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ABSTRACT

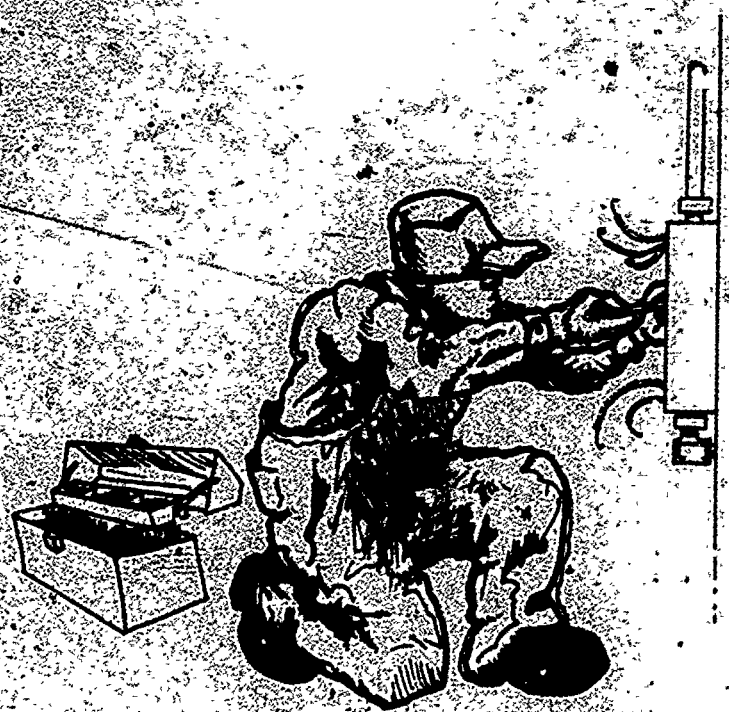
This instructor's guide accompanies the self-paced student training modules on the electrical trade, one of which is available separately as CE 032 874. Introductory materials include an introduction to pre-apprenticeship training, and a course outline. Teaching outlines are then provided for the 11 modules that comprise this course. For each module some or all of this material may be presented: instructional outcomes; introduction; outline of content with teaching methods and aids listed and/or sketched, notes for self-assessment, assignment, and post assessment; and suggested readings. Modules include Introduction to the Electrical Trade, Diagnostic Testing/Electrician, Survival Skills, Trade Math (diagnostic test and remedial work), Physical Requirements, Safety, First Aid, Blueprint Reading, Trade Tools, Schematic Symbols and Definitions, Basic Electricity, and Basic Wiring Concepts (student projects). Project sheets are provided. An occupational analysis/task inventory for manufacturing/maintenance electrician is appended. (YLB)

PRE-APPRENTICESHIP

PHASE 1 TRAINING
Instructor's Guide

Electrical

- Diagnostic Tests
- Survival Skills
- Math
- Tools
- Materials
- Project



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INTRODUCTION TO PRE-APPRENTICESHIP

DESCRIPTION OF APPRENTICESHIP

The Federal Bureau of Apprenticeship identifies an apprenticeable occupation as a skilled occupation that requires a minimum of one year of 2000 hours on-the-job training. This on-the-job training and related educational training is the apprenticeable period.

VIEWPOINTS ABOUT PRE-APPRENTICESHIP

Pre-apprenticeship is viewed in many different ways by craftpersons, apprenticeship committees, educators and the general public.

Concerns about pre-apprenticeship include the belief that the pre-apprenticeship training will flood the market with applicants for apprenticeship or that these trainees will go to work in the occupation as partly trained workers or that pre-apprenticeship would be considered a guarantee of entry into apprenticeship. These conflicting viewpoints create problems for persons interested in apprenticeship training and make it difficult to operate pre-apprenticeship training programs.

NEED FOR PRE-APPRENTICESHIP

Pre-apprenticeship provides three benefits:

1. Provides a screening device to determine motivation, interest, manipulative aptitude and ability of persons to learn the skills of the occupation.
2. Provides the individual with survival skills for handling personal problems and interpersonal relations on the job that may include abuse and sexual harrassment.
3. Provides entry level skills to help make the apprentice productive from the first day on the job. The higher entry level skills of the apprentice provides an incentive for the employer to hire apprentices.

PRE-APPRENTICESHIP HELPS PEOPLE

To select a skilled occupation.
To identify the educational requirements of an occupation.
To experience the hands-on skills of an occupation.
To develop good work habits.

* Good job attendance
* Punctuality
* Dependability
* Time management

To develop good attitudes.

* Concern for the job
* Initiative
* Interest
* Healthy, cooperative working relations with fellow employees.

TRAINING LEVELS FOR PRE-APPRENTICESHIP

Pre-apprenticeship training can be separated into three phases or stages of training. These are:

PHASE 1

Provides the trainee with an opportunity to explore several occupations. This orientation to the auto mechanics trade includes training in trade terminology, blueprint reading, tool usage, first aid and safety practices. This familiarization training includes hands-on experience in some of the basic skill areas together with information about the advantages and requirements of auto mechanics. The choice of an occupation to train for in Phase 2 of pre-apprenticeship will be based on these experiences. If the trainee decides not to pursue this occupation any further, the training received to this point will be useful in every day life.

Phase 1 includes diagnostic tests to determine if reading or mathematical deficiencies exist that would handicap a person in the auto mechanics trade. Remedial work will be provided to correct these deficiencies.

Success on the job is directly related to job attitudes, work habits, and the individual survival and coping skills. Training will begin on helping each individual attain full potential in these personal skills.

Interpersonal skills will be developed which include:

* Communication skills
  - paraphrasing, perception checks, non-verbal communication
  - communicating with superiors.
* Personal effectiveness
  - problem solving, family relationships, sexual harrassment and pestering on the job.
* Interview techniques
  - apprenticeship committee interview procedure

PHASE 2

This training begins the serious preparation for an occupation. The training related to job attitudes, work habits and individual survival and coping skills will be continued from Phase 1 with more emphasis on the relationship to the job.

Manipulative skills will be developed by the completion of a series of projects involving basic trade skills which have a carryover benefit to persons outside of the occupation. At least 3/4 of the training will consist of hands-on experiences. This instruction should be conducted by a skilled craftsperson from the trade or occupation who has the necessary teaching skills.

The joint apprenticeship committee for the occupation will be invited to observe the progress of trainees during Phase 2 and to evaluate the potential for trainees for entry into apprenticeship. The participation of the appropriate joint apprenticeship committee is essential to the success of a pre-apprenticeship program. This community involvement insures that the training is relevant to the occupation and meets industry training standards.

At the completion of Phase 2 the trainee will have enough experience with the occupation to decide whether to continue with the training into Phase 3. The joint apprenticeship committee will have knowledge of the quality of the training program and will be in a position to judge the qualifications of the students for entry into the apprenticeship training program.

PHASE 3

Training is concentrated on improvement of manipulative skills so that the trainee will be a productive employee the first day on the job. This training can be either industry conducted specialized training, secondary school vocational programs or community college preparatory courses specifically related to the occupation. Trainees can also participate in co-op work experience involving hands-on training at the secondary or community college level. Hands-on training is considered essential for an effective pretraining program.

The Phase 3 training period provides the trainee with an opportunity to search for an employer willing to take an apprentice. Frequently the employer providing co-op work experience training will hire the trainee as a regular employee.

It is possible that some employers will hire the trainee without further training. Some of these employers train specifically for their own needs. In the process, job descriptions have become highly diluted. Instead of producing journeymen possessing a wide range of skills, companies have settled for specialists trained to perform the specific tasks needed in certain narrow operations. While this may be adequate to meet the special needs of an industry, it certainly will not meet the training and manpower needs of the nation in the future.

Apprenticeship provides a broad base of training by giving the apprentice a wide range of skills which insures continuous employment. Workers least vulnerable to unemployment are those with the highest and broadest skills and best training. The trainee should make every effort to enter an apprenticeship training program designed to provide training in all skills required

in the trade or go to work for an employer who will provide broad based trajning.

Each trainee will choose a joint apprenticeship committee meeting to attend during Phase 3 training. This will provide an opportunity for the trainee to become acquainted with members of the joint apprenticeship committee and to see how the committee functions.

PHASE 4 EMPLOYMENT AS AN APPRENTICE

Trainee enters apprenticeship training on a direct referral basis under agreement with the appropriate joint apprentice committee which permits persons trained in programs financed with federal funds to enter apprenticeship on direct referral. Direct referral eliminates several of the procedures in the selection process and makes entry into apprenticeship less cumbersome.

Not all joint apprenticeship committees use the direct referral system. This is the reason why sponsors of pre-apprenticeship training should directly involve joint apprenticeship committees in the operation of their programs. This provides committees with an opportunity to evaluate the effectiveness of pre-apprenticeship.

The federal Job Corps Programs enjoy direct referral placement in apprenticeship for their graduates. The Job Corps operates an ideal pre-apprenticeship program. Proposed sponsors of pre-apprenticeship training are advised to visit the nearest Job Corps Center to see how the programs operate.

The Job Corps Centers in Oregon are located at:

Angel Job Corps
Star Route North
Yachats, OR 97498
547-3137

Timber Lake Job Corps
Star Route Box 109
Estacada, OR 97023
834-2291

Wolf Creek Conservation Center
Little River Route
Glide, OR 97443
496-3507

Tongue-Point Job Corps
Astoria, OR 97103
325-2131

Job Corps Centers in Oregon Offer Training in these apprenticeable occupations:

- Carpentry
- Cement Mason
- Brick Laying
- Plastering
- Tile Setting
- Automotive Painting

RECOMMENDED PROCEDURE FOR CONDUCTING PRE-APPRENTICESHIP TRAINING

ADMINISTRATION

Pre-apprenticeship training can be conducted by various sponsors. These include secondary schools, community colleges, unions, employer associations, labor/management training trusts and private groups such as O.I.Cs.

ADVISORY COMMITTEES

Use of broad-based community advisory committees is mandatory for pre-apprenticeship programs conducted by secondary schools and community colleges. Pre-apprenticeship needs the support and recognition of the community in order to be successful

The advisory committee should have representatives from these groups:

School administration	-high school principal
	-board members
	-vocational director
	-co-op work experience
	-T & I instructors
Community	-school graduate in trade
	-member of joint apprenticeship committee
	-employer member of trade
	-employee member of trade
	-union business agent
	-industry training coordinator
	-representative of financial community
	-representative of press
Government personnel	-ESD regional vocational coordinator
	-Oregon Division of Apprenticeship field representative
	-Federal Bureau of Apprenticeship representative
	-State Dept. of Education specialist

FINANCING

Vocational training programs generally cost more than academic programs because the student/teacher ratio is smaller, consumable supplies are required, and expensive equipment is needed. Resources to finance pre-apprenticeship training are available from a number of sources. These include:

Vocational rehabilitation	-tuition fees
Federal funds for immigrants	-Asian -Cuban -Spanish American
Special grants	-U.S. Dept. of Labor U.S. Dept. of Education CETA, Industry State Dept. of Education Economic Development Administration
Secondary school funding	-basic school grant from federal funds
Community college funding	-basic state funding

INSTRUCTIONAL DELIVERY SYSTEMS

The type of sponsor for pre-apprenticeship training will determine the time-block used for the program. If training is started at the 9th grade level, a two-hour training period will generally be used. A half-day training period should be used for an accelerated program at the secondary level covering two years. Community college programs can be either half-day or full-day programs. Private sponsors generally will operate on a full-day basis.

Instructors for the trade specific training should be qualified craft workers. These may be employed on a part-time basis, or full-time, serving several programs. The necessity for skilled workers to teach the trade specific items of the program

cannot be over-emphasized. The work experience of skilled craft workers gives them the insight into the occupation needed for effective teaching.

MANIPULATIVE SKILL TRAINING

The manipulative skills or hands-on experiences provide the basis for a sound and effective pre-apprenticeship training program. Unless this training is available the program will not succeed.

Important considerations involve the following items:

Basic tools	-tools required for each participant
General or shop tools	-power tools (purchased or rented)
Materials	-purchased by training agency -purchased by others (training project sponsor) -donations by industry (defective goods)
Training facilities	-school based -community based
Training projects	-school maintenance work -simulated projects -community projects -private projects (non-profit organizations-low income persons)

COORDINATION WITH EXISTING PROGRAMS

Pre-apprenticeship should be coordinated with related programs in secondary schools and community colleges.

Welding	Electronics
Blueprint reading/drafting	Industrial mechanics cluster
Surveying	Construction cluster
Automotive	Electricity/electronics cluster

MISCELLANEOUS CONSIDERATIONS

Legislation, community support and political considerations will all have an effect on pre-apprenticeship training. Activities related to these concerns include:

Workshops and technical assistance	-State Dept. of Education
Publicity notices	-public service -newspaper -radio -translation to Asian/Spanish American
Civil rights	-effect of civil rights compliance
Transfer of learning	-benefits of vocational training to other occupational endeavors

COURSE OUTLINE

1.0 Introduction to the Electrical Trade

- 1.1 History
- 1.2 Trends
- 1.3 Working Conditions
- 1.4 Hiring Practices
- 1.5 Wages
- 1.6 Common Worker Benefits
- 1.7 Trade Terminology

2.0 Diagnostic Testing

- 2.1 SATB

3.0 Survival Skills

- 3.1 Expectations
- 3.2 Communication Skills
- 3.3 Giving and Receiving Feedback
- 3.4 Dealing with Interpersonal Conflict
- 3.5 Group Problem Solving, Goal Setting and Decision Making
- 3.6 Wider Influences and Responsibilities
- 3.7 Identifying and Developing Individual Strengths
- 3.8 Worksite Visits
- 3.9 Resumes
- 3.10 Interviews
- 3.11 Appropriate Work Habits and Attitudes

4.0 Trade Math

- 4.1 Math Diagnosis
- 4.2 Math Remedial

5.0 Physical Requirements

- 5.1 Physical Requirements
- 5.2 Developmental Processes

6.0 Safety

- 6.1 General Safety
- 6.2 Personal Safety
- 6.3 Fire Types and Prevention
- 6.4 Hygiene Safety
- 6.5 Hand Tool Safety
- 6.6 Power Tools

7.0 First Aid

7.1 First Aid

8.0 Blueprint Reading

8.1 Scaling and Dimensioning
8.2 Sketching
8.3 Drawing Types and Views

9.0 Tools

9.1 General Tools

10.0 Schematic Symbols and Definitions

10.1 Common Schematic Symbols
10.2 Terms and Definitions

11.0 Basic Electricity

11.1 Terms and Definitions
11.2 Ohm's Law
11.3 Watt's Law
11.4 Series Circuits
11.5 Parallel Circuits

12.0 Basic Wiring Concepts

12.1 Wire Outlet-lighting fixture with in-line switch

II. WORD TO THE INSTRUCTOR

This course was designed to be a trade-related, self-screening, job exploration package, providing the student with basic trade theory, basic trade manipulative practice, projects and on-job-site visitations.

Further, it is to be implemented by instructors who are skilled in each of the general topics described in the course outline and expanded on in the instructor's guide.

The curriculum is comprised of two parts: 1) the instructor's guide, and 2) supporting modules and references which are specified in the instructor's guide. The instructor should seek other supporting resources where available or necessary.

The instructor should bear in mind that there are two broad objectives written into the design of this course: 1) that the student will receive instruction in the preapprenticeship mode of the trade (which is designed to enable him or her to gain enough exposure to the trade to (a) aid in making a career decision, and (b) facilitate entry into the trade), and 2) that the student will retain some carryover skills which he or she can use in life, even should the student decide not to enter the trade.

Essentially, this guide is patterned after a program begun in Oregon in 1979-80. The participants in the program are wholly CETA-sponsored, many with motivational or physical impairments. The program concentrates on providing motivational support and/or physical therapy. A typical program, broken down into its major components, would be:

40% hands-on, manipulative work
30% motivational support work
10% job visitation
5% physical development or therapy
15% class lecture, discussion, etc.

Not all institutions will have the resources, nor will all programs' students have the need, for such a breakdown. The instructor should identify the needs of the students and utilize the guide in the manner best suited to meet them.

III. RECOMMENDATIONS

Hands-on work is probably the best learning experience for students in trade work. It is essential if the two broad objectives listed above are to be met. Therefore, implied in the topics covering tools, materials and tasks or work processes is the notion (emphasized in the Instructional Outcome for these topics) that the student will practice using the tools and materials described therein.

