



**COMMERCIAL/INDUSTRIAL  
ELECTRICAL INDUSTRY  
CONSTRUCTION TRAINING  
CRITERIA**

**0\*NET CODE 47-2111.00**

**Revised  
October 2010**

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**ELECTRICAL INDUSTRY TRAINING COMMITTEE MEMBERS**  
**OCTOBER 2010**

Don R. Davis, Co-Chair  
Electrical Training Institute  
6023 So. Garfield Avenue  
City of Commerce, CA 90040  
(323) 221-5881 Fax: (323) 721-6522

Keith Chitwood, Co-Chair  
Western Electrical Contr. Assn.  
9719 Lincoln Village Dr., Ste. 303  
Sacramento, CA 95827  
(916) 453-0112

Kathleen Barber  
San Mateo JATC  
625 Industrial Road  
San Carlos, CA 94070  
(650) 591-5217

Ron Dion  
Gould Electric, Inc.  
12975 Brookprinter Pl., Ste. 280  
Poway, CA 92064  
(858) 748-2474

Tom Lauchenauer  
San Francisco JATC  
4056 Mission Street  
San Francisco, CA 94112  
(415) 587-2500

Dave Dobson  
Helix Electric Inc.  
2840 Howe Road, Suite B  
Martinez, CA 94553  
(925) 372-9600

Earl Restine  
Fuller Electric Corp.  
1018 Cudahy Place, Suite B  
San Diego, CA 92110  
(619) 276-5411

Brad Silva  
Bergelectric Corp.  
5650 W. Centinela Avenue  
Los Angeles, CA 90045  
(310) 373-0258

Gary Leder, Alternate  
Electric Service & Supply Co.  
2668 East Foothill Blvd.  
Pasadena, CA 91107  
(626) 795-8641

John McQueen, Alternate  
Brudvik Inc.  
600 Eugene Road  
Palm Springs, CA 92264  
(760) 567-2576

Jerry Melson, Alternate  
Kern County JATC  
401 19<sup>th</sup> Street  
Bakersfield, CA 93301  
(661) 324-0105

Dave Nelson, Alternate  
Bergelectric Corp.  
650 Opper Street  
Escondido, CA 92029  
(760) 741-1003

## **INTRODUCTION**

The Electrical Industry Training Committee is appointed by the California Apprenticeship Council (CAC) with the assigned task of scheduled and periodic reviews of the uniform Minimum Industry Training Criteria for the occupation of Commercial/Industrial Electrician. During this review process, the Committee's responsibility is to recommend updates and revisions to the CAC. This will insure the minimum training criteria for all Electrical Apprenticeships within California are current and relevant to the Electrical Construction Industry. We believe this document contains the current knowledge, skills, and abilities required to be successful in a career as a Commercial/Industrial Construction Electrician.

## **LENGTH OF TRAINING**

Program sponsors shall establish a minimum of a four (4) year program of not less than 8,000 hours of on-the-job training and 640 hours of classroom instruction both of which are further detailed below.

## **RELATED SUPPLEMENTAL INSTRUCTION**

The required prescribed courses of related and supplemental instruction shall be no less than 160 hours per year. This instruction must include, at a minimum, the related and supplemental training processes listed in Exhibit "A". Additional focus on environmental awareness, energy efficiency, renewable and sustainable resources and recycling have been added in this 2010 revision.

## **ON-THE-JOB TRAINING**

On-the-Job Hands-on Skill Training shall be as continuous as possible throughout the 4-year program and shall be no less than 8,000 hours. This training must include, at a minimum, the processes listed in Exhibit "B".

## **COMPETENCY TESTING**

All apprentices must prove a satisfactory competency of prior skills and knowledge at the time of their advancement to the next higher level. The tests shall be based on all Related and Supplemental Instruction and hands-on manipulative skills. Periodic testing shall be done during each level of coursework and apprentices shall not advance to the next level unless they have achieved an average total score of 70% or higher.

## **COMPLETION PERCENTAGES**

Program sponsors must have a 65% graduation rate of all apprentices who satisfactorily complete the first year of their program

# **EXHIBIT A**

## **COMMERCIAL/INDUSTRIAL ELECTRICAL CONSTRUCTION INDUSTRY ELECTRICAL WORKER TRAINING CRITERIA**

### **RELATED SUPPLEMENTAL INSTRUCTION**

#### **Safety**

- A. General job-site safety awareness
- B. First Aid/CPR Certification
- C. Emergency Procedures
- D. Compliance with OSHA, NFPA and EPA Regulations
- E. Substance Abuse Awareness

#### **Tools, Materials and Handling**

- A. Proper care and use of hand and power tools
- B. Proper rigging methods
- C. Proper digging techniques
- D. Proper use of motorized equipment; platform lifts, fork-lifts and bucket trucks
- E. Proper material lifting and handling

#### **Math**

- A. Appropriate mathematical calculations to solve for related problems.

