workbook and manual as including hydraulics and pneumatics. In addition, the ratings for the device and workbook as a hydraulics unit, and the ratings for the device and workbook as a pneumatics unit, were combined.

As may be seen in Table 8, participants in the seven institutes ranked the devices and books, both hydraulic and pneumatic, in the following order:

Hydraulics	Pneumatics
Vega	Vega
Electromatic	Capital
Technical	Technical
Capital	

TABLE 8

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: TOTAL SUMMARIES

	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Combination Rank Hyd.	Combination Rank Pne.
Capital						
Hydraulics						
Equipment	3					
Book		4			3	
Pneumatics						
Equipment			2			
Electromatic				2		2
Hydraulics						
Equipment	2					
Book		2			2	
Pneumatics						
Equipment						
Book						
Technical Equipment						
Hydraulics						
Equipment	4					
Book		3			3	
Pneumatics						
Equipment			3			
Book				3		3
Vega						
Hydraulics						
Equipment	1					
Book		1			1	
Pneumatics						
Equipment			1			
Book				1		1

TABLE 8--Continued

	Rating Excell. 1	Good 2	Satis. 3	Fair 4	Poor 5	Mean Rating
Capital						
Hydraulic						
Equipment	1	5	1			2.12
Book	1	1	3	2		2.98
Pneumatics						
Equipment	3	4				1.69
Book	1	2	2	1		2.53
Electromatic						
Hydraulics						
Equipment	1	3	2			2.10
Book	2	3	1	1		2.18
Pneumatics						
Equipment						
Book						
Technical Equipment						
Hydraulics						
Equipment	1	3	3			2.20
Book	1	1	3	1	1	2.90
Pneumatics						
Equipment		3	3			2.43
Book		1	3	1	1	3.70
Vega						
Hydraulics						
Equipment	2	2	1			1.85
Book	2	3				1.79
Pneumatics						
Equipment	3	4				1.53
Book	3	4				1.59

Suitability for School Use

When rating laboratory and demonstration devices, participants used Form I-B-2, "Suitability of Training Device for School Use." In this form, six factors were identified and a scale was provided for reporting the judgment of the participants.

These data together with a mean rating for each factor are shown for each device at each institute in Tables 9-36 which may be found in the Appendix.

The judgments of the participants in all institutes for each of the four devices are totalled in Tables 37, 38, 39, 40, and mean ratings for each of the factors are shown. These may be found in Appendix A.

Summarized in Table 41 are the mean ratings of all institutes for each training device and accompanying rank orders, for each factor individually, and for all factors together. From this table it may be seen that in the judgment of the participants, and in consideration of all factors, the training devices ranked in the following order of suitability: 1) Vega, 2) Capital, 3) Electro-matic, and 4) Technical. It will be noted, in addition, that none of the devices was rated by participants as unsatisfactory for school use (3.5 or more).

TABLE 41

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE
MEAN RATINGS AND RANK ORDERS

	Capitol		Electrom.		Tech. Equip.		Vega	
Individual Factors	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank
Size of components	1.9	2	1.4	1	1.9	2	1.9	2
Provisions for preventing unauthorized use	3.9	3	3.0	2	3.9	3	2.7	1
Daily maintenance required oil, dust, etc.	1.9	2	3.1	4	2.9	3	1.7	1
Portability	1.3	1	1.5	2	3.3	4	2.3	3
Storage when not in use	2.7	2	3.4	3	4.0	4	2.0	1
Adaptability	1.2	1	1.7	2	2.4	4	2.0	3
All factors	2.2	2	2.3	3	3.1	4	2.1	1

Size of Components

Of particular interest is the first of the factors under Suitability for School Use--Size of Components. Manufacturers produce components of various capacities and sizes, and these are precision-made to very close tolerances. Generally, larger size components are more expensive than smaller sizes. If a training device makes use of small components, the total cost will be lower which is of concern to schools. On the other hand, smaller components may be less effective in reinforcing learning or may inadvertantly create incorrect impressions of various fluid power components and circuitry.

The opinion of participants, who had opportunity to use each of the training devices, is reported in Table 42. For each of the four training devices, size of components and mean rating, are shown. Size is reported as size of port openings (fittings) rather than physical size, capacity, or ratings such as gallons-per-minute or pounds-per-square inch. Mean ratings are those previously reported in Table 41.

In examining the data in Table 42, it will be noted that: none of the devices were rated below satisfactory (3.5 or more); that the training device having the largest

TABLE 42

COMPARISON OF SIZES OF COMPONENTS AND MEAN RATINGS

Training Device	Size of Components	Mean Rating
Capitol	$\frac{3}{8}$ to $\frac{3}{4}$	1.9
Electromatic	$\frac{3}{8}$ to $\frac{3}{4}$	1.4
Technical Equipment	$\frac{1}{4}$	1.9
Vega	$\frac{1}{4}$	1.9

size of components, Capitol, was given a rating approximately equal to the devices using smaller size components.

Safety

In performing various demonstrations or experiments, participants in the institutes were asked to indicate if, in their opinion, the activity could be performed safely by checking one of three responses: Safe--Doubtful--Unsafe. See I-B-1 Checklist. In addition, space was available for specific comments or recommendations.

In the checklist, safety was intended as one of the factors to be considered in making an estimate of value and suitability of the device, and is not reported separately. But those who had a strong feeling about some aspect of the device or its use, did comment in writing. These comments pertaining to safety in the use of demonstration and laboratory devices have been summarized and listed in Table 43.

Participant Preferences

During the Summer of 1965 and after two of the institutes had been completed, a suggestion was made that participants describe their teaching assignments and then indicate which of the four devices they would select as most useful or appropriate. These data, it was felt,

TABLE 43

SUMMARY OF COMMENTS PERTAINING TO SAFETY IN THE USE OF DEMONSTRATION AND LABORATORY DEVICES

	Capitol	Electro-matic	Tech. Equip.	Vega
Safety was not stressed in the workbook		x	x	
Safety switch with lock to prevent use by unauthorized persons				x
Instrumentation not labelled permanently				x
Equipment lacked a shield for auxiliary power unit	x			
No drain in bottom of the bench leads to oil build-up		x		
Quick-disconnects require careful inspection			x	
Weights and moveable bars can be dangerous				x
Safety guard on main pump should be extended to cover gearing and coupling	x			
Available related components were rated as doubtful		x		
Flow meter should be installed at exhaust to prevent weight from falling too rapidly				x

may be of use in further interpreting the data collected on checklists previously described and, conceivably, in answering requests from schools for recommendations.

Accordingly, a memorandum was prepared and mailed to each institute director. A copy of this memorandum may be found in Appendix A.

Because of the timing of the procedure, provisions for obtaining the information needed could not be included in the checklists; instead, it was suggested that it be added to the "Participants Evaluation of the Instructional Program."

But since these were submitted unsigned and in sealed envelopes, it was not possible to identify the participant's ratings of the various devices with his preferences. If a participant, for example, was or would be teaching at the Junior College level, and aware of the age-range and industrial experiences of his students, he might prefer a particular training device and this preference might be the basis of his judgment for rating the various devices.

A closer examination of participant preferences and the nature of the instructional program, however, minimizes such preference as a basis for judgment.

First, the instructional program of the 1965 Institutes may be described as consisting of basic principles and applications; because of time, it could not include maintenance and service functions which is regarded as a second program for which basic principles and applications is a pre-requisite.

A program of basic principles and applications at any one of several school levels therefore, might include use of the same training device for teacher demonstrations of the basic principles and student laboratory experiences as that used in programs at other school levels.

Second, the manufacturers of the four devices used in the 1965 Institutes have not designed their devices for a particular school level but have, instead, designed them for use in an instructional program consisting of basic principles and application suitable as a first program at all school levels.

For these reasons no further attempt was made to find correlations between ratings by participants and their preferences. Instead, data are reported only as preferences by teaching assignment. These are shown in Table 44.

TABLE 44

TRAINING DEVICES AND EVALUATION GROUP PREVERENCE BY SCHOOL LEVEL

	Number of Participant Preferences				
School Level	Capitol	Electro-matic	Tech. Equip.	Vega	Totals
A. Secondary Vocational Course	2	2	3	0	7
B. Trade Extension Course for Adult Employed Workers	2	1	1	1	5
C. Post-High School Technical or Junior College	9	1	0	1	11
D. Industrial Education at Secondary Level	2	3	6	4	15
Totals	15	7	10	6	38

It will be noted first that all of the evaluation groups responded to the request for this information. Next, that those teaching Vocational Education courses at the secondary school level indicated the following preferences: first, Technical Equipment; and second, Capital or Electromatic. For those teaching trade extension courses for employed adult workers: first, Capital; and second, any of the other three. For those teaching at the post-high school technical or junior college level: first, Capital; and second, Electromatic or Vega. And for those teaching Industrial Education at the secondary school level: first, Technical Equipment; and second, Vega.

Findings:

1. Since fluid power includes both hydraulics and pneumatics, devices intended for use in teacher-demonstrations and in laboratory work by students should include provisions and components for both, either in one combined unit or as separate units. The following devices include provisions for hydraulics and pneumatics: Capitol, Technical Equipment, Vega.

2. Institute Participants, after approximately 30 hours of laboratory experience, gave the four devices for

both hydraulics and pneumatics over-all ratings which resulted in the following rank orders:

Hydraulics	Pneumatics
1. Vega	1. Vega
2. Electromatic	2. Capitol
3. Capitol	3. Technical
3. Technical	

3. Institute Participants, considering six factors representing suitability for school use, rated the four devices in the following order:

1. Vega
2. Capitol
3. Electromatic
4. Technical

4. To institute participants, size of components was not considered to be significant. The device with the largest size of components was rated approximately equal to the devices using smaller-size components.

5. Manufacturers of training devices for instruction in Fluid Power have given adequate attention to safety in the design of the devices. Also, safe practices in performing various demonstrations and experiments have been formulated by either manufacturers or teaching personnel.

6. For Fluid Power courses at various school levels, participants indicated the following preference

for training devices:

A. Secondary Vocational:

1) Technical

2. Capitol or Electromatic

B. Trade Extension:
Adult Employed:

1. Capitol

2. Any other of three

C. Post-High School, Technical or
Junior College:

1. Capitol

2. Electromatic or Vega

D. Industrial Education;
Secondary Level:

1. Technical

2. Vega

Instructional Program

Final Examination

Construction.--At a meeting of the Institute Directors and the Coordinator, it was agreed that the instructional program would be based upon the course outline developed during the 1964 Summer institute on Fluid Power, and that a final examination for evaluation of the seven 1965 Institutes would be constructed by the Directors. Accordingly, the topics in the accepted outline were divided equally among the Directors who agreed to prepare six multiple-choice--four-response test items, and answers for each of the topics; and to submit these to the Co-ordinator who would combine them into a final examination and duplicate copies. Following the meeting, Directors constructed test items and mailed them to the Coordinator who, in turn, combined them into a document, and duplicated copies for later use. A copy of the outline and of the final examination may be found in Appendix B.

Administration.--One week before the closing of each of the institutes, the Coordinator mailed sufficient copies of the final examination to each of the Institute Directors together with directions for the procedure to be followed. Mailing was done in this way to eliminate the possibility of Directors inadvertantly teaching the final examination which may have occurred if the final examination had been made available to Directors earlier.

Following directions of the Coordinator, the Directors administered the examination during the last few days of the institutes and, without correcting them, since Directors were not provided with answer sheets, mailed all copies to the Coordinator.

Examinations were corrected and scored by clerical staff in the office of the Fluid Power Society.

Analysis of Test Items.--Because the various items in the final examination had not been used before, it was necessary to analyze both the item and the response submitted as the correct one by the Director who wrote the item. Conceivably, the "correct" response could be "incorrect," the language of the item could be inaccurate or evasive, or the item may have prompted a wrong or right response. A test item thus characterized would not, obviously, reveal whether or not the institute participant had the information or knowledge being tested. If there was a number of such items, the final examination would have little value in determining the content and quality of the instructional programs of the various institutes.

The statistical technique used was Difference in Proportions. First, the scores of all final examinations were tabulated, and the high 25 per cent and low 25 per cent were identified and grouped for study. See Table 45. Next, the proportion of correct scores for each item in the low group and the proportion in the high group were counted. For each item, the difference between these proportions was estimated by the following confidence intervals at the 95 per cent confidence limits:

TABLE 45

UNCORRECTED SCORES: FINAL EXAMINATION

Score	f	cf	Score	f	cf
81	1	1	61	8	109
80	1	2	60	8	121
79	1	3	59	3	124
78	0	3	58	6	130
77	1	4	57	4	134
76	3	7	56	3	137
75	4	11	55	2	139
74	2	13	54	3	142
73	5	18	53	2	144
72	6	24	52	2	146
71	12	36	51	6	152
70	6	42	50	1	153
69	11	53	49	3	156
68	10	63	48	2	158
67	7	70	47	1	159
66	6	76	46	1	160
65	5	81	45	0	160
64	10	91	44	1	161
63	7	98	43	1	162
62	3	101	42	0	162

25 per cent of 168 = 42

High 25 per cent is 81 - 70 = 42

Low 25 per cent is 59 - 42 = 41

$$\bar{X}_1 - \bar{X}_2 + z_{\frac{1}{2}a} \sqrt{\frac{\bar{X}_1 (1-\bar{X}_1)}{N_1} + \frac{\bar{X}_2 (1-\bar{X}_2)}{N_2}} < P_1 - P_2 < \bar{X}_1 - \bar{X}_2$$

$$+ z_{1-\frac{1}{2}a} \sqrt{\frac{\bar{X}_1 (1-\bar{X}_1)}{N_1} + \frac{\bar{X}_2 (1-\bar{X}_2)}{N_2}}$$

If these limits covered zero, the item was rejected since the difference was not statistically significant. For each of the items, the confidence intervals were calculated, and those which were to be retained in the final examination were selected.

FINDINGS:

1. Of the 96 test items in the final examination 57 were found to discriminate positively and, hence, were retained.

2. Thirty nine test items were rejected as discriminating negatively or because the extent of positive discrimination may have occurred by chance and, thereby, was not statistically significant.

Coverage of Corrected Final Examination.--In the original examination, there were 8 test items on each topic in the outline of the instructional program. After an analysis of test items, some were rejected. Tables 46 and 47 show the number of items retained per topic, and gives estimates of topic representation.

TABLE 47

NUMBER OF RETAINED ITEMS PER TOPIC WITH ESTIMATES OF REPRESENTATION

Topic	# Items Retained	Adequate Representation Yes	No	Questionable
Basic Laws	9	X		
Symbols Terms	2			X
Fluids	4	X		
Fluid Conditioners	6	X		
Pumps	6	X		
Pressure Control Valves	3	X		
Directional Control Valves	5	X		
Flow Control Valves	3	X		
Actuators	5	X		
Boosters	1			X
Conductors	7	X		
Circuits	6	X		
Totals		54	0	3
Percent		95	0	5

TABLE 46

CONTENT OF INSTRUCTIONAL PROGRAMS

Topics Adequately Represented by Test Items: Table	Test Items	Percent of Correct Response by Institute						
		1	2	3	4	5	6	7
Basic Laws	9	59	70	61	87	74	81	79
Symbols, Terms	2	78	50	39	74	67	77	80
Fluids	4	84	75	70	91	67	90	81
Fluid Conditioners	6	70	50	50	84	79	73	80
Pumps	6	77	63	67	80	75	95	70
Pressure Control Valves	3	75	82	71	82	79	85	84
Directional Control Valves	5	50	56	53	50	60	70	60
Flow Control Valves	3	30	50	50	59	50	62	64
Actuators	7	43	50	43	75	65	67	67
Boosters	1	0	15	0	38	23	50	56
Conductors	7	59	69	52	62	70	79	79
Circuits	6	30	43	49	60	50	72	55

Specific knowledge about components and circuitry can be said to be outside of the general information acquired by teachers of Industrial Education, and unless all participants of the institutes had previous training or experience in Fluid Power, even a few questions per topic would indicate whether or not the instruction was offered.

FINDINGS:

Based upon percentages of correct responses to retained test items, adequate coverage of all topics, adequately represented by retained test items in the course outline was provided at all seven institutes.

Comparison of Techniques.--Each of the seven institutes was provided the same laboratory devices and instructional materials, the directors of each had participated in the 1964 Institute and were familiar with the outline of instruction, the participants at the various institutes were comparable. Three of the seven institutes, however, were staffed with instructors who had previous teaching experience in Fluid Power at the technical institute or college level, and who used some guest-lecturers from the Fluid Power industry but only as resource people. Two institutes also used competent instructors but relied almost entirely upon guest-lecturers for the instructional program.

Two other institutes used instructors to a very limited degree; instead, the director of each performed a dual function and acted also as the instructor; at these two institutes, guest-lecturers were used exclusively. Three patterns are, thus, identifiable: (1) director, instructor, resource people; (2) director, instructor, guest-lecturers; (3) director, guest-lecturers.

Of importance in the planning of similar programs, in which much of the technical information has not yet reached schools and colleges, is the question, "To what extent can guest-lecturers from industry be used effectively in introducing a new technology?"

There are a number of advantages in using guest-lecturers, of course; some of these are: teachers participating in the institute come to know many people in the new industry who may be of help later; when given by a recognized expert, technical information is accepted as authoritative; in a day consisting of six to eight hours or more of classwork, a guest-lecturer provides a respite for the instructor and introduces variety in classroom activities; and guest-instructors frequently bring with them visual aids and demonstration equipment which may not otherwise be available.

On the other hand, the guest-lecturer may inadvertantly repeat information previously presented; he may present his topic in greater depth than necessary thus talking over the heads of his listeners; and he may incorrectly assume that his audience has certain information necessary in the development of the concepts which he is attempting to help form.

In addition to these considerations is a second question related to staffing of the institutes; "Can the director also serve effectively as the instructor if he relies heavily upon guest-lecturers to present the instruction?"

Answers to the two questions might be found in the achievement of participants as measured by the corrected final examination. Accordingly, the seven institutes were first divided into three groups:

I. Director, Instructor, Resource People

II. Director, Instructor, Guest-Lecturers

III. Director, Guest-Lecturers

Then, the number of participants in each institute was counted and totals were obtained for each group. Next, all of the corrected scores of the final examination were tabulated for Groups I, III, II and III, I and II.

For these, mean scores were calculated. Then, the differences between the mean scores were compared using 95 per cent confidence limits:

$$\bar{X}_1 - \bar{X}_2 + t_{\frac{1}{2}a} \sqrt{\frac{S_2^2}{N_1} + \frac{S_2^2}{N_2}}$$

$$\bar{X}_1 - \bar{X}_2 + t_{1-\frac{1}{2}a} \sqrt{\frac{S_1^2}{N_1} + \frac{S_1^2}{N_2}}$$

These data are shown in Table 48 and Table 49.

As shown in Table 48 the upper and lower confidence limits do not include zero; we can therefore be reasonably sure that the difference between the mean scores was not due to chance, and that achievement of the participants in Group I, as measured by the corrected final examination was higher than that of the other two groups, II and III.

As shown in Table 49, the upper and lower confidence limits do not include zero; we can therefore be reasonably sure that the difference between the mean scores was not due to chance, and that achievement of the participants in Group III, as measured by the corrected final examination, was lower than that of the other two Groups, I and II.

TABLE 48

COMPARISON OF DIFFERENCES BETWEEN MEAN TEST SCORES OF GROUP I INSTITUTES AND MEAN TEST SCORE OF GROUP II AND III INSTITUTES

Group	Institutes	Number of Participants	Mean	Lower Limit	Upper Limit
I	3 6 7	62	39.1	+4.99	+8.61
II and III	1 2 4 5	106	32.3		

TABLE 49

COMPARISON OF DIFFERENCES BETWEEN MEAN TEST SCORE
OF GROUP III INSTITUTES AND MEAN TEST SCORE
OF GROUP I AND II INSTITUTES

Group	Institutes	Number of Participants	Mean	Lower Limit	Upper Limit
III	4 5	64	31.2		
I and II	3 6 7 1 2	104	36.9	+3.91	+7.49

FINDINGS:[1]

1. An instructional program in a new technology for teachers taught by a qualified instructor, when such an instructor is available, using resource people from the new industry as may be desirable, appears to be preferable to a program in which guest lecturers are used extensively.

