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ELECTRICAL APPLIANCE SERVICEMAN, SUGGESTED GUIDE FOR A TRAINING COURSE.

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DESCRIPTORS- *ELECTRICAL APPLIANCE SERVICEMEN, *CURRICULUM GUIDES, *TRADE AND INDUSTRIAL EDUCATION, *ELECTRICAL APPLIANCES, PROGRAM DEVELOPMENT, MDTA PROGRAMS,

THE PURPOSE OF THIS GUIDE IS TO AID IN PLANNING AND DEVELOPING A COURSE FOR TRAINING ELECTRICAL APPLIANCE SERVICEMEN. OUTLINES (ONE PAGE EACH) COVER -- (1) RELATED INSTRUCTION, (2) FUNDAMENTALS OF ELECTRICITY, (3) BASIC CONTROLS AND ELECTRONIC COMPONENTS, (4) RESISTANCE HEATING APPLIANCES, (5) MOTORS FOR ELECTRIC APPLIANCES, (6) MOTOR DRIVEN APPLIANCES, (7) REFRIGERATION, AND (8) MISCELLANEOUS OPERATIONS. THE OUTLINES GIVE OBJECTIVES (INSTRUCTIONAL), UNIT OUTLINE, AND REFERENCES. THE GUIDE SUGGESTS 268 CLASSROOM HOURS AND 572 LABORATORY HOURS FOR THE COURSE. THE TEACHER SHOULD HAVE TECHNICAL AND BUSINESS EXPERIENCE. STUDENTS SHOULD HAVE THE EQUIVALENCE OF A HIGH SCHOOL EDUCATION. THE GUIDE WAS DESIGNED FOR A CLASS OF 20 STUDENTS. OTHER SECTIONS DEAL WITH COURSE ORGANIZATION, STUDENT EVALUATION, REFERENCES AND AIDS, EQUIPMENT AND TOOL LISTS AND PRICES, FLOOR PLANS, AND EXPENDABLE SUPPLY LISTS AND PRICES. (EM)

A Suggested
Guide for a
Training Course

ELECTRICAL APPLIANCE SERVICEMAN

U.S. Department of Health, Education, and Welfare
Office of Education

ELECTRICAL APPLIANCE SERVICEMAN

(D.O.T. Occupational Code 5-83.041)

Suggested Guide for a Training Course

U.S. Department of Health, Education, and Welfare
John W. Gardner, Secretary

Office of Education
Francis Keppel, Commissioner

Manpower Development and Training Program

FOREWORD

Electrical appliance repair has become important to the American householder and to the American economy as the number of electric motors has multiplied and as automatic controls have become more commonplace. Work performed by the electrical appliance serviceman involves locating trouble, installing new parts, testing the appliance, and making minor adjustments to insure proper functioning of the unit. The serviceman needs a general understanding of the functions of all appliances, although he may develop special competency in one type or "line" of equipment.

The appliance serviceman should have an understanding of good business practices and should know how to get along well with customers. He must be tactful and courteous and should present a neat, clean appearance.

The increase in marriages and population growth will continue to make the demand for appliances high. The complexity of many modern appliances places heavy emphasis upon the need for skilled servicemen to handle problems of malfunction. Capable servicemen with a working knowledge of electricity, electronics, and mechanical devices will find many job opportunities open to them. Preparation for employment through vocational courses should open the way for many job opportunities within the occupation.

The hours allocated in the guide to the various units are merely a suggestion. Active advisory committees should be called upon by the school administrator when arranging courses to meet local conditions in the industry. The course content should be considered flexible enough to meet local appliance shop conditions and the level of the group to be trained.

Pertinent references are given at the end of each Course Unit in this publication. A complete list of references, with the names of authors, titles, publishers, and addresses is given in the Suggested List of Textbooks and References.

Prepared under contractural arrangement with the Oklahoma State University, the material has been reviewed by competent advisory groups. Recognition is given to Maurice W. Roney, Director, School of Industrial Education, for having supervised the development of the content, and to L. Carl Love, Oregon State University, Corvallis, for his assistance as a consultant during the preparation of the guide.

Walter M. Arnold
Assistant Commissioner for
Vocational and Technical Education

CONTENTS

TRAINING COURSE FOR ELECTRICAL APPLIANCE SERVICEMAN

Purpose of the Guide

This training guide has been prepared to assist in planning and developing the course of training for workers who expect to find employment in the field of household appliance maintenance and repair. The guide has been organized in a manner to be of maximum value to school administration personnel who are not themselves specialists in the occupation. Sufficient details have been included, however, to provide an outline of instruction for the instructor who will be expected to develop and operate an efficient training program.

No attempt has been made to cover every detail of instruction, but rather to suggest a basic approach to the training of electrical appliance servicemen. The suggested course outline may require modification to meet special needs. The sequence of presentation as well as the final selection of topics for special emphasis should be determined by instructional specialists and will vary, depending upon the needs and background of the trainee group. Supplemental material may be found in the suggested textbooks, references, manufacturers' bulletins and catalogs, and films.

