This course outline was developed by industrial arts teachers during the 1968 National Defense Education Act summer institute. It is intended for the specific use of teachers involved in fluid power courses. A topical outline covers terminology, equipment, procedures, and safety techniques. Other sections include a book list, a book evaluation form, an audiovisual materials list, and floor plans for school laboratories. The appendix includes a participant list. The final report of the institute is available as VT 008 185. (EM)
Integration of Fluid Power Instruction Into Energy and Propulsion Systems

SIX WEEKS JUNE 24 TO AUGUST 2, 1968

WAYNE STATE UNIVERSITY
DETROIT, MICHIGAN 48202

IN COOPERATION WITH THE U.S. OFFICE OF EDUCATION, AS AUTHORIZED UNDER TITLE XI OF THE NDEA, AS AMENDED
Prepared at The

NDEA SUMMER INSTITUTE
June 24 – August 2, 1968

Prepared By:

THE NDEA PARTICIPANTS

Under the Direction of:

William D. Wolansky
And
Leslie H. Cochran
ACKNOWLEDGEMENTS

Through the combined efforts of the Project Staff this 1968 Summer Institute was a worthwhile and successful program. It is hoped that the continuation and extension of similar institutes will be brought about by the marked success of this one. The experience and knowledge of the following personnel connected with this program contributed to its success.

Dr. G. Harold Silvius,  
Director

John Nagohosian,  
Instructor

Leslie H. Cochran,  
Associate Director

William F. Gayde,  
Instructor

Dr. William D. Wolansky,  
Instructor

Kenneth McLea,  
Industrial Coordinator

Credit is also extended to the participating industries and resource personnel that contributed to the success of this Institute. These include:

Chrysler Corporation  
P. O. Box 118  
Detroit, Michigan 48231

Ford Motor Company  
Rouge Engine Assembly Plant  
3001 Miller Road  
Dearborn, Michigan 48210

Ford Motor Company  
Sterling Plant  
39000 Mound Road  
Warren, Michigan 48092

Scott Engineering  
1400 S.W. 8th Street  
Pompano Beach, Florida 33060

Detroit Diesel Engine Plant  
13400 West Outer Drive  
Detroit, Michigan 48239

Joseph Lamb Company  
5663 East Nine Mile Road  
Detroit, Michigan 48220

MacValves Inc.  
13200 Capital  
Oak Park, Michigan 48237

Pontiac Motors Co.  
Assembly Plants and Training School  
Pontiac, Michigan 48053

Rosaen Filter Company  
1776 East Nine Mile Road  
Hazel Park, Michigan 48220

Technical Education and Manufacturing Inc.  
161 Vester  
Ferndale, Michigan 48220

Vickers A & E Center  
and Hydraulics Training School  
Troy, Michigan 48202
FOREWORD

The Summer Institutes have as their primary objective to update the technical and professional competencies of practicing teachers. The 1968 Summer NDEA Institute in industrial education at Wayne State University had as its central purpose the "Integration of Fluid Power Instruction Into Energy and Propulsion Systems." Specifically, the program was designed to strengthen the teacher's background in fluid power technology through:

1) Technical instruction covering the content of fluid power as it relates to energy and propulsion.

2) Directed field experiences with local industries.

3) Teaching strategies directed at the development, the evaluation, and the utilization of instructional materials.

The participants in this Institute were selected from secondary schools and teacher education programs, and represented thirteen states. They were teaching in the Power Technology area previous to their coming to WSU.

To assist the teachers to infuse fluid power into their existing power programs, a series of professional seminars were conducted. As a result of their technical instruction, field experiences, and laboratory activities it was possible for them to develop instructional materials for their own classroom situations.

During the seminar the participants worked in small groups giving attention to such aspects as objectives, course content, instructional resources, and laboratory layouts. The materials developed and contained in this brochure are the products of these twenty-four teachers, and represent their insights and experiences.

NDEA Staff
# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acknowledgments</td>
<td>1</td>
</tr>
<tr>
<td>Foreword</td>
<td>ii</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>iii</td>
</tr>
<tr>
<td>Objectives</td>
<td>1</td>
</tr>
<tr>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>Course Outline</td>
<td>2</td>
</tr>
<tr>
<td>Textbooks</td>
<td>6</td>
</tr>
<tr>
<td>Audio-Visual Materials</td>
<td>12</td>
</tr>
<tr>
<td>Laboratory Layout</td>
<td>16</td>
</tr>
<tr>
<td>Appendix A: Participants in 1968 NDEA Fluid Power Institute</td>
<td>21</td>
</tr>
<tr>
<td>Appendix B: Participating Lecturers and Consultants</td>
<td>24</td>
</tr>
<tr>
<td>Appendix C: The Fluid Power Society</td>
<td>26</td>
</tr>
<tr>
<td>Appendix D: Laboratory Test Equipment</td>
<td>33</td>
</tr>
</tbody>
</table>
INTRODUCTION

The purpose of this fluid power course outline is to serve as a guide for introducing basic fundamentals necessary for entry into the field of fluid power and related curricula. All students entering the comprehensive high school, as well as technical and vocational high schools, should have the opportunity to study and experience this new instructional area of fluid power. They should then have an opportunity to discover firsthand the significance and vocational implications of this curriculum area. It will also permit students to discover the interrelatedness of fluid power with other energy sources.