In lieu of describing in the Teaching Methods and Aids section of the guide those tasks which will be performed with the described tools and materials, the writers leave it to the imagination and material resources of the instructor. Practice is the method by which skill is developed.

1.0 Introduction to the Electrical Trade

INSTRUCTIONAL OUTCOMES: The student will be able to identify and briefly explain the history, trends, working conditions, places of employment, hiring practices and wage scale, as well as working people's benefits and trade terminology.

INTRODUCTION: In order to become an effective worker or make an effective realistic career decision, an individual must be exposed to various aspects of the trade.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
1.1 History A. Electricity was available to very small areas in the early 1900s. B. First telegraph wires were strung between Washington and Baltimore in 1844. 1. Electricity was thereafter considered more important. 2. Transatlantic cable was laid in 1848. C. Edison's lamp was invented in 1879. 1. Usefullness of electricity then recognized.	Explain and Discuss ILS Introduction to the Electrical Trade

D. First Electric Power and Light Company established in 1882.

1.2 Trends

A. Job increase for electricians in 1980s will parallel most other occupations.

B. Construction activity will influence demand for electricians.

1.3 Working Conditions.

A. Electrical work requires less strength and much endurance.

B. Most work is indoors.

C. Injury rate has lowered due to safety practices.

D. In 1978, aobut 270,000 construction electricians worked for electrical contractors
   1. Some were also self-employed.

1.4 Hiring Practices

A. Applicants requrements include people who are 18 years of age or over.
   1. Must have high school diploma, one year of algebra.
   2. Need to be healthy, not color blind, dexterous and agile.

B. Some cities require a license to practice as an electrician.

Jobsite Visitation
Invite Job Specialist

C. More electricians than other construction workers learn their trade through apprenticeship.

D. The 4-year apprenticeship programs also require 144 classroom hours annually.

E. Helpers (who are not apprentices) can learn on the job by picking up practical knowledge as they work.

1.5 Wage Scale

A. Electricians on the average earned $11 an hour in 1978.

B. Seasonal changes do not noticeably affect a worker's earnings.

C. Apprentices earn 50% of journeyman level.

D. Most workers are members of International Brotherhood of Electrical Workers.

1.6 Common Worker Benefits

A. Unemployment Insurance

1. Purpose.
   a. transition from job to job.
   b. ease strain of layoffs.
2. Source of benefits.
   a. payroll tax on wages.
3. Eligibility.
   a. depends on base year earnings.
   b. depends on reasons for leaving work.

Explain and Discuss
ILS Common Worker Benefits
Invite Field Rep
Workmen's Compensation Board
BOL Wage and Hour
Employment Division

4. Level of benefits.
   a. level of base year earnings.
5. Claims process.
   a. report to Employment Division office.
   b. provide required information.
      (1) employer's name and address.
      (2) your social security number.
      (3) wage earning records.
      (4) current address.
6. Appeals/hearing process.
   a. initiated by worker.
   b. in writing.
   c. within time limits.

B. Wage and Hour Commission
1. Purpose.
   a. to investigate and attempt equitable settlement of wage claims.
2. Areas of claim review.
   a. pay periods.
   b. pay days.
   c. final pay days.
   d. wage payments in cases of dispute.
   e. methods of compensation and overtime.
   f. minimum wage laws.
   g. limitation of hours in certain industries.
   h. restrictions on employment of minors.
3. Jurisdiction.
   a. Federal vs. State.

4. Claim process:
   a. contact wage and hour commission.
   b. provide required information on appropriate form.
      (1) dates of employment.
      (2) rate of pay.
      (3) reason for non-payment.
      (4) estimate of disputed amount.
   c. wage claim conference.
   d. collection process.
   e. protection against retaliation for filing a claim.
5. Time limits for filing.
   a. regular pay.
   b. overtime pay.

C. Workers Compensation
1. Purpose
   a. provide medical care payment for on-the-job accidents.
   b. provide time loss payments.
   c. provide payments for permanent disability.
   d. provide death benefits.
2. Source of benefits.
   a. employer premiums for insurance.
   b. employee contributions.
3. Level of benefits.
   a. complete for medical costs.
   b. varies according to level of final disability.
4. Eligibility.
   a. any job-related accident or condition causing the worker to leave work and seek medical treatment.

5. Claim process.
   a. report accident to employer.
   b. fill out claim form.
      (1) know your employer's legal name.
      (2) know your employer's insurance carrier.
   c. see your doctor for treatment.
6. Final determination.
   a. doctor's statement of stabilized condition.
   b. board's findings of disability and payment.
7. Reopening claim for aggravation of injury without a new injury.
   a. contact employer's insurance company if occurs within the first five years.
   b. contact worker's compensation board after five years.

1.7 Trade Terminology

A. Common Trade Terms

1. Volt--practical unit of electromotive force which causes current of one amp to blow through the resistance of one ohm.
2. Ohm--unit measure of resistance.
3. Current--transmission of electricity through a conductor.
4. Ampere (amp)--unit of electric current
5. Watt--unit of power represented by current of one ampere produced by the electromotive force of one volt.

6. Gauge--system of classifying wire by measuring thickness.
7. Wire--metal drawn into form of a thread or cord used as a conductor of electricity.
8. Cable--stranded insulated conductor.
9. Insulation--material used to bar the passage of electricity.
10. Ground--conducting line between electrical equipment and the ground to protect against shocks.
11. Circuit--wire pathway for electrical current.
12. Circuit breaker--device designed to interrupt electrical current flow if shorts occur and to turn off current for repair to wiring.
13. Short (circuit)--passage of electrical current by a shorter route than designed for it.
14. Fuse--protective device used in electrical circuits. Available in wide range of amperage loads. If circuit overloads fuse will break circuit and interrupt flow of electricity.
15. Switch--device to start and stop flow of current in an electrical circuit.
16. Outlet/receptacle--electrical fixture placed in circuits for plug in appliances.
17. Conduit--metal tubing used to enclose electrical wiring.
18. Tubing cutter--tool used to cut conduit to desired length.

19. Continuity tester--device used to determine if electrical circuits are complete and properly functioning.

21. Twist nuts--screw cap device used to secure and protect joints/splices in wire.

22. Tubing/conduit bender--tool used to form conduit to shape for installation.

23. Wire Cutter/stripper--tool used to cut wire to length and remove insulation for connections.

2.0 Diagnostic Testing/Electrician

INSTRUCTIONAL OUTCOMES: The Student will complete a Specific Aptitude Test Battery (SATB), administered by a qualified examiner and will have the results explained by a qualified examiner.

INTRODUCTION: The General Aptitude Test Battery is a standardized test that has become recognized as the best validated multiple test battery in existance for use in vocational guidance. The tests are used by apprenticeship committees to assist in the screening process for appropriate candidates when apprenticeship openings occur, and to provide individuals with an indication of the probability of their being successful in a particular trade.

Many apprenticeship programs require applicants to have certain aptitudes as demonstrated by passing appropriate tests. For example, the applicant may be required to pass Specific Aptitude Test Battery (SATB) administered by the State Job Service. SATBs test two or more of the following nine general aptitudes: general learning ability (cognitive functioning), verbal aptitude, numerical aptitude, spatial aptitude, form perception (ability to perceive small detail), clerical perception (ability to distinquish pertinent detail), motor coordination, finger dexterity and manual dexterity.

Each battery tests different combinations of these nine general aptitudes because each occupation requires different specific abilities. The following SATB tests and cutting scores are required by the apprenticeship committee for the trade. The student should be aware of the trade requirements and determine how he or she feels about his or her abilities in the tested aptitudes in order to make a career decision.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
2.1 SATB A. Complete exam described below: KEY: Trade Occupation Code # for the occupation SATB for the trade = Recommended cutting	

score for the trade

Location of the SATB within the GATB

ELECTRICIAN S#72R –

Numerical Aptitude = 85

Arithmetic Reason; Book II, Part 6

Computation; Book I, Part 3

Spatial Aptitude = 100

Three Dimensional; Book I, Part 3

Finger Dexterity = 85

#11 Assemble, #12 Disassemble; Board

Manual Dexterity = 85

#9 Place, #10 Turn; Board

	Cutting Scores		
	Adult	Grade 10	Grade 9
Numerical Aptitude	85	80	79
Spatial Aptitude	95	94	91
Finger Dexterity	80	75	72

B. Discuss results:

3.0 Survival Skills/Electrical

INSTRUCTIONAL OUTCOMES: The student will learn and practice fundamental concepts in: a) dealing with expectations, b) communication skills, c) giving and receiving feedback, d) dealing with interpersonal conflict, e) group problem-solving, goal-setting and decision-making, f) outside influences and responsibilities, g) identifying individual strengths, h) appropriate work habits and attitudes, and, i) phases of job search and worklife.

INTRODUCTION: Training and proficiency in human relations skills are essential for successful adaptation to worklife. All too often in job preparation programs, these basic survival skills are neglected or put aside in favor of training in the technical aspects of work.

This topic describes the many skills necessary to become a stable, productive and satisfied worker.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
3.1 Expectations A. Predicting the future 1. Self-fulfilling prophecies a. setting yourself up for failure b. thinking positively	ILS Survival Skills-Expectations PREPARATION Be familiar with the material beforehand, and think up some relevant examples AVAILABILITY Be available to students. Go around those students reading the material. Be prepared to answer and ask questions that increase students' understanding.

B. Two-step process to opening up expectations.

1. Being idealistic and realistic

a. being creative and having ideas

b. keeping close to the facts

c. effects of leaving out one of the two steps.

d. combining the two

C. Prejudice about other groups.

D. Being a winner

ELICIT RESPONSE

Ask individuals what they would like to do most of all. Use their reply even if it seems trite. Suggest two alternative possibilities--the worst and the best. Ask how each would affect that student's feelings and behavior at this moment.

RELEVANT COMPARISONS

Illustrate creativity from movies, TV or writing. Tell the beginning of a story and ask for suggestions on how it might end. Give the original writer's version. Show how anything is allowed in creative ideas. Suggest students read court reports or news coverage.

STUDENTS' EXAMPLES

Encourage extreme examples of fantasy and of sticking close to the facts.

EXAMPLES OF PREJUDICE

Show how stereotypes arise out of stereotyped expectations.

ROLE MODEL

Be heard thinking positively. Encourage positive thinking in students.

E. Self-Assessment--looking at common personal expectations

F. Post Assessment

IDENTIFY PROBLEM AREAS

Go through questions to see where students are putting themselves down. Give encouragement. Ask what they want to change.

EXPLAIN

Read through examples, answer questions.

FLEXIBILITY

Allow students to demonstrate their understanding in less than suggested number of situations.

3.2 Communication Skills

A. Good communication

1. two-way process
2. importance
3. innate abilities
4. showing mutual respect

ILS Survival Skills-Communication Skills.

PREPARATION

Be familiar with the material.

BEING A ROLE MODEL

Demonstrate active listening. Ensure that students voice problems and doubts. Allow frequent opportunity for students to give responses to on-going work. Be ready to demonstrate bad examples of listening, to group or individuals, and contrast with good examples.

B. Active listening.

1. Centering attention on the other person.
   a. being seen to be listening
   b. finding out what is important to the other person
   c. following the other person's lead
   d. listening to feeling
2. Checking that you have understood what the other person is communicating.
   a. checking feeling

b. checking content c. when it is inappropriate C. Being listened to. 1. Your rights as an individual 2. When to keep quiet 3. Avoiding being aggressive 4. A three-step approach a. showing you understand b. taking responsibility for your own feelings c. suggesting alternatives D. Overall importance of respect for individuals. 1. Communication between equals E. Self-Assessment 1. How individuals communicate with others F. Practicing the skills in triads 1. Active listener of personal experience 2. Role play being listened to	ASSERTIVENESS Draw examples from books on being assertive. Think up appropriate examples in work context. Discuss aggressive responses with individuals. Describe alternative approaches. Discuss possible exceptions--where aggression might be appropriate. INSTRUCTOR/STUDENT RELATIONS Assess relations in class in terms of respect for, and equality of, individuals. Ask students for comments. IDENTIFY PROBLEM AREAS Give help and encouragement. Find out from students what skills they want to practice. TRIADS Form triads (trios) as students finish Self Assessment. FEEDBACK Listen to one example of active listening in each triad. Give suggestions for improvement. Be open to alternative situations for the role play. Ensure students are willing to practice being sensitive to possible reluctance and shyness. Be prepared to role play yourself.

3.3 Giving and receiving feedback.

A. Importance of being able to give praise and criticism (introduction).

B. Importance of group support and teamwork
   1. Being a team member
   2. Building a team
      a. knowing where you are
      b. pulling your weight
      c. responsibilities for others
      d. group aims and goals
   3. Poor working environments
      a. indirect communication
      b. not knowing where you stand

C. Reading attitudes
   1. Hired or fired?
   2. How do you come across to other people?
   3. Interpreting other people's behavior

D. Giving and receiving positive opinions
   1. Importance of praise
   2. Taking compliments
   3. Giving praise

E. Getting and giving criticism
   1. Its importance
   2. Being criticized
   3. Avoiding being threatened
   4. Between equals

F. Self Assessment-Feelings and Preferences

ILS Survival Skills-Giving and Receiving Feedback

PREPARATION

Be familiar with the material and prepared to participate actively and equally.

FACILITATION

Facilitate continuously the building of group support. Give extra support to students who have difficulties participating fully. Enlist help of more confident and verbal to share the responsibility. Give support, but principally be a neutral chairperson or facilitator. Encourage group members to observe each others' non-verbal behavior between class times.

POSITIVE REINFORCEMENT

Give frequent verbal praise to individuals who are working well and to the group as it becomes more supportive

MONITORING

Walk around and ask permission to join in some partner discussions. Encourage greater depth. Avoid any judgments. Use paraphrase

G. Assignments 1. Telling individuals what you like	and feeling as checking skills. A DEVELOPING PROCESS Introduce when group is ready. First three assignments could be practiced even before module has been read. Explain, in turn each assignment to whole group. Deal with worries, doubts or questions before you begin.
2. Reading attitudes within the group. 3. Opening self-sharing important experiences	Use all your facilitating skills. Especially be sensitive to members' non-verbal responses. Follow up, after the class, on any individual who is upset. At all times encourage positive support within the group. Be prepared to intervene if criticism becomes too negative.
4. Receiving direct positive feedback 5. Receiving direct positive and negative feedback	
H. Post Assessment	Organize small groups or lead discussion of whole group. Use small groups to extend each individual's range of interactions.
3.4 Dealing with interpersonal conflict	ILS Survival Skills-Dealing with Interpersonal Conflict
A. Consequences of poor interpersonal relations	PREPARATION Be familiar with the material and ready to supply further relevant examples from the

B. Recognizing conflict in a work context
   1. Open arguments
   2. Possible causes
   3. Consequences
C. Them and Us atmosphere
   1. The conditions you deserve
   2. Whose responsibility?

D. Unproductive ways of solving conflict
   1. Finding someone to blame
E. Productive ways of solving conflict
   1. Taking responsibility for doing something about it
      a. when people feel threatened by you
      b. when you feel threatened

F. Remaining passive.
   1. Poor working conditions
   2. Physiological and psychological problems
   3. Irrational fears
      a. fear of not being liked
      b. fear of hurting others
G. Action model for solving interpersonal conflicts.
   1. Choosing the best time
   2. Taking responsibility for your feelings

world of work.

BE AVAILABLE

Encourage students to comment and question points as they arise. Ask them to come up with their own examples, either confirming or disconfirming the information.

RESPONSIBILITY

Throughout Survival Skills, individual responsibility is repeatedly stressed. Periodically, reassess your own role. Avoid being pushed into the "expert" stance. Try to be an impartial facilitator, encouraging student's learning without passing judgments. Ensure students take responsibility for what they want to achieve.

3. The four-step language formula
   a. tell the other person that what he or she is doing is upsetting you
   b. speak your feelings
   c. describe how his or her behavior is affecting you
   d. suggest an alternative

H. Negotiating
   1. Give and take
   2. Compromise

I. Discrimination and prejudice
   1. Different types
   2. Dealing with it

J. Self Assessment

K. Assignments
   1. Sharing in small groups.

L. Post Assessment
   1. The formula

IDENTIFY IMPORTANT GROUP ISSUES

Deal in a neutral manner with examples of discrimination. Ask individuals for personal experience of racial and sexual prejudice and discrimination. Facilitate discussion on Equal Opportunity and Affirmative Actions. Invite solutions to problems from group members.