Although this training guide has been developed primarily for use by the Manpower Development and Training Program, it includes instructional material that will help those people involved to develop and advance beyond the basic skill requirements for job application. Much of the related material included in the course outline has been added specifically for the purpose of assisting the trainee to meet the public and to progress beyond the entry level classification.

Job Description

The work of the electrical appliance serviceman requires a knowledge of mechanical and electrical devices such as those used in homes. In the larger cities, the appliance repairman may specialize in certain types of appliance work. However, many small dealers require employees who are competent in the range of jobs normally found in the field of appliance repair. There are many distinctly different types of jobs in this industry; the repairman needs to have some broad understanding of the function of all appliances, although he may develop a special competency in one type of equipment.

The serviceman in this field of work may have a great deal more contact with the public than either the salesman or the management; consequently, the appliance serviceman needs to have some of the abilities of the salesman and some understanding of good business practices. Good public relations are important. Much of the minor repair work of an appliance repairman will be carried on at the customer's home. Good personal habits of cleanliness, promptness, honesty, and courtesy are mandatory.

The demand for trained workers far outweighs the supply; yet there is considerable competition for the good jobs. The average worker can expect earnings of about $5,700 per year.

Length of Course and Course Units

The training course as outlined covers a period of 28 weeks with a total of 840 hours of class instruction and laboratory practice. Instruction is planned for 6 hours per day and 5 days per week.

Unit	Title	Suggested class hours	Suggested laboratory hours
I.	Related Instruction	110	0
II.	Fundamentals of Electricity	40	110
III.	Basic Controls and Electronic Components	50	140
IV.	Resistance Heating Appliances	10	40
V.	Motors for Electric Appliances	15	60
VI.	Motor Driven Appliances	10	100
VII.	Refrigeration	25	100
VIII.	Miscellaneous Operations	8	22
	Sub-total	268	572
			268
		Total	840

Qualifications of Trainees

Generally, the equivalent of a high school education is expected of candidates prior to training. This is important because the serviceman is actually representing his organization to the public. Since public relations are so important, the trainee is expected to have the ability to greet customers on a friendly, yet business-like basis. Being a good listener, while not mandatory, may be exceedingly helpful in providing clues for diagnosing existing appliance problems.

Trainees are expected to possess enough initiative to work out the specific servicing problems. Workers in this field, which is becoming more technical each year, are expected to possess a continuing desire to learn about new products, new installations, new tools, and new testing equipment.

Teacher Qualifications

A teacher for this program must have experience in electrical appliance repair and preferably, should have business experience as an owner or operator of an appliance repair service.

If the person selected for this teaching assignment has no teaching experience, he should be given teacher education including fundamental principles of lesson planning and presentation.

Suggestions for the Organization of Instruction

The total program in this guide is intended to develop a skill-level which will qualify individuals for employment. While this is the major objective, the program is also designed to provide the trainee with a background of related material that will help him develop versatility and enable him to meet the changing requirements in the appliance service field.

Laboratory experiences, as well as classroom instruction, should be carefully selected to give the trainee as many varied experiences as possible. When the training program is being organized the instructor should evaluate the total experiences listed in view of local requirements.

The allocation of hours to each unit of instruction serves to indicate the relative emphasis to be placed on the units. However, this program was designed to represent a typical situation, and changes in the distribution of time may be necessary to adapt the program to local conditions and to the background of the group in training. The sequence of instructional units shown in the outline may be varied in any way. For example: the unit on Related Instruction may be spread throughout the course in one or two weekly sessions. Further, the ratio of classroom time to actual shop practice should be left to the discretion of the instructor.

This training guide was designed for a class of 20 persons, but the optimum trainee-teacher ratio in the laboratory would be about 10 to 1.

Course Unit I

RELATED INSTRUCTION

Training Time — Classroom, 110 hrs; laboratory, 0 hours

Objectives

To orient trainees to the nature and scope of the electrical appliance serviceman's work and to provide certain specialized skills trainees will need for successful employment.

To provide selected skills in mathematics, business English, and business practices.

Unit Outline

A. Orientation
   1. Class procedure
   2. Methods of evaluating progress
   3. Safety in industry
   4. How to use parts and service manuals
B. Basic Mathematics
   1. Definition of terms
   2. Using fractions and decimals
   3. Shop computations involving measurement and conversion factors
C. Business English
   1. Spelling
   2. Use of words
   3. Sentence structure
   4. Composition
D. Business Practices
   1. Public relations
   2. Salesmanship

References

Blumenthal, Joseph C. English 3200: A Programmed Course in Grammar and Usage.
Fergus, Patricia M. Spelling Improvement: A Program for Self-Instruction.
Graham, Frank Duncan. Audel's New Electric Library.
Huffman, Harry. Programmed Business Mathematics, Concepts, Skills, and Applications, Parts I and II.
Parkhurst, Charles Chandler. English for Business, 4th Edition.

See SUGGESTED LIST OF TEXTBOOKS AND REFERENCES for complete details on ordering books

Course Unit II

FUNDAMENTALS OF ELECTRICITY

Training Time — Classroom, 40 hrs; laboratory, 110 hours

Objectives

To develop an understanding of basic electrical theory, use of testing equipment, and safety relating thereto.