2. For an intensive institute planned to introduce a new technology or to up-grade teacher competencies in the new technology, both a director and an instructor are necessary.

Qualifications of Instructors of Institutes

The technical and professional competencies of institute instructors were recognized as one of several factors determining the quality of instructional programs. But because such competencies are complex and difficult to measure, descriptions of education and experience were used instead.

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[1] "Since no pretest was given to the participants and no statistically validated examination was available, the test results in which the statistical technique, "Difference in Proportions" was utilized for our limited evaluation of participants who could not be considered a random sampling is questionable."

--Evaluation Committee

Accordingly, pertinent information was obtained from each instructor by the use of a form prepared for that purpose, then those members of the Evaluation Committee,who are competent themselves in Fluid Power, examined the information thus obtained, and made judgments of competency. The individual judgments were then summarized for each instructor. These data are shown in Tables 50, 55, 54, 55, 56, 57.

The summaries for all instructors were then combined, values were assigned for each of the scale steps, and arithmetic means were calculated.

In Table 56, it will be noted that five were assigned a mean rating of 1.0 to 1.499 (adequate); that two were assigned a mean rating of 1.50 to 2.499 (acceptable); and that none were assigned a mean rating below 2.50 (attention needed).

Qualifications of Guest-Lecturers

Early in the planning of the 1965 Summer Institutes on Fluid Power, use of guest lecturers from the fluid power industry was anticipated and, for some of the institutes, such lecturers would present all, or the major part, of the instructional program.

INSTRUCTOR A
PROGRAM I

TABLE 50

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 3	Attention Needed 3	Mean
Formal Education	X			
Informal Education	X			
Teaching Experience	X			
Industrial Experience			X	
Professional - Technical Activities		X		
Summary--All Items	3	1	1	1.4

The guest-lecturer program had been used in the 1964 Summer Institute on Fluid Power which four of the five directors had attended as participants and each was favorably impressed with the highly competent guest

INSTRUCTOR B
PROGRAM II

TABLE 51

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 2	Attention Needed 3	Mean
Formal Education		X		
Informal Education	X			
Teaching Experience	X			
Industrial Experience	X			
Professional - Technical Activities	X			
Summary--All Items	4	1	0	1.2

lecturers which appeared on that program. As a result, the completed plans provided for guest lecturers at four of the institutions.

INSTRUCTOR C
PROGRAM III

TABLE 52

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 2	Attention Needed 3	Mean
Formal Education	X			
Informal Education	X			
Teaching Experience	X			
Industrial Experience	X			
Professional - Technical Activities	X			
Summary--All Items	5			1.0

The director of the institute, or the instructor responsible for the instructional program, was asked to prepare an introduction. This material was to be added to Form II-C along with other information identifying

INSTRUCTOR D
PROGRAM IV & V

TABLE 53

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 2	Attention Needed 3	Mean
Formal Education	X			
Informal Education	X			
Teaching Experience		X		
Industrial Experience			X	
Professional - Technical Activities	X			
Summary--All Items	3	1	1	1.4

the speaker, topic, data, and institute. The director was then asked to submit the completed forms to the institute coordinator at the completion of the institute. A copy of the forms may be found in the Appendix.

INSTRUCTOR E
PROGRAM VI

TABLE 53

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 2	Attention Needed 3	Mean
Formal Education	X			
Informal Education	X			
Teaching Experience	X			
Industrial Experience			X	
Professional - Technical Activities	X			
Summary--All Items	4	0	1	1.4

Because of the large number of guest lecturers, it was felt inadvisable to include all reports; there were 75 guest lecturers, representing 60 different companies. Instead, each director was requested to evaluate

INSTRUCTOR E
PROGRAM VII

TABLE 55

SUMMARY OF JUDGMENTS OF PROFESSIONAL AND TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

Item	Adequate 1	Acceptable 2	Attention Needed 3	Mean
Formal Education	X			
Informal Education	X			
Teaching Experience	X			
Industrial Experience			X	
Professional - Technical Activities	X			
Summary--All Items	4		1	1.4

the guest lecture procedure of instruction.

A summary of guest lecturers' contribution to each program follows:

TABLE 56

TECHNICAL COMPETENCIES OF INSTITUTE INSTRUCTORS

	Technical Competency		
	Adequate	Acceptable	Attention Needed
Institute Instructor	1	2	3
I		1.6	
II	1.2		
III	1.0		
IV		1.6	
V	1.4		
VI	1.4		
VII	1.4		

<u>California State College at Los Angeles</u>.--Evaluation of each lecturer was made by instructor and students as to the effectiveness of the lecture and/or

demonstration. Nineteen guest-lecturers were used. Of these, 12 were considered to be excellent, 6 good, and 1 fair.

The instructor supplied the guest lecturer with the subject matter to be covered prior to his presentation. Any item that was not given complete treatment by the guest lecturer was covered in more detail by the instructor in a later session.

Trenton State College.--Twenty-two guest-lecturers participated. Contributions made added considerably to the value of instruction.

a. They were competent in their field;

b.

b. They distributed numerous written materials, that may not have been obtained otherwise;

c. They brought along equipment for disassembly and assembly that may not have been available for this purpose otherwise;

d. They supplied films and other visual aids that contributed to the effectiveness of the institute;

e. They helped hold the attention of participants because new personalities added interest to the lectures;

f. The twenty-two guest lecturers came from equipment distribution companies; most of them were sales engineers;

g. The participation of industry is indicative of industry's interest in Fluid Power education.

Tuskegee Institute.--Instructor was Dudley Pease, President of the Fluid Power Society, and instructor of Fluid Power at Kenosha Technical Institute. Because of his own unquestioned professional and technical competencies, and because of the distances which guest-lecturers would need to travel, none were used.

University of Minnesota-Duluth.--A total of 25 guest-lecturers appeared at the two institutes, some of them more than once. Their instruction was of great value because of the detail and background which they gave to their assigned topics. Another important contribution was the personal and professional relationships that were established between these representatives of industry and the participants. In addition, the guest-lecturers contributed a great amount of printed material, and many cutaways and components, thereby enriching the institute program in a manner that was not open to the director in any other way.

Wayne State University.--In the first institute, five guest lecturers and in the second institute, four guest lecturers were invited to present certain topics of the instructional program. Each of these is well-known in the Detroit area, and has an enviable reputation as a specialist in his field. Instructors reported that each presentation was well done, and participants reported that they enjoyed meeting these leaders, and that they had gained a great deal of understanding and knowledge from their presentations.

Qualifications of Personnel

Participants

The 1965 Summer Fluid Power Institutes were intended as in-service programs for those now teaching, and those who will be teaching in the 1965-1966 school year, Fluid Power at the secondary or post-secondary school level but below the engineering level, with occupational training as an objective.

Qualifications of participants were, thereby, clearly established.

To support his application, each teacher applying for one of the institutes provided a letter or statement signed by an appropriate school official stating that the applicant was now teaching, or would be assigned in the 1965-1966 school year to teach, Fluid Power.

Qualifications and the need for supporting letters or statements were explained to institute directors who then developed the necessary application forms and procedures for selecting participants.

The Executive Secretary of the Evaluation Committee then visited each institution concerned and, with the institute director's assistance, examined the applications and supporting documents for each of those selected as a participant. Each of the directors had followed directions carefully, and all participants selected were found to have met the qualifications.

The names of participants at each of the Institutes and a memorandum from the Executive Secretary are included in the Appendix.

Guide Lines for Teacher Preparation

Instruction in Fluid Power below the engineering level, as in other new technologies, has not yet been identified and defined, and then organized into blocks of instructional material for teaching purposes. Also, the occupations in Fluid Power have not, as yet, been sufficiently defined to permit accurate job descriptions for inclusion in the Dictionary of Occupational Titles. Yet, teachers and instructors for secondary and post-secondary schools are needed and must be prepared.

In Fluid Power instruction, then, what constitutes technical competency?

To provide guidelines for institutions preparing teachers of industrial and vocational education, and for State departments of education in certifying teachers, a sub-committee of the Evaluation Committee prepared recommendations which were presented to the institute directors and membership of the Evaluation Committee for corrections, additions and deletions, and subsequent approval.

I. Program Objectives for a Teaching Major

Instruction in Fluid Power is offered in the secondary school in non-reimbursable but occupationally-oriented programs, in vocational schools and classes at the secondary school level, and at the post-secondary school level such as apprentice schools, community colleges, and technical institutes.

For a teaching major, three technical objectives are thus identifiable: secondary, vocational, and technical.

It is recommended, therefore, that institutions offering, or intending to offer pre-service or in-service teaching majors in Fluid Power, identify the objective of each program offered and plan each occordingly.

II. General Education Pre-requisites

Fluid Power, like other new technologies, has extensive backgrounds in mathematics and the physical sciences. Minimum requirements, however, are mathematics through trigonometry, and one year (two semesters or three quarters) of laboratroy courses in physics and/or chemistry.

III. Pre-requisites in the Major

Most of the present courses in Industrial Education will be helpful to the teacher of Fluid Power because of the continuing expansion of Fluid Power in industry. Minimum needs, at the present time however, are one or more courses in basic electricity, drafting, and manufacturing processes. Trade experience may be an acceptable substitute for any of the three.

IV. Instruction in Fluid Power

At the present time, and to meet requirements of technical competency, it is believed that a total of four courses are needed:

A. Basic Principles and Applications

B. Installation, Maintenance, and Service Techniques

C. Controls and Circuitry

D. Analysis of Components and Circuits

The program for secondary school teaching should include (A); vocational, (A) and (B); technical, A, B, C, and D.

For pre-service programs, student teaching should be provided in Fluid Power at the school level corresponding to the program objective.

V. Laboratory Facilities and Demonstration Equipment

At the present stage of the development of instruction in Fluid Power, it is clear that the development of necessary competencies require demonstration and some laboratory work, and that an institution preparing teachers should set aside a room for this purpose; until such a room is available, instruction might be given in a related or all-purpose laboratory if space is available, but this should be understood as temporary.

For laboratory work in Program A, minimum requirements are test stands, commercially produced, with provisions for both hydraulics and pneumatics; four students per stand should be maximum. Also needed are such hand tools as pliers, wrenches, and screwdrivers of various types and sizes; portable tool racks for tools and supplies; bench space for disassembly and assembly of components, and storage facilities for them.

For Program B, laboratory facilities should include such teacher-made devices and other machines and equipment or realistic mock-ups that typical circuits may be studied. Because present Fluid Power applications are industrial, mobile including mining, marine, and aero-space, it is desirable that the laboratory assembled at the institution preparing teachers reflect needs in its service area, and that laboratory facilities make corresponding provisions for such instruction.

In addition to typical circuits, facilities should include instruments necessary to identify needed service, tools to replace and service various components, and storage for tools, supplies, and components, and instruments.

The laboratory for Program B will serve also for Program C with the addition of necessary instrumentation.

V. Industrial Experience

Fluid Power, like other emerging technologies, was born, is developing, and has its existence in industry. Ideally, the teacher of Fluid Power should be from the application area in industry, and maintain such relationships that his instructional program is always current and abreast with developments.

Observation and Evaluation

During the summer, each of the institutes was visited at least three different times by individual members of the Evaluation Committee who observed the instructional program, examined the facilities, and talked with participants concerning arrangements provided for them. Names of committee members, institutes visited, and week of each visit are shown in Table 57.

TABLE 57

PERSONNEL, OBSERVATION PERIODS, AND INSTITUTES VISITED

Institute	Week	Observer
Los Angeles State College	2	Max Covert
	3	Gerald Baysinger
	4	Robert Worthington
Trenton State College	3	Gerald Baysinger
	4	Max Covert
	5	George Kinzler
Tuskegee Institute	2	Max Covert
	3	George Altland
	4	John Pippenger
University of Minnesota-Duluth I	3	Theodore Pearce
	4	Edwin Taibl
	5	Carl Turnquist
University of Minnesota-Duluth II	2	Max Covert
	3	George Kinsler
	6	Philip Ruehl
	6	Max Covert
Wayne State University I	4	Edwin Taibl
	5	George Altland
	5	Max Covert
Wayne State University II	3	Jack Harris
	4	Philip Ruehl
	5	Carl Turnquist
	5	Max Covert

In Tables 58 through 64, the six factors evaluated were:

1. Initial Conferences--Conferences between the evaluator and university officials (Department heads, Deans, Provosts, Presidents, et cetera).

2. Class Visits, Observations--Evaluator's observations gained from visiting classes and laboratory sessions.

3. Laboratory Facilities--Available demonstration units, work areas, cleanliness, lighting, safety, storage areas, etc.

4. Lecture-Demonstration Facilities--Available classroom facilities, audio-visual aid equipment, ventilation, lighting, storage areas, work areas, etc.

5. Arrangements--Housing, registration procedures, fo service, recreational and social facilities, prompt payment of stipends and travel allowances, et cetera. As an aid to observation and as a device for recording first-hand experiences and on-the-spot judgments, copies of Form II-A were provided (see Appendix).

For each institute, the evaluations made by the observers using forms II-A have been summarized in Tables 58, 59, 60, 61, 62, 63, and 64, which are included in the Appendix. In these tables, five factors and a general evaluation are listed, each evaluation is recorded, the evaluation of each item by each observer is indicated; and, by assigning scale values to each of the three levels of quality, arithmetic means were obtained which represent the combined judgments of the evaluators.

The information reported by evaluators was more extensive, of course, than that summarized in Tables 58 through 64. The more extensive information and observations of evaluators were effectively used by the Coordinator in working with the Institute Director to improve any questionalbe condition immediately after the evaluator filed the report of his visit.

The data shown in Tables 58-64 are summarized in Table 65 for all seven institutes. An examination of the table will show the mean evaluation of each item for each institute, the mean evaluation of each item for all institutes, and the mean evaluation for all items for all institutes.

TABLE 65

SUMMARY OF OBSERVATIONS AND EVALUATIONS OF INSTITUTE PROGRAMS, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS

Item	Institute							Mean
	I	II	III	IV	V	VI	VII	
1. Initial Conferences	1.67	1.33	1.00	1.00	1.00	1.00	1.33	1.29
2. Class Visits, Observations	1.33	1.33	1.00	1.33	1.00	1.00	1.00	1.14
3. Laboratory Facilities	1.33	2.00	1.00	2.00	2.00	1.75	1.00	1.50
4. Lecture-Demonstration Facilities	1.33	1.67	1.67	1.33	1.50	1.50	1.33	1.54
5. Arrangements	2.00	1.67	1.00	1.00	2.00	1.75	1.33	1.48
6. General Evaluation	1.33	1.33	1.00	1.67	1.00	1.25	1.00	1.24

Based on the data in Table 65, the institutes were then placed in rank order according to the means of the General Evaluation:

1	III	1.00
2	V	1.00
3	VII	1.00
4	VI	1.25
5	I	1.33
6	II	1.33
7	IV	1.67

Next, and based on the data reported, the means of the five items evaluated were calculated for the total of seven institutes, and the items were then placed in their corresponding rank order:

1	Class Visits, Observations	1.14
2	Initial Conferences	1.29
3.	Arrangements	1.48
4	Laboratory Facilities	1.50
5	Lecture-Demonstration Facilities	1.54

FINDINGS:

1. According to the combined judgments of 23 observers, the Fluid Power Institute Program (General

Evaluation) rated 1.24 or very good.

2. The quality of the institute program, however, varied somewhat from one college to another. Of the seven institutes, 6 were judged to be very good; one was judged to be adequate.

3. Of the five factors evaluated, three were judged to be very good: Class Visits, Observations; Initial Conferences; and Arrangements. Two were judged to be adequate: Laboratory Facilties, and Lecture-Demonstration Facilities. None was judged to be less than adequate.

Cooperation of Industry

Fluid Power technology is represented by two groups: The National Fluid Power Association, and The Fluid Power Society. The Association's membership consists of manufacturers of various Fluid Power components, while The Fluid Power Society's membership consists of research and development personnel, engineers, field representatives and consultants, directors of training programs, and educators. The Association might be called a trade organization while the Society is a professional organization. Both, incidentally, share the same offices and the same staff since neither is sufficiently large and affluent to provide its own. For the purposes of this report, then, industry is defined as member companies of the Association and individual members of the Society.

Four areas of cooperation were identified, and plans were made to collect information on which judgments might be made.

First, however, directors of the Fluid Power Institutes were advised by the Coordinator that the use of advisory boards was approved and that such boards might be helpful in four ways:

1. Serve as consultants in selection of laboratory and demonstration devices, supplies, hand tools; and in the planning and layout of the laboratory including tool panels and storage facilities.

2. Select, arrange, and conduct field trips to observe applications of fluid power in industry.

3. Serve as lecturers on specific instructional topics.

4. Provide some appropriate extra-curricular activity.

Six of the seven institutes used advisory boards as referred to above. Because of the absence of industry in the area, Tuskegee Institute did not make use of a local advisory board. However, Tuskegee did utilize the services of advisory boards of the other institutes through the liaison of the institute coordinator.

Plant Training Programs

In the fluid power industry at the present time, there are two training facilities available to teachers: schools operated by component manufacturers for customer personnel, and special internships for teachers. Because most manufacturers are small in size, only the largest can support schools; there are only three of these in the United States at the present time. Internships consist of a one- or two-week period of job experience and have been arranged, in the past, for teachers by the Fluid Power Society.

The Fluid Power Society and institute directors recognized, of course, that a short, intensive instructional program is initial preparation only, and that more instruction is desirable and necessary.

Accordingly, institute participants were invited to make application for schools and internships for the 1965 Summer, if there was time available after the institute was completed, or for the 1966 Summer. Applications were accepted by institute directors who sent them to the Fluid Power Society.

The number of these requests for additional training was 140. These were about equally divided between the Summers of 1965 and 1966. Arrangements were made immediately for those participants who requested placement in the Summer of 1965, and approximately one-third or 47 were placed in either training programs or internships. Another third or 45 were placed during vacation periods and in the Summer of 1966. The remaining requests were postponed by participants because of changes in teaching assignments and other commitments.

Instructional Materials and Teaching Aids

Previous to the opening of the first institute, an ex-officio member of the Evaluation Committee, Mr. George Carlson, volunteered for an assignment to write personal letters to member companies of the National Fluid Power Association, suggesting that such materials as might be useful be sent to each of the colleges offering an institute on Fluid Power.

The number of companies which responded were 44; these shipped a total of 14,252 catalogs; 6,335 manuals; 257 components of various sizes and types; 637 demonstration models; and 92 cut-away models of various components. Films were loaned and donated when possible to the institutions. These data are shown in Table 66. The names of the companies and the materials which they contributed are shown in the Appendix.

Component manufacturers also contributed textbooks, technical references, instructional materials, and catalogs to each of the participating institutions.

These contributions involved the use of staff members, secretarial assistance, and considerable cost. This material was of such a nature as to serve as a nucleus for the technical section of libraries in Fluid Power at each of the participating colleges.

TABLE 66

INSTRUCTIONAL MATERIALS AND TEACHING AIDS PROVIDED BY COMPONENT MANUFACTURERS

Item	Number
Catalogs	14,252
Instructional manuals	6,335
Components	257
Demonstration models	633
Cut-away models	92
Films (loaned and given)	32

Evaluation Committee

To provide the technical competence needed, four members of the Fluid Power Society, two of whom also represented the National Fluid Power Association, were asked to serve as members of the Evaluation Committee. As such, they attended both meetings of the Committee, made a total of 16 observation and evaluation trips, and performed other Committee assignments. Estimated number of days spent during July and August by these four members was 74. One member devoted his annual vacation to the institute program, while three took time off from their jobs and worked on Saturdays and Sundays.