NEW ISSUES.

Be aware of any controversial issues that arise during the Self Assessment. Introduce them to the group for general discussion.

ORGANIZE GROUPS

Form groups as students finish writing. Limit talk to five minutes on each topic. Maintain some urgency by announcing the five minute intervals.

COLLECT WORK

Read and make encouraging

2. Personal examples

written comments. Arrange contract for completion of work with any students who produce low standard work.

3.5 Group Problem Solving, Goal Setting and Decision-making

ILS Survival Skills-Group Problem Solving, Goal Setting and Decision-Making

A. 10-step model
1. Define the problem
2. Look at the known facts
   a. what is happening
   b. who is involved
   c. when does the problem occur
   d. where does it occur
   e. why has it become a problem
3. Agree on your goals
4. Pool ideas for achieving your main goal without evaluating them
5. Look more closely at some of the more interesting and unusual ideas
6. Include any other ideas that you think might be helpful
7. Agree on some guidelines for achieving your goal
   a. be specific about minimum behavior required
8. Decide on a plan to implement your proposed solutions
9. Assess the likelihood of success
10. Evaluate the success of your decisions after they have been implemented.

B. Self Assessment

PREPARATION AND MATERIALS

Know the 10-step model without having to refer to it on the page. Work through the process beforehand. Have photocopies of the model.

Have ready one large newsprint pad and one marker for every five students. Choose about six examples of unusual tools or materials that students are unlikely to have seen. Have them ready, but hidden. Get advice from specialists beforehand.

AVAILABILITY

Go around students in class while they are reading material. Help them understand the 10 steps.

CHECK LACK OF UNDERSTANDING

Look over individuals' answers. Give help for misunderstandings.

C. Assignment in small groups

1. Producing quality of ideas
2. Practice in thinking creatively

3. Identifying unusual objects.

4. Quality circle

MATERIALS REQUIRED

Sheets of newsprint and sufficient markers

ARRANGE GROUPS

During these assignments, there may be laughter and a lot of excited talk. Encourage composition of groups on basis of who works well together rather than primary friendships. Keep groups separated by space. Go around groups, sit in and participate. Keep up speed of work by giving limited time to gather ideas.

Invite spokesperson from each group to report back on ideas. Write down ideas as they are given and summarize range of proposed solutions.

OBJECTS REQUIRED

Supply one object for each group. Choose trade tools or materials that most students are unlikely to have used.

MONITOR PROGRESS

Encourage written records of proposed solutions. Ensure all members of each group take some responsibility for finished product. If possible, get results typed out so they can be shared within larger group.

D. Post Assessment

PREPARE HANDOUT

Have copies of 10-step model. Make sure students check what they have written and correct it.

PERSONAL EVALUATIONS

Invite students to read out or tell others what they wrote under 2 in the Post Assessment.

3.6 Wider influences and responsibilities

A. Relations with people in authority
   1. Formal workplace
      a. job titles
      b. hierarchy
   2. Informal workplace
      a. unwritten rules and unstated expectations
   3. Showing respect and being relaxed

ILS Survival Skills-Wider Influences and Responsibilities

PREPARATION

Be familiar with the module and gather useful newspaper cuttings, brochures and leaflets that illustrate the range of possible influences on somebody settling down to work.

BE A READY RESOURCE

Give examples informally to students from personal experience to back up information.

DRAW ON STUDENTS' EXPERIENCE

Encourage individuals to think of relevant illustrations from their own experience in a work setting.

B. Relations with family and friends
   1. Changes in responsibilities
   2. Affects of changes on old relationships
      a. being prepared
      b. communicating problems
   3. Planning quality time
      a. keeping work problems at work
      b. maintaining relationships

4. Keeping up leisure activities
5. Home problems at work
   a. leaving problems at home
   b. serious problems

C. Other influences
1. apprenticeship
2. union
3. social organizations
4. other workers
5. state and federal agencies

D. Self Assessment

E. Assignment

F. Post Assessment

SUPERVISION

Ask students to show their answers to the Self Assessment. Since it is a test of comprehension, follow up on any difficulties revealed.

CHOOSING PARTNERS

Encourage students to work with someone different each time. After majority of students have completed assignments, hold a report-back session with whole group. Ask students to summarize and draw conclusions from reports given.

DEMONSTRATE

Show what is required by illustrating it on a chalkboard.

3.7 Identifying and developing individual strengths:

A. Evaluating yourself and others
   1. Expectations
   2. Personal theories
      a. predicting
      b. controlling

B. Identifying personal values
   1. Significant role models

   2. Eliciting personal constructs

   3. Bi-polar nature of constructs

ILS Survival Skills-Identifying and Developing Individual Strengths

PREPARATION

Work through module beforehand. Acquaint yourself with any areas that might cause difficulties in understanding. Make extra copies of exercise sheets. Refer to ILS Expectations.

AVAILABILITY

Be at hand throughout this module. For students to discover significant things about themselves, instructions must be followed closely. Ensure that students have had a personal relationship with each of people listed in right column. Ask them to put names they used to address these people.

Check students' understanding of procedure. If necessary, go through method with whole group. Ensure that the description is of importance to each student and not superficial, such as hair color, etc.

Stress that there is no correct answer; it is important for each person to write what seems opposite to him or her personally regardless of what anyone else might say.

4. Identifying important personal values	ARRANGE PARTNERS Go around and offer interpretations if requested or encourage students to draw conclusions. Ask what they recognize and what is new.
5. Evaluating yourself. a. as you feel you are b. as you would like to be c. looking at the amount of congruity	DISCUSS WITH INDIVIDUALS OR SMALL GROUPS Be tentative about what is identified. The conclusions can only be significant if the individual finds them significant. Use words and phrases such as..."it seems...," "you may..." "I would guess...." "it might indicate.." Use grid to prompt questions rather than answers.
6. Evaluating significant others a. comparing ratings	IN PARTNERS Suggest each student in turn tries to describe what people the other one might like and what people he or she might not like, based on the constructs on paper. Ensure that students follow instructions closely. Encourage them to search for all influences. If they have difficulty, suggest situations where students make choices, e.g. career, friends, classes, out-of-school activities.
C. Influences on personal decisions 1. How much are you in control of your own life? 2. Positive and negative influences. a. other people b. aspects of self c. organizations	

D. Time management

1. Organizing skills
2. Being responsible for your own life
3. Prime time
4. Making a time chart
   a. procedure
   b. interpretation

EXTRA COPIES

Have ready prepared extra copies of time chart

Ensure agreement on completing time chart. Go over method of calculating actual time.

Illustrate on chalkboard or newsprint paper; give example of one day's record. Use tally system.

CHECK STUDENTS' UNDERSTANDING

Do this before anyone starts recording. It might be advisable to go over procedures one day ahead and practice be done in class.

E. Post Assessment

1. Personal values
2. Influences
3. Use of time

Collect, read and hand back during class. Give encouraging comments.

3.8 Worksite Visits

A. Building realistic expectations
   1. Questioning job descriptions
   2. The human side of the job
   3. On-the-job visits
   4. Talking with people in the trade

B. Group visits
   1. Exposure to different working environments
   2. Practice in observation
   3. Asking questions

C. Individual visits
   1. After working hours
   2. Interviewing the worker
   3. Arranging the visit

D. Self Assessment-Comprehension

E. Assignment
   1. Looking at Help Wanted ads

ILS Survival Skills-Finding a Job
Worksite Visits

PREPARATION

Arrange with any company that allows it a group visit during working hours.

Have sufficient copies for use by whole class of Help Wanted ads from local newspapers.

Become an informed source of possible contacts for student interviews with journeymen and apprentices.

CHECK UNDERSTANDING

Ensure students comprehend all of the material before making any contacts or visits.

HELP WITH ASSIGNMENTS

Supply Help Wanted sections--one to each student. Suggest they read through and circle in ink interesting ads. Stress importance that each works on his or her own; it is practice in looking for jobs. Collect what students write and report back

	to whole group with summary of students findings.
2. Writing realistic job descriptions.	Read and comment on students' descriptions. With individual's permission, read out selection to whole group and invite comparisons with job descriptions in newspaper.
3. Contacting a journeyman or apprentice	Supply names and encourage students to come up with own contacts. If necessary, two students could team up to make a visit. Role play telephone contact and get students to copy out suggested questions. Make individual contract with each student, setting deadlines to call, to visit and to report back. Check on progress and share with rest of group.
4. Asking questions	Arrange for individuals to report back to whole group at same session.
5. Making a group visit	Go over observations and questions beforehand. Ask students to write questions down. Divide questions, and order of asking, among group. Add any other questions suggested by group.
6. Reporting back	Ensure that each student records his or her observations. Invite individuals to report on their feelings and findings.
7. Discussion	Lead group discussion on overall findings.

3.9 Resumes

A. Nature and function
   1. Self advertisement
   2. Summary of strengths and skills
   3. Different ways to use resumes
   4. Contrast application forms
B. Extracts from resumes
   1. People with little work experience
   2. Presenting the best interpretation of the facts
C. Suggested format
   1. Position desired
      a. finding out about the job
      b. matching your skills
   2. Education
   3. Relevant work experience
   4. Other relevant experience
   5. Personal data
   6. References
      a. making a list of your achievements.
D. Identification of your skills
   1. Personal and interpersonal skills
   2. Skills used in leisure and work activities
      a. what could go wrong
      b. what skills you need to avoid mistakes
      c. stamp collecting
      d. planting a garden
E. A professional finish
   1. Typing
   2. Paper

Arrange another worksite visit.

ILS Survivial Skills-Finding a Job-Resumes

PREPARATION AND MATERIALS

Large pad of newsprint and sufficient markers for group. Ensure that there are adequate flat surfaces.

F. Cover letter
1. Why them?
2. Why you?
3. Let's meet

G. Self Assessment

1. Personal and interpersonal skills

2. In a job context

3. Analyze three examples of work

H. Post Assessment

1. Organizing personal work experience

HELPING WITH ASSIGNMENTS

Be available throughout, when students are working on Self and Post Assessment. Write on chalkboard further suggestions of personal and interpersonal skills.

Suggest students help each other in finding relevant examples of their application of skills.

Allow partners to choose each other. Emphasize broad definition of work to include paid and unpaid, part-time, etc. Give examples.

Model how students can help each other. Go around and ask questions to elicit relevant information.

Supply sheets of newsprint and markers. Tell students to use the full area of paper. Check that students are recording all the suggested information.

Inspect sheets individually and suggest best way to organize data. Advise on where to include or omit dates and which experience to group or

2. Writing a draft resume	separate. Give encouragement and direct help with drafting of resume. Take best draft, type it and duplicate it on quality colored paper. With permission of student, share with whole group. Encourage sharing of draft resumes. Offer to help later if individuals want to develop a finished version of resume.

3.10 Interviews

A. Subjective nature of interviews
   1. Content of hiring interviews
   2. Interviewers' opinions
   3. Interviewees' opinions
B. Facts and opinions
   1. Giving honest opinions
   2. Interpreting facts
   3. Quoting references and examples
   4. Deciding what is relevant
C. Employers' expectations
   1. Objective measures of aptitude and achievement
   2. Appropriate attitudes and work habits
D. How to communicate interest and enthusiasm
   1. Be genuine
   2. Be informed
   3. Showing enthusiasm
      a. non-verbally
      b. how to speak and what to say
E. How to communicate that you will be a good worker
   1. Finding examples
F. How to show you are trainable
   1. School and non-school
G. How to show you work well with people
   1. Relations with the interviewer
   2. Giving examples
H. How to be realistic about what you want
   1. Knowledge of the work environment
   2. Knowledge of the career structure
   3. Answering questions about goals

ILS Survival Skills-Finding a Job-Interviews

PREPARATION AND MATERIALS

Read material beforehand and recall examples from own experience. Have two copies of observers' checklist for each student.

I. Appearance
   1. Clothes
   2. Grooming

J. Non-verbal behavior
   1. Punctuality
   2. Nervousness
   3. Body posture
   4. Gestures
   5. Smoking and chewing

K. Being positive
   1. About yourself
   2. About others

L. Self Assessment
   1. Role play
      a. interviewer
      b. interviewee
      c. observer
   2. List of questions
   3. Checklist

M. Post Assessment
   1. Interview in front of the group
   2. Questions from Joint Apprenticeship Committee
   3. Giving positive feedback

FORM TRIADS

Go through checklist to ensure understanding. Choose best working groups. Keep it moving by limiting time for each role play. Be willing to model positive answers in interviewee's role.

Ask for a volunteer, then allow him or her to select next interviewee. Suggest use of observer's checklist, plus any other positive comments. Give feedback from group and yourself, immediately after each interview. Invite interviewee to share his or her feelings experienced during role play.

I. Appearance
   1. Clothes
   2. Grooming

J. Non-verbal behavior
   1. Punctuality
   2. Nervousness
   3. Body posture
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3.11 Appropriate work habits and attitudes

A. Surviving on the job.

1. Keeping informed

B. Employer's expectations

1. Being punctual and dependable
2. Being honest
3. Being loyal
4. Being willing to learn and able to take criticism

C. Expectations of fellow workers

1. Proving your competence
2. Being reliable and dependable
3. Being a learner
4. Being enthusiastic and interested
5. Being honest and loyal

D. Proving your competence to your supervisor

1. High standard of work
2. Keeping a written record of your achievements
3. Showing initiative
4. Taking on responsibility
5. Asking for help.

E. Interference of personal habits

1. Substance abuse
2. Seeking help

ILS Survival Skills-Finding a Job -Appropriate Work Habits and Attitudes

BE A RESOURCE

Share personal experience with individuals. Encourage students to ask any older people about work habits and attitudes. Give time for sharing students' findings.

Show relevance of previous modules to both 2 and 3. Ask individuals what expectations a member of Survival Skills class has.

POSSIBLE DISCUSSION

What do individuals expect of friends? What are peer group's attitudes toward 4?

Be sensitive to possibility of substance abuse affecting student performance. Learn physical indicators; have referral addresses available.

F. Self Assessment

G. Post Assessment

Check comprehension.

Tell students to repeat reading and doing Post Assessment until acceptable standard is reached.

Discuss with individuals any disagreements over appropriate answers and be flexible.

SUGGESTED READINGS:

Alberti, R.E. and Emmons, M.
Your Perfect Right
Impact, 1974.

Blicq, Ron
On the Move: Communication for Employees
Prentice-Hall, 1976

Bolles, Richard N.
The Three Boxes of Life
Ten Speed Press, 1978

Fast, Julius
Body Language
Pocket Books, 1971

Chapman, Elwood N.
Your Attitude is Showing: A Primer on Human Relations
Science Research Associates, 1972

Ford, George A.
Planning your Future: A workbook for Personal Goal Setting
University Associates, 1976

McCay, James T.
The Management of Time
Prentice-Hall, 1977

Nelson, Robert E.
Decision Making
Vision Publishing, 1976

Peale, Norman V.
The Power of Positive Thinking
Prentice-Hall, 1952.

4.0 Trade Math

INSTRUCTIONAL OUTCOMES: The student will complete a diagnostic examination to determine his or her level of math competency, and will receive instruction in those areas of mathematics in which he or she experiences difficulty.

INTRODUCTION: People in every apprenticeable occupation routinely use mathematics in their work. The skilled worker who can perform fast and accurate math calculations can work quickly and efficiently.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
4.1 Math Diagnosis A. Used to test skills 1. Math diagnostic exam, attached, or other suitable exam.	Explain "placement exam" concept Administer exam Grade performance
4.2 Math Remedial A. Used to upgrade skills 1. Modules, as listed, improve performance levels.	Assist student tc achieve performance level

ILS	Math--Linear Measurement
ILS	Math--Whole Numbers Addition Subtraction Multiplication Division
ILS	Math--Addition & Subtraction of common fractions and mixed numbers
ILS	Math--Multiplication & Division of common fractions and whole and mixed numbers
ILS	Math--Compound numbers
ILS	Math--Percent
ILS	Math--Ratio and Proportion
ILS	Math--Decimals Addition Subtraction Multiplication Division
ILS	Math--Perimeters Areas and Volumes
ILS	Math--Circumference and Area of Circles
ILS	Math--Areas of Plane Figures, Volumes of Solid Figures
ILS	Math--Metrics

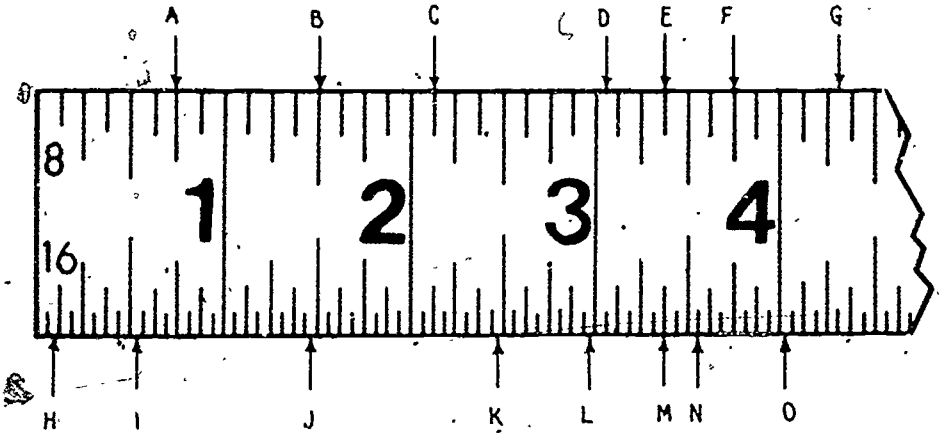
4.0 Trade Math Diagnosis
Placement Test

Name _____

Date _____

1.