Unit Outline

A. Introduction to electricity
B. Definitions and explanations of terms
C. Discussion of atomic structure
D. Discussion of the flow of electricity
E. Explanation of electrical symbols
F. A discussion of the electrical circuit and Ohm's Law
G. Introduction to Kirchhoff's Law
H. Explanation of testing equipment
I. Use, care, and safety of tools and testing instruments
J. Introduction to future appliances
   1. Dielectric heating
   2. High frequency heating
   3. Electric devices

Suggested Laboratory Exercises

1. Exercises in reading electrical symbols
2. Problems in electrical circuitry involving Ohm's Law
3. Exercises in drawing involving the use of electrical symbols
4. Analysis of electrical devices involving the use of test equipment

References

Graham, Frank Duncan. Audel's New Electric Library.
Suffern, M. G. Basic Electrical Principles.

Course Unit III

BASIC CONTROLS AND COMPONENTS

Training Time — Classroom, 50 hrs; laboratory, 140 hours

Objectives

To provide understanding of principles and practices in the repair and replacement of electro-mechanical sensing devices and controllers.

Unit Outline

A. Introduction to theory of electronics
B. Definition and explanation of terms
C. Electronic symbols
D. Identification of schematic drawings
E. Manual switching
F. Electro-mechanical switching devices
G. Electric timers
H. Use of thermostats
I. Methods of speed control

Suggested Laboratory Exercises

1. Locating basic controls from a schematic drawing
2. Troubleshooting controls with power off
3. Testing controls while in operation
4. Analysis of machine controls while operating with full load or overload
5. Precautions to be taken during removal and replacement of controls
6. Analysis of whether to repair or replace specific controls

References

Graham, Frank Duncan. Audel's New Electric Library.
Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair.
Westinghouse. Factory Testing of Electrical Apparatus.

Course Unit IV

RESISTANCE HEATING APPLIANCES

Training Time — Classroom, 10 hrs; laboratory, 40 hours

Objectives

To provide students with the necessary knowledge and skills in the operation and repair of resistance heating appliances.

Unit Outline

A. Visual examination while in operation
B. Theory of resistance heating
C. Discussion of preventive maintenance
D. Use of precision instruments for calculating proper operation
E. Importance of visualizing electrical circuits for troubleshooting
F. Aspects of installation
G. Preparing work orders for repair
H. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Construct schematic diagrams for tracing complete electrical circuit
2. Remove and replace heating assembly
3. Analyze power requirements and check rated wattage against manufacturer's rating
4. Calculate size of wire needed to furnish power
5. Study wire sizes required by the electrical code
6. Become familiar with local requirements concerning a disconnect beyond main power panel
7. Ground appliances and use instruments to analyze whether or not connections are adequate
8. Make sketch for each different type of machine, showing theory of operation

References

Anderson, Edwin. Audel's Home Appliance Guide.
Brockwell, P. T. How to Repair Household Appliances.
Brockwell, P. T. Major Appliance Service.
Gabbert, William. Electrical Appliance Service Manual.
Tricomi, Ernest. How to Repair Major Appliances.

Course Unit V

MOTORS FOR ELECTRIC APPLIANCES

Training Time — Classroom, 15 hrs; laboratory, 60 hours

Objectives

To teach the students the theory, operation, and repair of motors for electrical appliances.

Unit Outline

A. Advantages and disadvantages of specific types of motors
B. Details of construction
C. Theory of operation
D. Care during disassembly and assembly
E. Preventive maintenance to extend the life time of specific types of operation
F. General points of attention during troubleshooting
G. When to repair or to replace electric motor parts or complete units
H. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Complete a schematic diagram of specific types of motors showing complete electrical circuit
2. Study faulty motors of specific types and locate source of trouble
3. Conduct tests of faulty motors with power off
4. Isolate trouble in specific motors with power on
5. Remove and clean complete motor units
6. Explain procedures for examining and correcting end-play
7. Study theory of controlling rotation of specific motors
8. Make safety analysis of electrical motors.

References

Fuller, Roger Alden. Motor Troubles and Their Correction.
Graham, Frank Duncan. Audel's New Automobile Guide for Mechanic Operations and Servicemen.
Green, Phillip T. Electrical Testing & Troubleshooting.
McCullough, William Wallace. Electric Motor Maintenance.
Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair.

Course Unit VI

MOTOR DRIVEN APPLIANCES

Training Time — Classroom, 10 hrs; laboratory, 100 hours

Objectives

To provide the students with the knowledge and skills needed in troubleshooting and repairing specific fractional-horsepower electric units.

Unit Outline

A. Theory of operation of specific units
B. Symptoms preceding trouble
C. Efficiency in methods of troubleshooting
D. Advantages and disadvantages in repair or replacement
E. Introduction to power transfer assemblies
F. Discussion of nomenclature of parts

Suggested Laboratory Exercises

1. Make a list and name main parts of specific units
2. Analyze vee belt for replacement
3. Replace specific transmission gears
4. Analyze and troubleshooting driving mechanism
5. Replace accessories
6. Study unit in operation for optimum service
7. Make approved installations of specific units

References

Brockwell, P. T. Major Appliance Service.
Manly, Harold. Electrical Appliance Repair & Servicing.
Tricomi, Ernest. How To Repair Major Appliances.