When asked for an evaluation of the attitude and performance of each, as provided in the Evaluation Procedure, the Executive Vice President of the Fluid Power Society and the Coordinator of the Institute Programs both reported that the attitudes of all four toward the assignments were "enthusiastic," and that performance of each assignment was judged to be "outstanding."

Guest Lecturers

The use of guest lecturers was varied and is indicated below in terms of total contact hours contributed and the number of people involved.

Institution	Total Contact Hours	Number Involved
Trenton State College	139	22
University of Minnesota-Duluth	95	36
Tuskegee Institute	0	0
Wayne State University	16	5
California State College of Los Angeles	35	19
	285	82

The average time required for each presentation was 3.3 hours. The speakers were rated by the institute directors and almost all of them were rated as "outstanding" and "enthusiastic." In addition to the work of the guest-lecturers, industrial executives and administrators participated in the coordination of programming and procurement of instructional materials. This expediting of operations was of a vital nature and, without this assistance, the quality of the presentations would not have been as effective.

Summary

While information and data has been partially summarized to show the numbers of people and companies from the fluid power industry who contributed their services and materials, this is the first time that an industry aided in development of instructional materials, in providing demonstration equipment, and in the preparation of teachers to this magnitude. The numerical data available cannot possibly show the total effort, interest, and willingness of the Fluid Power industry to cooperate in this endeavor.

Significant, however, is the fact that the industry has refrained from attempts to dictate or control any part of the total school activity; and that the very noticeable high morale of participants, instructors, and directors, which approaches an esprit de corps, could only have been engendered through personal contacts with members of the Fluid Power Society and the National Fluid Power Association.

Findings

1. The fluid power industry is highly interested in assisting schools to develop and expand instruction in Fluid Power.

2. The fluid power industry cooperated actively with education, and to a high degree, in the 1965 Summer Institutes.

3. The degree of interest and the extent of cooperation by the fluid power industry are believed to be sufficiently compelling to serve as justification for continuing and expanding programs of Fluid Power in schools, since they reflect the inability of industry itself to provide the training to meet manpower needs, and the belief by knowledgeable people in the industry that Fluid Power requires new basic knowledges and understandings which are not now being taught.

Evaluation by Participants

The attitudes, reactions, and recommendations of the participants at the completion of the institute were felt, by the Evaluation Committee, to be a desirable addition to other evaluations of the instructional program, and a sub-committee prepared an instrument, together with directions, for this purpose. This consisted of seventeen open-ended questions concerning the following six topics:

I. Two Established Goals for Institute

II. Pre-Selected Content

III. Techniques Employed with Methods and Teaching Aids

IV. Evaluation Instruments

V. Physical Facilities Provided

VI. Over-all Reaction to Institute

The response to these questions reveals the feelings and suggestions of the participant regarding the effectiveness of this institute and for improving the pattern of future Fluid Power Institutes.

Accordingly, the response to each of the seventeen questions prepared by each participant was carefully read and then the attitudes, reaction, or recommendation was interpreted as positive, neutral, or negative. These data are shown in Tables 67 through 84.

In interpreting the data it was to be assumed that, if the participant's attitude or reaction at the time was critical of any phase of the institute program, his response would reflect his attitude in content or tone; that if he were neither highly pleased nor highly displeased, his response may be either positive or neutral, or he may not have made any response at all; and if he was highly pleased, his response would be positive. Three comparisons are thus possible: percentages of positive, neutral, and negative responses.

TABLE 67

ITEM 1: IMPROVEMENT OF TEACHING COMPETENCIES IN TEACHING HYDRAULICS AND PNEUMATICS

Institute	Positive No.	Positive %	Neutral No	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	28	100	0	0	0	0	0	0	28
2	33	97	0	0	1	3	0	0	34
3	21	100	0	0	0	0	0	0	21
4	20	100	0	0	0	0	0	0	20
5	15	100	0	0	0	0	0	0	15
6	21	95	1	5	0	0	0	0	22
7	23	100	0	0	0	0	0	0	23
Totals	161	98.8	1	.6	1	.6	0	0	163

Typical Comments:

* Even though I have been teaching fluid power, I have learned much more by participating in this institute.

* Have progressed to a broad understanding of theory and practical applications of fluid power.

* An appreciation and understanding of fluid power and applications in industry were impressively increased.

TABLE 68

ITEM 2: PREPARED TO ESTABLISH AN INSTRUCTIONAL PROGRAM IN FLUID POWER

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	28	100	0	0	0	0	0	0	28
2	33	97	0	0	1	3	0	0	34
3	21	100	0	0	0	0	0	0	21
4	20	100	0	0	0	0	0	0	20
5	15	100	0	0	0	0	0	0	15
6	22	100	0	0	0	0	0	0	22
7	21	92	1	4	1	4	0	0	23
Totals	160	98.2	1	.6	2	1.2	0	0	163

Typical Comments:

* Am quite well prepared and feel very anxious to practice what I have learned and gained through experiences in the institute.

* Am now prepared to the same degree in hydraulics and pneumatics that I am in other areas of concentration.

* Goals have been established, content planned, and course is planned for the Fall.

TABLE 69

ITEM 3: NEED FOR ADDITIONAL GOALS FOR FUTURE FLUID POWER INSTITUTES

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	24	86	0	0	0	0	4	14	28
2	29	85	0	0	2	6	3	8	34
3	19	90	0	0	0	0	2	10	21
4	18	90	0	0	0	0	2	10	20
5	13	87	0	0	0	0	2	13	15
6	16	73	0	0	0	0	6	27	22
7	21	91	0	0	0	0	2	9	23
Totals	140	85.9	0	0	2	1.2	21	12.9	163

Typical Comments:

* Goals were adequate and inclusive.
* To develop materials and provide opportunity for school administrators to become familiar with fluid power and needed educational programs.
* To develop a central library of instructional aids and activities.

TABLE 70

ITEM 4a: EXTENT TO WHICH BASIC INSTRUCTION IN FLUID POWER WAS ADEQUATE

Institute	Positive No.	%	Neutral No.	%	Negative No.	%	No Response No.	%	Number of Respondants
1	28	100	0	0	0	0	0	0	28
2	27	82	1	3	6	15	0	0	34
3	21	100	0	0	0	0	0	0	21
4	17	85	0	0	3	14	0	0	20
5	14	93	0	0	1	7	0	0	15
6	21	95	0	0	0	0	1	5	22
7	21	92	0	0	1	4	1	4	23
Totals	149	91.4	1	.6	11	6.8	2	1.2	163

Typical Comments:

* Goal was realistic and was fulfilled to a high degree.
* Goal was met in every respect.
* More attention needs to be devoted to pneumatics.

TABLE 71

ITEM 4b: EXTENT TO WHICH SEMINARS ASSISTED IN THE DEVELOPMENT OF COURSE MATERIALS

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	27	97	0	0	1	3	0	0	28
2	27	79	1	3	6	18	0	0	34
3	18	86	0	0	3	14	0	0	21
4	14	70	0	0	6	30	0	0	20
5	14	93	0	0	1	7	0	0	15
6	21	95	0	0	0	0	1	5	22
7	16	70	0	0	6	0	1	4	23
Totals	137	84.1	1	.6	23	14.1	2	1.2	163

Typical Comments:

* Goals fulfilled my needs.
* Goal was well accomplished.
* More seminar discussions and time to develop instructional and course materials

TABLE 72

ITEM 5: REACTION TO THE APPROPRIATE SELECTION OF CONTENT AND ADEQUATE BLOCKS OF TIME

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	27	97	0	0	1	3	0	0	28
2	31	91	0	0	3	9	0	0	34
3	18	86	0	0	3	14	0	0	21
4	20	100	0	0	0	0	0	0	20
5	14	93	0	0	1	7	0	0	15
6	21	95	0	0	0	0	1	5	22
7	20	87	0	0	3	13	0	0	23
Totals	151	92.6	0	0	11	6.8	1	.6	163

Typical Comments:

* Subject matter was very well selected and the time allocations were adequate.
* Overall planning was extremely good.
* The subject matter was excellent but more time should be devoted to laboratory work and experimentation

TABLE 73

ITEM 6: SATISFACTION WITH PRESENT TIME-ALLOTMENTS

Institute	Positive No.	%	Neutral No.	%	Negative No.	%	No Response No.	%	Number of Respon-dants
1	25	89	0	0	2	8	1	3	28
2	32	94	0	0	0	0	2	6	34
3	18	86	0	0	0	0	3	14	21
4	18	90	0	0	0	0	2	10	20
5	13	86	0	0	1	7	1	7	15
6	15	68	1	5	2	9	18	22	
7	21	92	0	0	1	4	1	4	23
Totals	142	87.1	1	.6	6	3.7	14	8.76	163

<u>Typical Comments:</u>

* Time was well-planned and allocated for the various units.

* We received good coverage by following through as per original plan.

* Provide more time for field trips and to integrate lecture and laboratory activities.

TABLE 74

ITEM 7: CONTENT TREATED ADEQUATELY

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	27	97	0	0	0	0	1	3	28
2	26	80	3	8	3	8	2	6	34
3	17	80	0	0	2	10	2	10	21
4	19	95	0	0	0	0	1	5	20
5	17	93	0	0	0	0	1	7	15
6	20	91	0	0	0	0	2	9	22
7	20	87	1	4	2	9	0	0	23
Totals	143	87.8	4	2.5	7	4.3	9	5.4	163

Typical Comments:

* Content broad and quite adequate.
* We received good coverage and were supplied with reference materials for further study.
* More problem-solving through the utilization of Mathematics.

TABLE 75

ITEM 8: THREE SESSIONS MOST LIKED

CODE: I - Instructor
GL - Guest Lecturer

	I	GL	Response Ratio
1 a. Service and Trouble-shooting		X	25/27
b. Gear Pumps		X	16/27
c. Commercial Demonstration-Devices		X	16/27
2 a. Services and Trouble-shooting		X	31/34
b. Gear Pumps		X	27/34
c. Tour of Air Force Base		X	10/34
3 a. Circuits		X	18/21
b. Hydraulic Circuits		X	11/21
c. Systems and Components	X		8/21
4 a. Activators and Air-oil Systems		X	12/24
b. Directional Control Valves		X	7/20
c. Commercial Demonstration Devices		X	6/20
5 a. Introduction to Fluid Power	X		8/12
b. Vickers Hydraulics		X	6/12
c. Commerical Demonstration-Device		X	4/12

6	a. Vickers Hydraulics			X	18/22
	b. Basic Hydraulics		X		10/22
	c. Penumatics			X	6/22
7	a. Vickers Hydraulics			X	10/23
	b. Introduction to Fluid Power		X		8/23
	c. Commercial Demonstration-Device			X	8/23
Totals		21	4	17	146/163

TABLE 76

ITEM 9: THREE SESSIONS LEAST LIKED

Institute	Subject	I	GL	Response Ratio
1 a.	Piston pumps		X	16/20
b.	Pumps		X	9/20
c.	Introduction to Pneumatics		X	3/20
2 a.	Tubes-Fittings		X	14/33
b.	Commercial Demonstration-Device		X	8/33
c.	Pneumatic Circuitry		X	4/33
3 a.	Hydrostatic Transmission		X	12/21
b.	Penumatics		X	9/21
c.	Vane Pumps		X	5/21
4 a.	Pneumatics-Basic Laws		X	11/18
b.	Circuitry		X	3/18
c.	Hydraulic Pumps		X	2/18
5 a.	Commercial Demonstration-Device		X	1/8
b.	Apprenticeships		X	1/8
c.	None			
6 a.	Air Valves		X	6/19

b. Commercial Demonstration-Device			X	5/19
c. Role of Education in Fluid Power			X	5/19
Totals	20	0	20	127/163

TABLE 77

ITEM 10: FIELD TRIPS LIKED MOST

Institute	Field Trip	Response Ratio
1	Diamond Match Company	15/27
2	Duluth Air Force Base	11/17
3	Vickers	11/21
4	General Motors: Ternstedt Plant	11/20
5	Redstone Missile Base	5/14
6	Vickers Hydraulics School	14/22
7	Ford Motor Co: Sterling Plant	12/23
Totals:	7	146/163

TABLE 78

ITEM 11: ADEQUATE TIME TO WORK ON INSTRUCTIONAL DEVICES

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	13	46	0	0	15	54	0	0	28
2	18	53	5	15	11	32	0	0	34
3	15	72	0	0	6	28	0	0	21
4	14	70	0	0	6	30	0	0	20
5	6	40	1	7	5	33	3	20	15
6	11	50	1	5	9	40	1	5	22
7	19	82	0	0	4	18	0	0	23
Totals	96	58.9	7	4.3	56	34.3	4	2.5	163

<u>Typical Comments:</u>

* Sufficient time was devoted to the study and use of individual units.

* Slowed by late arrival of devices and operator's manuals.

* Too many participants per unit for a short-term course.

TABLE 79

ITEM 12: REACTION TO FINAL EXAMINATION

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respon-dants
1	5	19	0	0	22	78	1	3	28
2	24	70	4	13	6	17	0	0	34
3	17	81	0	0	3	14	1	5	21
4	11	55	0	0	6	30	3	15	20
5	6	40	2	13	6	40	1	7	15
6	13	59	0	0	9	41	0	[illegible]	22
7	10	43	1	4	9	40	3	13	23

<u>Typical Comments:</u>

* Very Comprehensive; a good index of covered materials.
* Well-planned and seemed to cover a wide-range of material, but a number of items could be revised.
* A number of questions had more than one possible interpretation and correct answer.

TABLE 80

ITEM 13: SUGGESTIONS FOR IMPROVING THE FINAL EXAMINATION

Institute	Positive No.	%	Neutral No.	%	Negative No.		No Response No.	%	Number of Respondants
1	25	89	0	0	2	8	1	3	28
2	31	91	2	6	0	0	1	3	34
3	18	85	0	0	2	10	1	5	21
4	13	65	0	0	2	10	5	25	20
5	14	93	0	0	0	0	1	7	15
6	20	90	0	0	1	5	1	5	22
7	18	79	1	4	3	13	1	4	23
Totals	139	85.3	3	1.8	10	6.1	11	6.8	163

Typical Comments:

* Greater cooperation by institute instructors in compiling the examinations.
* Use greater diversity of questioning methods.
* Provide a series of unit tests which would facilitate periodic evaluation of the student's progress.

TABLE 81

ITEM 14: ADEQUACY OF PHYSICAL FACILITIES

Institute	Positive No.	%	Neutral No.	%	Negative No.	%	No Response No.	%	Number of Respondants
1	26	92	0	0	1	4	1	4	28
2	28	84	1	3	5	15	0	0	34
3	19	90.5	0	0	2	9.5	0	0	21
4	19	95	0	0	1	5	0	0	20
5	14	93.4	0	0	1	6.6	0	0	15
6	21	95.5	0	0	1	4.5	0	0	22
7	10	41.8	0	0	13	58.2	0	0	23
Totals	137	84	1	.3	24	15.1	1	.2	163

Typical Comments:

* Physical Facilities were adequate and satisfactory.

* Late arrival of demonstration devices caused some delay in the instructional program of the institute.

* Considerable lack of smaller components, hand tools, and devices for the size of the class.

TABLE 82

ITEM 15: SUGGESTIONS FOR ADDITIONAL INSTRUCTIONAL SUPPLIES AND EQUIPMENT

Institute	Positive No.	%	Neutral No.	%	Negative No.	%	No Response No.	%	Number of Respondants
1	26	93	0	0	0	0	2	7	28
2	29	85	2	6	2	6	1	3	34
3	21	100	0	0	0	0	0	0	21
4	20	100	0	0	0	0	0	0	20
5	10	66.7	0	0	0	0	5	33.3	15
6	16	72.6	0	0	0	0	6	27.4	22
7	21	91.3	0	0	2	8.2	0	0	23
Totals	143	87.7	2	1.2	4	2.4	14	8.6	163

Typical Comments:

* Additional visual aids, and a listing of these to be made available.

* Need for more laboratory manuals and a specific textbook.

* Need for more components (for dis-assembly and assembly) and testing devices (demonstration and laboratory devices).

TABLE 83

ITEM 16: SATISFACTORY ARRANGEMENTS FOR LIVING ACCOMMODATIONS

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	23	82.1	0	0	3	10.7	2	7.2	28
2	29	85.3	2	6.9	3	8.8	0	0	34
3	18	85.7	0	0	3	14.3	0	0	21
4	20	100	0	0	0	0	0	0	20
5	13	86.7	0	0	1	6.6	1	6.6	15
6	13	59.	0	0	5	22.5	4	19.5	22
7	21	91.3	0	0	2	8.7	0	0	23
Totals	137	84.0	2	1.2	17	10.4	7	4.6	163

<u>Typical Comments:</u>

* The school was gracious in providing information on housing and entertainment.
* Living as a group in residence was helpful.
* Allowances for dependents and early notification of the institutes are desirable.

TABLE 84

ITEM 17: OVERALL EVALUATION OF THE INSTITUTE

Institute	Positive No.	Positive %	Neutral No.	Neutral %	Negative No.	Negative %	No Response No.	No Response %	Number of Respondants
1	27	96.4	0	0	0	0	1	3.6	28
2	33	97	0	0	1	3	0	0	34
3	21	100	0	0	0	0	0	0	21
4	20	100	0	0	0	0	0	0	20
5	12	100	0	0	0	0	0	0	15
6	12	100	0	0	0	0	0	0	22
7	23	100	0	0	0	0	0	0	23
Totals	161	98.8	0	0	1	.6	1	.6	163

Typical Comments:

* The institutes are to be commended and praised for the excellent instruction and cooperation by industry and education.

* Impressive array of prominent leaders - people from all levels of industry - and contacts with individuals from other States all contributed to a profitable educational experience.

* One of the most productive five weeks I have ever spent in Education.

For each of the 17 items and for all institutes, the data are shown in Tables 67-84 ; listed also for each item are selected comments written by participants and judged to be typical.

Summary

These data in Tables 67-84 are summarized by item for all institutes in Table 85, and by each of six topics in Tables 86 and 87.

In examining these tables, it will be noted that positive participant-response was 81% for all topics, and that the negative response was 12.3%. Mosc favorable responses were given Goals, Overall Raction, and Content in that order. Least favorable were given Final Examination, Physical Facilities, and Quality of Instruction. It should be noted that Quality of Instruction, however, included items asking for three sessions liked most, three sessions liked least, and field trips liked most; as such, the percentage of positive responses may not adequately reflect the attitudes of participants particularly because the 127 responses to "sessions liked least" could only be tabulated as "negative." This does not necessarily mean that the twenty-one sessions liked least were poorly conducted or that the instruction was ineffective; instead, and of the fifty or more meetings of the various institute groups, participant's did not like the twenty-one as well as they did others.

In Table 88 , percentages of various responses are shown. By use of the statistical technique of "Difference of Proportions," it was found that differences between the percentage of negative responses and the percentage of positive responses was significant at a confidence level of .95.