This course outline was developed by practicing teachers during the 1968 Summer NDEA Institute at Wayne State University through the combined efforts of the participants and staff. It is intended for the specific use of teachers involved and interested in fluid power laboratory and classroom instruction. This outline is a tentative guide and should be used accordingly. It is hoped, however that it will facilitate the teaching and preparation of students in this area of education. Its intent was also to provide added information and direction to the experienced teacher as well as the new and inexperienced teachers entering this field.

OBJECTIVES

This course outline was designed to provide the student with a background of the terminology, equipment, procedures, and safety techniques used in the fluid power industries.
The general objectives are directed at helping the student to:

1) Develop an understanding and appreciation of fluid power as it applies to industry and everyday living.

2) Acquire an understanding of the basic physical laws as applied to energy, fluid mechanics, and related materials.

3) Become involved in meaningful activities and problems that are designed to be solved through the fundamentals of fluid power laboratory instruction.

4) Acquire a command of the basic communication skills in fluid power technology.

5) Acquire a sensitivity to the importance of fluid power as it contributes to man's utilization of the total energy sources.

In order to realize the general objectives above, the student will be expected to attain these outcomes:

1) Be able to explain the basic fluid power principles.

2) Be able to demonstrate his proficiency in the basic application of fluid power components and systems.

3) Be able to interpret basic terminology of the fluid power industry.

4) Be able to identify the basic components used in the fluid power industry and explain the function of these components.

5) Be able to apply proper safety precautions, to safeguard himself and others.

INTRODUCTION TO FLUID POWER

Unit 1 - Orientation

A. Classroom Presentation
   1. Overview
   2. Classroom Orientation
   3. Rules of Conduct in Classroom
   4. Safety Instruction

B. Laboratory Activities
   1. Safety Instruction
   2. Laboratory Orientation
   3. Rules of Conduct in Laboratory
4. Locker Assignments
5. Duty Assignments
6. Station Assignments

C. Related and Instructional Information
   1. Occupational Information
      a. Types of Occupations
      b. Frequency of Opportunities
      c. Places of Employment

Unit 2 - Basis and History of Fluid Power

A. Classroom Presentation
   1. Historical Applications
   2. Contemporary Uses
   3. Occupational Information
   4. Potential Applications

B. Laboratory Activities
   1. Hydraulic Actuated Devices
      a. Cylinders
      b. Pumps
      c. Motors
   2. Pneumatic Actuated Devices
      a. Cylinders
      b. Motors
      c. Compressors
   3. Combination Devices
      a. Accumulator
      b. Intensifiers

C. Related and Instructional Information
   1. Interview
      a. Industrial Representatives
      b. Fluid Power Society
   2. Guest Speakers
   3. School Demonstrations

Unit 3 - Introduction to Fluid Power and Formulas

A. Classroom Presentation
   1. Pascal's Law
   2. Gas Laws
      a. Charles' Law
      b. Boyle's Law
   3. Other Related Laws and Formulas

B. Laboratory Activities
   1. Cylinder Demonstrations with Pascal's Law
   2. Working with Pump Mock-ups
   3. Use of Gauges to illustrate practical application of Gas Laws
C. Related and Instructional Information
1. Analysis Form
2. Reference Books
3. Reference Materials

Unit 4 - Circuitry Application

A. Classroom Presentation
1. Cut-a-way Diagrams
2. Graphic Diagrams
3. Graphic Symbols

B. Laboratory Activities
1. Setting up Working Circuits
   a. Cycle One Cylinder
   b. Sequence Two Cylinder
   c. Cycle One Cylinder with One Direction Speed Control
   d. Other Selected Circuits

C. Related and Instructional Information
1. Films and Film Strips
2. Slides and Transparencies
3. Cut-a-ways
4. Working Transparencies and Models

Unit 5 - Medium of Power Transmission

A. Classroom Presentation
1. Types
2. Uses
3. Additives
4. Specifications

B. Laboratory Activities
1. Observe Fluid Characteristics
2. Samples of Oil
3. Viscosity Tests
4. Compressibility

C. Related and Instructional Information
1. Components
2. Models
3. Cut-a-ways
Unit 6 - Components of Fluid Power

A. Classroom Presentation
   1. Reservoirs - strainers - filters
   2. Cylinders
   3. Pumps
      a. Positive and non-positive
      b. Design types
   4. Motors
      a. Positive and non-positive
      b. Design types
   5. Hoses - tubing - pipe
      a. Types
      b. Applications
      c. Fittings
      d. Flow characteristics
   6. Valves
      a. Types
      b. Applications
   7. Instrumentation
      a. Flow
      b. Pressure
      c. Torque
      d. Power
      e. Vacuum
   8. Accumulators
      a. Types
      b. Applications
   9. Intensifiers - Boosters

B. Laboratory Activities
   1. Identification
   2. Disassembly and Assembly
   3. Testing

C. Related and Instructional Information
   1. Hydraulic Equipment Manufacturers
   2. Industrial Applications
   3. Field Applications

Recommended Time Allotments
For a One Semester Course in Fluid Power

<table>
<thead>
<tr>
<th>Unit Number</th>
<th>Hours in Laboratory</th>
<th>Hours in Classroom</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit I</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Unit II</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Unit III</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Unit Number</td>
<td>Hours in Laboratory</td>
<td>Hours in Classroom</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Unit IV</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Unit V</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Unit VI</td>
<td>29</td>
<td>18</td>
</tr>
<tr>
<td>Field Trips</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
<td>37</td>
</tr>
</tbody>
</table>

90 Sessions
1 Semester

TEXT EVALUATION

During the 1968 Summer NDEA Institute in Fluid Power—attended by 24 teachers from all parts of the country—a committee of four was formed and charged with the responsibility of selecting a text and other reference materials for a secondary school course in fluid power. Because of changes in terminology and recent developments in the field of fluid power, it was decided by the committee to evaluate only those publications printed from 1960 to the present time (1968).