Course Unit VII

REFRIGERATION

Training Time — Classroom, 25 hrs; laboratory, 100 hours

Objectives

To acquaint the students with the basic theory of refrigeration and the approved methods of diagnosing trouble and replacing components.

Unit Outline

A. Basic theory of refrigeration
B. Definition of the components and their function in a refrigeration system
C. Explanation and importance of making a diagnosis
D. Discussion of the tools and instruments used in making a diagnosis
E. Procedures in changing components

Suggested Laboratory Exercises

1. Make a schematic diagram showing theory of operation
2. Analyze the problem when motor-compressor will not run
3. Study a defective unit which runs continuously
4. Diagnose the problems on a unit with high cabinet temperature
5. Discharge a system preliminary to component replacement
6. Disconnect and prepare the new motor compressor for installation
7. Replace the condenser
8. Install a precooler
9. Repair and replace a freezer coil
10. Install the molecular sieve drier
11. Sweep the system to eliminate moisture
12. Conduct a check for restrictions
13. Test for leaks
14. Charge the system

References

Althouse, A. D., and Carl H. Turnquist. Modern Refrigeration and Air Conditioning.

American Society of Refrigeration Engineers. Air Conditioning Refrigeration Data Book.

Derman, Joseph, Floyd Maksten and Harold Seaman. Home Air Conditioning Installation and Repair.

Manly, Harold P. Drake's Refrigeration Service Manual.

Marsh, R. Warren and Thomas Olivo. Principles of Refrigeration.

Course Unit VIII

MISCELLANEOUS OPERATIONS

Training Time — Classroom, 8 hrs; laboratory, 22 hours

Objectives

To develop within the students the ability to lay out sheet metal work and to use tools and equipment associated with sheet metal operations.

Unit Outline

A. Introduction to sheet metal work
B. Discussion of metal finishing
C. Introduction to metal fastening and joining
D. Use of the soldering iron, propane torch, and oxyacetylene torch
E. Discussion of the installation survey

Suggested Laboratory Exercises

1. Exercises in simple sheet metal operations
2. Assignments using the oxyacetylene torch
3. Brazing and soldering exercises
4. Exercises in refinishing scratches and complete panels
5. Complete installation surveys related to customer convenience of operation

References

Ruden, Edword M. and Juan R. Griffin. Basic Arc Welding.
Ruden, Edword M. and Juan R. Griffin. Basic Oxyacetylene Welding.

TEACHING THE COURSE

Planning the Lesson

The best guide or lesson plan is, of course, one that has been prepared by the individual teacher, based on personal experience and manner of teaching. Although teachers differ in their ways of organizing and coordinating important parts of their presentations, they agree that the purpose of a lesson is effective and meaningful class room instruction.

Written plans may be brief, but the good teacher will know before the class starts:

1. The goals or objectives of the lesson - the kind of learning desired
2. The outline and suggested time schedule for the lesson, including:
    a. An interest approach - a way to introduce the lesson, to capture the interest of the trainees and to direct their attention to the lesson's goals or objectives
    b. Activities which will involve the trainees in discovering new facts and principles, solving realistic problems, or practicing skills
    c. A way to summarize the lesson - to help trainees arrive at some valid conclusions and/or to evaluate the extent to which lesson goals have been achieved
3. The subject matter content - the facts and principles or main ideas to be brought out in the lesson
4. The teaching materials and references to be used

Training Facility Considerations

It is the purpose of this guide to describe a typical training facility, see Appendix D, that may be adapted to meet local requirements. The physical layout, space, machines, equipment, and tool lists, contained as Appendixes A, B, and C, should be considered minimum requirements for an optimum program; however, the specialists responsible for particular programs may wish to make some substitutions, deletions, or additions to suit individual needs. In the list of equipment, estimated prices have been included to indicate quality requirements. Should it be advisable to order from the equipment list, more detailed specifications will be required for purchase orders.

The laboratory should contain the necessary electrical, hot water, cold water, sewer, and gas outlets. Glare-free lighting with an illumination of approximately 50-foot candles at work table height is recommended. An attempt has been made to arrange the work stations to permit at least three men to work together in repairing or analyzing each large appliance.

The spray booth and the welding area should be connected to exhaust fans capable of providing good ventilation. It is advisable to check with the local building code for specifications.

The training facility and items related thereto, which are included as Appendixes A through E, are designed for a class of 20 trainees.

Criteria for Evaluating Trainee Readiness for Employment

The criteria which serve as guides in determining whether the trainee is ready for employment as an electrical appliance serviceman may be more stringent than in some other occupations. However, some understanding and insight into how to provide various services are of such importance that every attempt should be made to evaluate trainee progress.