#### **Electrical Theory**

- A. Basic electro -magnetic principals
- B. Ohm's Law
- C. AC/DC Theory
- D. Series, Parallel and Combination Circuits
- E. Characteristics of circuits; voltage, current, power, resistance, impedance, capacitance and reactance.
- F. Theory of superposition and solving for multiple voltage-sourced circuits
- G. Operation and characteristics of three-wire systems
- H. Operation and characteristics of three-phase systems
- I. Use of electronics in the electrical industry

#### **Code Requirements**

National Electrical Code and Local Codes

### **Conductors**

- A. General characteristics
- B. Conductor installation codes and techniques
- C. Methods for selecting proper size and type of conductors

### **Conduit and Raceways**

- A. Terms associated with conduits and raceways
- C. Procedures for laying out various types of bends
- D. Procedures for making proper bends when fabricating conduits
- B. Conduit support systems recognized by Code

### **Lighting Systems**

- A. Function, operation and characteristics of various lighting systems
- B. Lighting distribution and layout
- C. Installation and connection of fixtures

### **Over-current Devices**

- A. Function, operation and characteristics of over-current protection devices
- B. NEC requirements for over-current protection devices
- C. NEC requirements for ground-fault and arc-fault protection

### **Grounding Systems**

- A. Functions, operation and characteristics of grounding systems
- B. Sizing, layout and installation of grounding systems
- C. Insulation and isolation
- D. Proper grounding and bonding techniques
- E. Special circumstances

### **Services and Distribution Systems**

- A. Function, operation and requirements for various panel boards and switch gear
- B. Grounding requirements
- C. Code requirements

### **Prints and Specifications**

- A. Creation of blueprints, plans and specification
- B. Use of blueprints, plans and specification
- C. Recognizing information contained within blueprints

### **Motors, Motor Controllers and Process Controllers**

- A. Function, operation and characteristics of motors (AC, DC, Dual-Voltage)
- B. Proper motor installations
- C. Motor controllers, control circuits and control devices
- D. Control Transformers, switches and relays
- E. Instrumentation, process control systems and devices

### **Generation and Power Supplies**

- A. Principles of generating electricity
- B. Principles of Alternative Energy Generating Systems
- C. Installation and maintenance of uninterruptible power supplies (UPS)
- D. Installation and maintenance of emergency battery systems

### **Transformers**

- A. Function, operation, and characteristics of transformers
- B. Selection and installation of transformer types
- C. Transformer grounding techniques
- D. Harmonics and power quality

### **Personal Development**

- A. Orientation to organization and structures
- B. Working with others
- C. Personal financial development

### **Electrical Testing**

- A. Steps used for various testing processes
- B. Proper selection and use of test meters
- C. Utilizing the results of testing procedures

### **Specialty Systems**

- A. Fire Alarms
- B. Security Systems

## **EXHIBIT B**

### **COMMERCIAL/INDUSTRIAL ELECTRICAL CONSTRUCTION INDUSTRY ELECTRICAL WORKER TRAINING CRITERIA**

#### **WORK PROCESSES**

1. Planning and Initiating a Project
2. Implementing Conservation and Recycling Practices on a Project
3. Establishing OSHA and Customer Safety Requirements
4. Establishing temporary power during construction
5. Establishing Power Distribution within a Project
6. Installing Service to Buildings and Other Structures
7. Installing and Maintaining Alternative Energy Generation Systems
8. Establishing a Grounding System
9. Planning and Installing Raceway Systems
10. Installing New Wiring and Repairing Old Wiring
11. Installing Indoor and Outdoor Receptacles, Lighting Circuits and Fixtures
12. Providing Power and Controls to Motors, HVAC and Other Equipment
13. Energy-Efficient Lighting and Equipment Control Systems
14. Installing Instrumentation and Process Control Systems
15. Installing and Maintaining Emergency Power Generation Equipment
16. Troubleshooting and Repairing Electrical Systems
17. Installing Fire Alarm Systems

By signature of the two (2) Co-Chairs below, we jointly confirm the Electrical Minimum Industry Training Criteria Committee recommends approval of this document by a greater than the required two-thirds majority.

**Respectfully submitted to the California Apprenticeship Council,**

Name:       **Keith Chitwood**       \_\_\_\_\_

Signature

Date:        October 22, 2010

Name:       **Don R. Davis**       \_\_\_\_\_

Signature

Date:        October 22, 2010