TABLE 85

SUMMARY OF PARTICIPANTS ATTITUDES TOWARD THE PROGRAMS

Item	Positive	Neutral	Negative	No Response
1	161	1	1	0
2	160	1	2	0
3	140	0	2	21
4a	149	1	11	2
4b	137	1	23	2
5	151	0	11	1
6	142	1	6	14
7	143	4	7	9
8*	146	0	0	17
9*	0	0	127	36
10*	146	0	0	17
11	96	7	56	4
12	86	7	61	9
13	139	3	10	11
14	137	1	24	1
15	143	2	4	14
16	137	2	17	7
17	161	0	1	1
Totals:	2,374	31	363	166
Percent	81.0	1.1	12.3	5.6

8* Three sessions most liked (all positive)
9* Three sessions least liked (all negative)
10* Field trip liked most (all positive)

TABLE 86

SUMMARY OF PARTICIPANTS' ATTITUDES TOWARD VARIOUS ASPECTS OF THE PROGRAM

Topic	Items	Positive	Neutral	Negative	No Response
Goals	1,2,3, 4a, 4b	747	4	39	25
Content	5, 6, 7	436	5	24	24
Quality of Instruction	8, 9, 10, 11	388	7	183	74
Final Examination	12,13	225	10	71	20
Physical Facilities	14,15	280	3	28	15
Overall Reaction	16, 17	298	2	18	8
Totals		2,374	31	363	166
Percent		81.0	1.1	12.3	5.6

TABLE 87

RANK ORDER AND PERCENTAGES OF POSITIVE RESPONSES TO SIX TOPICS

Topic	Positive Responses Ratio	Positive Responses Percent
Goals	747/815	91.6
Overall Reaction	298/326	91.4
Content	436/489	89.1
Physical Facilities	280/326	85.8
Final Examination	225/326	69.0
Quality of Instruction	388/652	59.5
Totals	2,374/2,934	81.0

TABLE 88

COMPARISON OF PERCENTAGES OF VARIOUS PARTICIPANT RESPONSES

Response	Number	Percent N=2934
Positive	2374	81.0
Positive, Neutral, No Response	2571	87.6
Negative	363	12.3
Total		99.9

95% Confidence Limits are (- 1.21 $P. - P_2$ + 2.71)

Interpretation of Data

1. Participants believed that their teaching competencies in Fluid Power were improved and that they were prepared to introduce Fluid Power in their schools.

2. Basic instruction in Fluid Power was adequate but additional time is needed for Pneumatics.

3. Seminar sessions were helpful and necessary in making preparations for introducing fluid power in school; more time should be allocated to this phase of the program.

4. Various units of instruction and program activities, were well selected; and time allocations with the exceptions of field trips, laboratory work, Pneumatics and Seminar Activities were adequate.

5. Instructional content was given adequate coverage; this was supplemented with many instructional materials which were donated for later study.

6. A guest-lecturer from the Fluid Power Industry may be excellent or poor; he may excell in performing his job responsibilities but this should not be equated with

his ability as an instructor. Selection, therefore, should be made on the basis of his proven competencies in teaching.

7. More time is needed for laboratory work, but this does not infer that less time should be spent on instruction. Instead, the length of the institute program should be increased so that more time would be available for laboratory activities.

8. The final examination was not popular but few such examinations are. Chief criticism was directed at questions in which there were more than one logical and correct answer. Improvements suggested included preparation of test items other than multiple-choice, and the use of unit tests given at intervals as a substitute for a final examination.

9. Physical facilities for conducting a laboratory course in Fluid Power were considered to be adequate; but concern was expressed by participants in one institute because the shipment of demonstration and laboratory devices was delayed in transit; and in another, which had an enrollment of 34 participants, because of a shortage of hand tools, components for dis-assembly and assembly, and

other laboratory devices. It should be reported that none of the institutions which conducted institutes have a Fluid Power laboratory, and that only one has offered courses in Fluid Power previously.

10. Living accommodations on the various campuses were generally satisfactory, but participants who brought their families had difficulty finding suitable accommodations nearby. Those who lived together in college dormitories reported the experience as helpful. Late notification of those accepted for the institutes was of concern to some, of 163 participants reporting, only 17 responded negatively.

11. Participant overall evaluation of the institute program was high; one responded negatively, and one made no response. The number of positive responses was 98.8%

Aduio-Visual Materials

With the growing interest in Fluid Power Education, there has been a corresponding development of audio-visual materials most of which are or can be made available to schools. However, teachers who have only recently become knowledgeable in Fluid Power may not know of these materials nor make selections wisely for instructional programs at the various school levels. To assist in the selection of these materials, it was decided to prepare a list of available materials with recommendations for their use. Accordingly, a format for describing material was prepared and duplicated. Copies were mailed to institute directors, with a request that they prepare written descriptions of films. These descriptions were then to be edited and prepared for duplication.

Reports show that at four of the seven institutes the instructional program was presented largely by guest-lecturers, many of whom brought their own instructional materials and devices. Then too, field trips aided in providing a wide variety of first-hand experiences.

Findings

1. In the 1965 Summer Institutes, instructors made use of laboratory teaching devices, field trips. Guest-lecturers used cut-away models, simulators, and other devices, thus making first-hand experiences available to participants.

2. Since the need for a list of instructional materials relative to Fluid Power Education still exists, it is recommended that this be undertaken as a special project.

CHAPTER IV

FOLLOW-UP OF PARTICIPANTS

Initial Plans

What participants do as a result of their training is probably the best measure of the effectiveness of the program. There are two interrelated factors, however: selectivity of the selection process, and quality of the institute program.

Participants who were motivated primarily by college credit that could be earned, opportunity to vist and vacation in another part of the country, or by expense allowances, may not have intended to do much in Fluid Power upon returning to their teaching assignments. But if all participants selected were those who desired to learn more about Fluid Power so that they could introduce new programs or improve present ones, then the extent to which this was done or not done would indicate the effectiveness of the institute program as a whole.

While it is true that applicants provided letters or statements, signed by their immediate superior, stating that they were now or would be in the fall of 1965, teaching a unit or course in Fluid Power, the possibility exists that the interpretation was broad and included exploring Fluid Power first before making a decision; or that a desire to be helpful to the teacher, exclusive of any future Fluid Power commitments, was the motivation.

Data obtained to date, and that obtained later requires therefore, careful interpretation.

To get the desired information, copies of a letter of explanation and a checklist of suggested activities were provided the director of each institute. Copies of these may be found in the Appendix.

Next, a copy of the letter and checklist were given to each participant and discussed. The checklists were then completed, and collected by the director who, in turn, forwarded them to the Institute Coordinator.

Directors explained that this activity was voluntary, and that a participant need not make any commitment at that time. Those which were made then, however, are summarized in Table 89 .

TABLE 89

SUMMARY OF PLANS OF PARTICIPANTS FOR THE 1965-66 SCHOOL YEAR

Item	Activity Projected	Number
7	Establish professional relationships with a local or nearby chapter of the Fluid Power Society, and participate in its activities.	94
6b	Prepare a course of study for a new unit or course.	87
4	Add laboratory and demonstration devices to an existing laboratory or shop.	80
1	Introduce a unit of Fluid Power in an existing course.	74
8a	Obtain assistance of local members of the Fluid Power Society as an unofficial advisory group.	68
9d	Involve the advisory group or committee in selecting teaching aids.	54
9c	Involve the advisory group or committee in selecting instructional materials.	47
9e	Involve the advisory group or committee in placement of graduates.	47
9a	Involve the advisory group or committee in constructing courses of study.	43
9b	Involve the advisory group or committee in selecting laboratory devices, planning layout of the laboratory.	42

TABLE (Continued)

Item	Activity Projected	Number
10	Prepare an evening program for employed adults	42
2	Introduce a course in Fluid Power.	40
6a	Prepare a course of study for an existing unit or course.	
11	Work with an education committee to prepare curriculum guides for a city or state	19
12	Other	15
8b	Obtain assistance of local members of the Fluid Power Society as an appointed advisory committee.	10
5	Remodel facilities to provide a separate room, and equip it with laboratory demonstration equipment.	8
3	Add one or more courses to make a curriculum in Fluid Power.	6
9f	Other	2
	Total	727

It will be noted in examining the data that projected activities are listed in rank order according to the number of responses of which the total is 727. The first four activities are:

7. Establish professional relationships with a local or nearby chapter of the Fluid Power Society, and participate in its activities.

6b. Prepare a course of study for a new unit or course.

4. Add laboratory and demonstration devices to an existing laboratory or shop.

1. Introduce a unit of Fluid Power in an existing course.

Of a total of 167 participants, 125 or 75% made plans during the institute for the 1965-66 School year. The number of specific activities to be accomplished averaged 6 to 7 per participant.

Obtaining plans from participants for the 1965-66 school year is the first step in the follow-up study. In November of 1965, participants were asked by means of a mailed questionnaire for a progress report, and in June of 1966 for a final report.

Findings

1. Three out of four participants saw possibilities in their present teaching assignments, and were sufficiently motivated and encouraged to make definite plans for the 1965-66 school year.

2. The number of specific activities which they saw possibility of completing, averaged 6 to 7 per participant.

3. The most frequently reported activities were initiatory in nature, and are judged to be realistic.

4. According to reports obtained voluntarily, the institute program was effective in preparing teachers to introduce or improve instructional programs in Fluid Power, which was the basic objective.

Progress Report

In December of 1965, each participant was mailed a Progress Report form with a covering letter asking the participant to check the one or more activities which he had planned to undertake, and then to check the status of the activity. To those who did not respond after several weeks, a second mailing was made. Of the 167 participants, 134 responded, or 82 per cent. It cannot be judged whether this is high or low, since there are no similar follow-up studies which can be used for comparison. It is believed, however, to be fairly high.

Of equal interest, but more surprising, are the numbers of activities reported as shown in Table 90, which is greater than the number of activities originally selected.

Total initial activities were 727, those reported by only 82 per cent were 872 instead of .82 of 727, or 589. This is an increase of 48 per cent and could have several possible explanations: one, with School administration aware of the participants' activities and achievements during the past summer as a result of individual reports written by the institute directors, participants were asked or encouraged to undertake additional activities; two, in selecting activities to be undertaken, participants were inclined to be somewhat conservative; and three, institute experiences provided opportunities for later services of which participants were not aware during the summer institute. Whatever the explanation may be, it is encouraging and reveals some unexpected strengths in the institute program.

TABLE 90

SUMMARY OF PROGRESS REPORTS

Item	Accomplished	In Planning Stage	Scheduled For Next Year	Total Reported	Total Planned
4	46	25	18	89	80
1	47	28	13	88	74
6b	35	38	5	78	87
7	45	26	6	77	94
8a	20	33	8	61	58
6a*	34	21	4	59	38
10*	22	16	18	56	42
2*	20	21	14	55	40
9d	16	29	8	53	54
9c*	18	27	5	50	47
9a*	8	26	10	44	43
9b	8	26	8	42	42
9e	5	20	11	36	47
8b*	3	20	6	29	10
11*	5	10	5	20	19
5*	4	10	5	19	8
3*	2	9	5	16	6
12	-	-	-	-	2
9f	-	-	-	-	-
Totals	338	385	149	872	727

Further examination of the data in Table 90 reveals that for 9 of the 19 items, which are starred for easy identification, the totals reported exceed the totals originally planned. These data have been assembled into a new table together with descriptions of the activities.

An examination of these data in Table 91 reveals that the largest increase in number of activities reported occurred in Items 2, 10, and 3, all describing additions to educational programs; 88 were originally selected, but 127 were reported. The largest increase, 21, was reported for Item 6a: "Prepare a course of study for an existing unit or course." Of the 134 participants who responded to the follow-up survey, 59, or 44 per cent prepared or are preparing a course of study. As a result of this information, plans for a professional seminar in which a course of study would be prepared were included in the 1966 summer institutes.

Final Report

In June of 1966, and at the end of the school year, all participants were mailed a second report form with a covering letter asking for their accomplishments to date.

TABLE 91

SUMMARY OF SELECTED ACTIVITIES

Item	Total Reported	Total Planned	In-crease	Activity
6a	59	38	21	Prepare a course of study for an existing unit on course
10	56	42	14	Prepare an evening program for employed adults
2	55	40	15	Introduce a course in Fluid Power
9c	50	47	3	Involve the Advisory Group in selecting instructional materials
9a	44	43	1	Involve the Advisory Group or committee in constructing courses of study
8b	29	10	19	Obtain assistance of local members of the Fluid Power Society as an appointed advisory committee
11	20	19	1	Work with an eduction committee to prepare curriculum guides for a city or state
5	19	8	11	Remodel facilities to provide a separate room and equip it with laboratory demonstration equipment
3	16	6	10	Add one or more courses to make a curriculum in Fluid Power

Because time did not permit a second mailing as was done with the first survey, responses are summarized in Table 92 in which both frequencies and percentages are shown.

First, of all the suggested activities which participants originally selected, the status of 656 of 727 or 90% were reported.

Of this number, 303 or 46% were reported as completed; 230 or 35% were in the planning stage; 68 or 10% were contemplated for next year but with no specific plans made; and 55 or 8% were dropped.

The five activities with the highest percentage of completion were:

1. Introduce a unit of Fluid Power in an existing course.

7. Establish professional relationship with a local or nearby chapter of the Fluid Power Society, and participate in its activities.

4. Add laboratory and demonstration devices to an existing laboratory or shop.

6a. Prepare a course of study for an existing unit or course.

TABLE 92

SUMMARY OF FINAL REPORTS

ITEM	ACCOMPLISHED NO.	ACCOMPLISHED PER CENT	IN PLANNING STAGE NO.	IN PLANNING STAGE PER CENT	SCHEDULED FOR NEXT YEAR NO.	SCHEDULED FOR NEXT YEAR PER CENT	DROPPED NO.	DROPPED PER CENT
1	63	86	3	4	5	7	2	3
7	46	75	4	7	4	7	7	12
4	37	52	17	24	11	15	6	8
6a	24	66	8	22	2	6	2	6
8a	21	57	11	30	2	5	3	8
6b	19	41	21	46	6	13	0	0
2	17	29	19	32	17	29	4	7
10	16	38	16	38	4	8	6	14
9c	11	33	19	57	2	6	2	6
5	9	24	18	49	3	8	7	19
9d	9	33	16	59	3	11	1	4
9b	8	25	20	63	2	6	2	6
12	7	88	1	13	0	0	0	0
9a	5	20	17	68	2	8	1	4
3	4	18	13	60	1	5	5	23
11	3	25	4	33	2	17	3	33
8b	2	15	7	54	1	8	3	23
9e	2	10	15	80	1	5	1	5
9f	0	0	1	100	0	0	0	0
TOTALS	303	46	230	35	68	10	55	8

8a. Obtain assistance of local members of the Fluid Power Society as an unofficial advisory group.

In addition to information requested on the form provided, many participants added brief descriptions of their activities. Examples: "Going to start a Fluid Power Course in the Community College this Fall."

"Have increased day program in Fluid Power by 50%."

"$12,000 approved for equipment."

"New addition to the school will include a complete lab and classroom for Fluid Power."

"I have expanded the present course and added an advanced course."

"New building being planned with a special laboratory. Four courses will be given."

"Developed a new course in Fluid Power for majors in Machine Design."

"Introduced a new course for majors in Industrial Education."

Fluid Power symbols and circuitry added to drafting classes."

"Great local interest by industry."

Findings

1. The criteria for acceptance into the program which implies a committment by the school administrator, and the follow-up study, offer a promising technique for evaluating summer institute programs. What the participant does, or doesn't do upon his return to his school the following September, would seem to be the best single measure of the need for such an institute program, and of the quality or effectiveness of the program.

2. Initial Planning, using the form prepared for that purpose, appeared to be an effective device for suggesting activities which the participant might undertake, and which are realistic in nature. Further, initial planning appears to imply a committment by the participant.

3. For mid-year progress reports and final reports, a second mailing should be made to those who did not respond to the first request for information. This should result in responses from four out of five participants.

4. The possibility of telephoning those who do not respond to the two mailings should be explored.

Progress reports could be taken over the telephone or, if the participant had little to report, an attempt could be made to determine the reason. Such information could, conceivably, be helpful in refining the criteria for acceptance into the institute program.

5. The encouragement and approval of initiatory activities of participants by school administration would appear to support the claim by the Fluid Power Society that educational programs are needed; it was not believed, however, that the school administrator was as aware of this need and as interested as the results of the follow-up study indicate that he appears to be. The assumption would seem to be disproved that the absence of educational programs in a new technology, such as Fluid Power, is due either to lack of information about new development in industry, or to an unwillingness or resistance to change. More realistic is the assumption that school administration, in general, is knowledgeable and desires change but lacks the trained manpower to bring it about. It is upon this assumption that the summer institute program is based, and results so far appear to indicate that the summer institute program is performing this important and necessary function.

6. Without similiar follow-up studies which could be used for comparison, objective evaluation of the job performance of participants cannot be made. But those working with the data, while hopefully expecting that results would be gratifying, were not prepared for the number and kind of voluntary activities reported which can possible be ascribed to high motivation and interest. It would appear that the measurement of quality of summer institute programs should not be restricted to achievement in the subject-matter presented, but include evidence of the extent of motivation and interest engendered. This would seem to be particularly true of those institute programs concerned with introducing and developing educational programs in the new technologies for it is not enough, quite obviously, for the participant to be knowledgeable and skilled unless, at the same time, he has selected and planned a series of professional activities, and has the necessary enthusiasm and determination to complete them.

In the Fluid Power Institute program, there would seem to be sufficient evidence to show that this was done.

CHAPTER V

RECOMMENDATIONS OF DIRECTORS

Previous to the October meeting of the Education Committee to which directors were invited, the institute coordinator asked each director to prepare a list of recommendations for subsequent institute programs based upon the 1965 Summer experience. These lists were collected and reviewed by the directors who then combined and re-stated those recommendations on which there was agreement. Next, this revised and combined list was reviewed and edited by a sub-committee of the Evaluation Committee, and submitted for approval. These are listed below:

1. Proposals for institutes should be submitted to the Fluid Power Society by November 15. Directors should receive a letter of intent by February 15, so that necessary arrangements can be completed before the end of the school year.

2. An attempt should be made to encourage schools to pay salaries to participants during the period they are attending institutes. However, further study should be made of this problem.

3. A firmer commitment to undertake introductory programs and to equip laboratories should be obtained from the administrators of the participants.

4. A series of requirements for summer institute programs should be determined and then used as a basis for selecting institutions which will offer institute programs; these requirements might be part of an institutional application, and may include such items as laboratory space, qualified instructors, administrative approval, food and housing facilities, group study facilities for evening use, and so on.

5. As a condition for acceptance, the applicant should agree to live in the immediate vicinity of the institute and to meet all course requirements.

6. It is recommended that adequate group activities, both social and professional, be planned for the institute.

7. Since summer institutes are intensive and require the full attention of personnel, plans for the collection of data to facilitate special studies should not detract from the effectiveness of the institute program.

8. Members of the Evaluation Committee who made observations and evaluations were welcome and found to be very helpful.

9. The coordinator's assignment should be expanded to include more supervision of the institutes.

10. Practices which worked very well and which should be continued are:

a. Standard Course Outline

b. Standard Final Examination

c. Follow-up of Participants

d. Certificate

e. Duplicated Schedule of Topics, Speakers, Trips

f. Fluid Power Society Membership

g. Laboratory Work

h. Letter of Commendation to Participant's School

i. Field Trips

j. Director, as well as instructor, is needed

k. Instructors should not be burdened with administrative duties

11. The instructional program should be conducted by an instructor using some resource people as may be desirable; the practice of using predominantly guest-lecturers should be discontinued.

12. Since teachers tend to "teach as they were taught," the program should be conducted as a model:

a. Require shop coats or aprons
b. Show films where appropriate
c. Plan and use a student organization for laboratory work
d. Include Safe Practices, Eye Protection
e. Work from written directions

13. Expectations of participant behavior should be a part of the description of the program mailed to the applicant.

14. There is a demand and need for a second institute in Fluid Power covering maintenance and service activities for vocational classes; this program would include four areas of specialization: industrial, marine, mobile, aerospace. This institute might be offered at several institutions during the 1967 summer, and limited

to teachers of vocational and technical education and those who teach evening adult programs.

15. The numbers of qualified applicants who could not be accepted in the 1965 summer institutes clearly indicates the need for continuing the present program next year.

16. An instructional resource center should be established which would develop and provide:

a. Sample courses of study

b. Tool and equipment lists

c. Audio-visual materials

d. Texts and references

17. For one instructor, the number of participants should be limited to not more than 16.

18. The length of the summer institute should be at least five but no more than six weeks in length.

19. The number of class hours should be no less than 175 and no more than 210 hours.

CHAPTER 6

CONCLUSIONS AND RECOMMENDATIONS

The rapid development of various technologies are resulting in such changes that Education, the Nation's biggest industry, is both affected and concerned. Automation, computerization, microminuturization, plastics, fluid power, instrumentation, numerical control, and others are changing manpower requirements and look expectantly to the school for training and their share of the curriculum; and, at the same time, provide the school with the hardware for a new educational technology. All of this is accompanied by an intensification of old social problems and the emergence of new ones.