The use of various evaluative devices is necessary for the teacher and the trainee to accumulate objective information about the growth of the trainee. The following kinds of competencies are important to develop or to strengthen during the training program:

A. Personal qualities
   1. Courtesy, friendliness, and tact in dealing with supervisors, fellow workers, and the general public
   2. Acceptable appearance - good grooming, cleanliness and neatness in dress, and sensible choice of clothing
   3. Good personal habits in speech, mannerisms, cleanliness, and method of work
   4. Acceptable attitudes - calmness in disorganized situations, positive attitude toward work, cooperativeness, willingness to work with others
   5. Understanding the role of the electrical appliance repairman

B. Activities showing knowledge, understanding, and skill
   1. Demonstrates knowledge of basic electrical appliance repair
   2. Understands and conforms to instructions or directions
   3. Demonstrates ability to work with minimum immediate supervision
   4. Demonstrates the ability to keep repair facilities clean and orderly
   5. Demonstrates the ability to maintain hand tools and test equipment used in electrical appliance repair
   6. Demonstrates the ability to order electrical appliance repair materials and to keep records on electrical supplies
   7. Demonstrates the ability to develop and follow a work plan or schedule
   8. Demonstrates understanding of basic safety precautions

SUGGESTED LIST OF TEXTBOOKS AND REFERENCES

Althouse, A.D. and Carl H. Turnquist. Modern Refrigeration and Air Conditioning. Chicago: Goodheart-Wilcox Publishing Co. 1960.

American Society of Refrigeration Engineers. Air Conditioning Refrigeration Data Book. New York. 1959.

Anderson, Edwin P. Audel's Home Appliance Guide. New York: Audel, 1958.

Blumenthal, Joseph C. English 3200, A Programmed Course in Grammar and Usage. New York: Harcourt, Brace and World, Inc. 1962.

Brockwell, P. T. How To Repair Household Appliances. New York: McGraw-Hill Book Co., Inc. 1957.

Brockwell, P. T. Major Appliance Service. New York: McGraw-Hill Book Co., Inc. 1957.

Darr, Jack. How To Repair Small Appliances. Indianapolis: Bobbs-Merrill Co., Inc. 1961.

Derman, Joseph, Floyd Maksten and Harold Seaman. Home Air Conditioning Installation and Repair. New York: J. H. Rider Publisher, Inc. 1964.

Fergus, Patricia M. Spelling Improvement: A Program for Self-Instruction. New York: McGraw-Hill Book Co., Inc. 1964.

Fuller, Roger Alden. Motor Troubles and Their Correction. Detroit, Michigan: Business News Publishing Co., 1944.

Gabbert, William. Electrical Appliance Service Manual. New York: Holt, Rinehart and Winston Inc. 1961.

Graham, Frank Duncan. Audel's New Automobile Guide for Mechanic Operations and Servicemen. New York: Theodore Audel & Co. 1963.

Green, Phillip T. Electrical Testing & Troubleshooting. New York: Industrial Press. 1956.

Huffman, Harry. Programmed Business Mathematics, Concepts, Skills, and Applications, Parts I and II. New York: McGraw-Hill Book Co., Inc. 1962.

McCullough, William Wallace. Electric Motor Maintenance. New York: John Wiley & Sons, Inc. 1947.

Manly, Harold. Electrical Appliance Repair & Servicing. Chicago: Frederick J. Drake and Co. 1958.

Manly, Harold. Drake's Refrigeration Service Manual. Chicago: Frederick Drake and Co. 1962.

Marsh, R. Warren and Thomas Olivo. Principles of Refrigeration. Albany, New York: Delmar, 1963.

Morgan. Alford Powell. Home Electrical Repair. New York: Crown Publishers, 1950.

Parkhurst, Charles Chandler. English for Business. 4th Ed. Englewood Cliffs, N. J.: Prentice-Hall. 1963.

Ruden, Edword M. and Juan R. Griffin. Basic Arc Welding. Albany, New York, Delmar, 1962.

Ruden, Edword M. and Juan R. Griffin. Basic Oxyacetylene Welding. Albany, New York: Delmar, 1962.

Schweitzer, Gerald. Basis of Fractional Horsepower Motors & Repair. New York: John F. Rider. 1960.

Stafford, Harry Earl. Troubles of Electrical Equipment, Their Symptoms, Causes and Remedy. New York: McGraw-Hill Book Co., Inc. 1947.

Suffern, M. G. Basic Electrical Principles. New York: McGraw-Hill Book Co., Inc. 1956.

Tricomi, Ernest. How To Repair Major Appliances. Indianapolis: Howard W. Sams & Company, Inc. 1962.

Westinghouse. Factory Testing of Electrical Apparatus. East Pittsburgh, Pennsylvania. 1951.

Wiring Master. Vols. I through IV. Joseph L. Spence, Ed. Los Angeles: The Master Publishers. 1963.