Read the distance from the start of the ruler to the letters A through O to the nearest 1/32".



A= _____ F= _____ K= _____

B= _____ G= _____ L= _____

C= _____ H= _____ M= _____

D= _____ I= _____ N= _____

E= _____ J= _____ O= _____

2.

686 + 240 + 1,320 + 16 + 400 =

40 - 16 =

292 X 16 =

180 ÷ 5 =

A contractor buys 400 sacks of rock for three different jobs. On the first job he uses 78 sacks; on the second, 85 sacks; and on the third, 205 sacks. How many sacks does he have left?

A contractor's bid on a school building is $78,265. When one wing is omitted to cut costs, he is able to cut his bid by $16,228. What is his new figure?

3.

If a bundle of rock lath weighs 35 lbs. and it is permissible to place 700 lbs. on any one area on a floor, how many bundles can be placed on any one area?

If 5 lbs. of putty are required to install one light of glass, how many lights can be installed with 85 lbs.?

4.

The improper fraction 48/32 expressed as a mixed number is:

The mixed number 4 3/8 expressed as an improper fraction is:

What is the least common denominator for the following group of fractions: 1/8, 1/2, 1/4, and 1/12?

What is the sum of the following fractions: 7/8, 3/4, and 9/16?

If 3/4 is subtracted from 11/12, the difference is:

The sum of 1 5/8, 2 11/64, and 19 1/4 is:

5.

One roof is 1/3 larger in area than another. The smaller roof takes 24 squares of roofing material. How many squares of roofing material will the larger roof take?

One-third of a box of glass is needed to glaze the north elevation of a building; 2/3 of a box is needed to glaze the south elevation; 1/16 of a box is needed to glaze the east elevation; and 1/2 of a box is needed to glaze the west elevation. How many boxes are needed to glaze all four elevations?

From a bundle containing 101 linear feet of molding, a cabinetmaker uses the following amounts: 11 1/3', 8 3/4', 12 1/8', and 9 5/8'. How many linear feet of molding does he use in all?

6.

The product of 1/2 X 7/8 is:

The quotient of 1/4 ÷ 1/3 is:

If a roll of carpet weighs 467 1/2 lbs. and a running foot of the carpet weighs 2 1/8 lbs., how many running feet are in the roll?

A piece of pipe must be cut to 3/8 the length of another pipe, which is 9' long. How long a piece must be cut?

7.

Write each of the following as decimals.

Seven tenths

Sixteen hundredths

Fifteen thousandths

Eleven ten-thousandths

Two thousand one hundred fifty-two thousandths

Convert each of the following measurements to feet in decimals.

4' 6"

2' 4 1/4"

A house with a floor area of 1,860 sq. ft. is estimated to cost $18,042. What is the cost per square foot?

A stack of plastic sheets measures 2.28" thick, and it is known that the sheets average 0.06" in thickness. How many sheets are in the stack?

8.

The labor cost for the concrete work for a house was $248. The material cost $210. What percent of the total cost of the concrete work was for material?

An architect indicates a 1/8" = 1'0" scale in the drawing of a swimming pool. What is this scale expressed as a ratio?

On a tile job in which fireclay is to be used, a tilesetter tells his helper to mix mortar according to the following formula: 6 buckets of river sand, 1 bucket of fireclay, and 2 buckets of cement. What is the ratio of sand to fireclay in the mixture?

9.

Divide 19' 2" by 3' 10".

How many pieces of 2' 3"-wide gypsum lath will be needed to cover a wall 48' 6" long?

10.

What is the perimeter of a room 20' wide and 30' long?

What is the area, in square feet, of a floor 42' by 42'?

How many cubic yards of dirt have been removed for the basement and foundations of a house if the excavation is 35' long, 35' wide, and averages 5' deep?

The area of a circular putting green with a radius of 17' is how many square feet?

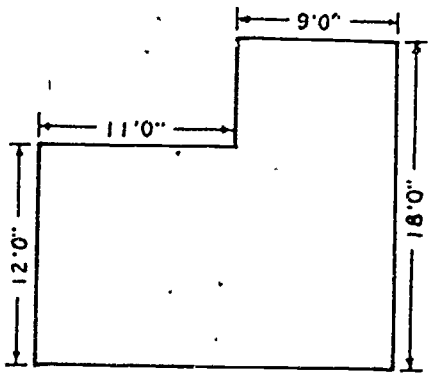
What is the area of a circular floor with a diameter of 10' 6", to the nearest square foot?

What is the area, in square inches, of an acute triangle with a base of 8 1/2' and an altitude of 11 1/4"?

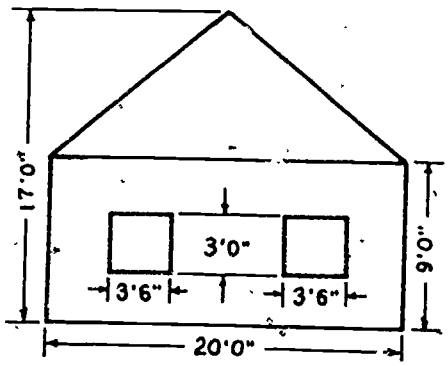
What is the area in square feet, of the floor shown below?

How many cubic yards of concrete will be needed for the foundation walls and footings in the plan below if the walls are 6" thick and 18" deep, and if the footings (shown in dotted lines) will require 2 5/27 cu. yd. of concrete?

1. 6
2. 6 2/3
3. 7
4. 7 1/6



What is the total area, in square feet, of the exterior wall and gable shown below, excluding window areas?



11. Metrics

3 inches	=	cm
5.4 inches	=	cm
7 feet	=	m
3.2 feet	=	m
6.5 yards	=	m
15.3 m	=	inches
12.7 cm	=	inches
50.8 mm	=	inches

5.0 Physical Requirements/Electrical

INSTRUCTIONAL OUTCOMES: The student will demonstrate knowledge of physical requirements of the trade and the processes of physical development.

INTRODUCTION: The trade requires certain physical skills and abilities of the worker. It is necessary that the student be aware of the physical demands of the trade and understand factors of physical development.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
5.1 Physical Requirements A. Strength 1. Lifting. a. materials and fixtures weighing up to 50 lbs. (e.g. wire). 2. Carrying. a. materials and fixtures weighing 20 to 50 lbs. (e.g. rolls of wire). 3. Pulling. a. wire through holes/conduit.	On-site visit or classroom simulation. A. Demonstrate B. Lead discussion or question on job site C. Discuss proper technique D. Administer work sheet

B. Balance
   1. Climbing.
      a. ladders.
   2. Balancing.
      a. working on ladders.

C. Body Dexterity
   1. Stooping.
      a. reaching for wall outlets.
   2. Kneeling.
      a. wiring wall outlets.
   3. Crouching.
      a. testing wall outlets.
   4. Crawling.
      a. wiring in crawlspace.
   5. Standing.
      a. wiring wall switches.
   6. Walking.
      a. movement about jobsite.

D. Manual Dexterity
   1. Reaching above shoulder.
      a. wiring ceiling fixtures.
   2. Reaching below shoulder.
      a. wiring wall outlets.
   3. Handling.
      a. gripping tools and material.
   4. Fingering.
      a. twisting wire for joint.

E. Talking
   1. Normal communication.

F. Hearing
   1. Normal communication.

G. Vision
   1. Normal vision.
      a. moving around jobsite.
   2. Acuity near.
      a. making wiring connections.
   3. Depth perception.
      a. working on ladders.
   4. Color vision.
      a. color coded wires.

H. Coordination
   1. Hand-arm.
      a. ceiling work.
   2. Foot-leg.
      a. ladder work.
   3. Eye-hand-foot.
      a. hanging ceiling fixtures.

PHYSICAL ACTIVITIES PRESENT IN THE TRADE: REQUIREMENTS (to be completed by student)

STRENGTH	Weight	Frequency	BODY DEXTERITY	Degree of Activ.	Frequency	MANUAL DEXTERITY	Degree of Activ.	Frequency
Lifting			Stooping			Reaching-above shoulder		
Carrying			Kneeling			Reaching-below shoulder		
Pushing			Crouching			Handling		
Pulling			Crawling			Fingering		
BALANCE	**Need**	**Frequency**	Standing			Feeling		
Climbing			Sitting			TALKING (speech)		Frequenc
Balancing			Walking			**HEARING**	**Acuity**	**Range**
			Reclining					
VISION	**Need**	**Frequency**	VISION (Cont'd)			**COORDINATION**	**Degree**	**Frequenc**
Normal vision						Hand-arm		
Acuity-near			Color vision			Foot-leg		
Acuity-far			Field of vision			Eye-Hand-Foot		
Depth perception								

5.2 Individual Developmental Processes A. Maturation 1. Causes physical changes in height and body proportion. 2. Causes emotional changes. 3. A gradual process. 4. Fluctuates from person to person. B. Nutrition 1. Vital to normal growth and development. 2. Essential food groups. a. dairy products. b. meat. c. vegetables and fruits. d. bread and cereals. C. Personal Care and Exercise 1. Good grooming habits. 2. Sufficient sleep and relaxation. a. fatigue increases chances for accidents. 3. Hobbies. a. source of relaxation, help to maintain good attitude. 4. Daily exercise. a. stimulates interest. b. relieves stress. D. Substance Abuse 1. Marijuana. a. affects nervous system. b. affects thinking, judgment and coordination. c. long-term effects unknown.	ILS Physical Development Explanation and Discussion Invite Specialist

2. LSD. a. affects chemical level in brain. b. produces bizarre mental reactions. 3. Barbiturates. a. one of most commonly abused drugs. b. slow responses. c. physically addicting. d. long-term use causes personality disorders. 4. Amphetamines. a. affect central nervous system. b. commonly abused. c. cause psychological dependence. d. dull emotions and impair ability to make decisions. 5. Alcohol. a. psychologically addicting.	
E. Meeting Various Trade Requirements 1. Recognize and prepare. a. natural maturation processes may play role. b. exercise will play role.	On-job-site visitations and consultation with occupational therapist.

6.0 Safety

INSTRUCTIONAL OUTCOMES: The student will be able to identify those hazards, acts and conditions which affect safety on the job and will be able to identify ways to avoid or correct them.

INTRODUCTION: A good worker is a safe worker; injury affects production, as well as the ability of a person to earn a living.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
6.1 General Safety A. Average--over 14,000 employees killed each of past several years. 1. From 1960 to 1970 over 150,000 fatalities. 2. Cost, excluding property damage, $11.5 billion. 3. 50 million employee days lost in 1972. B. Accidents 1. An unplanned and unforeseen occurrence that interferes with or interrupts orderly progress of activity.	Explain and Discuss ILS General Safety

2. Should be analyzed to determine why and how happened.
   a. unsafe conditions; poor or defective equipment, poor housekeeping, inadequate lighting.
   b. unsafe acts; loose-fitting clothing; horseplay, removing guards.

C. OSHA
1. Williams-Steiger Occupational Safety and Health Act, 1970.
2. Requires employers to provide safe conditions.
3. Requires employees to comply.
4. Covers about 60-million people; excludes federal employees.

6.2 Personal Safety

ILS Occupational Safety--Personal Safety

A. Safety Consciousness
1. Be aware of good safety practices.
   a. learn the rules.

B. Safety Awareness
1. Put safety consciousness to use.
   a. obey the rules.

C. Head Protection
1. 130,000 head injuries in 1976.
2. Wear clean, adjustable hard hat.

D. Eye and Face Protection
1. 1,000 eye injuries each day.
2. Wear safety glasses, goggles, masks; shields if near harsh chemicals.
3. Wear safety glasses under shields.

E. Hearing Protection

1. Ear inserts lower high frequency.
2. Ear muffs lower low frequency.

F. Lung Protection

1. Mechanical filters protect against non-toxic dust.
2. Chemical-cartridge types protect against low concentration of some vapors.
3. Gas masks protect against organic vapers and toxic gases for limited time.
4. Supplied-air respirators protect against high concentrations of gases and fumes.
5. Self-contained breathing apparatus protects against high concentrations of gases, vapors, dusts, etc.
6. Air line respirators protect against high concentrations of dusts, fumes, mists, and low concentrations of gases.
7. Select proper one for each job.

G. Hand Protection

1. Average of over 1,300 disabling hand and finger injuries each day in 1976.
2. Gloves.
   a. asbestos protects against thermal burns, hot or cold.
   b. metal mesh protects against cuts and sharp objects.
   c. rubber protects against electrical and chemical burns.

d. neoprene and vinyl protect against chemicals.
e. leather protects against rough objects, heat and sparks.
f. fabric protects against dirt, abrasions, slivers.
g. coated fabrics protect against chemicals.

3. Creams also used.

H. Foot Protection

1. Over 200,000 disabling foot and toe injuries each year.
2. Wear leather steel-toed safety shoes or boots.

6.3 Fire Types and Prevention

ILS Fire Types and Prevention

A. Fire Types

1. "Class A" of wood, cloth, paper.
2. "Class B" of liquids and gases, paint, grease.
3. "Class C" of energized electrical equipment.
4. "Class D" of metals or metallic dusts.

B. Methods of Extinguishing

1. Absorb heat--add water.
2. Smother--add dry chemicals, foam.
3. Remove fuel--shut off supply.

C. Fighting Classes of Fires

1. Class A
   a. water to cool heat.

2. Class B.
   a. CO_2, powder to smother fire.
3. Class C.
   a. non-conducting agent.
   b. attempt to de-energize.
4. Class D.
   a. special extinguishing agent for types of metals.

6.4 Hygiene Safety

A. Exposure to Toxic Materials
   1. Can create health hazards.
   2. Internal exposure.
      a. breathing contaminants.
      b. swallowing contaminants.
      c. absorption through skin.
   3. External exposure.
      a. contact with skin.
      b. can affect senses.

B. Noise Pollution
   1. Measured in decibels.
   2. Can affect hearing over period of time.
   3. Affects other parts of body.
      a. changes size of blood vessels, makes heart work faster.
      b. produces headaches.
      c. negatively affects nerves, decreases powers of judgment.

ILS Occupational Safety--Hygiene Safety

C. Airborne Contaminants

1. Dusts; particles generated mechanically.
   a. can affect skin, eyes, lungs.
2. Fumes; solid particles of condensation process.
   a. common fumes caused by oxidation of metal.
3. Mists; particles of liquids or liquids and solids.
4. Gases; low density, change to liquids or solids.
5. Vapors; gases normally in solid or liquid state at room temperature.
6. Contaminants may affect body in four ways.
   a. as irritants to lungs.
   b. as asphyxiants, prevent blood from normal transfer of oxygen.
   c. as anesthetics or narcotics, cause drowsiness and nausea.
   d. as systemic poisons, attack vital organs.

6.5 Hand Tool Safety

A. Hammers

1. Face should be 3/8" larger in diameter than object.
2. Strike object squarely and flatly.
3. Replace damaged handles before use.
4. Don't strike wood- or plastic-handled chisels.
5. Don't pound with cheek (side) of hammer.

ILS Occupational Safety--Hand Tools

6. Don't pound sharp objects with mallets

B. Chisels, Punches, Nail Sets
   1. Be sure tools are ground at proper angles.
   2. Remove mushroomed heads.
   3. Hold tools with tongs if being struck by another worker.