The school, of course, changes but the rate of this change is out-paced by the rate of technological development. Teachers must first be trained or retrained. This, in turn, requires that faculty in institutions preparing teachers be trained first so that teachers can be prepared. Next, the new technologies need curriculumization; content needs to be sorted into groups, basic knowledges identified, items arranged from simple to complex, groups sequenced for "grade-level" presentation, textbooks and manuals written, new laboratories designed and built, and the rest of the present curriculum altered or extended to provide both space and pro-requisites for the new.

Aware of the many problems presented by the development of new technologies, particularly as they affect manpower training and requirements, the Division of Vocational Education of the Office of Education approved a pilot program in fluid power designed to explore and tryout techniques of introducing a new technology into schools. In its first year, the pilot program consisted of seven summer institutes offered at five different institutions and providing initial preparation for 168 in-service teaching personnel from high schools, vocational schools, community and junior colleges, technical institutes, and teacher education institutions. From this experience, various observations can be made.

1. Evidence of Need.--In a technology not yet introduced into schools, the existence of a professional society and its demonstrated interest in public education, and an accompanying interest and willingness to cooperate by the

industry involved, may be accepted as evidence of the need for new educational programs.

2. Federal Support.--If the technology is not localized but is of such size and scope as to require interstate programs, it is appropriate and necessary for the Federal Government, through the Office of Education, to facilitate its introduction into education.

3. Teachers First.--Although needs are many, it is believed that the first step should be the in-service training of teachers, and that this be undertaken during the summer months; but because of family responsibilities and other committments, no more than one-half of the summer vacation should be scheduled for this purpose.

4. Prime Contractor.--The professional organization in the new technology may request or be asked to serve as the prime contractor for the program, and thus provide the coordination needed in a multiple-summer-institute program. Then too, the professional organization will be aware of concentrations of needs, and can thereby make functional selection of institutions for summer institutes. Knowing

the subject-matter content of the new technology, it can advise and assist in the selection of instructional content; it can assist in obtaining such specialists as are needed for guest-lecturers; working with the parent industry, it can assist in obtaining copies of technical papers, manuals, and other teaching aids; and finally, it can provide one-year guest memberships to participants which in turn provide the basis for a continuing and working relationship with local representatives of the new technology. Such active participation provides the teacher with technical magazines and, through various technical meetings, continually up-dates his knowledge and adds to his supply of instructional devices.

For the prime contractor, a minimum of three staff members are needed to provide planning and reporting, coordination and supervision, and overall administration.

5. Summer Institute Pattern.--As summer institutes, those in the new technology must use the existing pattern of other summer institutes, and provide the same participant support. There are several reasons for this: one, without such support, the implication is easily made that the introduction of a new technology is of minor importance;

two, teachers in the industrial technologies are generally men, most of whom have families to support, and usually are required to work during the summer months; three, a summer institute is, by nature, an intensive program placing correspondingly high demands upon both time and performance which can lower participant morale unless there is a feeling of fair and equal treatment; and finally, various practices in vocational certification in the various States are such that it is highly desirable that a summer institute be offered for credit purposes, that a transcript showing such credit be made available, and that this be done without cost to the participant.

6. Participant-Selection Criteria.--Once the new technology has been introduced into schools, school supply companies can be expected to develop laboratory equipment, and writers and publishers to prepare textbooks and manuals for student use. While these services might be planned and undertaken as a part of a project for introducing a new technology, it appears to be more desirable to cooperate with such private enterprise and to concentrate on introducing and expanding new school programs. If this judgment

is correct and acceptable, then the criteria for selection of participants is simplified. If the applicant is beginning to teach a unit or course in fluid power or is expected to do so during the coming school year, then he is qualified for the institute program. Further, other assumptions can be made: the administration of his school has been alerted to the needs of the new technology, and has made some tentative committment of staff, laboratory, and curriculum; for introducing such a program, the administration has selected a staff member with some knowledge of consumer or industrial applications who is willing to accept the challenge to time and energy in building a new and untried program; and finally, summer institute personnel can accept the judgment of school administration without further specifying degrees completed, age, certificates held, amount and nature of industrial experience, and prerequisites in science, mathematics, electronics, graphics and manufacturing processes. Hopefully, among such approved applicants, there are some actual or potential textbook writers, and creative and imaginative teachers who will develop new and effective demonstration and laboratory devices and equipment which might find their way to the school market.

7. Program.--Characteristics apparently common to all technologies are a foundation in the physical sciences, ingenuous and sophisticated hardware, and multiple and varied applications. This defines the content of an initial program for preparing teachers which could be called, "Basic Theory and Applications." For this program, the institute staff can develop a topic outline of the instructional program.

The experienced instructor will be competent in most or all topics; he can, for those in which his knowledge is limited or uncertain obtain a guest-lecturer from the industry. If an experienced instructor is not available, a pattern of team-teaching can be used successfully with guest-lecturers; in this case, the instructor should structure each presentation, provide a bridge from one topic to the next, review salient points, and add any overlooked details. In general, guest-lecturers can be obtained with high specialization in one or more topics; they provide validity and credibility; regardless of their techniques of group presentation, which may range from excellent to poor, they communicate a marked enthusiasm and vitality for the new technology.

Laboratory experiences are necessary for a review and understanding of the principles drawn from the physical sciences, and to develop an understanding of the hardware and its application. Such laboratory work differs from that in which the development of manipulative skills is the primary objective; it has new emphasis: understanding and verification. Because even the best equipped laboratory cannot illustrate all applications, selected field trips are highly desirable and should be included in the program.

The institute program should include, also, a professional seminar so that participants may develop, individually or in groups, the materials which they will need to introduce new units in existing courses or new courses. These include a course outline, text and reference books, list of audio-visual materials, list of teaching aids, list of laboratory equipment and supplies, and a layout of an existing shop or laboratory showing the placement of various new laboratory facilities. With such materials, the participant is well prepared for a conference with his school administrator upon his return to his teaching assignment.

8. Laboratories.--If the technology is in fact, new and not an extension of an existing industrial activity, then institutions preparing teachers will not have the needed laboratories. Further, demands upon these institutions are such that necessary funds are not immediately available. As a part of the institute program, therefore, laboratory materials should be provided the institution on a loan basis. This is strongly believed to be a proper expenditure of funds.

In selecting laboratory materials, it is desirable to use current offerings of school supply organizations rather than attempt custom-made facilities. There are several reasons for this: the participant, as a part of his planning, will want to select and specify the laboratory materials currently available which he will need in his own school; and, as stated in Item 6, Selection Criteria, "it appears to be more desirable to cooperate with such private enterprise. . ." in the improvement and further development of laboratory materials specifically designed for schools, than to develop custom-made materials.

9. Professional-Social Activities.--Not strictly a part of the technical or professional programs, professional-social activities nevertheless serve a real purpose through group planning and reinforcement of individual committments, the development of new friendships, and the further stimulation of high morale needed to introduce the new.

Results appear to be best when participants leave their families at home, and live together in campus facilities. Scheduled activities may include visits to industrial plants and research facilities, local tourist attractions, trade-fairs, summer concerts, art institutes, and others.

10. The Institute Director.-- Key to a productive summer institute is the institute director who should be knowledgeable in the pattern and techniques previously described, and who should have the same motiviation and high interest which he is expected to develop in his own participants.

In the first summer institute on fluid power, 1964, participants were selected from institutions preparing teachers and as potential institute directors. Directors for 1965 institutes were, thereby, previously trained. While such an institute program has proven to be effective in developing institute directors, there are no data or experiences for comparisons; it is, however, highly recommended.

11.--Evaluation.--A report of what was accomplished by the multiple-institute program is worthwhile, expected, and can be of value to others. But such evaluation should not be conceived as research but as feed-back. If the main purpose of the institute program is to introduce a new technology into schools by providing initial preparation for selected teachers, then other needs such as curriculum research and laboratory development are extraneous regardless of their importance. To accomplish its purpose, the institute program cannot include other and related research without being diverted.

It would seem logical to develop plans, evaluation, and an outline for the final report together. A final report might contain the following information:

a. Institutions, Staff, and Dates of Institutes

b. Adequacy of Physical Facilities

Living Accomodations

Food Service

Lecture-Demonstration

Laboratory

Group Study

c. Institute Program

Content of Technical Program

Field Trips

Professional Seminar Activities

Social-Professional Program

Time Allocations

d. Participants

Verification of Qualifications

Names, Schools, School Addresses

Types of Schools or School Levels

Geographical Area by States

e. Instructors' Qualifications

f. Quality of Programs

Test Scores

Participant Appraisal of Instruction

Number, Time Spent, and Value of Laboratory Experiences

Seminar Assignments Completed

Social-Professional Activities: Value, Participation

g. Cooperation of Industry

Institute Advisory Committee, Local

Guest Lecturers

Instructional Materials and Teaching Aids

h. Follow-Up Study of Participants

Educational Plans

Mid-Year Progress Report

Final Report

12. Next Steps.--First, the summer institute program should be continued a second and third year, perhaps longer. Assuming that colleges preparing teachers will introduce a program in the new technology immediately, four years would elapse before graduates would be available for teaching assignments. The time can be shortened for some by offering courses during summer sessions for graduate credit to those

now teaching; but this, it is believed, would not provide enough teachers to meet the demand.

Second, colleges preparing teachers also need competent instructors with training beyond that which can be obtained in a summer institute. Some plan needs to be developed and funds made available for a one-year program for college instructors. Because of the number of such colleges, it will be necessary to be selective.

Third, the selected colleges will need financial help in developing suitable laboratory materials which, roughly estimated, may amount to $80,000 for fluid power. To many colleges such an amount of funds and building space for one specialization would be difficult to justify in terms of the number of students to be served. It may be desirable, therefore, to select those colleges which, in addition to teacher education, offer two or four technology programs.

Fourth, curriculumization of the new technology is needed. What should be taught at the senior high school level? The area vocational school in an agricultural community? The technical institute in an industrial area? To answer these and other questions, job analyses and an occupational survey should be made to find present job titles of employees in the new technology, job descriptions, and other information. Next, how many such employees are there now, and how many will be needed in the years ahead? And are there concentrations in particular geographical areas? All this and other information is needed to design laboratories and construct courses of study.

In fluid power a start has been made, and all those who have assisted in this ground-breaking endeavor should be accorded the appreciation of both industry and education.

APPENDIX A

APPENDIX A

1965 SUMMER INSTITUTES ON FLUID POWER EDUCATION

EVALUATION PROCEDURE I

LABORATORY MANUALS AND WORKBOOKS

AND DEMONSTRATION AND LABORATORY DEVICES

In the more recent technologies, such as Fluid Power, occupational competence requires more information and understanding, and fewer manipulative skills than in the traditional skilled trades. Of the various types of laboratory devices now available, are all satisfactory? And finally, are the workbooks and/or laboratory manuals for each of the laboratory devices sufficiently comprehensive?

To obtain data necessary to provide answers to these questions, the following procedure is suggested:

1. During the institute, each group of participants will evaluate both the device and the workbook or manual, using a checklist prepared for that purpose. The evaluation committee will prepare and include a summary report of the participant's checklists in the June, 1966 report to the USOE.

2. Of many factors considered in evaluating laboratory devices for school use, size of components used is of particular concern. For this reason opinions of participants will be tabulated on size of components for each device, and conclusion if any will be drawn.

To Instructors:

1. Divide participants into groups of equal numbers. This would be approximately 5 (five) members per group.

2. With a total of 30 (thirty) hours devoted to laboratory devices, this would give about 7 (seven) hours per group per laboratory device.

3. Please advise participants of importance and necessity of this evaluation.

4. Send completed laboratory report forms to me weekly so that I can keep abreast of the tabulation.

5. Assign laboratory demonstrations or experiments to the groups. They will then conduct assignments using related laboratory manuals and fill out evaluation form for each device and manual. They should list each demonstration and experiment and its evaluation.

<u>To Student</u>:

1. Please keep accurate records of your demonstration or experiment. List the name of the demonstration or experiment and evaluate the device.

2. Evaluate the workbook as well as the instructional devices.

3. Please turn in the completed form at the end of each week to your instructor so they can be forwarded to the coordinator for tabulation.

Thank you, for your cooperation,

Fred Lamb,
Coordinator

I-A. CHECKLIST: Laboratory Manuals and/or Workbooks

Title____
Publisher or Manufacturer____________________
Content____ Hydraulic____Pneumatic____ Both ______

Demonstration or Experiment	Included Yes	Included No	Technical Information	Procedure
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5
______________	___	___	1 2 3 4 5	1 2 3 4 5

Key: 1-Excellent
2-Good
3-Satisfactory
4-Fair
5-Poor

Circle the number corresponding to your judgment.

I-B-1 CHECKLIST: Demonstration and Laboratory Devices

NAME OF UNIT____

A. INSTRUCTION

Demonstration or Experiment	Area		Possible		Ease of Set Up					Safety		
	Hydr.	Pneu.	Yes	No	1	2	3	4	5	Safe	Doubt	Unsafe
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			
					1	2	3	4	5			

Key: 1-Excellent
2-Good
3-Satisfactory
4-Fair
5-Poor

Circle the number corresponding to your judgment

I-B-2. SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Factor	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components (too large or too small)	____	____	____	____	____
Provisions for Preventing Unauthorized Use	____	____	____	____	____
Daily Maintenance Required(oil, dust, etc.)	____	____	____	____	____
Portability	____	____	____	____	____
Storage When Not in Use	____	____	____	____	____
Adaptability as to:					
Power	____	____	____	____	____
Size	____	____	____	____	____
Flow	____	____	____	____	____

Comments: ____

____

____

____

I-C. GENERAL ESTIMATE

	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Laboratory Devices	____	____	____	____	____
Manual or Workbook	____	____	____	____	____

State your reactions in brief by complete statements as to the general estimate of each of the four teaching systems represented at this workshop.

Reported by ______________________________

Date ______________________________

Institution ______________________________

FLUID POWER SOCIETY

ADDRESS REPLY TO:
2079 E. McLean Avenue
Flint, Michigan 48507

To: Institute Directors

Re: Instructional Devices

Please ask each participant to indicate the instructional device he would select for his present or projected teaching assignment in Fluid Power.

Ask him to indicate the level of instruction:

(a) Secondary Vocational Course

(b) Trade Extension Course for Adult employed workers

(c) Post-High School Technical or Junior College

(d) Industrial Arts at Secondary Level

It would also be desirable for them to indicate in a brief statement why they would choose one above another. If you would ask them to add this to the open-ended questions entitled "A Participant's Evaluation of the Instructional Programs," it would eliminate an additional form.

Thank you.

Very truly yours,

Frederick W. Lamb
Coordinator

TABLE 1

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE:
INSTITUTE SUMMARY

College: Los Angeles
Institute: 1
No. of Groups: 4

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics						
Equipment	3				3	
Book		3				
Pneumatics						
Equipment			2			2
Book				2		
ELECTROMATIC						
Hydraulics						
Equipment	2				2	
Book		2				
Pneumatics						
Equipment			-			-
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment	3				3	
Book		3				
Pneumatics						
Equipment			3			3
Book				2		
VEGA						
Hydraulics						
Equipment	1				1	
Book		1				
Pneumatics						
Equipment			1			1
Book				1		

TABLE 1 contd..

College: Los Angeles
Institute: 1
No. of Groups: 4

	Rating					Mean Rating
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	
CAPITAL						
Hydraulics						
Equipment			1			3.0
Book				1		4.0
Pneumatics						
Equipment		1				2.0
Book				1		4.0
ELECTROMATIC						
Hydraulics						
Equipment		1				2.0
Book		1				2.0
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment			1			3.0
Book				1		4.0
Pneumatics						
Equipment			1			3.0
Book				1		4.0
VEGA						
Hydraulics						
Equipment	1					1.0
Book	1					1.0
Pneumatics						
Equipment	1					1.0
Book	1					1.0

TABLE 2

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Minnesota-D
Institute: #1
No. of Groups: 5

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics					1	
Equipment	1					
Book		2				
Pneumatics						1
Equipment			1			
Book				2		
ELECTROMATIC						
Hydraulics					3	
Equipment	3					
Book		3				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					2	
Equipment	2					
Book		3				
Pneumatics						-
Equipment			-			
Book				-		
VEGA						
Hydraulics					2	
Equipment	-					
Book		-				
Pneumatics						1
Equipment			1			
Book				2		

TABLE 2 contd..

College: Minnesota-D
Institute: #1
No. of Groups: 5

	Rating					Mean Rating
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	
CAPITAL						
Hydraulics						
Equipment	1					1.0
Book		1				2.0
Pneumatics						
Equipment	1					1.0
Book		1				2.0
ELECTROMATIC						
Hydraulics						
Equipment			1			3.0
Book			1			3.0
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment		1				2.0
Book			1			3.0
Pneumatics						
Equipment						--
Book						--
VEGA						
Hydraulics						
Equipment						--
Book						--
Pneumatics						
Equipment	1					1.0
Book		1				2.0

TABLE 3

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Minnesota-D
Institute: #2
No. of Groups: 7

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne
CAPITAL						
Hydraulics					4	
Equipment	2					
Book		3				
Pneumatics						2
Equipment			1			
Book				-		
ELECTROMATIC						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						3
Equipment			3			
Book				5		
VEGA						
Hydraulics					3	
Equipment	2					
Book		2				
Pneumatics						1
Equipment			2			
Book				2		

TABLE 3 contd..

College: Minnesota-D
Institute: #2
No. of Groups: 7

	Rating: Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	Mean Rating
CAPITAL						
Hydraulics						
Equipment		1				2.0
Book			1			3.0
Pneumatics						
Equipment	1					1.0
Book						--
ELECTROMATIC						
Hydraulics						
Equipment	1					1.0
Book	1					1.0
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment	1					1.0
Book	1					1.0
Pneumatics						
Equipment			1			3.0
Book					1	5.0
VEGA						
Hydraulics						
Equipment		1				2.0
Book		1				2.0
Pneumatics						
Equipment		1				2.0
Book		1				2.0

TABLE 4

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Trenton
Institute: #1
No. of Groups: 4

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics					2	
Equipment	2					
Book		3				
Pneumatics						1
Equipment			1			
Book				2		
ELECTROMATIC						
Hydraulics					3	
Equipment	4					
Book		2				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					4	
Equipment	3					
Book		4				
Pneumatics						3
Equipment			3			
Book				3		
VEGA						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						1
Equipment			2			
Book				1		

TABLE 4 contd..

College: Trenton
Institute: #1
No. of Groups: 4

	Rating					Mean Rating
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	
CAPITAL						
Hydraulics						
Equipment	2	1		1		2.0
Book	1	1			2	3.2
Pneumatics						
Equipment	2	2				1.5
Book	1	1		1	1	3.0
ELECTROMATIC						
Hydraulics						
Equipment		2	1		1	3.0
Book	1	2		1		2.3
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment		2		1		2.7
Book				1	2	4.7
Pneumatics						
Equipment	1	1	2	1		2.6
Book			1	3	1	3.2
VEGA						
Hydraulics						
Equipment	2	2				1.5
Book	2	1		1		2.0
Pneumatics						
Equipment	1	2				1.7
Book	1	2				1.0

TABLE 5

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Tuskegee
Institute: #1
No. of Groups: 3

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						1
Equipment			1			
Book				1		
ELECTROMATIC						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						1
Equipment			1			
Book				1		
VEGA						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						1
Equipment			1			
Book				1		

TABLE 5 Contd..