SUGGESTED LIST OF FILMS

BALSAM WOOL RESEARCH HOUSE
16 mm, sound, color, 15 minutes
Depicts the results of intricate measurements of heat loss and heat gain in two identical houses built for this experiment. It includes effect of solar energy, basement heating, insulation, efficiency, triple versus double glazing of windows, room temperature studies, calculated heat loss versus actual heat loss, etc.
Wood Conversion Company
Director of Advertising
W-1800 First National Bank Building
St. Paul 1, Minnesota

BASIC ELECTRICITY--THE ELECTRON THEORY
16 mm, sound, 5 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

ELECTROMAGNETS
16 mm, sound, black and white, 10 minutes
McGraw-Hill Book Co., Inc.
330 West 42nd Street
New York, N. Y. 10036

ELEMENTS OF ELECTRIC CIRCUITS
16 mm, sound, black and white, 11 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

ELECTRONS
16 mm, sound, black and white, 10 minutes
Encyclopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

THE FACTORY: HOW A PRODUCT IS MADE
16 mm, black and white, 13 minutes
Designed to teach basic principles of oxyacetylene safety
Airco Welding Products Division
Air Reduction Co., Inc.
150 East 42nd Street
New York, N. Y. 10017

HOME ELECTRICAL APPLIANCES
16 mm, sound, black and white, 11 minutes
Encyclopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

INTRODUCTION TO ELECTRICITY
16 mm, sound, black and white
Coronet Films
Wilmette, Illinois

MAGNETISM
16 mm, sound, black and white, 16 minutes
Encylopedia Britannica Films
65 E. South Water Street
Chicago 1, Illinois

MEASUREMENT OF ELECTRICITY
16 mm, sound, black and white
Coronet Films
Wilmette, Illinois

NATURE OF HEAT
16 mm, sound, black and white, 10 minutes
Coronet Films
Wilmette, Illinois

MODERNIZING MOTORS
16 mm, sound, color, 19 minutes, 1960
Dow Corning Corporation
8555 16th Street
Silver Spring, Md.

Note: Send directly to appliance manufacturers for training films that will cover specific equipment.

APPENDIX A. SUGGESTED LIST OF MACHINES

Quantity	Description	Estimated Total Price
1	Bench grinder, ½ hp., double arbor, equipped with flexible abrasive belt attachment	$ 140.00
1	Drill press, ½ inch chuck capacity	300.00
1	Metal lathe & armature under cut	300.00
1	Arc welder, type: transformer, 250 amp. capacity	225.00
1	Spot welder, 220 volt, 60 cycle, 1.5 KVA	175.00
1	Arbor press, 3 ton capacity	115.00
1	Air compressor complete, air delivery @ 175 psi - 4 cu. ft. per min.	500.00
	Total	$1,755.00

APPENDIX B. SUGGESTED LIST OF TOOLS

Quantity	Description	Estimated Total Price
2	Portable electric drills $\frac{1}{4}$ inch	$ 60.00
1	Portable electric drill, $\frac{1}{2}$ inch	50.00
1	Bearing puller	7.75
4	Machinist's vise, $3\frac{1}{2}$ inch jaw, $5\frac{1}{4}$ inch max. opening	160.00
1	External growler	40.00
1	Internal growler	35.00
10	Machinist's vises, $2\frac{1}{2}$ inch jaw, $2\frac{1}{2}$ inch max. opening	50.00
20	Soldering guns, 150 watt	116.00
5	Vise grip pliers, 4 inch	8.75
5	Vise grip pliers, 6 inch	12.50
5	Needle nose pliers, 6 inch, curved nose	13.75
2	Pliers, $6\frac{1}{2}$ inch	2.60
2	Pliers, 8 inch	4.00
2	Wire hose-clamp pliers, 7 inch	4.00
2	Sheet metal shears, combination pat rn, length of cut, 3 inches	13.00
4	Terminal crimpers	8.00
1	Pipe wrench, 6 inch	2.30
1	Pipe wrench, 8 inch	2.75
1	Pipe wrench, 12 inch	4.00
3	Allen wrench sets, sizes 5/64 to 1/2 inch, 7 pieces	3.00
3	Socket sets, $\frac{1}{2}$" drive, 7/16" to 1 1/4", 17 pieces	57.00
3	Socket sets, $\frac{1}{4}$" drive, 7/32" to 7/16", 17 pieces	27.00
1	Ball peen hammer, 8 oz.	2.45
1	Ball peen hammer, 12 oz.	2.75
2	Rawhide mallets	4.00
5	Soldering guns, 250 w.	55.00
1	Soldering copper, $\frac{1}{2}$ lb. size	1.25
1	Wire gauge	4.50
1	Micrometer, 0-1 inch	15.00
10	Feeler gauges, .003 to .025	10.00
1	Tap and die set, NC - 1/4 x 20 to 3/4 x 10, NF - 1/4 x 28 to 3/4 x 16	10.00

Quantity	Description	Estimated Total Price
1	Screw extractor set, for bolts, 3/16 to 1", 6 pieces	$ 10.00
2	Hacksaws, tubular frame	6.00
20	Individual toolboxes consisting of:	1,770.00
	a. 4 oz. ball peen hammer b. Punch & chisel set, 12 pieces c. Pin punch set, sizes 1/16" to 1/4", 7 pieces d. Set of 3 cresent wrenches, 4, 6, 8, inches e. Set of box-end-open-end wrenches, 1/4" to 1" by 1/16" steps, 13 pieces f. Chain nose plier g. Diagonal plier h. Lineman's plier i. Combination plier, 6 inch j. Water pump plier, 10" length k. Stubby slot-head screwdriver l. Set of screwdrivers, 4, 6, 8, 10 inch m. Stubby phillips screwdriver, tip No. 1 n. Set of phillips screwdrivers sizes 0, 1, 2, 3, 4, 6, 8, 10 inch, tip o. Offset screwdriver set, std. tip bit widths - 1/4", 5/16", 3/8", phillips tip 1 & 2, 3-4 p. Nutdriver set (7 sizes) q. Test lamp r. Electrician's knife s. Point file t. Hacksaw u. Toolbox	
	Total	$2,572.35