The first problem confronting the committee was the development of criteria as a basis for meaningful evaluation. Using suggestions made by Dr. G. Harold Silvius and Dr. William D. Wolansky, the committee developed the analysis form that is included in this section.

The committee concluded that the material currently available in the form of textbooks which were reviewed by the committee were primarily intended for use in engineering, maintenance, and related areas. These books were not intended for basic and general informative use.

The main problems encountered in the use of these books at a secondary
school level are as follows:

1) Much of the background needed for a thorough understanding of the presented material was not included in the book.

2) The terminology and symbols used in the book were either obsolete or too technical to be used without detailed explanations. These explanations were often not included in the publication.

3) The style or method of presenting the material was lacking in illustrations and related examples to bring across the author's ideas.

At the present time the committee recommends that the following books (listed on pages 11 and 12) could be used in a form of reference books, but none of these books should be used as a text. The committee also recommends that material which is available in the form of pamphlets, charts, calculators, filmstrips, and instructor-prepared information sheets could be used as the main source of material for presenting a course in fluid power.

It is hoped that a publication will soon be available that will better fit the needs of a program presented at the secondary school level in fluid power.

The instrument developed for textbook analysis was used to evaluate the suitability of recent reference sources, and is included.
<table>
<thead>
<tr>
<th></th>
<th>Question</th>
<th>Code</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Is the level of instructional material appropriate for intended use?</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>2</td>
<td>Is the book written at a suitable readability level?</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Is the book written in a style that generates interest on the part of the reader?</td>
<td></td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>Does the book, chapter, and/or unit follow a logical sequence and development of technical content?</td>
<td></td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Are there adequate easily understood illustrations?</td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>6</td>
<td>Do the illustrations clarify or reinforce technical content or procedure?</td>
<td></td>
<td>6</td>
</tr>
<tr>
<td>7</td>
<td>Are difficult theoretical concepts simplified by analogy and comparison?</td>
<td></td>
<td>7</td>
</tr>
<tr>
<td>8</td>
<td>Does the author define a new term when he first uses it and repeats it to reinforce technical vocabulary?</td>
<td></td>
<td>8</td>
</tr>
<tr>
<td>9</td>
<td>Does the author summarize the key points made in the unit?</td>
<td></td>
<td>9</td>
</tr>
<tr>
<td>10</td>
<td>Does the author include related and occupational information?</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>11</td>
<td>Does the book list test questions and problems at the end of each chapter and unit?</td>
<td></td>
<td>11</td>
</tr>
<tr>
<td>12</td>
<td>Does the book include assignments or experiments to be performed by the student?</td>
<td></td>
<td>12</td>
</tr>
<tr>
<td>13</td>
<td>Are safety precautions stressed?</td>
<td></td>
<td>13</td>
</tr>
<tr>
<td>14</td>
<td>Does the book contain bibliographies?</td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>15</td>
<td>Does the book list films, slides, and other teaching aids?</td>
<td></td>
<td>15</td>
</tr>
</tbody>
</table>

**CODE:**

- (-) Does not apply to this book.
- (0) Not included in this book.
- (1) Inadequate.
- (2) Adequate
- (3) Highly satisfactory.
BOOKS REVIEWED

A.
TITLE: ________________________  AUTHOR: ________________________  COST: $____
QUALIFICATIONS OF AUTHOR: ____________________________________________
________________________________________________
________________________________________________
________________________________________________
PUBLISHER: ____________________________________  DATE: ________
COMMENDS & RECOMMENDATIONS: __________________________________________
________________________________________________
________________________________________________
________________________________________________

B.
TITLE: ________________________  AUTHOR: ________________________  COST: $____
QUALIFICATIONS OF AUTHOR: ____________________________________________
________________________________________________
________________________________________________
________________________________________________
PUBLISHER: ____________________________________  DATE: ________
COMMENDS & RECOMMENDATIONS: __________________________________________
________________________________________________
________________________________________________
________________________________________________

C.
TITLE: ________________________  AUTHOR: ________________________  COST: $____
QUALIFICATIONS OF AUTHOR: ____________________________________________
________________________________________________
________________________________________________
________________________________________________
PUBLISHER: ____________________________________  DATE: ________
PERIODICALS

Fluid Power Handbook,
The Industrial Publishing Corporation
812 Huron Road
Cleveland, Ohio 44115

Fluid Power International,
John Trundell,
Eversholt Street
London, N.W. 1, England

Hydraulics and Pneumatics Magazine,
Industrial Publishing Company
Penton Building
Cleveland, Ohio 44113

OTHER SOURCES


Filtration for Hydraulic Fluid Power Systems, Technical Manual T3 10.65.2
Hazel Park, Michigan: Rosaen Filter Company.