C. Screwdrivers
   1. Select correct size and tip style.
   2. Don't pound on screwdrivers.
   3. Don't put hands and fingers under work.
   4. Don't use screwdrivers to pry.
   5. Use appropriate wrench on square-shank screwdriver.
   6. Use magnetized screwdriver to start screws in awkward places.
   7. Use non-sparking screwdrivers if working near explosive hazard.
   8. Use insulated screwdrivers when working on electrical devices.
   9. Don't use screwdriver for electrical testing.

D. Wrenches
   1. Select correct type for job.
   2. Select correct size for snug fit.
   3. Don't use cheater bars.
   4. When using adjustable wrenches, always pull, always against fixed jaw.
   5. Be sure wrench fits squarely, not tilted.
   6. Don't pound with a wrench.

7. Use penetrating oil on "frozen" objects.

E. Pliers

1. Select correct size and type.
2. Don't use cheater.
3. Excessive heat will draw temper from metal.
4. Don't pound with pliers.
5. Cutting pliers.
   a. cut at right angle to wire.
   b. point open side down so cut end will not fly out.
6. Use pliers with high dielectric insulation when working on electrical devices.
7. Keep jaws clean.

F. Vises

1. Work as close to vise as possible.
2. Clamp objects in middle of jaws.
3. Don't use cheater bar.
4. Use adequate-sized vise.
5. Support far end(s) of long work to avoid putting excess strain on vise.

G. Clamping Tools

1. Select correct size and type.
2. Keep moving parts clean and lightly-oiled.
3. Don't over-tighten.
4. Don't use cheater.
5. Don't use for hoisting materials.

H. Saws

1. Select correct size and type.
2. Maintain sharpness.
3. Check material before sawing.
4. Use sawhorse or bench, not knee, when sawing.
5. Make sure handle is clean and tight.
6. Be aware of hand, finger and leg position before sawing.
7. Hacksaw teeth should point away from handle to saw on push stroke.
8. Wear gloves when sawing metal.

I. Snips, Shears

1. Select correct size and type.
2. Keep blades sharp.
3. Do not cut wire.
4. Use only hand pressure.
5. Wear gloves.

J. Files, Rasps

1. Select proper size and type.
2. Don't use wood file or rasp on metal.
3. Cut on forward stroke.
4. Keep teeth clean.
5. Use proper sized handles.
6. Don't use to pry.

6.6 Power Tools

A. Circular Saws

1. Operate only with fixed guard on upper half of blade and flexible guard on lower half; don't tamper with guards.

ILS Occupational Safety--Power Tools

2. Blade should clear material by maximum 1/8".
3. Operate by not forcing; forward motion only.
4. Check material for nails, grit, etc.; support material so it doesn't bind.
5. Allow blade to come to full speed before cutting; prevents kickback.
6. Make sure lower guard has returned before setting down.
7. Clean sawdust from lower guard often.

B. Sabre Saws
1. Select proper blade for material.
2. Feed blade slowly.
3. Hold saw base against material.

C. Pneumatic Tools
1. Secure all hoses.
2. Clean with compressed air only if less than 30 PSI with guard.
3. Hoses over 1/2" diameter must have safety valve at source.
4. Hose couplings must have safety connection.
5. Nailers should have device to prevent ejecting when not in contact with work.
6. Point tools toward floor when carrying.
7. Shut down, turn off air supply, bleed line.
8. Wear safety equipment, goggles, shields, etc.

D. Hydraulic Power Tools

1. Fluid used must be fire-resistant and approved by U.S. Bureau of Mines.
2. Don't exceed manufacturer's pressure recommendations.
3. Don't touch stream of fluid from leak.

E. Compressors

1. Storage tanks must be approved by American Society of Mechanical Engineers.
2. Drain condensed water daily.
3. Tanks must have safety relief valve.
4. Pressure gauge must be maintained accurately.

F. Powder-Actuated Tools.

1. Test before loading each day.
2. Load just before using.
3. Wear hearing, eye protection.
4. Don't point at anyone; keep hands away from barrel end.
5. Leave protective guards in place.
6. Must have safety device to prevent accidental firing, and to prevent firing if tilted.
7. Don't operate near combustion hazard.
8. Should only be operated by trained and qualified personnel.
9. Return tool to case after use.
10. Don't drive fasteners into extremely hard or brittle materials.

7.0 First Aid

INSTRUCTIONAL OUTCOMES: The student will successfully complete an eight-hour multi-media first aid class, taught by a qualified instructor, and will obtain a First Aid Card.

INTRODUCTION: Persons employed in any occupation, especially those occupations which deal with power and hand tools, encounter situations when first aid may be necessary to prevent an injury from becoming more serious. A first aid course, successfully completed, prepares individuals to cope with many of those situations.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
7.1 First Aid A. Eight-hour multi-media course, or equivalent, offered by: 1. Red Cross 2. Medical Services, Inc. 3. Police Department 4. Fire Department 5. Other service and health organizations.	Administer course

8.0 Blueprint Reading

INSTRUCTIONAL OUTCOMES: The student will be able to identify and use the concepts of working drawings and their components: scaling and dimensioning, sketching, orthographic, pictorial and isometric projections, as well as construction symbols commonly found in blueprints.

INTRODUCTION: A skilled worker must understand the language of blueprints to advance in any trade where prints are used.

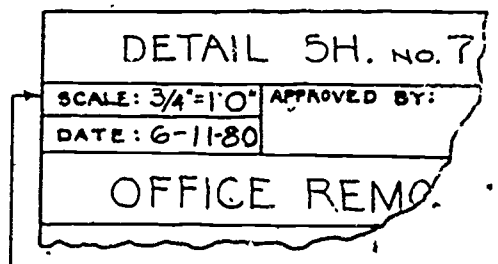
PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS

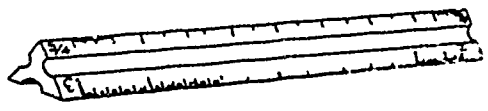
8.1 Scaling and Dimensioning

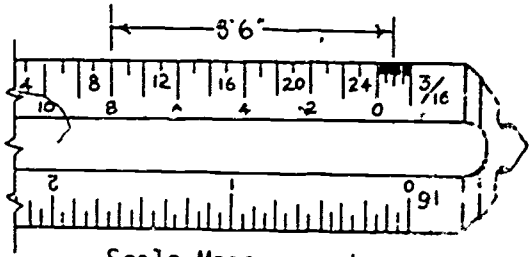
A. Scale

1. The ratio of drawing dimensions to object dimensions.
2. Always indicated on drawing.
3. Vary, depending on size of paper and detail to be shown.
4. Measured by architect's scale, engineer's scale, draftperson's scale.
5. Technique of measurement: architect's scale is placed on drawing, read in marked increments.



Scale as Shown

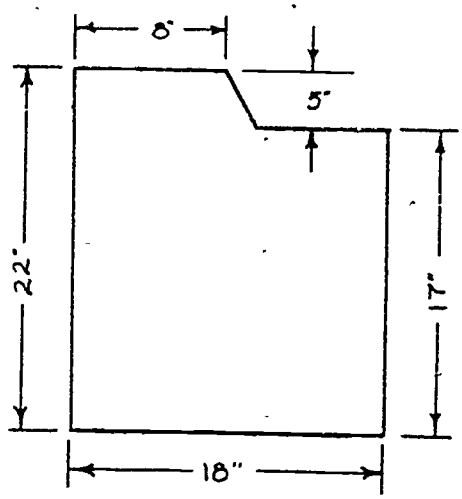

Architect's Scale



Scale Measurement

B. Dimensions

1. Are size descriptions for drawn objects.
2. Located on working drawings by:
   a. dimension lines--indicate distance between two points (usually between two extension lines); contain dots or arrows at ends.
   b. extension lines--mark the beginning and end of distance.
3. Placed in orderly fashion on drawing.

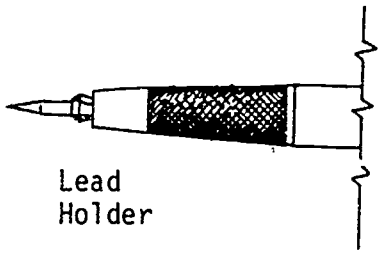


Dimensions

8.2 Sketching

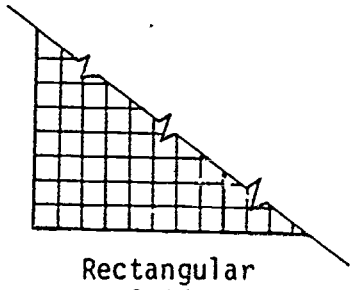
A. Uses

1. For conveying rough ideas or organizing ideas.
2. For details, developed from existing drawing.


Lead Holder

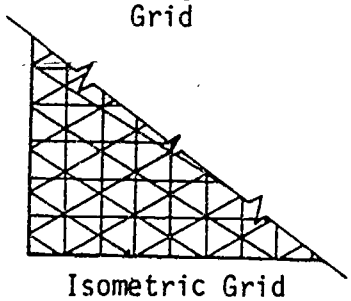
B. Materials

1. Pencil, soft lead.
2. Eraser, gum.
3. Paper, coordinate.
   a. rectangular grid
   b. isometric grid


Rectangular Grid

C. Size, Proportions

1. Generally not drawn to scale, but should remain proportionately accurate.


Isometric Grid

D. Procedures

1. Determine overall size of object.
2. Create short lines by one firm, quick stroke.
   a. go through motion of stroke with pencil removed from paper.
   b. pencil point on paper entire time.

E. Basic Forms

1. Squares, rectangles, triangles, circles.
2. Layout crosses (intersecting lines) to provide reference points for drawing.
3. Circles and arcs sketched with little finger of drawing hand as pivot; move paper, not hand.

Explain and discuss;
All References made to:

ILS Scaling and Dimensioning

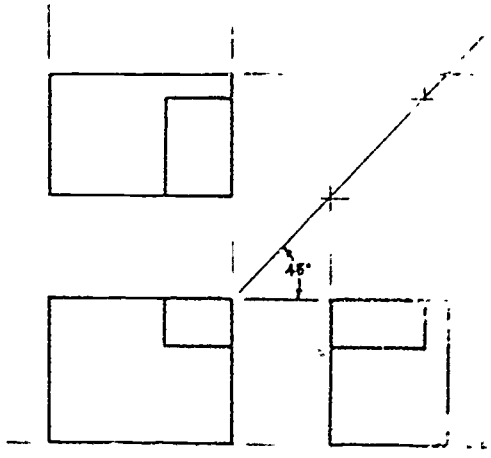
ILS Sketching

ILS Types of Drawings and Views

8.3 Drawing Types and Views

A. Orthographic Projection

1. Called orthograpic drawings or "true" drawings, also "three-view" or "multiview."
2. Almost universally used in architect and engineer drawings.
3. Drawn to scale.
4. Each view shows one face or side of object as seen from square view.
5. Possible to indicate true size, shape and location of all object parts, and dimension clearly.

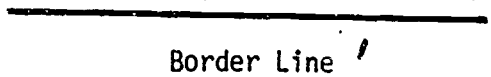


Orthographic Drawing

6. Each view is 90° rotation of other view.
7. All related views must be studied together to visualize object shape.

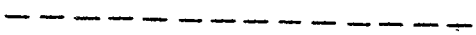
B. Types of Lines

1. Border Line.
   a. a thick, solid black line (blue).
   b. shows geographical or space borders.
2. Visible object line.
   a. a thinner solid black line (blue).
   b. shows visible edges of object.
3. Hidden object line.
   a. a line of equidistant and equal length dashes.
   b. shows edges of important elements hidden from view.
4. Section line.
   a. a thick, broken line with arrows turned at 90° angle.
   b. delineates sections of object represented.
5. Center line.
   a. a thin line of alternately long and short dashes.
   b. shows centers of objects (doorways, e.g.) and relationship with given dimensions.

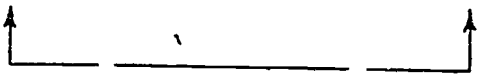


Border Line

Object Line



Hidden Object Line

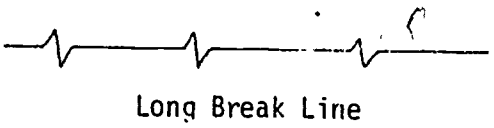


Section Line

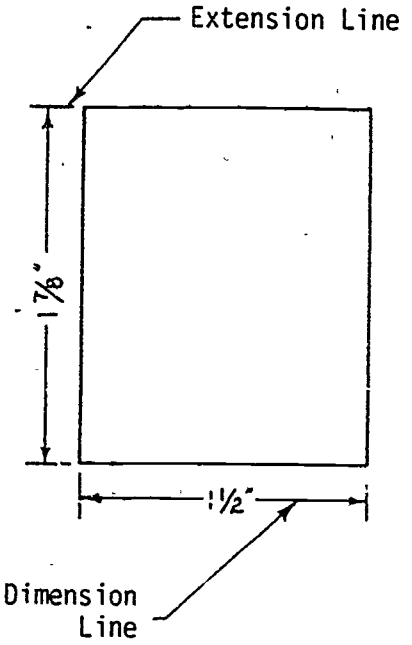
Center Line

6. Long break line.
   a. a thin solid line, straight, with occasional zig-zags.
   b. indicates a break in object.
7. Extension line.
   a. a short thin line. drawn perpendicular to dimension line.
   b. shows beginning and ending point of measurement; lines are extensions of object or part.
8. Dimension line.
   a. a long thin line, with dots or arrows on each end, broken in middle for numbers.
   b. touch extension lines and give measurement from one extension line to another.

C. Pictorial Drawing
   1. Shows more than one face of object.
   2. Advantage: easier for lay person to understand.
   3. Disadvantage: distorted object lines and angles.
   4. Useful to give "completed" look renderings.



Long Break Line

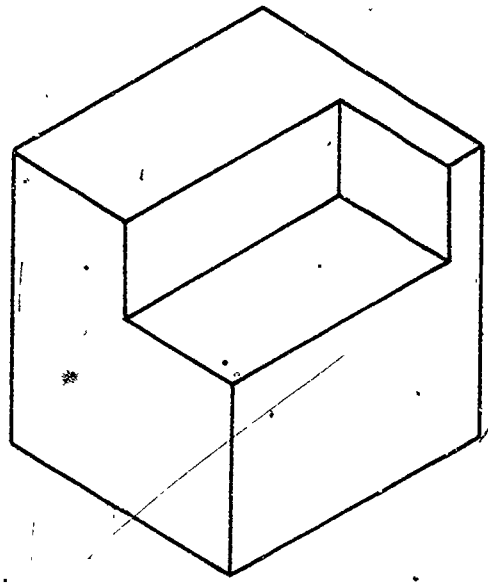


D. Axonometric Drawing

1. A type of pictorial drawing.
2. Three principle axes used.
3. Can represent any object by changing viewpoint.
4. Isometric position is principle one used.

E. Isometric Drawings

1. Viewed from exact position in which three of sides are equally foreshortened.
2. Three axes: one axis vertical and other two at 30^{0} from horizontal base.
3. Will appear in true proportion.
4. Will not appear in true scale lengths.



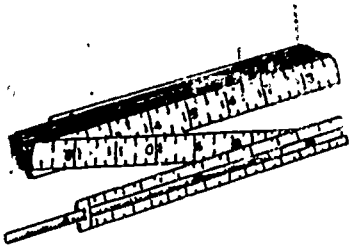
Isometric Drawing

9.0 Trade Tools/Electrical

INSTRUCTIONAL OUTCOMES: The student will be able to identify, select and explain the use of common tools of the trade, as well as to demonstrate basic proficiency in their use.

INTRODUCTION: The skilled worker, to accomplish his or her work tasks efficiently, must choose the correct tool for a given task, and use it proficiently.