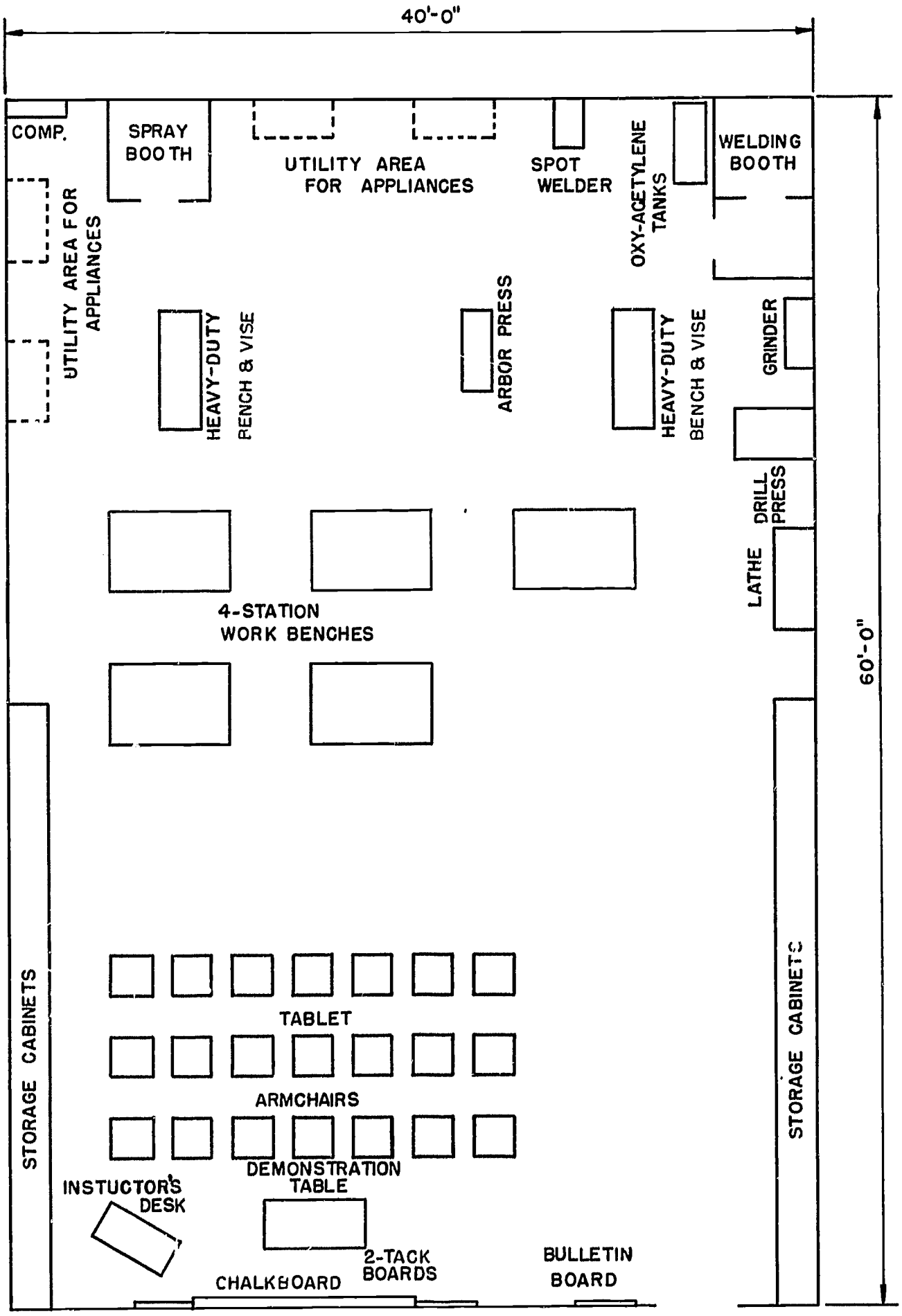
APPENDIX C. SUGGESTED LIST OF EQUIPMENT

Quantity	Description	Estimated Total Price
1	Twist drill set, (high speed, 1/16" to 1/2") 32 drills	$ 88.00
1	Gas welding and cutting torch complete	95.00
1	Welding booth	75.00
1	Spray booth and exhaust system	500.00
1	Solvent tank	35.00
1	Shop anvil, weight, 30 lbs	30.00
6	Thermometers, scale 100° - 350° Fahrenheit	24.00
2	Thermometers, scale 30° - 212° Fahrenheit	10.00
6	Thermocouples, complete, scale 50° - 1000° Fahrenheit	70.00
1	Recording watt meter, 2 scale	200.00
10	Ammeters, tong type, range: 0-5/15/40/100 A.C. and 0-150/600 V.A.C.	400.00
6	A.C. ammeters, 0 to 10 scale	72.00
6	A.C. volt meters, 0 to 150 scale panel meters	72.00
3	A.C. volt meters, 0 to 250 scale	36.00
10	Multi-meters	400.00
4	Ohm meters, ranges: .1 ohm, 1 ohm, 10 ohms	600.00
20	Test lamps, 100 watt	10.00
5	Electric workbenches, 4 station top 72" x 48"	940.00
20	Armchair desks	300.00
20	Lab stools, 26" high	200.00
1	Chalkboard and equipment	75.00
1	Teacher's desk and chair	139.00
1	Demonstration test bench Includes: 6 storage drawers, 1 file drawer, 8 15 amp. duplex outlets, 1 duplex outlet variable A.C. 0-120 volts @ 5 amps., variable A.C. 0-12 volts from 2 jacks @ 10 amps., variable A.C. 0-24 volts from 2 jacks @ 5 amps., variable D.C. 0-30 volts from 2 jacks @ 5 amps. Complete with panel pilot light, controls and breakers.	420.00

Quantity	Description	Estimated Total Price
1	File cabinet, 3-drawer	$ 75.00
1	Bulletin board	25.00
2	Storage cabinets, 10 compartment (metal) 30' x 24"	200.00
2	Heavy duty work benches (metal) 48" x 72" x 32"	180.00
1	Moving picture projector, 16 mm, sound	450.00
1	Slide projector, 35 mm	150.00
1	Overhead projector	150.00
	Miscellaneous; manufacturers specialty tools, training aids, films, transparencies, etc.	1,000.00
	Total	$7,021.00

APPENDIX D

SUGGESTED TRAINING FACILITY



APPENDIX E. SUGGESTED LIST OF EXPENDABLE SUPPLIES

Quantity	Description	Estimated Total group Price
1	Nut & bolt assortment	$100.00
1	Sheet metal screw assortment	15.00
1 box	Stove bolts, 150 pieces per box, 3/16" x 1/2" and 1/4" x 2"	3.00
4 boxes	Hexagon nuts, 113 pieces per box, 1/4" to 9/16"	15.00