REFERENCE BOOKS


**FLUIDICS REFERENCE MATERIAL**


**AUDIO VISUAL MATERIALS**

**Films and Filmstrips**

Films: (16MM)

1. *Hydraulic Oil*
   
   Texaco, Inc.
   125 East 42 Street
   New York, New York 10017

2. *The Hidden Giant*
   
   Vickers Inc.
   Administration and Engineering Center
   P.O. Box 302
   Troy, Michigan 48084
3. **Controlled Power**
   Vickers, Inc.
   Administration and Engineering Center
   P. O. Box 302
   Troy, Michigan 48084

4. **Cavitation**
   Shell Oil Company
   50 W. 50th Street
   New York, New York 10020

5. **Harnessing Liquids**
   Shell Oil Company
   50 W. 50th Street
   New York, New York 10020

6. **Basic Hydraulics**
   United World Films
   Gout Films Dept.
   1445 Park Avenue
   New York, New York 10029

7. **Fluid Flow in Hydraulic Systems**
   United World Films
   Gout Films Dept.
   1445 Park Avenue
   New York, New York 10029

8. **Hydraulic Turret Traversing Mechanism**
   The Oilgear Company
   1560 West Pierce Street
   Milwaukee, Wisconsin 53204

9. **Operation Pushbutton**
   Bellows Valvair
   Attn: Sales Manager
   222 W. Market Street
   Akron, Ohio 44303

10. **Denison Vane Pumps**
    Denison Division-Abex Corp.
    Attn: Advertising Manager
    1160 Dublin Road
    Columbus, Ohio 43213
11. **Design for Power**

   Denison Hydraulics Division-Abex Corp.  
   Attn: Advertising Manager  
   1160 Dublin Road  
   Columbus, Ohio  43212

12. **Hydraulic Components**

   Denison Hydraulics Division-Abex Corp.  
   Attn: Advertising Manager  
   1160 Dublin Road  
   Columbus, Ohio  43212

13. **Power Up**

   Denison Engineering Division-Abex Corp.  
   Box 713  
   Lima, Ohio  45802

14. **Our Industrial Air Power**

   Quincy Compressor Company  
   Quincy, Illinois  62301

15. **Basic Principles of Hydraulics**

   Jam Handy Organization  
   2821 S. Grand Blvd.  
   Detroit, Michigan  48212

**FILMSTRIPS**

1. **Elements of Compressed Air**

   Parker-Hannifin Corporation  
   17325 Euclid Avenue  
   Cleveland, Ohio  44112

2. **Elements of Hydraulics**

   Parker-Hannifin Corporation  
   17325 Euclid Avenue  
   Cleveland, Ohio  44112
3. **Hydraulic Fittings**
   Parker-Hannifin Corporation
   17325 Euclid Avenue
   Cleveland, Ohio 44112

4. **Pneumatic Circuitry**
   Parker-Hannifin Corporation
   17325 Euclid Ave.
   Cleveland, Ohio 44112

5. **Introduction to Fluid Power**
   Miller Fluid Power Institute
   Flick-Reedy Corporation
   7N015 York Road
   Bensenville, Illinois 50106

6. **Cylinders**
   Miller Fluid Power Institute
   Flick-Reedy Corporation
   7N015 York Road
   Bensenville, Illinois 50106

7. **Air Valves and Pneumatic Systems**
   Miller Fluid Power Institute
   Flick-Reedy Corporation
   7N015 York Road
   Bensenville, Illinois 50106

8. **Air - Oil Systems**
   Miller Fluid Power Institute
   Flick-Reedy Corporation
   7N015 York Road
   Bensenville, Illinois 50106

9. **Air - Oil Boosters**
   Miller Fluid Power Institute
   Flick-Reedy Corporation
   7N015 York Road
   Bensenville, Illinois 50106
16

10. **Air is Power** with record disc and booklet

Ross Operating Valve Company
120 East Golden Gate Avenue
Detroit, Michigan 48203

11. **Air Control Techniques** with Record disc and booklet

Ross Operating Valve Company
120 East Golden Gate Avenue
Detroit, Michigan 48203

Transparencies available from the following companies:

2) McKnight and McKnight, Bloomington, Illinois 60601
3) 3M Company, Minneapolis, Minnesota 55402
4) Parker-Hannifin, 17325 Euclid Avenue, Cleveland, Ohio 44112
5) Racine Hydraulics & Machinery Inc., Racine, Wisconsin 53406
6) Howard Sams, Indianapolis, Indiana 44112
7) TEAM, Inc., Ferndale, Michigan 48220
8) Vickers Inc., Division of Sperry Rand Corporation, Maple and Crooks Roads, Troy, Michigan 48084
9) Vega Enterprises, Inc., Route 3, Box 30015, Decatur, Illinois 62526
10) Wilkerson Corporation, Englewood, New Jersey 07631
11) Womack Machine Supply Company, P.O. Box 35027, Dallas, Texas 75235

**LABORATORY LAYOUT**

The Institute committee on laboratory design for fluid power technology felt there was no single laboratory design adequate for instructional purposes, since the requirements of the various school districts and the depth of instruction would vary. With these points in mind a committee developed
three typical laboratory layouts. One allowing 50 square feet per student, the other two would have 100 square feet per student. It was the consensus of the committee that these plans be used only as an aid in planning a new laboratory, while keeping in mind the following points: portability of the equipment, flexibility of the facilities, and future growth in the technology.