College: Tuskegee
Institute: #1
No. of Groups: 3

	Rating					Mean Rating
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	
CAPITAL						
Hydraulics						
Equipment	1	1	1			2.0
Book	1	2				1.7
Pneumatics						
Equipment	1	1	1			2.0
Book	1	2				1.7
ELECTROMATIC						
Hydraulics						
Equipment	1	1	1			2.0
Book	1	2				1.7
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment	1	1	1			2.0
Book	1	2				1.7
Pneumatics						
Equipment	1	1	1			2.0
Book	1	2				1.7
VEGA						
Hydraulics						
Equipment	1	1	1			2.0
Book	1	2				1.7
Pneumatics						
Equipment	1	1	1			2.0
Book	1	2				1.7

TABLE 6

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Wayne
Institute: #1
No. of Groups: 4

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics					4	
Equipment	3					
Book		4				
Pneumatics						3
Equipment			3			
Book				3		
ELECTROMATIC						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					3	
Equipment	4					
Book		3				
Pneumatics						2
Equipment			1			
Book				2		
VEGA						
Hydraulics					2	
Equipment	4					
Book		2				
Pneumatics						1
Equipment			1			
Book				1		

TABLE 6 contd..

College: Wayne
Institute: #1
No. of Groups: 4

	Rating					Mean Rating
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	
CAPITAL						
Hydraulics						
Equipment	1	2		1		2.3
Book			1	2	1	4.0
Pneumatics						
Equipment	1	2		1		2.3
Book	1			2	1	3.5
ELECTROMATIC						
Hydraulics						
Equipment	1	3				1.8
Book	3	1				1.3
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment		1	3			2.8
Book		2	1		1	3.0
Pneumatics						
Equipment		4				2.0
Book		2		1	1	3.3
VEGA						
Hydraulics						
Equipment		1	3			2.8
Book		3	1			2.3
Pneumatics						
Equipment		4				2.0
Book	2		1	1		2.3

TABLE 7

LABORATORY MANUALS AND WORKBOOKS, AND DEMONSTRATION AND LABORATORY DEVICES

FORM 1-C GENERAL ESTIMATE: INSTITUTE SUMMARY

College: Wayne
Institute: #2
No. of Groups: 4

	Individual Rank				Combination Rank	
	Hyd.E.	Hyd.M.	Pne.E.	Pne.M.	Hyd.	Pne.
CAPITAL						
Hydraulics					3	
Equipment	3					
Book		1				
Pneumatics						2
Equipment			2			
Book				1		
ELECTROMATIC						
Hydraulics					2	
Equipment	1					
Book		2				
Pneumatics						-
Equipment			-			
Book				-		
TECHNICAL EQUIPMENT						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						3
Equipment			2			
Book				3		
VEGA						
Hydraulics					1	
Equipment	1					
Book		1				
Pneumatics						1
Equipment			1			
Book				1		

TABLE 7 contd.

Collage: Wayne
Institute: 2
No. of Groups: 4

	Rating					Mean
	Excel. 1	Good 2	Satis. 3	Fair 4	Poor 5	Rating
CAPITAL						
Hydraulics						
Equipment		1	1			2.5
Book	1				1	3.0
Pneumatics						
Equipment		1				2.0
Book	1					1.0
ELECTROMATIC						
Hydraulics						
Equipment		1				2.0
Book				1		4.0
Pneumatics						
Equipment						--
Book						--
TECHNICAL EQUIPMENT						
Hydraulics						
Equipment		1				2.0
Book			1			3.0
Pneumatics						
Equipment		1				2.0
Book			1			3.0
VEGA						
Hydraulics						
Equipment	1					1.0
Book	1					1.0
Pneumatics						
Equipment		1				2.0
Book				1		4.0

College: Los Angeles

Institute: #1

No. of Groups: 1

Device: Capital

TABLE 9

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis fac-tory	4 Fair	5 Poor
Size of Components	3.0			1		
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	2.0		1			
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Los Angeles

Institute: #1

No. of Groups: 1

Device: Electromatic

TABLE 10

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, Etc.	5.0					1
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	4.0				1	
Size	1.0	1				
Flow	1.0	1				

College: Los Angeles

Institute: #1

No. of Groups: 1

Device: Technical

TABLE 11

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	5.0					1
Storage When Not in Use	5.0					1
Adaptability:						
Power	3.0			1		
Size	3.0			1		
Flow	3.0			1		

College: Los Angeles

Institute: #1

No. of Groups: 1

Device: Vega

TABLE 12

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	1.0	1				
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	4.0				1	
Storage When Not in Use	1.0	1				
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Minn. - Duluth (1)

Institute: #2

No. of Groups: 5

Device: Capital

TABLE 13

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Minn. - Duluth (1)

Institute: #2

No. of Groups: 5

Device: Electromatic

TABLE 14

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	2.0		1			
Storage When Not in Use	4.0				1	
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Minn. - Duluth (1)

Institute: #2

No. of Groups: 5

Device: Technical

TABLE 15

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	5.0					1
Portability	2.0		1			
Storage When Not in Use	5.0					1
Adaptability:						
Power	1.0	1				
Size	2.0		1			
Flow	2.0		1			

College: Duluth (2)

Institute: #2

No. of Groups: 5

Device: Vega

TABLE 16

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Duluth (2)

Institute: #3

No. of Groups 7

Device: Capital

TABLE 17

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	2.0		1			
Adaptability:						
Power	2.0		1			
Size	1.0	1				
Flow	2.0		1			

College: Duluth (2)

Institute: #3

No. of Groups: 7

Device: Electromatic

TABLE 18

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	1.0	1				
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	1.0	1				
Storage When Not in Use	2.0		1			
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Duluth (2)

Institute: #3

No. of Groups: 7

Device: Technical

TABLE 19

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	3.0			1		
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	2.0		1			
Portability	2.0		1			
Storage When Not in Use	4.0				1	
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Duluth (1)

Institute: #3

No. of Groups 7

Device: Vega

TABLE 20

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	2.0		1			
Portability	2.0		1			
Storage When Not in Use	3.0			1		
Adaptability:						
Power	3.0			1		
Size	2.0		1			
Flow	2.0		1			

College: Trenton

Institute: #4

No. of Groups: 4

Device: Capital

TABLE 21

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	3.0			1		
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	3.0			1		
Portability	2.0		1			
Storage When Not in Use	3.0			1		
Adaptability:						
Power	1.0	1				
Size	2.0		1			
Flow	1.0	1				

College: Trenton

Institute: #4

No. of Groups: 4

Device: Electromatic

TABLE 22

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	2.0		1			
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Trenton

Institute: #4

No. of Groups: 4

Device: Technical

TABLE 23

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Good
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	3.0			1		
Portability	4.0				1	
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	3.0			1		

College: Trenton

Institute: #4

No. of Groups: 4

Device: Vega

TABLE 24

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	4.0				1	
Storage When Not in Use	1.0	1				
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Tuskegee

Institute: #5

No. of Groups: 3

Device: Capital

TABLE 25

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Tuskegee

Institute: #5

No. of Groups: 3

Device: Electromatic

TABLE 26

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Tuskegee

Institute: #5

No. of Groups: 3

Device: Technical

TABLE 27

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Good
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Tuskegee

Institute: #5

No. of Groups: 3

Device: Vega

TABLE 28

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	2.0		1			
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	3.0			1		
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Wayne State (1)

Institute: #6

No. of Groups: 4

Device: Capital

TABLE 29

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	3.0			1		
Portability	2.0		1			
Storage When Not in Use	3.0			1		
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Wayne State (1)

Institute: #6

No. of Groups: 4

Device: Electromatic

TABLE 30

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	3.0			1		
Portability	2.0		1			
Storage When Not in Use	4.0				1	
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	2.0		1			

College: Wayne State (1)

Institute: #6

No. of Groups: 4

Device: Technical

TABLE 31

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	4.0				1	
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	4.0				1	
Storage When Not in Use	4.0				1	
Adaptability:						
Power	3.0			1		
Size	3.0			1		
Flow	3.0			1		

College: Wayne State (1)

Institute: #6

No. of Groups: 4

Device: Vega

TABLE 32

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	3.0			1		
Storage When Not in Use	2.0		1			
Adaptability:						
Power	3.0			1		
Size	3.0			1		
Flow	3.0			1		

College: Wayne State (2)

Institute: #7

No. of Groups: 4

Device: Capital

TABLE 33

SUITABILITY OF T[illegible]I[illegible]I[illegible]G DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	2.0		1			
Portability	1.0	1				
Storage When Not in Use	2.0		1			
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	1.0	1				

College: Wayne State (2)

Institute: #7

No. of Groups: 4

Device: Electromatic

TABLE 34

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	2.0		1			
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	4.0				1	
Portability	2.0		1			
Storage When Not in Use	5.0					1
Adaptability:						
Power	1.0	1				
Size	1.0	1				
Flow	4.0				1	

College: Wayne State (2)

Institute: #7

No. of Groups: 4

Device: Technical

TABLE 35

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	5.0					1
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	5.0					1
Storage When Not in Use	4.0				1	
Adaptability:						
Power	3.0			1		
Size	4.0				1	
Flow	2.0		1			

College: Wayne State (2)

Institute: #7

No. of Groups: 4

Device: Vega

TABLE 36

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.0	1				
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	1.0	1				
Portability	1.0	1				
Storage When Not in Use	1.0	1				
Adaptability:						
Power	2.0		1			
Size	2.0		1			
Flow	1.0	1				

College: All 5

Institute: All - 7

No. of Groups: 28

Device: Capital

TABLE 37

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Institute Summary

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.9		1			
Provisions for Preventing Unauthorized Use	3.9				1	
Daily Maintenance Required: Oil, Dust, etc.	1.9		1			
Portability	1.3	1				
Storage When Not in Use	2.7			1		
Adaptability:						
Power	1.3	1				
Size	1.3	1				
Flow	1.1	1				

College: All - 5

Institute: All - 7

No. of Groups: 28

Device: Electromatic

TABLE 38

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.4	1				
Provisions for Preventing Unauthorized Use	3.0			1		
Daily Maintenance Required: Oil, Dust, etc.	3.1			1		
Portability	1.5		1			
Storage When Not in Use	3.4			1		
Adaptability:						
Power	1.9		1			
Size	1.4	1				
Flow	1.9		1			

College: All - 5

Institute: All - 7

No. of Groups: 28

Device: Technical

TABLE 39

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Factor	Mean	1 Excellent	2 Good	3 Satisfactory	4 Fair	5 Poor
Size of Components	1.9		1			
Provisions for Preventing Unauthorized Use	3.9				1	
Daily Maintenance Required: Oil, Dust, etc.	2.9			1		
Portability	3.3			1		
Storage When Not in Use	4.0				1	
Adaptability:						
Power	2.3		1			
Size	2.6			1		
Flow	2.4		1			

College: All - 5

Institute: All - 7

No. of Groups: 28

Device: Vega

TABLE 40

SUITABILITY OF TRAINING DEVICE FOR SCHOOL USE

Factor	Mean	1 Ex-cel-lent	2 Good	3 Satis-fac-tory	4 Fair	5 Poor
Size of Components	1.9		1			
Provisions for Preventing Unauthorized Use	2.7			1		
Daily Maintenance Required: Oil, Dust, etc.	1.7		1			
Portability	2.3		1			
Storage When Not in Use	2.0		1			
Adaptability:						
Power	2.1		1			
Size	2.0		1			
Flow	1.9		1			

APPENDIX B

APPENDIX B

INSTRUCTIONAL PROGRAM

A. Examinations

The directors of the institutes meeting in Milwaukee, May 17 and 18, adjusted the length of their institutes to approximately the same number of days; agreed upon total time in hours for class instruction, laboratory work and other activities; identified main topics in both Hydraulics and Pneumatics; and each agreed to prepare six multiple-choice test items on four main topics.

Time Allocation

Class Instruction	
Hydraulics	55 hours
Pneumatics	30
Disassembly-Assembly	36
Laboratory	30
Seminar	7
Field Trips	14
Examination	3
Total	175 hours

Content

Hydraulics

Basic Laws
Language: Symbols, Terms

Fluids
Fluid Conditioners
Pumps
Pressure Control Valves
Directional Valves
Flow-Control Valves
Actuators--Motors
Boosters--Accumulators
Conductors
Circuits

Pneumatics

Basic Laws
Language: Symbols, Terms
Pumps
Conditioners
F R L
Valves
Actuators
Conductors
Circuits

When received, test items will be carefully edited and assembled to form a test of 126 items. Copies will be made and mailed to each institute director with directions for giving the examinations. At the appointed time, the examination will be conducted. The director will score each examination, keeping a record of such scores for his own evaluation purposes, and then return all copies to the Fluid Power Society.

Next, an item analysis will be made, using difference of percentages. Those which do not discriminate will be discarded; re-scoring and further statistical treatment will be based on discriminating items only. (See I, 2.)

Finally, the mean scores for all institutes will be compared and differences, if any, will be tested for significance by the F ratio at the .95 level.

B. Qualifications of Instructors of Institutes

The technical and professional competencies of institute directors, although supplemented by specialists from industry, are one of several factors determining the quality of instructional programs. But because such competencies are extremely difficult to measure, it is proposed that descriptions of education and experience be used instead.

First, information will be obtained from each instructor using a form prepared for that purpose.

Next, members of the Evaluation Committee who are themselves competent in Fluid Power, will examine personal information obtained, and make judgments of technical competency required to conduct the Institute using a form, Competency Report, prepared for that purpose. Finally, these individual judgments will be summarized, and made a part of the final report. Institute instructors, however, will not be identified by name or institution.

C. Observation and Evaluation

Three members of the Evaluation Committee who have competencies in both Fluid Power and instruction will visit each of the institutes once during the summer to get first-hand impressions of the quality of the programs.

To assist in making these visits and to facilitate the summarization of information, a checklist has been prepared.

For each institute, a combined judgment will be reported but individual institutions will not be identified.

FLUID POWER SOCIETY
Thiensville, Wisconsin
P.O. Box 49

Summer Institutes on
Fluid Power Education
Frederick W. Lamb, Coordinator

TO: Directors of Summer Institutes in Fluid Power

SUBJECT: Final Exam

Please give Final Exam near the end of the Institutes. Upon completion of the exam, return to me, I will correct and tabulate the results.

The purpose of this Exam is not to compare results of one Institute with another, but to indicate weak spots, if any, in the structure of Course Content, methods of instruction and administration of such Institutes. This will aid us in conducting similar Institutes at some future date.

Thank you for your cooperation in writing the questions. I am sure we will be pleased with the results of this portion of the evaluation.

Frederick W. Lamb
Coordinator

Name______________________________
(last) (first) (M.I.)

Institution_______________________

Date____________________________

EXAMINATION

Directions: The following are multiple choice questions. Each has four (4) possible answers, designated A, B, C, D. Please read the question thoroughly and indicate the right answer by placing the appropriate letter in the space provided.

________ 1. The pressure that is available in an open tank to force oil into the pump is the: (a) suction pressure, (b) system pressure, (c) zero pressure, (d) atmospheric pressure.

________ 2. A device used to regulate the functions of a machine is called: (a) control, (b) pump, (c) actuator, (d) filter.

________ 3. A drawing that shows the function of all valves, controls, and actuators is called: (a) graphical diagram, (b) pictorial diagram, (c) working diagram, (d) elementary diagram.

________ 4. The excess pressure existing in a pressure wave is known as: (a) back pressure, (b) operating pressure, (c) shock pressure, (d) head pressure.

________ 5. "The absolute pressure of a confined body of gas varies inversely as the volume" is: (a) Bernoulli's Law, (b) Boyle's Law, (c) Charles' Law, (d) Pascal's Law.

________ 6. The term "Static Head" can be defined as: (a) distance from the center line of the pump to the free discharge surface, (b) $h = \frac{V^2}{2g}$, (c) the height of a column of fluid above a given point, (d) 64.4 ft./sec.^{2}.

_________ 7. Metered flow is: (a) flow at a controlled rate, (b) flow in which motion occurs or a movement of one layer of fluid upon another, (c) flow in which fluid particles move at random, (d) flow in which conditions such as pressure, temperature, and velocity at points in the liquid change.

_________ 8. The total force developed by an actuating cyclinder is the product of pressure and the: (a) diameter of the cylinder, (b) cross-sectional area of the cylinder, (c) volume of oil in the cylinder, (d) length of the cylinder.

_________ 9. The resistance a liquid offers to flow is called: (a) flash point, (b) pour point, (c) hydraulic instability, (d) viscosity.

_________10. Air pressure at absolute zero is: (a) 100 P.S.I. (b) 14.7 P.S.I. (c) 0 P.S.I. (d) 10 P.S.I.

_________11. A fixed volume of air at 80 P.S.I.G. and at 70° F is heated to 140° F. What is its new pressure?: (a) 107.2 P.S.I.G. (b) 92.5 P.S.I.G. (c) 94.7 P.S.I.G. (d) 160 P.S.I.G.

_________12. Force equals: (a) pressure divided by area, (b) distance times pressure, (c) distance divided by area, (d) area times pressure.

_________13. A cylinder has an area ratio of 2:1. If the piston extends in one minute it will retract in: (a) one minute, (b) three minutes, (c) one-half minute,

_________14. Doubling the inside diameter of a pipe will: (a) double the inside cross sectional area, (b) cube the inside cross sectional area, (c) increase the velocity of the oil flowing through it, (d) decrease the friction of the oil flowing through it.

_________15. The cross sectional area of a one-inch diameter piston is: (a) .7854 square inch, (b) one square inch, (c) one cubic inch, (d) 7.854 square inches.

_________16. The power required to drive a 10 G.P.M. pump with a 1000 O.S.I. load is approximately: (a) 14 H.P. (b) 7 H.P. (c) 8 H.P. (d) 10 H.P.

_________17. The most important thing to do before attempting to remove a hydraulic line is (a) consult a circuit diagram, (b) drain reservoir, (c) release system pressure, (d) place all controls in neutral.

_________18. What pressure is available in an open reservoir to force oil into the pump?: (a) system pressure, (b) suction pressure, (c) atmospheric pressure, (d) return line pressure.

_________19. How much pressure is required to move a load of 100 lbs., if the piston is 3 inches in diameter?: (a) 33.3 P.S.I., (b) 14.1 P.S.I., (c) 141.1 P.S.I., (d) 333.3 P.S.I.

_________20. Torque is equal to: (a) force x distance, (b) force x radius or lever arm, (c) force divided by area, (d) force divided by work.

_________21. Three actuating cylinders have an area of 1, 3, and 5 square inches respectively, hooked to a common pressure inlet line, and are loaded with the same weight. The first cylinder to move its load will be the cylinder with the area of: (a) 5 sq. in., (b) 3 sq. in., (c) 1 sq. in., (d) All will move at the same time.

_________22. A cylinder has an area ratio of 2:1. The maximum force which can be exerted by the piston rod will be: (a) greater when oil is directed to the rod end, (b) equal in both directions, (c) half as great when oil is directed to the head end, (d) two times greater when oil is directed to the head end.

_________23. The term "Isothermal" means: (a) temperature change of 100° C, (b) temperature will vary with heat, (c) constant temperature change, (d) no change of temperature.

_________24. Hydraulic fluid should serve as a: (a) lubricant, (b) seal agent, (c) power transmitting medium, (d) all of the above.

________25. Which of the following hydraulic fluids is not considered fire resistant?: (a) paraffinic base, (b) oil-in-water, (c) water-in-oil, (d) water-glycol.

________26. Which of the following temperature ranges in degrees Fahrenheit is recommended for hydraulic oil in the reservoir of operating systems?: (a) 90-100, (b) 120-130, (c) 150-160, (d) 170-180.

________27. Which of the following characteristics has a direct bearing on the performance of a hydraulic oil?: (a) color of oil, (b) flash point of oil, (c) carbon residue in oil, (d) viscosity of oil.

________28. Use of a hydraulic oil that is too light usually results in: (a) higher power consumption, (b) increased pressure drop, (c) higher oil temperatures, (d) increased component wear.

________29. The chemical stability of oil is least affected by: (a) high temperatures, (b) passage through orifices, (c) high pressures, (d) water deposits.