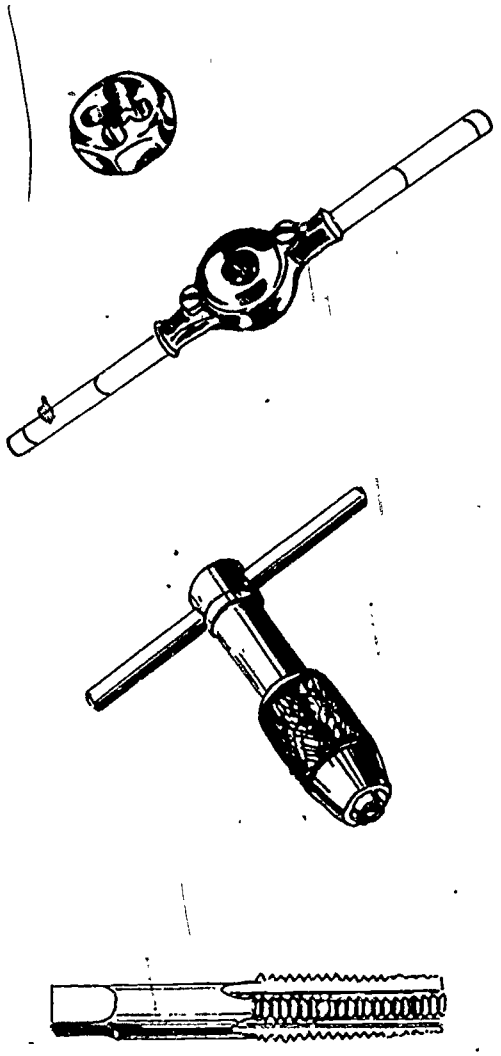
PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
9.1 General Tools A. Folding Rule with Sliding Scale 1. Used for measuring distances on blueprints, locating boxes and determining depth and setout. 2. By using the scale on blueprints, estimated length of wire and conduit runs can be determined. Example: If the scale on the blueprint is 1/8" = 1' and distance measured is 4", the length of wire or conduit needed will be approximately 32'.	Demonstrate and Explain ILS EL-RS-07 

3. Locating boxes can be simplified by using rule; vertical height can be determined by using rule to locate the box the appropriate height from floor or counter; centers of ceilings are also easily located by using rule.
4. Inserting the sliding scale into a hole and reading directly from the scale will show hole depth.

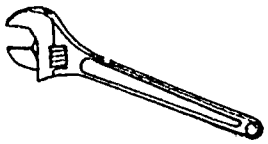
B: Tap Tools

1. Used for tapping drill holes for securing equipment to metal, tapping enlarged holes for larger screws and retapping damaged threads, determining screw sizes.
2. After drilling proper hole (see chart for proper tap drill sizes), hole can be threaded by using tap. (Be sure to use the proper tap drill; a drill that is too small could result in a broken tap, a drill that is too large will result in loose fitting screws.)
3. A hole with stripped threads can be rethreaded for a larger screw by enlarging the hole with reamer or drill and then tapping.
4. Damaged threads may be cleaned by running proper size tap through hole before inserting screw.
5. Screw size of a hole can be determined by finding the tap that will run through threads easily, without binding or excessive wobble.



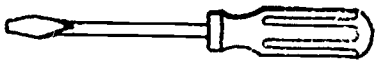
C. Adjustable Wrench

1. Used for tightening couplings and connections, tightening pressure-type wire connectors and removing and holding nuts.
2. Nuts can be tightened or loosened; always pull away from stationary jaw to prevent breaking.
3. Keep worm gears clean and properly lubricated.



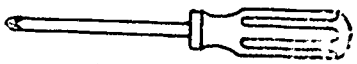
D. Flat Blade Screwdriver

1. Used for removing and installing slot head screws, tightening and loosening slot head lugs.
2. Use a blade that fits the slot without being so loose as to twist the blade, or too wide, which will strip the slot.
3. Keep sufficient pressure on handle to keep blade firmly in slot; do not use pliers on wrench to increase torque, can cause blade to twist or break, break the screw or strip out screw slot.
4. Damaged blades can be reground on grinding wheel.



E. Phillips Head Screwdriver

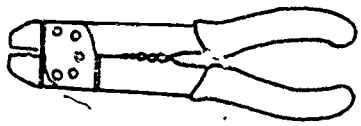
1. Used for removing and installing Phillips head screws and loosening and tightening Phillips head lugs.
2. Select proper size screwdriver to fit screw head; a screwdriver that is too small or large can slip and strip out head of screw.



3. Do not use wrench or pliers to increase torque, can strip out screw head and damage blades of screwdriver.
4. Screwdrivers with damaged heads should be replaced.

F. Adjustable Wire Strippers
1. Used for stripping insulation from conductors, cutting conductors and forming conductors.
2. Insulation can be cut and stripped from wire by using adjustable blades of tool; care must be taken to prevent nicking or damaging wire.
3. Cutting blades are used for cutting wire to desired length.
4. Conductor can be formed to desired bend by holding it firmly in adjustable jaws.

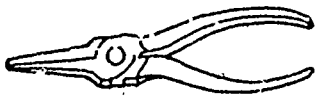
G. Six-in-one Tool
1. Used for stripping insulation, cutting conductors and cutting small bolts.
2. Insulation may be cut and removed by using various marked slots in tool; be careful to place wire in slot marked for its gage.
3. Conductors can be cut by using cutters at tip of tool; place wire between cutting jaws and squeeze handle; do not attempt to cut larger wires or bolts with these jaws.



4. Small bolts can be cut by screwing them through proper hole in center of tool and then squeezing handle; take care to install screw on threaded side.

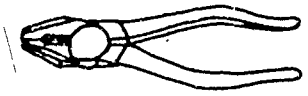
H. Long-nose Pliers (Needle-nose)

1. Used for forming small conductors, stripping insulation from small conductors (some long nose pliers come with a stripping slot), cutting conductors and holding and pulling on conductors.
2. The point of jaws is used for forming conductors by holding conductor in jaw and twisting to desired shape.
3. Those long-nose pliers that are equipped with cutting jaws can be used for cutting smaller conductors; do not attempt to cut conductors that are too large for jaws.
4. Those needle-nose pliers that are equipped with a stripping slot can be used to strip insulation; place wire in slot, squeeze gently, being sure not to nick or damage conductor; and pull insulation from conductor.



I. Lineman's Pliers (Side-cutters)

1. Used for cutting cables and conductors, cutting small screws, stripping conductors, forming large conductors and pulling and holding conductors.
2. Cables, conductors, and small screws are cut by placing them between cutting blades; firmly squeezing handles



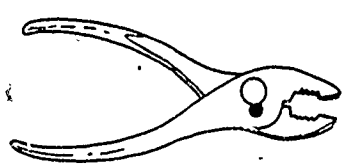
3. Those lineman's pliers equipped with stripping slot can be used to strip insulation from wire; place conductor in stripping slot, cut insulation and pull from conductor.
4. Conductors may be formed by grasping firmly in jaws and bending to desired shape.
5. Conductors can be held and pulled by grasping firmly between jaws.

J. Diagonal Pliers

1. Used for cutting cables and conductors and stripping conductors.
2. Cables and conductors are cut by placing them between jaws and squeezing handles. (These cutters are extremely useful for cutting cables and conductors in limited spaces.)
3. Those diagonal pliers equipped with stripping slot can be used for stripping insulation; place conductor in stripping slot, squeeze handles, taking care not to damage metal, and strip insulation.

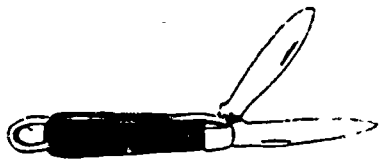
K. Groove Joint Pliers (Slip-joint)

1. Used for holding and lightening couplings and connectors, and holding and turning conduits and tubing.
2. Couplings, connectors and tubing can be held and turned by grasping firmly in jaws and turning to desired position; care must be taken not to damage lugs and couplings with sharp edges of jaws.



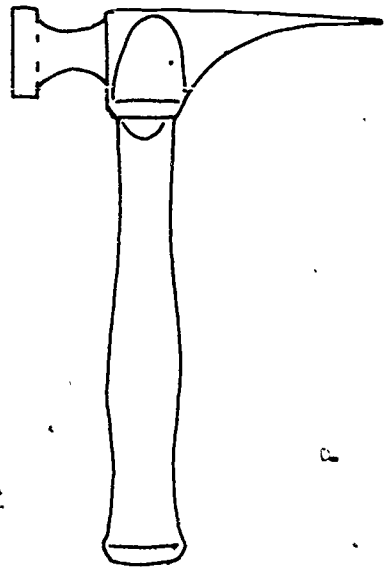
L. Pocket Knife

1. Used for opening cartons and stripping larger cables and conductors.
2. When using a knife, exercise caution to prevent cutting self; do not cut toward self, and protect others.



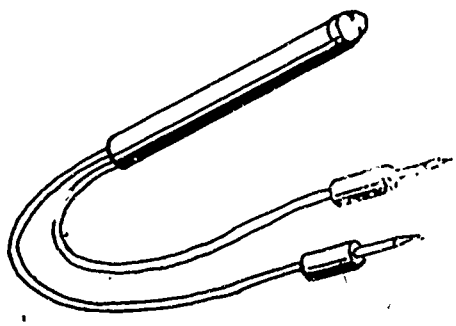
M. Electricians's Hammer

1. Used for driving and pulling nails, prying boxes loose, chipping wood and breaking plasterboard.
2. Flat portion of head is useful for driving nails and wedges by striking.
3. Nails and boxes may be pulled by using flat claw peculiar to this type of hammer.
4. Can be used to chip plasterboard; holes can be driven by using flat head, and board removed using claw.
5. Sharp edges of claw can be used to chip wood by striking and prying with claw.



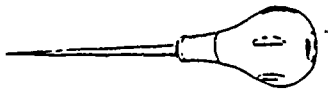
N. Neon Test Light

1. Used for checking for live conductors and identifying conductors.
2. Live circuits and hot leads can be identified by touching with leads of test lamp and checking for glow; care must be exercised to prevent electrical shock by contact with bare conductors.



O. Awl

1. Used for starting holes for screws and making dull starts.
2. Appropriate techniques: Starting holes for drills and screws can be accomplished placing the point of the awl at the place where the hole is desired and pressing firmly or striking the awl with the heal of the hand.



SUGGESTED READING

1. California Department of Education
   Electrical Wiring Workbook

   California Department of Education, 1974

2. Richter, H. P.
   Wiring Simplified 32nd ed.

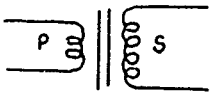
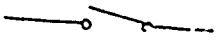
   Pork Publishing Co., 1977

10.0 Schematic Symbols and Definitions

INSTRUCTIONAL OUTCOMES: The student will be able to identify and explain common symbols used in the electrical trades, and explain their meanings and proper uses.

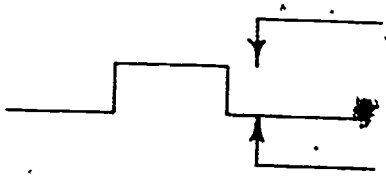
INTRODUCTION: Schematic symbols are used as part of the language of the electrical trades; the skilled worker is able to speak and understand the language.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
10.1 Common schematic symbols A. Transformer; a device used to increase or decrease the voltage in an electrical circuit. B. Contacts; the points of a switch, circuit breaker or relay that make and break the electrical circuit.	Explain and demonstrate  step down  step up normally open  normally close ILS-EL-RS-24  breaker switch

C. Fuse; a device designed to melt a link and break a circuit in the event of excessive current

D. Fixed bimetal thermostat; a device designed to open an electrical circuit in the event of excessive temperature.



E. Resistor; a circuit component that opposes electron flow.

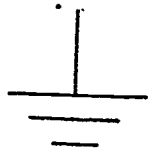
1. Fixed; a set value resistance

fixed

2. Variable; resistive value is adjustable, can be connected to control current or to provide voltage control.

variable

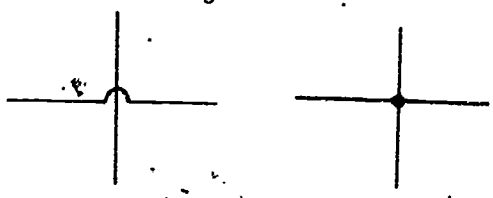
F. Ground connection; indicates a common line or reference potential.



ground

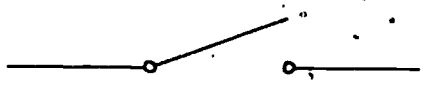
G. Wire crossover; a point where wires cross but do not connect.

H. Wire connection; a point where wires connect.



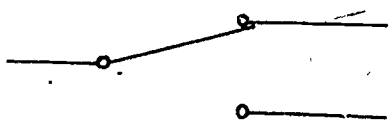
crossover connection

I. Single pole single throw (SPST) switch; a switch that breaks one side of the line only.



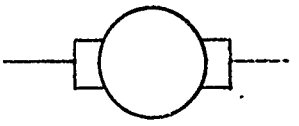
SPST

J. Three way switch (Single pole double throw, SPDT); routes one side of the line to either of two lines.



SPDT

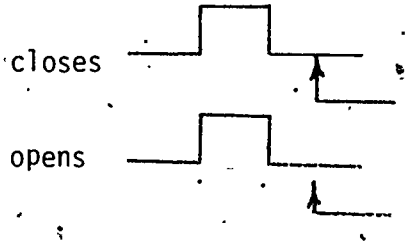
K. Four-way switch; reverses the direction of flow on two lines.



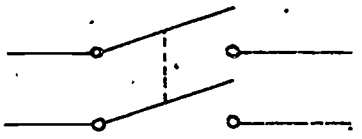
L. Single phase motor; an electric motor that runs on single phase a.c.

M. Thermostat; a device that controls circuit conditions due to changes in temperature.

1. Closes on rising temperature
2. opens on rising temperature



N. Double pole single throw switch (DPST); a switch that opens or closes both sides of the line.



DPST open

10.2 Terms and definitions.

A. Hertz; unit of frequency equal to one cycle per second.

B. Alternation; one-half (either positive or negative) of one cycle of alternating current (A.C.)

C. Alternating current; electron flow that periodically changes direction.

D. Current; electron flow or drift through a conductor.

E. Cycle; one complete operation of A.C.; consists of two alternations (one positive, one negative) or 360° of operation.

F. Resistance; opposition to electron flow or in a conductor or circuit.

G. Ampere; unit of measurement of electron flow.

H. Voltage; unit of measurement of difference in potential or electromotive force (EMF) between two points in an electric circuit.

I. Power; rate of consumption of electrical energy.

J. Watt; unit of measurement of power.

K. Conductor; a material which offers extremely low opposition to electron flow.

L. Insulator; a material which offers extremely high (infinite) resistance.

M. Overcurrent device; a component designed to protect the circuit from excessive current.

N. Circuit; a complete path for current from the source, through the load, and back to the source.

O. Series circuit; an electrical circuit with all loads connected in a single path, providing only one path for current.

F. Resistance; opposition to electron flow, or in a conductor or circuit.

G. Ampere; unit of measurement of electron flow.

H. Voltage; unit of measurement of difference in potential or electromotive force (EMF) between two points in an electric circuit.

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N. Circuit; a complete path for current from the source, through the load, and back to the source.

O. Series circuit; an electrical circuit with all loads connected in a single path, providing only one path for current.

P. Parallel circuit; an electrical circuit with loads installed across circuit conductors providing more than one path for current.

Q: Meter; an instrument for measuring the properties or values in an electrical circuit.

R. Electricity; a natural phenomenon dealing with the movement of electrons and the effect.

11.0 Basic Electricity

INSTRUCTIONAL OUTCOMES: The student will be able to apply Ohm's Lay and Watt's Law to calculate current, voltage, resistance and power in electrical circuits, and will be able to apply the rules of series and parallel circuits to calculate circuit values.

INTRODUCTION: In order to work effectively and safely with electrical equipment, it is necessary to have an understanding of the basic properties of electricity. Only after this is accomplished can one expect to work toward proficiency and understanding in electrical trades.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
11.1 Terms and definitions A. Volt; unit of measurement of potential difference or electromotive force. B. Ohm; unit of measurement of electrical resistance or opposition to electron flow. C. Ampere; unit of measurement of electron flow; often abbreviated as amp.	Explain and discuss

D. Watt; unit of measurement of electrica power.

E. E; electromotive force or difference in potential, measured in volts.

F. I; electrical current, measured in amperes.

G. R; resistance or oppostion to current, measured in Ohms.

H. P; electrical power, measured in watts.

11.2 Ohm's Law

A. States the relationship of E, I and R in an electrical circuit.

1. Can be stated as "The current in a series circuit varies directly with the voltage and inversely with the resistance."