Due to the nature of, and infinite number of different existing shops, the committee felt it would be beyond the scope of this publication to develop a layout that would be of assistance to every situation. Therefore, it was decided that the following list of items, if not already in the area to be converted, should be installed:

**Electrical:**

- 120-240 volt A.C. 3-phase
- Overhead buss drop

**Pneumatics:**

- Supply of air: Preferably piped in by locating compressor outside the laboratory.
- Pneumatic trainer or equivalent.
- Quick disconnect hose couplings.
- Hose rack.
- Assortment of components.

**Hydraulic:**

- Hydraulic trainer with power unit.
- Quick disconnect hose couplings.
- Hose rack.
- Assortment of components.

**General:**

- Arbor press (hydraulic)
- Drill Press
- Grinder
- Metal lathe
- Component storage
- Parts washer
- Hoist
- Hydraulic oil supply
- Oil dry Compound
- Appropriate hand tools
- Provision for eye and clothing protection
- Portable chalk board
- Resource and literature display
This dual purpose area will accommodate twenty-four students allowing floor space of 50 sq. ft. per student. The desks are of a design that allows for stacking so that the space may be used for laboratory sessions. During the lab periods the trainers, hose cart, and other accessories are brought into the class area for student use. Pupils should be encouraged to use the resource area where they will not be bothered by noise or other typical school interference.
The unique aspect of this laboratory layout is the open type organization which allows for ease of control but requires good administration to maintain good housekeeping. One unique feature is the central office area with audio visual equipment and elevated rostrum area which allows for a compact lecture area. This organizational idea was contributed by John Comer of the WSU faculty.

1. Elevated rostrum
2. Audio-visual equipment
3. Hydraulic component storage
4. Hydraulic demonstration table
5. Pneumatic component storage
6. Pneumatic demonstration table
7. Wash area
8. Parts cleaner
9. Hydraulic arbor press
10. Metal lathe
11. Drill press
12. Grinder
13. Portable hydraulic pump
14. Component test stands
15. Hose racks
16. Pneumatic trainer
17. Hydraulic trainer
18. Work benches (four station)
19. Work benches
20. Desk
21. File cabinets
The floor space allowance is 100 sq. ft. per student which meets the present day desired standards for shops of this capacity. Separation of the hydraulics area from the pneumatics permits the components to be kept separate, thereby reducing potential accidents. Special student projects and repair work can be done in the machine area.
<table>
<thead>
<tr>
<th>Participants</th>
<th>Local High Schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Acord</td>
<td>Fontana High School</td>
</tr>
<tr>
<td></td>
<td>9453 Citrus Avenue</td>
</tr>
<tr>
<td></td>
<td>Fontana, California 91225</td>
</tr>
<tr>
<td>Jerry Cohen</td>
<td>Pershing High School</td>
</tr>
<tr>
<td></td>
<td>18775 Ryan Road</td>
</tr>
<tr>
<td></td>
<td>Detroit, Michigan 48234</td>
</tr>
<tr>
<td>Albert W. Dahlberg</td>
<td>Lamphere High School</td>
</tr>
<tr>
<td></td>
<td>13 Mile Road</td>
</tr>
<tr>
<td></td>
<td>Madison Heights, Mich. 48071</td>
</tr>
<tr>
<td>Ronald W. Dunn</td>
<td>Ernest Righetti High School</td>
</tr>
<tr>
<td></td>
<td>945 East Foster</td>
</tr>
<tr>
<td></td>
<td>Santa Maria, California 93454</td>
</tr>
<tr>
<td>T. J. Eastlack</td>
<td>Arbor Heights Junior High</td>
</tr>
<tr>
<td></td>
<td>8601 Martha Street</td>
</tr>
<tr>
<td></td>
<td>Omaha, Nebraska 68124</td>
</tr>
<tr>
<td>Joel D. Fowler</td>
<td>T. W. Brown Junior High</td>
</tr>
<tr>
<td></td>
<td>3333 Sprague</td>
</tr>
<tr>
<td></td>
<td>Dallas, Texas 75236</td>
</tr>
<tr>
<td>Gerald Golden</td>
<td>Western High School</td>
</tr>
<tr>
<td></td>
<td>1500 Scotten Avenue</td>
</tr>
<tr>
<td></td>
<td>Detroit, Michigan 48209</td>
</tr>
<tr>
<td>Gerald L. Greischar</td>
<td>Industrial Arts Department</td>
</tr>
<tr>
<td></td>
<td>Fairmont Senior High School</td>
</tr>
<tr>
<td></td>
<td>District 454</td>
</tr>
<tr>
<td></td>
<td>Fairmont, Minnesota 56031</td>
</tr>
<tr>
<td>Participants</td>
<td>Local High Schools</td>
</tr>
<tr>
<td>------------------</td>
<td>--------------------------------------------------------</td>
</tr>
<tr>
<td>John E. Gundersen</td>
<td>Highland High School</td>
</tr>
<tr>
<td></td>
<td>2166 S. 17th Street</td>
</tr>
<tr>
<td></td>
<td>Salt Lake City, Utah 84106</td>
</tr>
<tr>
<td>Robert Henderson</td>
<td>Cody High School</td>
</tr>
<tr>
<td></td>
<td>18445 Cathedral</td>
</tr>
<tr>
<td></td>
<td>Detroit, Michigan 48228</td>
</tr>
<tr>
<td>Frank Jolly</td>
<td>Department of Industrial Education</td>
</tr>
<tr>
<td></td>
<td>Humboldt State College</td>
</tr>
<tr>
<td></td>
<td>Arcata, California 95521</td>
</tr>
<tr>
<td>Eugene J. Kirby</td>
<td>Co-Operative Machine Department</td>
</tr>
<tr>
<td></td>
<td>East Boston High School</td>
</tr>
<tr>
<td></td>
<td>White and Brooks Street</td>
</tr>
<tr>
<td></td>
<td>East Boston, Massachusetts 02107</td>
</tr>
<tr>
<td>Ed Moomaugh</td>
<td>Stadium High School</td>
</tr>
<tr>
<td></td>
<td>111 N. &quot;E&quot; Street</td>
</tr>
<tr>
<td></td>
<td>Tacoma, Washington 98403</td>
</tr>
<tr>
<td>James E. McGraw</td>
<td>Industrial Arts Department</td>
</tr>
<tr>
<td></td>
<td>Willson Junior High School</td>
</tr>
<tr>
<td></td>
<td>1625 East 55th Street</td>
</tr>
<tr>
<td></td>
<td>Cleveland, Ohio 44103</td>
</tr>
<tr>
<td>Andrew M. McClenny</td>
<td>Carver High School</td>
</tr>
<tr>
<td></td>
<td>Box N</td>
</tr>
<tr>
<td></td>
<td>Richmond, Virginia 23831</td>
</tr>
<tr>
<td>Henry C. Ortner</td>
<td>Moorhead Senior High School</td>
</tr>
<tr>
<td></td>
<td>2300 4th Avenue</td>
</tr>
<tr>
<td></td>
<td>South Moorhead, Minnesota 56560</td>
</tr>
<tr>
<td>Participants</td>
<td>Local High Schools</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------------------------</td>
</tr>
</tbody>
</table>
| Max Pleasant      | Department of Industrial Education  
|                   | Cass Technical High School  
|                   | 2421 Second Avenue  
|                   | Detroit, Michigan 48201                                                            |
| Earl K. Reynolds  | Department of Industrial Education  
|                   | Bend Senior High School  
|                   | Bend, Oregon 97701                                                                 |
| Claude Tate, Jr.  | Industrial Arts Department  
|                   | Rebuen McCall Senior High School  
|                   | 803 Fish Street  
|                   | Tallulah, Louisiana 71282                                                          |
| R. W. Thornton    | Department of Industrial Education  
|                   | North Texas State University  
|                   | Box 5328 N.T. Station  
|                   | Denton, Texas 76203                                                                |
| Roger A. Vicroy   | Industrial Education Department  
|                   | Glassboro State College  
|                   | Glassboro, New Jersey 08028                                                       |
| Arlen R. Van Fossen| Central Union High School  
|                   | 2045 N. Dickenson  
|                   | Fresno, California 93702                                                           |
| Richard A. Weiss  | Auto Aero Ref. Technical Department  
|                   | Cass Technical High School  
|                   | 2421 Second Avenue  
|                   | Detroit, Michigan 48201                                                            |
| Robert Zanello    | Guilford High School  
|                   | Spring Creek Road  
|                   | Rockford, Illinois 61111                                                           |
APPENDIX B