________30. Why is water not an ideal fluid for hydraulic systems?: (a) water is much more compressible than oil, (b) the weight of water compared to oil makes it undesirable for universal use, (c) water does not flow as freely as oil in hose and tubing, (d) water has a specific freezing and boiling point within normal operating service.

________31. The selection of the mesh size of a filter located on the suction side of the pump is determined primarily by: (a) the amount of water to be removed from the oil, (b) the amount of metal to be removed from the oil, (c) the amount of lint to be removed from the oil, (d) the amount of pump pressure drop.

________32. Filters located in the reservoir on the suction side of the pump should have an approximate mesh size of: (a) 100-200, (b) 200-300, (c) 300-400, (d) 400-500.

_________33. Which of the following positions for filter installation in a system is not recommended: (a) return line filter, (b) relief valve discharge filter, (c) pressure line filter, (d) directional control valve filter.

_________34. Which of the following conditions have little or no affect on the location of a filter in the hydraulic system?: (a) required degree of filtration, (b) manufacturer's grade of oil (c) system pressure, (d) frequency of maintenance.

_________35. Absorbent (active) type filters function by chemical attraction in addition to purely mechanical means. Caution should be taken when selecting absorbent filters because: (a) they are not effective in removing metal particles from oil, (b) they may remove additives from oil, (c) they cannot remove water from oil, (d) they are only slightly effective in removing sludge from oil.

_________36. Absorbent (inactive) filters contain such filtering elements as asbestos, quartz, mineral wool, felt, wool yarn, etc. Absorbent filters will not remove (a) coarse contaminants, (b) fine metal particles, (c) water in oil, (d) oil additives.

_________37. A circuit that performs functions in a predetermined order as a result of increases in pressure is called a: (a) sequence circuit, (b) counter-balance circuit, (c) parallel circuit.

_________38. A drill press feed would use a: (a) meter-in circuit, (b) meter-out circuit, (c) pressure-reducing circuit, (d) parallel circuit.

_________39. A meter-in circuit is used when: (a) operation is erratic, (b) pump delivery is greater than requirement of feed mechanism, (c) pressure control is required, (d) sequence operations are used.

_________40. Parallel circuits can be operated on equal pressures by the use of (a) flow dividers, (b) pressure reducing valves, (c) counter-balance valves, (d) sequence valves.

_________41. Flow control valves are used in: (a) safety circuits, (b) speed control circuits, (c) fixed displacement pumps.

_________42. Important components that must be included in the design of safe air circuits are: (a) intensifiers, (b) check valves, (c) intercoolers, (d) lubricators and filters.

_________43. Logic functions of pneumatics parallel those of: (a) hydraulics, (b) mechanical controls, (c) electrical controls, (d) remote controls.

_________44. A series circuit is commonly used with: (a) safety applications, (b) speed controls, (c) sequence operations, (d) transfer operations.

_________45. Air circuits usually do not have: (a) pressure controls, (b) return lines, (c) volume controls, (d) sequence controls.

_________46. A common use of pneumatics is found in: (a) safety applications, (b) moving heavy loads, (c) rotary power of machines, (d) multiplication of force in power tools.

_________47. A device that assists in increasing the speed of an air piston during fluctuating system pressures is called a: (a) surge tank, (b) intensifier, (c) receiver, (d) variable speed.

_________48. One of the following factors is not an advantage common to vane type air actuators: (a) explosion-proof, (b) high torque at low speeds, (c) cool running, (d) variable speed.

_________49. The force of a circuit using a pneumatic cylinder is most easily increased by changing: (a) bore-size, (b) stroke length, (c) system pressure, (d) method of control.

_________50. Rotary air actuators are commonly used for: (a) clamping, (b) feed circuits, (c) driving threaded fasteners, (d) raising loads.

_________51. The velocity of a pneumatic piston is affected greatly by: (a) packing friction, (b) system pressure, (c) volume of air available, (d) type of control.

_________52. Shock and damage to cylinders are prevented by: (a) cushioning, (b) bumpers, (c) increased pressure, (d) decreased pressure.

_________53. A circuit that maintains pressure on the rod side of a vertically mounted cylinder to hold the piston in place is known as a: (a) pressure control circuit, (b) sequence circuit, (c) counter-balance circuit, (d) pressure-reducing circuit.

_________54. An advantage of a rotary hydraulic motor over other types of rotary power is: (a) storage of energy, (b) infinitely variable speed with constant torque, (c) very little heat build-up under heavy loads, (d) high torque at low pressure.

_________55. The difference in rate of movement of a cylinder to left or right is determined by: (a) type of packing, (b) type of oil, (c) system pressure, (d) difference in area of rod and head end.

_________56. In a system with a piston diameter of 4" and a displacement of 2 gallons per minute, the velocity of the rod extending is: (a) 370 inches per minute, (b) 35 inches per minute, (c) 37 inches per minute, (d) 38 inches per minute.

________57. Cushioning in a cylinder is: (a) done by use of external springs, (b) done by use of internal springs, (c) a deceleration device, (d) not commonly used.

________58. A piston with a diameter of 4" operating with a system pressure of 500 P.S.I. exerts: (a) 6400 pounds of force, (b) 6100 P.S.I. (c) 6250 P.S.I. (d) 6250 pounds of force.

________59. Incorrect alignment when installing a cylinder will cause the cylinder to: (a) move too fast, (b) move too slowly, (c) operate erratically, (d) has little bearing on the cylinder's use.

________60. Which of the following statements is false? (a) A directional valve can function as a pilot valve. (b) A directional valve can function as a sequence valve. (c) A directional valve can function as an unloading valve. (d) A directional control can function as a relief valve.

________61. What type of hydraulic pump is generally most efficient for use in systems with high pressures and small delivery? (a) vane type, (b) piston type, (c) screw gear type, (d) centrifugal type.

________62. What is a by-pass type of flow control?: (a) A valve that is manually adjusted to bleed off excessive fluid from the circuit. (b) A valve that restricts flow at its inlet to cause excessive fluid to by-pass back to the reservoir through a relief valve. (c) A valve that by-passes fluid from the system at a pressure slightly higher than that of system pressure. (d) A valve that by-passes fluid from a system at a pressure slightly higher than the relief valve setting.

_________63. What is an unloading valve?: (a) A valve with the primary function of controlling pilot pressure. (b) A valve with the primary function of eliminating excessive pressures. (c) A valve that serves a primary function of providing braking action. (d) A valve with the primary function of permitting a pump to operate at minimum speed.

_________64. Which of the basic designs of directional control valves provide the best metering characteristics for controlling actuator speeds? (a) Spool types. (b) Poppet types. (c) Rotary shear plate types. (d) Shear slide plate types.

_________65. Which of the following is incorrect, if flow controls are used for metering-in-metering-out and bleed of circuits?: (a) Fluid metered to an actuator is meter in. (b) Fluid metered from an actuator is meter out. (c) Fluid mete d from the main circuit is bled off. (d) Fluid by-passed from the circuit is bled off.

_________66. Which of the following is not a flow control valve?: (a) Restricted inlet type. (b) Variable orifice type. (c) By-pass type. (d) Fixed orifice type.

_________67. Under what classification would an axial hydraulic piston pump be classed?: (a) A non-positive displacement axial flow pump. (b) A non-positive displacement hydraulic pump. (c) A positive displacement hydraulic piston pump. (d) A positive displacement velocity pump.

_________68. Which of the following methods is not generally used to control a three position, 4-way, spring-centered valve? (a) Electrical, (b) Pilot, (c) Mechanical, (d) Servo.

_________69. What is a relief valve? (a) A valve with the primary function of increasing system pressure. (b) A valve with the primary function of limiting system pressure. (c) A valve with the primary function of stopping system pressure. (d) A valve with the primary function to lower system pressure.

_________70. What is a sequence valve? (a) A valve with the primary function of eliminating flow. (b) A valve with the primary function of directing flow in a predetermined cycle. (c) A valve with the primary function of helping direct flow back to tank. (d) A valve with a design similar to that of a slip valve.

_________71. What is a pressure reducing valve? (a) A pressure control valve with the primary function of limiting outlet pressure. (b) A pressure control valve with the primary function of limiting inlet pressure. (c) A pressure control valve with the primary function of compensating for pressure drop. (d) A pressure control valve with the primary function of eliminating pressure drop.

_________72. What is the purpose of a hydraulic pump? (a) To convert electrical energy into pressure. (b) To convert mechanical energy into pressure. (c) To convert mechanical force and motion into hydraulic fluid power. (d) To convert horsepower into pressure.

_________73. What type of flow is more efficient for a metering-in application? (a) Restricted inlet type. (b) Variable orifice type. (c) Fixed orifice type. (d) By-pass type.

_________74. Which of the four is the best method of porting fluid through a hydraulic pump? (a) The pintle arrangement. (b) The valve plate method. (c) The pressure compensated method. (d) The hydrostatic method.

_________75. What is meant when a hydraulic pump is pressure compensated? (a) It means the hydraulic pump is servo controlled. (b) Pressure compensated means the pump is reversible. (c) It is built-in mechanical device to change the operating speed of the pump. (d) A pressure compensated pump is designed with a device that changes pump delivery in response to work load.

_________76. What is a positive displacement pump? (a) A pump that delivers a specific amount of hydraulic fluid to the system for each revolution. (b) A pump that delivers a specific velocity of flow to the system. (c) A pump that delivers a specific pressure to the hydraulic system. (d) A pump that delivers a variable pressure to the system.

_________77. Which of the following is not an important factor in the selection of a hydraulic pump? (a) Displacement per revolution. (b) Maximum pressure rating. (c) Minimum pressure rating. (d) Maximum operating speed.

_________78. How does a pressure compensated flow control valve control fluid flow? (a) By maintaining a constant input pressure. (b) By increasing the size of metering orifice in proportion to flow increase. (c) By sensing output pressure and utilizing this pressure to vary a metering orifice. (d) By maintaining a constant pressure drop across the metering orifice.

_________79. Pneumatic circuits in factories differ from hydraulic circuits in that they: (a) Do not need a prime mover. (b) Are basically used in linear applications. (c) Operate from a central power source. (d) Have different symbols and diagrams.

_________80. Which of the following installation positions is recommended for filter-lubricator-regulator units in pneumatic systems? (a) As close as possible to the compressor (pressure side). (b) As close as possible to the compressor (intake side). (c) As close as possible to directional control valves only (intake side). (d) As close as possible to all operating equipment (intake side).

_________81. Sags in tubing and hose lines between filter-regulator-lubricator units and operating equipment should be avoided because: (a) air volume will be reduced, (b) oil in air will not be atomized, (c) oil mist will cause a back pressure, (d) oil mist may collect in the sag.

_________82. The selection of a filter-lubricator-regulator should be determined by: (a) volume of air used by equipment, (b) pressure of air in the system, (c) size of compressor unit, (d) efficiency of filters on the compressor.

_________83. Correct oil-air mixture from the F.R.L. unit to various operating components can be sufficiently determined by: (a) consulting F.R.L. manufacturers charts, (b) watching the oil flow thru the visa dome on the lubricating unit, (c) disconnecting pressure line from the operating unit and blowing the air, (d) disconnecting pressure line from operating unit and completely disassemble unit for analysis.

_________84. Installation of slow moving pneumatic equipment above a filter-regulator-lubricator unit should be avoided because: (a) slow moving pneumatic equipment requires more oil-air mixture, (b) slow moving pneumatic equipment may not carry oil-air mixture to a higher level, (c) slow-moving pneumatic equipment will tend to force oil-air mixture back to F.R.L. (d) F.R.L. will not force an oil-air mixture to a higher level.

_________85. The filter-regulator-lubricator will <u>not</u> accomplish the following task: (a) compensate for fluctations in air pressure delivered from supply, (b) compensate for CFM demands of equipment downstream, (c) regulate downstream PSI when air turbulence between supply and FRL unit.

_________86. A three way valve: (a) has three ports for flow into or out of the valve, (b) can be placed in three positions, (c) has three different flow paths through the valve, (d) is solenoid controlled.

________ 87. In pneumatic directional valves the return air: (a) is usually exhausted to atmosphere, (b) is usually returned to the receiver, (c) is usually piped back to the regulator, (d) is used to shift the valve.

________ 88. A pneumatic 4-way, 3-position, open-center valve: (a) has all ports open to each other, (b) has all ports blocked, (c) has inlet open to exhaust and the cylinder ports blocked, (d) has the pressure port open to the cylinder ports and the exhaust port blocked.

________ 89. A pneumatic flow control valve: (a) is always pressure compensated, (b) is usually not pressure compensated, (c) is always on the meter-in side, (d) is not a practical type of valve.

________ 90. The most widely used type of pneumatic directional valve: (a) is a two-position, 2-way valve, (b) is a 3-position, 2-way valve, (c) is a 3-position, spring offset valve, (d) is a solenoid controlled pilot operated valve.

________ 91. In a conductor, flow velocity varies: (a) inversely with the inside diameter, (b) inversely with the square of the inside diameter, (c) directly with the inside diameter, (d) directly with the square of the inside diameter.

________ 92. In a standard 1/2" steel tube: (a) the inside diameter is 1/2", (b) the wall thickness is 1/2", (c) the outside diameter is 1/2", (d) the area is 1/2 sq. in.

________ 93. A conductor that provides multiple connections is: (a) a passage, (b) a channel, (c) a sub-plate, (d) a manifold.

________ 94. The recommended velocity range through a conductor is: (a) 2-3 ft/sec. (b) 7-15 ft. sec. (c) 25-35 ft/sec. (d) 50-55 ft/sec.

________ 95. Friction in a conductor: (a) decreases as the length of the conductor increases, (b) is not a very important factor in hydraulic circuits, (c) varies inversely with the square of the velocity of the oil, (d) varies directly with the velocity of the oil.

_______96. In standard 1/2" pipe: (a) the inside diameter is 1/2", (b) the outside diameter is 1/2", (c) the wall thickness is 1/2", (d) none of the above.

FORM II-B

F L U I D   P O W E R   S O C I E T Y

PERSONAL INFORMATION ON 1965 SUMMER INSTITUTE INSTRUCTORS

Name ______________________ ______________________
First Last

Position or Title ______________________

Institution ______________________

Address ______________________
Street and Number

______________ ______________ ______
City State Code

A. FORMAL EDUCATION

1. Institution | Degree | Date

______________ ______________ ______

______________ ______________ ______

______________ ______________ ______

2. Technical Courses in Fluid Power

Course | Hours

______________ ______

______________ ______

______________ ______

______________ ______

3. Related Technical Courses

Course | Hours

______________ ______

______________ ______

______________ ______

4. Related Science and Mathematics

Course	Hours

5. Plant Training Programs and Interneships

Company	Weeks	Year

B. INFORMAL PROGRAMS: (Please list any conferences of meetings on Fluid Power which you have attended, books which you have read and studied, and other informal educational experiences in Fluid Power.)

C. TEACHING EXPERIENCE

Institution or School	Subjects Taught	Grade Level	Year

D. INDUSTRIAL EXPERIENCE[1]

Job	Company	Dates

[1] Indicate any work assignment which included operation, service, maintenance, installation, or design of fluid power systems or components by circling the name of the job.

E. PROFESSIONAL-TECHNICAL ACTIVITIES: (Please List)

1. Participation in Fluid Power Society Chapter Programs:

2. Preparation of instructional material in Fluid Power:

3. Preparation of magazine articles:

4. Participation in state and national meetings:

COMPETENCY REPORT

Name ____________________

Item	Adequate	Acceptable	Attention Needed
Formal Education	____	____	____
Informal Education	____	____	____
Teaching Experience	____	____	____
Industrial Experience	____	____	____
Professional-Technical Activities	____	____	____
Summary	____	____	____

By ____________________

Date ____________________

The Director for each of the five institutions approved for a 1965 summer Fluid Power Institute will be expected to develop one or more paragraphs (one-half page or more typed information) for each person assisting with the instructional program for the institute. Reference is made here to persons invited to lecture or demonstrate at any one of the sessions, persons assuming responsibility for field trips, or assisting with planning or enriching the scheduled units.

In developing this description that is to be directed at reporting the qualifications that present the individual as an outstanding contributor in some phase of fluid power instruction.

The following factors are merely suggestions to assist the Director in formulating a brief statement for each resource person:

1.
   a. Name________________________________

   b. Company______________________________

   c. Position_____________________________

   d. Identification with fluid power industry________

   ____

2. Membership offices held in professional societies

   ____

3. Degrees if any______________________________

4. Previous Industrial Positions____________________

5. Technical and leadership positions in Industry______

   ____

6. Authorship__________________________________

7. Speaking engagements_________________________

8. Leadership in community_______________________

9. Teaching experience__________________________

   ____

10. Major interests and hobbies________________________

____

11. Research Developments, inventions, and patents_____

____

12. Recognitions______________________________________

13. What topic did you present?________________________

____

FORM II-C

GUEST LECTURER

Name______________________________

Company______________________________

Position______________________________

Topic______________________________

Introduction:

Institute

Date

MEMORANDUM

Subject: Qualifications of Participants

To: Evaluation Committee

From: Fred Lamb, Executive Secretary

Date: October 14, 1965

I have personally examined applications and supporting documents for the participants in the Fluid Power Institutes at the California State College at Los Angeles, Trenton State College, Tuskegee Institute, University of Minnesota-Duluth, and Wayne State University, and have found that all participants in these institutes met the qualifications as established.