B. By Ohm's Law, I=E/R, or current equals voltage divided by resistance.

1. R=E/I, or resistance equals voltage divided by current.
2. E=IR, or voltage equals current times resistance.
3. Ohm's law in triangle expression
   a. by covering the desired element in triangle, the formula for its solution is shown; if I is desired, cover it and E/R remains.

triangle expression

C. Application of Ohm's Law

1. Calculating circuit voltage can be done when current and resistance in a circuit are known, by using the formula E=IR.
2. Using Ohm's Law, solve the following: Class participation
   a. I=20A, R=6 ohms, E=____V
   b. I=4 A, R=6 ohms, E=____V
   c. I=9.6 A, R=2.5 ohms, E=____V
   d. I=5 A, R=2.4 ohms, E=____V
3. Calculating circuit current can be done when voltage and resistance are known, by using the formula I=E/R
4. Using Ohm's Law, solve the following: Class participation
   a. E=230 V, R=120 ohms, I=____A
   b. E=110 V, R=110 ohms, I=____A
   c. E=440 V, R= 20 ohms, I=____A
   d. E=120 V, R= 40 ohms, I=____A
5. Calculating circuit resistance can be done when voltage and current are known, by using the formula R=E/I.
6. Using Ohm's Law, solve the following: Class participation
   a. E=240 V, I= 4 A, R=____ohms
   b. E= 24 V, I=9.6 A, R=____ohms
   c. E= 12 V, I= 5 A, R=____ohms
   d. E=230 V, I= 5 A, R=____ohms

11.3 Watt's Law (Power calculation)

A. Power in an electrical circuit can best be described as work, and is measured in watts. Power (work) is the product of pressure (voltage) and movement (resistance).

B. The formula for calculating power in an electrical circuit is P=EI. 1. Power formula in triangle expression 2. By covering the desired element in the triangle, the formula for its solution is shown; if P is desired, cover it and the formula for its solution is P=EI	triangle expression
C. Application of power formula 1. Circuit voltage can be found when power and current are known, by using the formula E=P/I. 2. Using the power formula, solve the following: a. I= 6A, P=1380 W, E=____V b. I=6.5A, P=715 W, E=____V c. I=2.5A, P=1100 W, E=____V d. I= 5A, P=600 W, E=____V	Class participation
3. Circuit current can be found when power and voltage are known, by using the formula I=P/E. 4. Using the power formula, solve the following: a. P=6000 W, E=120 V, I=____A b. P=2640 W, E=240 V, I=____A c. P=8800 W, E=440 V, I=____A d. P= 690 W, E=115 V, I=____A	Class participation
5. Circuit power can be found when voltage and current are known, by using the formula P=EI. 6. Using the power formula, solve the following:	Class participation

a. E=240 V, I=11 A, P=____w
b. E=115 V, I= 6 A, P=____w
c. E=440 V, I=20 A, P=____w
d. E=230 V, I= 5 A, P=____w

11.4 Series Circuits

A. Current in a series circuit will be the same throughout.

1. Formula for describing current in series circuit is:
$I_t=I_1=I_2=I_3....=I_n$
(I_t=total current; I_1=current in load 1; I_2=current in load 2; I_3=current in load 3; I_n=for any number of loads)

B. Voltage in a series circuit: the sum of the voltages across the individual components equals the voltage applied to the circuit.

1. Formula for describing voltage in a series circuit is:
$E_a=E_1 + E_2 + E_3.....+ E_n$
(E_a=applied voltage; E_1=voltage drop across load 1; E_2=voltage drop across load 2, etc.

2. Largest voltage drop will be across the component with the largest resistance.

a. E=IR, with I the same in all components; as R increases, so will E.

C. Resistance in a series circuit; the total resistance is the sum of the individual resistors.

Demonstrate circuit, at least three branches

1. Formula for describing resistance is: $R_t = R_1 + R_2 + R_3 \ldots + R_n$ (R_t=total resistance; R_1=resistance of resistor 1; R_2=resistance of resistor 2, etc.).

D. Power in a series circuit: total power is the sum of the individual powers

1. Formula for describing power in a series circuit is: $P_t = P_1 + P_2 + P_3 \ldots + P_n$ (P_t=total power; P_1=power on load 1; P_2= power on load 2, etc.).
2. Common applications of series circuits
   a. switches
   b. overcurrent devices
   c. thermal protection devices

11.5 Parallel Circuits

Demonstrate circuit with at least three branches

A. Current in a parallel circuit: total current is equal to the sum of the individual branch currents.

1. Formula representing total current in a parallel circuit is: $I_t = I_1 + I_2 + I_3 \ldots + I_n$ (I_t=total circuit current; I_1=current in branch 1; I_2= current in branch 2, etc.).

B. Voltage in a parallel circuit: the voltage is the same across all branches

1. Formula representing voltage in a parallel circuit is:
$E_a=E_1=E_2=E_3....=E_n$
(E_a=applied voltage; E_1=voltage across branch 1; E_2=voltage across branch 2, etc.).

C. Resistance in a parallel circuit: the total resistance is always less than that of the lowest resistor in parallel.

1. Formulas for resistors in parallel are:

a. for 2 resistors in parallel

$$R_t=\frac{R_1 \times R_2}{R_1 + R_2}$$

b. for more than 2 resistors in parallel

$$R_t=\frac{1}{1/R_1 + 1/R_2 + 1/R_3...1/R_n}$$

D. Power in a parallel circuit: total power consumed in a parallel circuit is the sum of the powers of the individual branches.

1. Formula representing power consumption in a parallel circuit is:
$P_t=P_1 + P_2 + P_3....+ P_n$
(P_t=total circuit power; P_1=power consumed by branch 1; P_2=power consumed by branch 2, etc.).

2. Common applications of parallel circuits
   a. applying receptacle outlets in a residence.
   b. supplying light fixtures in a residence.

12.0 Basic Wiring Concepts

INSTRUCTIONAL OUTCOMES: Student will demonstrate and execute basic trade skills by completing a project to the satisfaction of the instructor.

INTRODUCTION: This instructional unit provides students an opportunity to practice techniques followed in the Pacific Northwest; appropriate techniques will have been learned in previous topics in this guide.

PRESENTATION

TEACHING OUTLINE	TEACHING METHODS AND AIDS
12.1 Wire Outlet-lighting Fixture with In-line Switch A. Layout 1. Locate intended position of switch and outlet. 2. Mark location using steel measuring tape, combination square and pencil. 3. Measure distances from circuit breaker wires to switch and outlet. B. Turn Off Power at Circuit Breaker 1. Test with continuity tester.	Explain and Discuss Administer Project Sheet

C. String Cable

1. Remove appropriate knockouts in receptables.
2. Insert 6" (min.) cable into outlet receptacle.
3. Tighten receptacle clamp.
4. Stretch cable to switch receptacle.
5. Insert loop of cable into receptacle and clamp.
6. Extend cable to circuit breaker wiring
   a. do not cut. (do not sever).

D. Wire Outlet

1. Remove insulation; outer and inner.
2. Attach wires to terminals.
3. Secure fixture to receptacle.

E. Wire Switch Fixture

1. Remove outer insulation from cable loop.
   a. do not cut through inner wires or insulation.
2. Remove insulation from black wire and ground wire (if any).
   a. do not cut either wire.
3. Attach wires to respective terminals.
4. Secure switch to receptacle.

F. Attach Cable to Circuit Breaker Leads

1. Remove insulation from cable.
2. Remove insulation from the individual wires.
3. Mate matching lead wires to cable wires.
4. Connect wires using twist nuts or electrical tape.

G. Test Circuit

1. Recheck all connections.
2. Turn on circuit breaker.
3. Turn on switch.
4. Test outlet with continuity tester.
5. Plug in test appliance (e.g. lamp).
6. Turn switch to off with appliance still on; ensure that it turns off.
7. Turn off circuit breaker.

H. Clean Up Trimmings and Insulation

ELECTRICAL PROJECT SHEET

1. Wiring an outlet-lighting fixture with in-line switch.

The student will complete a wiring project, using appropriate tools in a safe manner, to industry standards.

REQUIREMENTS

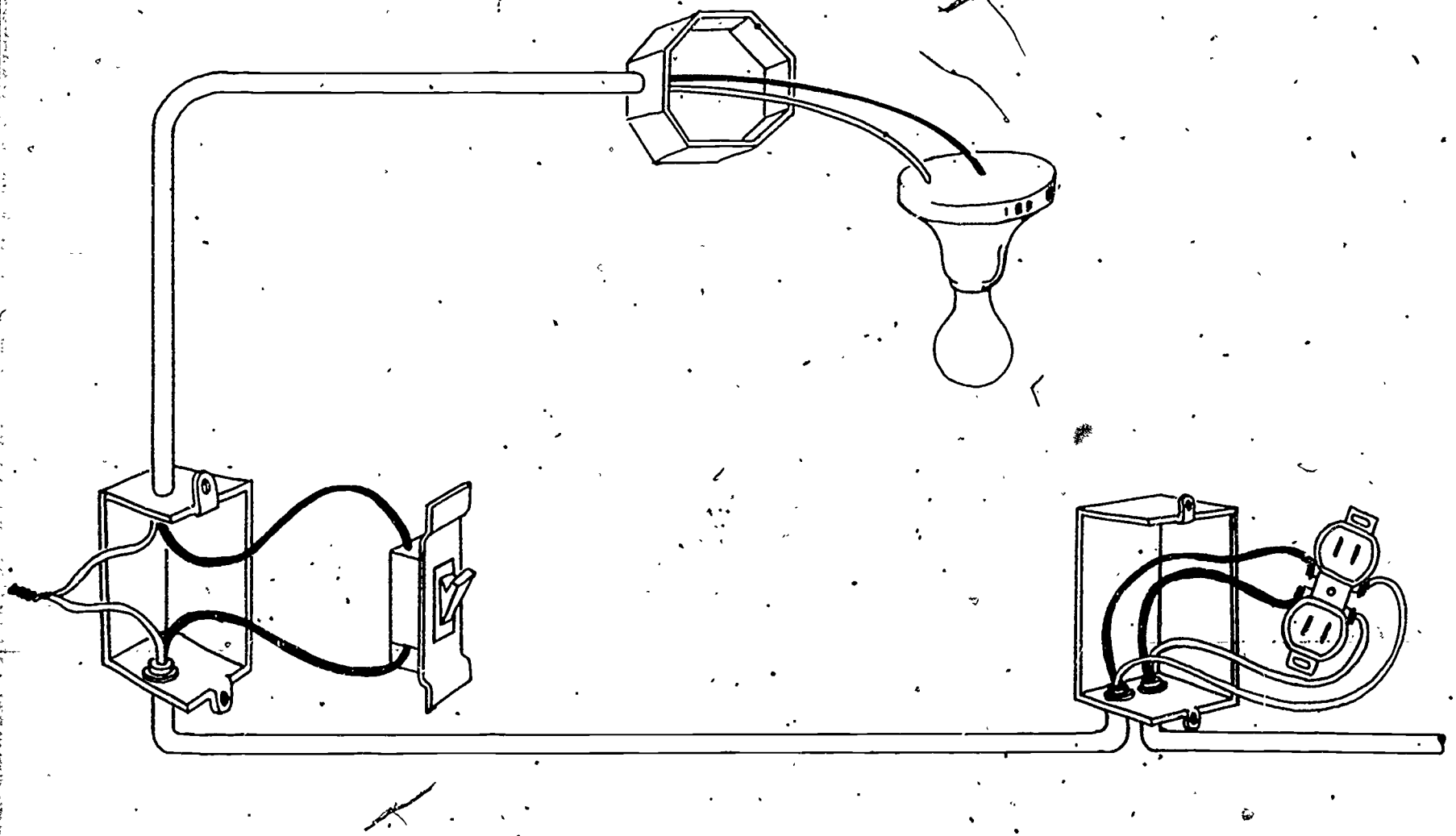
Wiring system with circuit breaker and three wire leads connected to circuit breaker (student will not add breaker to service). Board to mount receptacle boxes and wiring (may be simple 2x4 frame).

TOOLS

slotted screwdriver
wirecutters/strippers
steel measuring tape
pencil
combination square
continuity tester

MATERIALS

duplex outlet or lighting socket with bulb
switch fixture
14-2 G TYPE NM (as a minimum) wire cable
outlet/receptacle boxes for switch and outlet
twist nuts or electrical tape



STEPS TO COMPLETION:

1. Locate position of switch and outlet.
2. Mark location using steel tape measure, combination square and pencil.
3. Measure distances from circuit breaker wires outlet and switch.
4. Ensure that circuit breaker is tuned off ("tripped"). Make continuity test on leads.
5. Remove appropriate "knockouts" from receptacle boxes.
6. Insert at least a 6"-length of cable into outlet receptacle and tighten clamp on cable.
7. Stretch cable to switch receptacle
8. Insert cable loop into receptacle and tighten clamp on cable.
9. Extend cable to circuit breaker wiring; do not cut.
10. Strip outer insulation from cable and remove insulation from individual wires in outlet.
11. Carefully attach wires to terminals of outlet fixture, including groundwire.
12. Secure outlet fixture into receptacle with two mounting screws.
13. Carefully remove outer insulation from cable loop in switch receptacle
14. Remove insulation from black wire and from ground wire (if insulated); do not cut.
15. Attach black wire to switch terminal.
16. Attach groundwire to ground terminal.
17. Secure switch into receptacle with two mounting screws.
18. Cut cable to proper length to attach to circuit breaker leads and ground.
19. Remove outer insulation from cable end.
20. Remove insulation from individual wires for connection.
21. Mate matching lead wires to cable wires.
22. Finish connection with twist nuts.
23. Re-check all connections.

24. Turn on circuit breaker.

25. Turn on switch.

26. Test outlet with continuity tester.

27. Plug in test appliance (e.g. lamp).

28. Turn switch to off with appliance still on; ensure that it turns off.

29. Turn off circuit breaker.

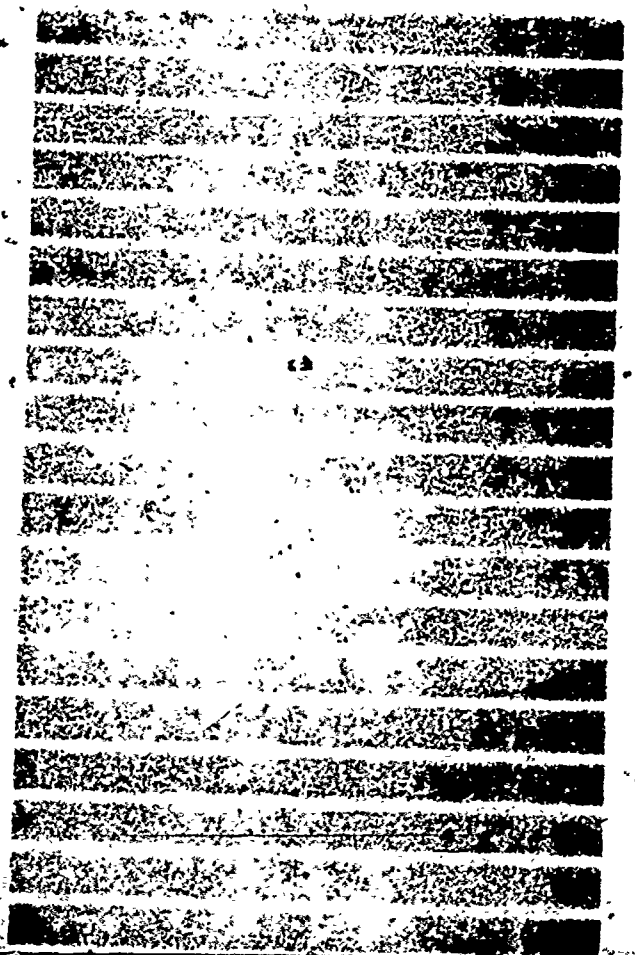
30. Clean up.