LECTURERS AND CONSULTANTS

Albert Ackerman
Sales Manager
MacValve Company
Oak Park, Michigan 48237

TOPIC: Pneumatics
POSITION: Sales Manager

George Altland
Customer Training
Vickers Hydraulic School
Troy, Michigan 48084

TOPIC: Hydraulic Circuitry
POSITION: Manager of Customer Training

Gerald B. Baysinger
Associate Professor
Dept. of Industrial Education
Wayne State University
Detroit, Michigan 48202

TOPIC: Integrating Fluid Power
POSITION: Former Institute Director on Fluid Power

Thomas Burford
Department of Instructional Technology
Wayne State University
Detroit, Michigan 48202

TOPIC: Production of Visuals

Max F. Covert
Training Section
Salaried Personnel and Training Manufacturing Services
Ford Motor Company
Dearborn, Michigan 48210

TOPIC: Opportunities in Fluid Power
POSITION: Supervisor of Training Section

Dr. Paul W. DeVore
Department of Industrial Arts
College of Human Resources and Education
West Virginia University
Morgantown, West Virginia 26505

TOPIC: Study of Technology
POSITION: Professor in Department of Industrial Arts

Arthur C. Evans, Jr.
Pressed Metal Plant
Pontiac Motors Division
Pontiac, Michigan 48053

TOPIC: Fluid Controls
POSITION: Processing Engineer
Leonard Gau  
P.O. Box 1118  
Chrysler Corporation, Dept. 9210  
Detroit, Michigan 48231  

TOPIC: Fluids  
POSITION: Senior Research Scientists

Russel W. Henke, Professor  
Fluid Power Institute  
Milwaukee School of Engineering  
1025 N. Milwaukee Street  
Milwaukee, Wisconsin 53201  