1 box	Cotter pins, 750 pieces per box, size from 1/16" x 1" to 1/8" x 2"	2.50
1 box	Lock washer assortment, 425 pieces per box, size from 3/16" to 9/16"	2.20
5 doz.	Hexagon socket set screws, size from 8-32 x 3/16" to 3/8-16 x 1/2"	7.50
5 lbs.	Steel washers	2.00
10 gal.	Synthetic enamel	60.00
2 gal.	Enamel undercoat	10.00
5 gal.	Paint reducer	4.00
2 gal.	Lacquer thinner	3.50
10 qts.	Lacquer, assorted colors	15.00
10	Assorted paint brushes	10.00
4 gal.	Rust inhibitive metal primer	21.00
10 rolls	Masking tape, 3/4" wide, latex adhesive binding with paper crepe backing	12.50
5 lbs.	Steel wool, grade N, 00 to 2	4.00
1 gal.	Rubbing compound, coarse grade	3.50
2 lbs.	Acid core solder, alloy 40/60, 1/8" diameter	2.50
4 lbs.	Rosin core solder, alloy 50/50, 1/8" diameter	2.50
2 lbs.	Aluminum flux-core solder	7.80
10 oz.	Silver solder, 1100° F. melting range	17.50
1	Silver solder flux, 10 oz. jar	1.20
200 lbs.	Arc welding electrodes. E6011-1/8" and E6018-1/8"	70.00
100 lbs.	Gas welding rods, 1/16" and 1/8"	35.00
20 lbs.	Cast iron rod, 3/16" x 18"	20.00
8 lbs.	Aluminum brazing rod, 1/16" diameter	22.00

Quantity	Description	Estimated Total group Price
16 lbs.	Maganese bronze rod, 3/32" and 1/8" diameter	$ 25.60
2 lbs.	Cast iron brazing flux	3.00
1 lb.	Aluminum brazing flux	2.75
2 lbs.	All purpose brazing flux	3.00
2 lbs.	Cast iron welding flux	2.40
2 tanks	One of oxygen, one of acetylene	15.00
1	Supply of lubricating oils, greases and materials	30.00
4 doz.	Hacksaw blades, 12 inches long, 24 and 32 teeth per inch	30.00
4 doz.	Assorted files	57.00
4 doz.	Sheets of abrasive paper	4.25
1	Assortment of electrical wire	50.00
1	Allowance for used appliances to use for demonstration and training aids	200.00
	Total	$892.20

DISCRIMINATION PROHIBITED - Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color or national origin, be excluded from participation in, be denied the benefits of, or be subject to discrimination under any program or activity receiving Federal financial assistance." Therefore the Vocational Education program, like every program or activity receiving financial assistance from the Department of Health, Education, and Welfare, must be operated in compliance with this law.