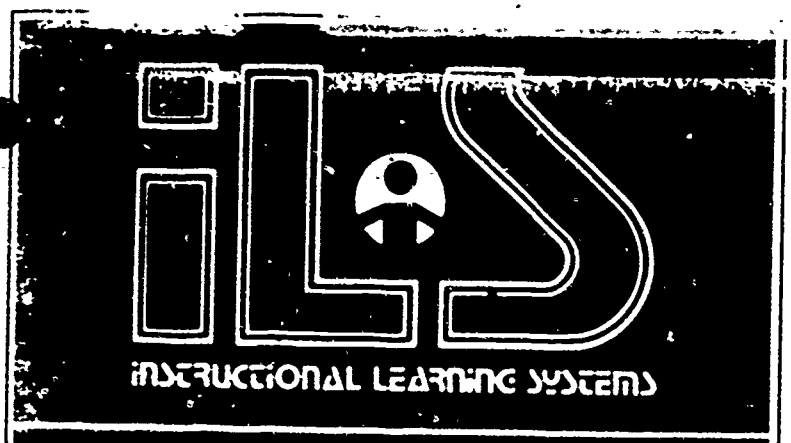
APPENDIX

OCCUPATIONAL ANALYSIS

Task Analysis

MANUFACTURING / MAINTENANCE ELECTRICIAN





DCOE Instructional Group Code: 17.100200
DOE Number: 824.261-010

ODE Specialists:
John Havery, Electronics & Graphics
John Barton, Curriculum Development

Date Analysis Completed:
June 6, 1975/Revised June 30, 1980

Analyst:
[illegible]

Task Inventory Review Committee:
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Jim Ames, Eastern Oregon JATC
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TASK INVENTORY

Manufacturing/Maintenance Electrici
Job Title

Ken Hershburger
Analyst

INSTRUCTIONS:

List each manipulative and knowledge skill relating to the job noted above. To the right of each task is a series of columns asking specific questions about the entry level, level of difficulty, frequency, and type of skill involved. Place an "X" in each of the four categories opposite the task description.

Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
1	0	REPLACE OR MOVE ELECTRICAL CONDUIT								
	1	Examine blueprints	X			X				X
	2	Install/replace surface type boxes	X		X				X	
	3	Install/replace explosion proof boxes		X		X		X		
	4	Install/replace special boxes	X		X			X		
	5	Screw or nail boxes in place	X		X				X	
	6	Install/replace rigid conduit	X			X			X	
	7	Cut conduit to length	X		X				X	
	8	Ream and thread conduit	X			X			X	
	9	Apply locknuts to bushing	X		X				X	
	10	Couple conduit lengths together	X		X				X	
	11	Install/replace Erickson coupling		X		X		X		
	12	Bend to offsets in conduit	X		X				X	
	13	Bend 0-90 degrees in conduit	X		X				X	
	14	Make kick in conduit	X		X				X	
	15	Bend saddle in conduit		X		X		X		
	16	Install/replace manufactured bends	X		X				X	
	17	Install/replace conduits	X		X				X	
	18	Install/replace watertight fittings		X		X		X		
	19	Install/replace explosion proof fittings		X		X		X		
	20	Install/replace underground conduit run	X			X		X		
	21	Apply gaskets on fittings	X		X			X		
	22	Pour sealing compound in fitting		X	X			X		
	23	Insert sealing plugs in fittings	X		X			X		
	24	Screw on covers and plates	X		X					X
	25	Level boxes, conduit & fittings	X		X				X	
	26	Strap or tie boxes on conduit	X		X				X	
	27	Fit dies to threading head		X		X		X		
	28	Manipulate shovel for conduit lay	X		X				X	
	29	Bolt and screw components	X		X					X
	30	Install straps with stud gun		X		X		X		
2	0	SERVICE ELECTRICAL WIRING & FUSES								
	1	Use current carrying tables of conductors	X			X			X	
	2	Use current carrying tables for equipment	X			X			X	
	3	Replace time-delay fuses		X	X			X		
	4	Install/replace single & three phase breakers	X		X				X	

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Duty No.	Task No.	Task Description	Entry Level: Entry	Entry Level: On The Job	Level of Difficulty: Easy	Level of Difficulty: Moderate	Level of Difficulty: Difficult	Frequency: Small Amount	Frequency: Average Amount	Frequency: Great Amount
2	5	Install/replace cartridge fuses	X		X			X		
	6	Install/replace thermal heaters	X		X			X		
	7	Install/replace links in existing cartridge fuses	X		X			X		
	8	Test fuses and breakers	X		X			X		
	9	Install plug & cartridge fuses	X		X			X		
	10	Inspect ladders, scaffolding	X		X			X		
	11	Inspect grounding of power tools	X		X			X		
	12	Inspect test equipment		X		X			X	
	13	Insulate prior to working on power panels		X		X		X		
	14	Insulate panel for pulling wire	X		X				X	
	15	Inspect overhead for tools & equipment	X		X				X	
	16	Remove fuses	X		X			X		
	17	Inspect hard hat, safety belt , hi-volt gloves		X		X			X	
	18	Assemble & test scaffolding frames	X		X			X		
						X			X	
			X		X			X		
3	0	MAINTAIN ELECTRIC HEATING								
	1	Identify types of cables	X			X			X	
	2	Identify nonmetallic covered cables	X			X			X	
	3	Identify metallic covered cables	X			X		X		
	4	Identify moisture proof cables	X			X		X		
	5	Determine number of conductors in cable	X		X				X	
	6	Identify service cables	X			X			X	
	7	Examine blueprints	X			X				X
	8	Locate boxes with blueprint	X			X				X
	9	Maintain boxes	X		X				X	
	10	Maintain panels	X		X				X	
	11	Maintain special equipment		X		X			X	
	12	Use stud gun for mounting		X		X		X		
	13	Insert cinch anchor	X		X			X		
	14	Replace cable	X		X				X	
	15	Re-attach cable in boxes	X		X				X	
	16	Install/replace cable clamps	X		X				X	
	17	Install/replace connectors	X		X				X	
	18	Install/replace watertight connectors	X		X			X		
	19	Support cables with straps	X		X					X
	20	Replace running board for cables	X		X				X	
	21	Strip cables in boxes	X		X					X
	22	Install/replace underground run		X		X			X	
	23	Seal cable ends		X		X			X	

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
5	2	Install/replace ground fittings	X			X				X
	3	Install/replace ground clamp or lug	X			X				X
	4	Install/replace pressure connectors	X		X					X
	5	Install/replace grounding bushings	X		X				X	
	6	Install/replace ground conductor	X			X				X
	7	Ground service entrance equipment	X			X			X	
	8	Ground outlet boxes	X		X					X
	9	Ground fixed equipment	X		X					X
	10	Ground portable equipment	X			X				X
	11	Ground conductor enclosures and raceways	X			X			X	
	12	Ground receptacles to grounded boxes	X		X				X	
	13	Ground to water pipe	X			X			X	
	14	Ground to gas pipe with special permission		X			X	X		
	15	Replace lightning arresters		X		X		X		
	16	Ground special tools		X		X		X		
	17	Ground test equipment		X		X		X		
	18	Replace ground fault interrupting device		X		X		X		
	19	Select proper size of grounding conductor		X		X			X	
6	0	~~MAINTAIN ELECTRIC DEVICES~~								
	1	Locate control and operating devices		X		X			X	
	2	Install/replace transformers		X		X		X		
	3	Install/replace switches		X		X				X
	4	Install/replace relays and timers		X		X		X		
	5	Install/replace selector switches		X		X		X		
	6	Install/replace wire and cable	X		X				X	
	7	Install/replace single conductor cable	X		X				X	
	8	Install/replace multi-conductor cable	X		X				X	
	9	Install staples	X		X				X	
	10	Mount outlet boxes	X		X				X	
	11	Mount transformers	X		X			X		
	12	Mount relays	X		X			X		
	13	Mount box covers	X		X			X		
	14	Connect devices	X			X		X		
	15	Connect switches		X		X		X		
	16	Connect transformers		X		X		X		
	17	Connect relays		X		X		X		
	18	Connect selector switches		X		X		X		
	19	Install/replace automatic control equipment		X		X		X		
	20	Install/replace a quastat		X		X		X		
	21	Install pressurestat		X		X		X		
	22	Install airstat		X		X		X		

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Duty No.	Task No.	Task Description	Entry Level		Level of Difficulty			Frequency		
			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
6	23	Install/replace furnacestat		X		X		X		
	24	Install/replace heating system controls		X		X		X		
	25	Install/replace stoker controls		X		X		X		
	26	Install/replace oil and gas pump controls		X		X		X		
	27	Install/replace optional or special equipment		X			X	X		
	28	Ground control equipment	X			X		X		
	29	Install hi-voltage/low voltage barrier		X		X		X		
	30	Install/replace fire alarm conduits	X		X				X	
	31	Install/replace fire alarm stations		X		X		X		
	32	Install emergency lighting		X		X		X		
	33	Support conduits and cables	X		X				X	
7	0	CONNECT AND INSTALL FIXTURES & APPLIANCES								
	1	Prepare wire	x		x				x	
	2	Install/replace outlets	x		x				x	
	3	Install/replace single pole switches	x		x				x	
	4	Install/replace 3-way switches	x			x		x		
	5	Install/replace fluorescent fixtures	x			x			x	
	6	Install/replace recessed fixtures		x		x			x	
	7	Install/replace surface fixtures	x		x				x	
	8	Install/replace special outlets		x			x	x		
	9	Install/replace range & oven receptacles		x		x		x		
	10	Install/replace water heaters		x		x		x		
	11	Install/replace wiring for central heating		x		x		x		
	12	Install/replace duct heating		x			x	x		
	13	Install/replace control contactor		x			x	x		
	14	Install/replace blower motor		x		x		x		
	15	Install/replace wiring for floor furnace		x		x		x		
	16	Install/replace wall heater		x		x		x		
	17	Install/replace baseboard-heaters		x		x		x		
	18	Install/replace thermostat wiring	x		x			x		
	19	Install/replace line voltage thermostat	x		x			x		
	20	Install/replace low voltage thermostat	x		x			x		
	21	Install/replace unit heaters		x		x		x		
	22	Install/replace heat pump unit		x		x		x		
	23	Install/replace air conditioning unit		x		x		x		
	24	Install/replace single phase motors	x			x		x		
	25	Install/replace pump motors	x			x		x		
	26	Install/replace furnace motors	x			x		x		

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			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
7	27	Install/replace 3-phase motors		X		X		X		
	28	Connect overcurrent devices		X		X		X		
	29	Connect manual overload switch		X		X		X		
	30	Connect magnetic switch		X		X		X		
	31	Replace control device		X		X		X		
	32	Replace float switches		X		X		X		
	33	Replace start-stop-reverse buttons		X		X		X		
	34	Replace cover plates	X			X			X	
	35	Connect communication systems		X		X		X		
	36	Connect multi-station intercom		X		X		X		
	37	Connect loudspeakers		X		X		X		
	38	Install/replace pilot lights		X		X		X		
	39	Install/replace fire alarm pull box devices		X		X		X		
	40	Install/replace fire alarm bells	X		X			X		
	41	Install/replace master control alarm		X		X		X		
	42	Install/replace exit fixtures		X	X			X		
	43	Install/replace surface raceways (wiremold)		X		X		X		
	44	Install/replace and assemble post lights		X		X		X		
	45	Install quartz iodized lamps		X		X		X		
8	0	INSTALL FLEXIBLE CONDUIT								
	1	Identify correct size and type of flex	X			X			X	
	2	Install/replace moisture proof flex. conduit	X		X			X		
	3	Install/replace explosion proof flex. conduit	X		X			X		
	4	Install/replace general purpose flexible conduit	X		X			X		
	5	Cut flexible conduit to length	X		X			X		
	6	Attach correct size connectors	X		X			X		
	7	Attach tite-bite connectors	X		X				X	
	8	Attach water tight connectors	X		X			X		
	9	Make attachment to equipment	X		X			X		
	10	Attach special fittings	X			X		X		
9	0	SERVICE ELECTRICAL SYSTEMS								
	1	Make tests with volt ohm meter	X			X			X	
	2	Make voltage tests	X			X			X	
	3	Make current measurements	X			X			X	
	4	Make resistance tests	X			X			X	
	5	Make amprobe tests	X			X			X	
	6	Take readings with megger	X			X			X	
	7	Calculate current capacities	X			X			X	
	8	Calculate loading effects		X		X			X	

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			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
9	9	Observe functioning circuits		X		X			X	
	10	Observe wear and operation.		X		X		X		
	11	Make minor adjustments		X		X		X		
	12	Make calibrations		X		X		X		
	13	Test protective devices	X		X				X	
	14	Test fuses and breakers	X		X				X	
	15	Replace delay fuses and breakers	X		X				X	
	16	Replace links in fuses (existing)	X		X			X		
	17	Replace cartridge fuses	X		X				X	
	18	Replace panel breakers	X		X				X	
	19	Clean parts or equipment								
	20	Clean contacts and moving parts								
	21	Install/replace electrical components	X		X				X	
	22	Install/replace heaters, switches and coils								
	23	Inspect blueprints and specifications	X			X				X
	24	Assemble electrical equipment		X		X		X		
	25	Assemble magnetic switches		X		X		X		
	26	Assemble push button devices		X		X		X		
	27	Assemble timers and regulators		X			X	X		
	28	Assemble electronic controls		X			X	X		
	29	Service residential, commercial and industrial		X		X			X	
	30	Record time, cost, inventory of work		X		X			X	
	31	Troubleshoot electrical circuit		X			X		X	
10	0	PLAN, EXAMINE AND INSTALL MATERIALS								
	1	Inspect material for physical damage	X		X				X	
	2	Install/replace flexible cords.	X		X			X		
	3	Install/replace pendants, fixtures	X		X			X		
	4	Install portable lamps	X		X			X		
	5	Install/replace appliances and wiring		X		X			X	
	6	Inspect & adjust frequency with equipment		X		X		X		
	7	Inspect for & prevent transmission of noise		X		X		X		
	8	Splice flexible cords in proper box or conduit	X			X		X		
	9	Inspect cord for thermal use	X			X		X		
	10	Inspect tension on suspended cords	X			X		X		
	11	Ground flexible cords to equipment	X			X		X		
	12	Install lighting equipment	X			X			X	
	13	Install/replace mercury arc lighting		X		X		X		
	14	Install/replace moisture proof fixtures		X		X		X		
	15	Install/replace equipment in corrosive locations		X		X		X		
	16	Install/replace wiring and equipment in explosive areas		X		X		X		

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			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
10	17	Install/replace electric space heating equipment		X		X		X		
	18	Install/replace wiring for boilers and furnaces		X		X		X		
	19	Install/replace individual space heaters		X		X		X		
	20	Install/replace deicing cables		X		X		X		
	21	Install/replace single phase motors	X			X			X	
	22	Install/replace three-phase motors		X		X			X	
	23	Install/replace motor controllers		X		X		X		
	24	Install/replace interlocking devices		X			X	X		
	25	Identify motors and control equipment		X		X			X	
	26	Install/replace protection devices	X		X			X		
	27	Install/replace ground fault equipment		X		X		X		
	28	Install/replace and wire for auxiliary generators		X		X		X		
	29	Install/replace power generators and wiring		X		X		X		
	30	Install/replace X-ray and hi-frequency equipment		X		X		X		
	31	Install/replace power factor correction capacitors		X		X		X		
	32	Install/replace capacitor protection								
	33	Ground capacitor units	X			X		X		
	34	Shunt capacitors		X		X		X		
	35	Maintain transformer ground		X		X		X		
	36	Install/replace resistors and reactors		X		X		X		
	37	Install storage batteries		X		X		X		
	38	Vent storage batteries		X	X			X		
	39	Maintain cranes and hoists power service		X		X		X		
	40	Install welders		X		X		X		
	41	Install/replace metalworking and machine tools				X			X	
	42	Maintain emergency lighting systems		X		X		X		
	43	Install/replace and wire electronic air cleaners		X		X		X		
	44	Install/replace precipitators		X		X		X		
	45	Read prints and specifications	X			X				X
	46	Talk to inspectors, architects, engineers		X		X			X	
	47	Coordinate work with allied trades	X			X				X
	48	Keep costs, time and material		X		X			X	
	49	Install and align electric motors		X	X			X		
	50	Clean and replace bearings		X		X			X	
	51	Test motor capacitors		X		X			X	
	52	Install motor over-current devices		X	X					X
	53	Install & replace running protection		X	X					X
	54	Install and replace interlocks		X		X			X	
	55	Design and install control circuits		X		X			X	

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			Entry	On The Job	Easy	Moderate	Difficult	Small Amount	Average Amount	Great Amount
11	0	FABRICATE & WELD METAL								
	1	Work with blueprints	x			x			x	x
	2	Follow structural layout plans		x		x			x	
	3	Install/replace brackets & supporting pieces		x		x			x	
	4	Weld channels in place		x		x			x	
	5	Fabricate and weld plates		x		x			x	
	6	Fabricate & weld electrical manhole ladders		x		x			x	
	7	Cut and weld equipment lifting hooks		x		x			x	
	8	Weld electrical fittings to structure		x		x			x	