TOPIC: Instrumentation  
POSITION: Institute Director and Vice-President of the National Fluid Power Society

Tom McMaster  
Rosaen Filter Company  
1776 E. Nine Mile  
Hazel Park, Michigan 48073  

TOPIC: Fluid Conditioners  
POSITION: General Sales Manager

Stig E. Ralstrom  
Western High School  
1500 Scotten Avenue  
Detroit, Michigan 48209  

TOPIC: Teaching Practice to Prevent Dropouts  
POSITION: Instructor

Dr. Charles Risher, Professor  
Department of Industrial Education  
Western Michigan University  
Kalamazoo, Michigan 49003  

TOPIC: Strategies for a Model Program  
POSITION: NDEA Institute Director

Jack Robinson  
Pitney Bowes  
8200 2nd Avenue  
Detroit, Michigan 48202  

TOPIC: Fluidics

Dave Royer  
Rosaen Filter Company  
1776 E. Nine Mile  
Hazel Park, Michigan 48073  

TOPIC: Fluid Conditioners  
POSITION: Engineer
THE FLUID POWER SOCIETY

THE FLUID POWER SOCIETY - a professional organization performing an educational and technological function, serves the interests of education and industry.

The Fluid Power Society has been actively engaged in promoting educational opportunities in the fluid power technology for the past decade. Teachers of fluid power cannot afford to ignore the benefits derived from active participation in local or the national chapter.

Specific information on the administration, organization, membership, and benefits of this society are provided to assist you become an active member.

Administration

THE FLUID POWER SOCIETY

Executive Officer

Chairman
Russell Henke
Elm Grove, Wisconsin 53122

Administrative Office
International Headquarters
Fluid Power Society
P. O. Box 49, Thiensville, Wisconsin 53092 U.S.A.

Phone
Area Code 414/242-2010

Organization and Membership

Four categories of membership are available in the Fluid Power Society. The largest segment consists of Regular Members, those whose primary professional and technical interests are in fluid power technology and
engineering and who, through Society affiliation, desire to contribute to the scientific and educational objectives of the Society. Active members, in turn, keep abreast of developments in fluid power through the Society's publications, annual technical meetings, and local chapter functions.

Individuals and organizations who wish to make a larger material contribution to support the Society's projects may become **Sustaining Members**. Qualified students may become **Student Members**, and the Society periodically honors leaders in fluid power by designating them **Honorary Members**.

The local chapters are the vertebrae which make up the backbone of the Society. They are the focal points of continuing activities, projects, and meetings.

Establishment of Society policy and continuity of operation are provided by the elected Board of Directors. So that chapters may also have a voice in the Society's government, each chapter is represented in a House of Delegates which meets annually, reviews Society activities, and serves in an advisory capacity to the Board. The Headquarters Office located in Thiensville, Wisconsin, a suburb of Milwaukee, includes the full-time staff of the Society. Here the membership records are kept, and the business of the society is conducted.

**Activities**

On the national and international scenes, the Society is recognized as the spokesman for fluid power engineering and technology. Examples of such recognition are its co-sponsorship of the biennial **Fluid Power International Exposition and Conference**, held in each even-numbered year in London, England, and its co-sponsorship of the National Conference on Fluid
Power held concurrently with the Society's Annual Meeting each year in the United States. Its membership in, and co-sponsorship of the Council for Fluid Power Education, and its recognition by national governments and educational agencies as the "center" of fluid power knowledge in the United States, Canada, Australia, and Great Britain was a fortunate development.

The Society is an institutional member of the American Automatic Control and the American Society for Engineering Education; and is a member of Sectional Committee B93, Fluid Power Systems and components, USA Standards Institute.

Benefits

Fluid Power Society members qualify to receive two outstanding publications, through the *Hydraulics & Pneumatics, the Magazine of Fluid Power Systems*. The thorough coverage in this magazine of technical and engineering news in Europe adds greatly to the scope of members' knowledge.

Members may also take advantage of two Society group insurance plans. One provides low cost term life insurance, and the other is an income protection plan which offers protection for as long as a lifetime in case of disabling illness or accident. Participation in local chapter activities enables the teacher to benefit most from the sponsored activities and association with representatives from the fluid power industry.

The primary reason for this action was to provide an identifiable agency responsible for formal programming in education on an international scale.

The purpose of the Fluid Power Society Education Institute is to help develop seminars, conferences, symposia, and short courses of greater scope and on a broader base than individual chapters can undertake.
APPENDIX C (Cont.)

Publications

The official publication of the Society is the "FPS News", which is published monthly in Hydraulics & Pneumatics. All members are eligible to receive the publication. Also, members may receive the Fluid Power International, a British publication at no cost.

The Directory of Members is published annually. Other publications include educational manuals and chapter communications. Under a cooperative arrangement with the National Fluid Power Association, standards and technical manuals published by NFPA are available to FPS members at reduced cost.

The Fluid Power Handbook & Directory can also be purchased from the Fluid Power Society.

Other Publications Available

The following publications are available at prices listed from the Society's Headquarters Office. On most publications, discounts are allowed for quantity orders of ten or more. Inquiries should be directed to the Society, P.O. Box 49, Thiensville, Wisconsin 53092.