Signed: Fred Lamb

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FORM II-A

OBSERVATION AND EVALUATION: Fluid Power Institutes

Institution ______________________________

Address ______________________________

____

Dates and Times of Visitation:

Beginning ______________ ______________
Date Time of Day

Completing ______________ ______________
Date Time of Day

Observer ______________________________

A. INITIAL CONFERENCES

Name	Position	Intro-duction	Purpose of Visit	Copies of Reports Yes	Copies of Reports No	Appreciation

Comments: ______________________________

____

____

____

____

B. CLASS VISITS AND OBSERVATIONS

Programs Observed	Technique Used Appropriate: Yes	Doubtful	No	Effectiveness: Quality of Program: Well Done	Adequate	Poor
Guest Instructor	___	___	___	___	___	___
Lecture-Demonstration	___	___	___	___	___	___
Film Presentation	___	___	___	___	___	___
Activity: Instructional Components	___	___	___	___	___	___
Activity: Circuit Development	___	___	___	___	___	___
Activity: Computations	___	___	___	___	___	___
Activity: Laboratory Work	___	___	___	___	___	___
Field Trip	___	___	___	___	___	___
Other	___	___	___	___	___	___

Comments: ____

____

____

____

____

____

____

____

____

C. LABORATORY FACILITIES

Item	Very Good	Ade-quate	Needs Attention
Bench Space: Assembly, Disassembly of Components	____	____	________
Work Space: Laboratory Devices	____	____	________
Hand Tools: Number and Kind	____	____	________
Hand Tools: Storage	____	____	________
Storage of Components and Cutaways	____	____	________
Supplies: Amount, Kind	____	____	________
Supplies: Storage	____	____	________

Comments: ____

____

____

____

____

____

____

D. LECTURE-DEMONSTRATION FACILITIES

Item	Very Good	Ade- quate	Needs Attention
Seating	____	____	________
Work Spaces: Tables	____	____	________
Chalkboard	____	____	________
Projection Screen	____	____	________
Space for Demonstration Equipment	____	____	________
Facilities for Demonstrations	____	____	________

Comments: ____

____

____

____

____

E. ARRANGEMENTS

(Informal Interviews with Students: Number_____)

Item	Excellent	Good	Accept-able	Needs Attention
Living Accommodations	_____	___	_____	_____
Food, Daily	_____	___	_____	_____
Food, Weekends	_____	___	_____	_____
Admissions--Enrollment	_____	___	_____	_____
Travel Payments	_____	___	_____	_____
Expense Allowance	_____	___	_____	_____
Dependents Allowance	_____	___	_____	_____
Library Facilities	_____	___	_____	_____
Extracurricular Program	_____	___	_____	_____
Parking	_____	___	_____	_____

Comments: ____

____

____

____

____

____

SUMMARY

OBSERVATION AND EVALUATION

FLUID POWER INSTITUTES

	Very Good	Adequate	Needs Attention
Initial conferences	____	____	____
Class Visits, observations	____	____	____
Laboratory facilities	____	____	____
Lecture-demonstration facilities	____	____	____
Arrangements	____	____	____
General evaluation	____	____	____

TABLE 58

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE I

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	1	2		1.67
Class Visits, Observations	2	1		1.33
Laboratory Facilities	2	1		1.33
Lecture-Demonstration Facilities	2	1		1.33
Arrangements	1	1	1	2.00
General Evaluation	2	1		1.33

TABLE 59

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE II

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	2	1		1.33
Class Visits, Observations	2	1		1.33
Laboratory Facilities	1	1	1	2.00
Lecture-Demonstration Facilities	1	2		1.67
Arrangements	2		1	1.67
General Evaluation	2	1		1.33

TABLE 60

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE III

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	3			1.00
Class Visits, Observations	3			1.00
Laboratory Facilities	3			1.00
Lecture-Demonstration Facilities	1	2		1.67
Arrangements	3			1.00
General Evaluation	3			1.00

TABLE 61

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE IV

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	3			1.00
Class Visits, Observations	2	1		1.33
Laboratory Facilities	1	1	1	2.00
Lecture-Demonstration Facilities	2	1		1.33
Arrangements	3			1.00
General Evaluation	1	2		1.67

TABLE 62

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE V

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	2			1.00
Class Visits, Observations	2			1.00
Laboratory Facilities	1		1	2.00
Lecture-Demonstration Facilities	1	1		1.50
Arrangements		2		2.00
General Evaluation	2			1.00

TABLE 63

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM, FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE VI

Item	Very Good 1	Adequate 2	Needs Attention 3	Mean
Initial Conferences	4			1.00
Class Visits, Observations	4			1.00
Laboratory Facilities	2	1	1	1.75
Lecture-Demonstration Facilities	2	2		1.50
Arrangements	2	1	1	1.75
General Evaluation	3	1		1.25

TABLE 64

OBSERVATION AND EVALUATION OF INSTITUTE PROGRAM FACILITIES, AND ARRANGEMENTS FOR PARTICIPANTS: INSTITUTE VII

Item	Very Good	Adequate	Needs Attention	Mean
	1	2	3	
Initial Conferences	2	1		1.33
Class Visits, Observations	3			1.00
Laboratory Facilities	3			1.00
Lecture-Demonstration Facilities	2	1		1.33
Arrangements	2	1		1.33
General Evaluation	3			1.00

INSTRUCTIONAL MATERIAL AND TEACHING AIDS CONTRIBUTED BY MANUFACTURERS OF FLUID POWER COMPONENTS

Company	Material
Allied Control Company, Inc. Valve Division 2 East End Avenue New York, 21, New York	1 - #20383 Solenoid 2-way Valve 51 - Allied Control Catalogs
Automatic Switch Company Florhan Park New Jersey 07932	55 - Asco solenoid valve catalogs #23
Barksdale Valve Company 5125 Alcoa Avenue Los Angeles, California	50 - Sets of Bulletins
The Bastian Blessing Company 4201 W. Peterson Avenue Chicago, Illinois 60646	1 - Rego Model #8804 Regulator (Cut-away) 1 - Rego Model #8824 Filter (Cut-away) 1 - Rego Model #8844 Lubricator (Cut-away)
The Beckett Company Box 809, 186 W. Locust Street Wilmington, Ohio	1 - Hi-Cyclic Hydraulic Valve Display Unit 1 - Beckett Catalog
Bellows Valvair Division of I.B.E.C. Akron 9, Ohio	80 - Field Engineers Hydraulic Circuit Selector 80 - Hydraulic Power Caluclator 1 - Model DA-6 1063-5 Air Cylinder 1 - Model 5 Electro Aire Valve 1 - Model 15 Electro Aire Valve 1 - Model MFV-2 Valve 1 - Type 10-1 Control Transformer 1 - Model PDSF B40 Air Cylinder

Company	Material
	1 - Model B.EM 5C30 Air Motor 1 - Model B.N.E.M.2-60 Air Motor 1 - Model 92-44-3-20, Air Valve 1 - Model 20-22-10 Air Valve 1 - Model 15A-34-23 Air Valve 1 - Model FD-123-RD1 Air Valve 1 - Model #2444 Air Valve 1 - Model #15B-038-81D Air Valve 1 - Model #SB-DA-50-A-60 Air Oil Comb. Cyl. 1 - Model B.C.A.M. 5C60 Air Motor C 1 - Model C. F. 10A020 Air Motor 1 - Model H.C.B.M.5C-60 Hydro-Check Air-Oil Cylinder 1 - Model M.F.F. 201A-70 Air Cylinder 1 - 80372-0909-0102 Air Cylinder 1 - B.C.A.E.M 5C-[illegible] Air Motor 1 - B911-201 Lubri Air Control unit complete 1 - Model 1/8" 3-way Air Valve
Bimba Manufacturing Company 111 Main Street Monee, Illinois 60449	55 - Bimba Cylinder Catalog #1264A
Chicago Fittings Corporation 18th Avenue at 21st Street Broadview, Illinois	6 - R2000 Rubberneck Catalogs 6 - S500 Sealastic Catalogs 6 - LT1000 Leaktest Catalogs 6 - R500-6 Rubberneck Conn. Assy. 6 - S2-055AE-6 Sealastic Conn. Assy. 6 - 1LTB-4-4 Leak Test Conn. Assy.
Circle Seal Products Co., Inc. 2181 East Foothill Boulevard Pasadena, California	5 - Cut-Away Valves 1 - Circle Seal Precision Valve Catalog
Commercial Shearing and Stamping Company Youngstown, Ohio	55 - Preventive Maintenance Tips 1, 2, and 3

Company	Material
Continental Machines, Inc. Hydraulics Division Savage, Minnesota 55378	1 - Variable Displacement Vane Pump 55 - Valve & Pump Catalogs
The Cuno Engineering Corp. 80 S. Vine Street Meriden, Connecticut	3 - Cuno General Catalogs
Delevan Manufacturing Company Grand Avenue & Fourth Street West Des Moines, Iowa 50265	55 - Fluid Power Catalogs
Double A. Products Company Manchester, Michigan 48158	6 - Double A Catalogs #630
Flick-Reedy Corporation 7N015 York Road Bensenville, Illinois 60106	50 - Bulletin AJH-104X 50 - Bulletin B-200-W2 50 - Bulletin 4061 50 - Stock Cylinder Calculators
Fluid Power Accessories, Inc. 1920 LeHigh Avenue, Box 69 Glenview, Illinois 60025	5 - Standard Catalogs
Fluid Controls, Inc. P.O. Box 49 Mentor, Ohio	50 - Fluid Control Devices Catalog
Galland-Henning Manufacturing Company No Pak Division Milwaukee, Wisconsin 53246	50 - Fluidic Devices Cross Reference Charts 50 - Fluidic Terminology Sheets
Garlock Inc. Palmyra, New York 14522	55 - Garlock Catalogs AD-231 Industrial Products for Plant and Equipment Maintenance
H. P. M. Division Koernig Company Mount Gilead, Ohio	50 - Hydraulic Valves for Industry
Honeywell, Inc. 415 East 27th Street Minneapolis 8, Minnesota	50 - Form #70-1205 Specification Data

Company	Material
Milwaukee Cylinder Company Division of I & M Machine Co. 5757 So. Pennsylvania Avenue Cudahy, Wisconsin	50 - Hydraulic Cylinder Bulletin #H103 50 - Air Cylinder Bulletin #H102
Minnesota Rubber Company 3630 Woodale Avenue Minnesota, Minnesota 55416	52 - Fact Books 25 - Data Kits
National Fluid Power Association P.O. Box 49	25 - Glossary of Terms Bulletin 25 - "Fluid Power" An Outline of Technical Content 50 - Filtration Bulletin T3-10-65.2 50 - Fire Resistance Fluids Bulletin #T3-11-64-1 55 - "How Fluid Power Serves" Bulletin
The Oil Gear Company 1560 West Pierce Street Milwaukee, Wisconsin 53204	1 - Oil Gear Catalog
Pegasus Laboratories, Inc. 3500 Eleven Mile Road Berkley, Michigan	50 - Theory of Operation Servo Valves 50 - Application Manual, Servo Valves
Racine Hydraulics & Machinery Inc. 2000 Albert Street Racine, Wisconsin	55 - Racine Sales Catalogs
Rosean Filter Company 1776 E. Nine Mile Road Hazel Park, Michigan	55 - Te-l Tale Filter Kits 56 - Filtration "Let's Be Practical" Bulletins
The S-P Manufacturing Company 30201 Aurora Road Cleveland, Ohio 44139	55 - S-P Cylinder Catalogs 55 - S-P Accumulator Catalogs
Schroeder Brothers Corporation Nichol Avenue, Box 72 McKees Rocks, Pennsylvania 15136	2 - HS-83 1/2" Fittings 1 - Slide-Sound Program 55 - Tester Bulletins 1 - Instruction Manual

Company	Material
Skinner Precision Industries New Britain, Connecticut	55 - Solenoid Valve Types
Snap Tite, Inc. 201 Titusville Road Union City, Pennsylvania	50 - Valved Quick Disconnect Coupling Catalog 50 - Data Pack Bulletins
Sun Oil Company 3215 Arch Street Philadelphia, Pennsylvania 19104	30 - Hydraulic Fundamentals Bulletin B-4
Superior Hydraulics 15201 St. Clair Avenue Cleveland, Ohio	55 - Superior Hydraulics Accumulators Catalogs
Texaco, Inc. 135 East 42nd Street New York 17, New York	30 - Operation and Care of Hydraulic Machinery
Tyrone Hydraulics Corinth 1, Mississippi	56 - Bulletin DP-100 Tyrone Pumps
Vickers, Inc. P.O. Box 302 Troy, Michigan 48084	50 - Industrial Hydraulics Manuals
Wabco Industrial Products Div. Westinghouse Air Brake Co. 1953 Mercer Road Lexington, Kentucky	55 - Catalog A9-150.04 50 - Catalog A4-65.00 50 - Catalog A4-72.03 50 - Catalog A-00-1 57 - Catalog Hydraulic Circuit Panel Blocks
Waldron-Couplings Division Midland-Ross Corporation New Brunswick, New Jersey	2 - Coupling Catalog #WC-65 1 - 1/2 Coupling
Waterman Hydraulics Corp. Box 391, 725 Custer Ave. Evanston, Illinois 60204	55 - Condensed Catalog 5000 Hydraulic Components
The Weatherhead Company Cleveland, Ohio 44108	55 - Hydraulic Pump and Valve Catalog

Company	Material
	55 - Industrial Fittings Catalog C2
	55 - Technical Paper IH-6208
	55 - Industrial Hose Catalog C1
	55 - Engineering Report No. WR64-1
	52 - Sermet Serrated Sleeve Catalog
	55 - Form KPT-65
Wilkerson Corporation Englewood, Colorado	51 - Technical Information about compressed Air Bulletins
	54 - Wilkerson Compressed Air Products Catalog 158C
American Oil Company 910 South Michigan Avenue	30 - Hydraulic Power Transmission Bulletin #221-S
Logansport Machine Company, Inc. Logansport, Indiana	51 - "Circuit of the Month Club," Manual

A PARTICIPANT'S EVALUATION
OF THE INSTRUCTIONAL PROGRAM

At ______________________________

Directions:

Each participant is asked to give careful attention to each issue or open-ended question in this evaluation instrument. This needed information is concerned with your reactions and observations regarding the Instructional Program for the Fluid Power Institute.

This form is to be completed and personally presented by you to the Director just before the Institute is to close (in the sealed envelope provided for this purpose). It is important that you give thought to each of your statements so that they may be recorded as briefly as possible.

The Director for each of the Institutes is being asked to check and make sure that you have submitted the completed form in the sealed envelope. These data will be analyzed and used for cross-checking purposes by the National Evaluation Committee responsible for preparing the report for the U. S. Office of Education regarding the effectiveness of each of the five centers established for the 1965 Summer Fluid Power Institutes.

The completed form is to be presented to the Director, unsigned. Your cooperation will be much appreciated by the National Evaluation Committee.

I. Your Reaction to the Two Established Goals for the Institute, which were:

(1) to provide 175 hours of basic instruction in the fundamentals of hydraulics and pneumatics, and

(2) to consider, through seminar discussions, what might be done in the participant's school to organize a unit, or a course or two, in fluid power, appropriate for the teaching situation.

In reflecting on these two goals for the 1965 Summer Fluid Power Institute, please record your reactions by answering these questions:

1. To what degree have your teaching competencies in hydraulics and pneumatics improved as a result of your experiences in this Institute, considering what you knew about pneumatics and hydraulics, at the beginning of the 1965 Summer Institute?

   (In making this statement you should summarize your personal growth and development in respect to the first goal promulgated for this Institute. This is done by considering where you were in respect to teaching competencies in hydraulics and pneumatics when you enrolled in the Institute, and where you think you are now in respect to these competencies, as the Institute is about to close.)

   ____

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2. To what degree are you now prepared to return to your teaching situation to establish goals, plan content, and establish an instructional program for a unit, or courses in fluid power instruction?

   ____

   ____

   ____

   ____

II. Your Reactions to the Selected Content

The plan for each of the institutes provided for having 175 hours allocated to: 55 hours of class instruction in hydraulics; 30 hours of class instruction in pneumatics; 36 hours for experiences in disassembly-assembly; 30 hours for laboratory work; 7 hours to seminar; 14 hours to field trips; and 3 hours to examinations.

5. What is your general reaction to the subject matter selected for the 1965 Summer Institutes in Fluid Power Instruction, and the allocation of time for each block of content?

6. Explain in specific terms, how these time allocations might be changed to make the Institutes more meaningful, if they are repeated during the summer of 1966.

7. Was there any content (such as a unit of subject matter) overlooked that you will need to consider (when returning to your school) to organize or course in Fluid Power?

____

____

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____

III. Your Reactions to the Techniques Employed with the Methods and Teaching Aids by the Teacher and Others who Assisted with the Instructional Program

8. Select the three sessions that you considered most effective and explain why, in each case.

The Three Sessions Most Liked

(a) Session ______________________________

Subject ______________________________

Persons Involved ______________________________

Techniques Employed
with Methods and Aids ______________________________

In my opinion, this session was especially effective, because:

____

____

____

____

____

(b) Session____

Subject____

Persons Involved_____________________________________

Techniques Employed
with Methods and Aids________________________________

In my opinion, this session was especially effective, because:

____

____

____

____

____

(c) Session____

Subject____

Persons Involved_____________________________________

Techniques Employed
with Methods and Aids________________________________

In my opinion, this session was especially effective, because:

____

____

____

____

____

9. Three Sessions Considered Least Effective

(a) Session ______________________________

Subject ______________________________

Persons Involved ______________________________

Techniques Employed
with Methods and Aids ______________________________

I feel this session to be somewhat ineffective, for this reason:

____

____

____

____

____

(b) Session ______________________________

Subject ______________________________

Persons Involved ______________________________

Techniques Employed
with Methods and Aids ______________________________

I feel this session to be somewhat ineffective, for this reason:

____

____

____

____

____

(c) Session______________________________

Subject______________________________

Persons Involved________________________

Techniques Employed
with Methods and Aids____________________

I feel this session to be somewhat ineffective, for this reason:

10. Which of the field trips did you consider most productive? State your reasons.

11. Did you have adequate time to participate and work with each of the instructional devices to become familiar with it?

IV. Your Reactions to Evaluation Instruments and Procedures Used in the Institute

12. What is your personal reaction to the course examination?

____

____

____

____

13. What specific suggestions do you have to improve the over-all examination for the Institute?

____

____

____

____

____

V. Your Reaction to the Physical Facilities Provided for the Implementation of the Institute in Fluid Power

14. In general, how effective was the physical facilities (laboratory conditions, instructional supplies, and equipment) for carrying out the established goals and the instructional program?

____

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____

15. What specific suggestions do you have for additional instructional supplies and equipment that might have been provided for the implementation of the instructional program (reference is made to those additional items that might be provided as essential and needed equipment, if the Institutes are repeated during the 1966 Summer Session)?

VI. Your Over-all Reaction to the Institute

16. To what extent were adequate arrangements made for your own living accommodations, food, week-ends and other activities?

17. If you were to be asked by the person to whom you report in your school system, about the unique features and the value you received from this Institute, what would be your reply?

Dear Participant:

I hope you received the form mailed to all participants of the 1965 Summer Institutes in Fluid Power.

In case you did not receive one, I am including another form and return envelope for your convenience.

It is most important that we receive the data requested for the follow-up study which will become part of the final report of the U.S. Office of Education.

Would you please take a few minutes to fill out and return this form now?

Thank you for your cooperation.

Frederick W. Lamb
Coordinator

CHECK LIST

EDUCATION PLANS FOR NEXT YEAR

Name: ______________________ ______________________
First Last

School: ____

School Address: ____
Number and Street

______________________ ______________ ________
City State Code

SUGGESTED ACTIVITIES
(Please check one or more)

___ 1. Introduce a unit of Fluid Power in an existing course.

___ 2. Introduce a course in Fluid Power.

___ 3. Add one or more courses to make a curriculum in Fluid Power.

___ 4. Add laboratory and demonstration devices to an existing laboratory or shop.

___ 5. Remodel facilities to provide a separate room, and equip it with laboratory demonstration equipment.

___ 6. Prepare a course of study for:

  ___ a. An existing unit or course.

  ___ b. A new unit or course.

___ 7. Establish professional relationships with a local or nearby chapter of the Fluid Power Society, and participate in its activities.

___ 8. Obtain assistance of local members of the Fluid Power Society as:

___ a. An un-official advisory group.

___ b. An appointed advisory committee.

___ 9. Involve the advisory group or committee in:

___ a. Constructing courses of study.

___ b. Selecting laboratory devices, planning layout of the laboratory.

___ c. Selecting instructional materials.

___ d. Selecting teaching aids.

___ e. Placement of graduates.

___ f. Other.

___ 10. Prepare an evening program for employed adults.

___ 11. Work with an education committee to prepare curriculum guides for a city or state.

___ 12. Other____

____
Institution Attended

____
Date

PROGRESS REPORT Name________________________

Activity	Accomplished	In Planning Stage	Scheduled for Next Year	Dropped: Reason
__1. Introduce a unit of Fluid Power in an existing course.				
__2. Introduce a course in Fluid Power.				
__3. Add one or more courses to make a curriculum in Fluid Power.				
__4. Add laboratory and demonstration devices to an existing laboratory or shop.				
__5. Remodel facilities to provide a separate room, and equip it with laboratory and demonstration equipment.				
__6. Prepare a course of study for:				
__a. An existing unit or course.				
__b. A new unit or course.				
__7. Establish professional relationships with a local or nearby chapter of the Fluid Power Society, and participate in its activities.				

Activity	Accom- plished	In Plan- ning Stage	Sched- uled for Next Year	Dropped: Reason
__8. Obtain assistance of local members of the Fluid Power Society as:				
__a. An un-official advisory group.				
__b. An appointed advisory committee.				
__9. Involve the advisory group or committee in:				
__a. Constructing courses of study.				
__b. Selecting laboratory devices, planning layout of the laboratory.				
__c. Selecting instructional materials.				
__d. Selecting teaching aids.				
__e. Placement of graduates.				
__f. Other .				
__10. Prepare an evening program for employed adults.				

Activity	Accomplished	In Planning Stage	Scheduled for Next Year	Dropped: Reason
__11. Work with an education committee to prepare curriculum guides for a city or state.				
__12. Other				

Directions: The activities checked are those which you selected last summer. Please report status of these by checking the appropriate column. Please add any activities not checked but which you have undertaken by placing an (ADD) in the first column; also, report status of these by checking the appropriate column.