<table>
<thead>
<tr>
<th>Technical Manuals</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Power -- An outline of technical Content and Suggested Resource materials</td>
<td>$2.00 ea.</td>
</tr>
<tr>
<td>Hydraulic Systems, by Russell W. Henke</td>
<td>2.00 ea.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Standards</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cylinder Bore and Piston Rod Sizes Code USASI B93.3-1965</td>
<td>.04 ea.</td>
</tr>
</tbody>
</table>
The Hydraulics & Pneumatics Magazine carries current published materials under the heading of: "Your Fluid Power File". Check or money order should accompany orders for publications, payable to the Fluid Power Society.

The primary reason for this action was to provide an identifiable agency responsible for formal programming in education on an international scale. The purpose of FPS-EI is to help develop seminars, conferences, symposia, and short courses of greater scope and on a broader scale than individual chapters can undertake.
FLUID POWER SOCIETY MEMBERSHIP

NUMERICAL LISTING

1 -- Detroit, Michigan
2 -- Milwaukee, Wisconsin
3 -- Chicago, Illinois
4 -- Cleveland, Ohio
5 -- Minneapolis-St. Paul, Minn.
6 -- Rockford, Illinois
7 -- Indiana
8 -- Toledo, Ohio
9 -- Boston, Massachusetts
10 -- Toronto, Ontario, Canada
11 -- Houston, Texas
12 -- Rhode Island
13 -- Seattle, Washington
14 -- Montreal, Quebec, Canada
15 -- Saginaw, Michigan
16 -- Illinois
17 -- Dayton, Ohio
19 -- New York-New Jersey
20 -- Wichita, Kansas
21 -- Syracuse, New York
22 -- Baltimore, Maryland
23 -- Philadelphia, Pennsylvania
24 -- Denver, Colorado
25 -- Indiana
26 -- Atlanta, Georgia
27 -- Columbus, Ohio
28 -- Dallas, Texas
29 -- New York
30 -- Erie, Pennsylvania
31 -- Connecticut
32 -- Kansas City, Missouri
33 -- Pittsburgh, Pennsylvania
34 -- California
35 -- Racine-Kenosha, Wisconsin
36 -- St. Louis, Missouri
37 -- Rochester, New York
38 -- Peoria, Illinois
39 -- Cincinnati, Ohio
40 -- Huntsville, Alabama
41 -- Georgia
42 -- Indianapolis, Indiana
43 -- Northern California
46 -- Greensboro, North Carolina
47 -- Phoenix, Arizona (Central Arizona Chapter)
48 -- Spokane, Washington
A -- Alpha, Kenosha Tech. Institute
A-1 -- Milbourne, Australian Section
A-2 -- Sidney
A-3 -- Adelaide
B-1 -- Birmingham-Midlands, British Section
B-2 -- London
B-3 -- Leeds
1 -- International Chapter

Chapter Officers

Detroit Chapter
No. 1

- President-Joe Allbs, 1641 Hollywood, Dearborn
- Secretary-George Schuran, 33038 Willow Lane, Fraser

Chicago Chapter
No. 3

- President-Vaughn Nelson, 5381 Middaugh, Downers Grove
- Secretary-S.C. Baker, 1611 E. Newberry, Chicago

Minn.-St. Paul
Chapter No. 5

- President-W. Bruce Jenkinson, Hydra-Power Inc., Minneapolis
- Secretary-Dean Wickoren, Equipment Parts & Service, St. Paul
- Res. Agent-Bruce Jenkinson
Rockford Chapter
No. 6

- President: Ted Brolund, 603 Sunrise Ln., Rockford
- Secretary: Robert A. Zanello, 2525 Ohio Pkwy., Rockford
- Res. Agent: Ian Proudfoot, 29 Airport Dr., Rockford

Boston Chapter
No. 9

- President: Robert Berlyn, Plas-Tech Equip. Co., Mercer Road, Natick
- Secretary: William C. Newhall, Harwood Engrg. Co., Inc. South St., Walpole

Philadelphia Chapter
No. 23

- INACTIVE

Baltimore Chapter

- President-to be elected
- Vice-President: Charles M. Dees, 273 Greenmount Ave., Baltimore

North Texas Chapter No. 28

- President: F.C. Ruth, Industrial Air & Hydr. Inc., Dallas
- Secretary: John Williams, 9827 Donegal, Dallas
- Res. Agent: John Williams

Southern California No. 34

- President: J.S. Cardillo, 4109 Via Pica Poste, Palos Verdes Estates
- Secretary: Alexander A. Toben, Ledeen, 13453 Delano St., Van Nuys

Northern California
No. 43

- President: A.B. Roth, 3376 Springhill Road, Lafayette
- Secretary: R.H. Edson, FMC Corp. P.O. Box 2812, San Jose
APPENDIX D

LABORATORY TEST EQUIPMENT

Capital Engineering Company
2020 W. 78th Street
Minneapolis, Minnesota  55423

Educational Program Development, Inc.
903 Nottingham
Grosse Pointe, Michigan  48230

Electromatic Manufacturing Co. Inc.
Box 183
McMinnville, Tennessee  37110

Scott-Engineering Sciences Corp.
1400 S.W. 8th Street
Pompano Beach, Florida  33060

Technical Education and Manufacturing
161 Vester
Ferndale, Michigan  48220

Vega Enterprises
Box 1006
Decatur, Illinois  60609

Vickers Inc.
14420 Linwood Avenue
Detroit, Michigan  48208