



# ELECTRICAL AND POWER TRANSMISSION INSTALLATION 46.0300.20 TECHNICAL STANDARDS

An Industry Technical Standards Validation Committee developed and validated these standards on October 31, 2019. The Arizona Career and Technical Education Quality Commission, the validating authority for the Arizona Skills Standards Assessment System, endorsed these standards on January 22, 2020.

Note: Arizona's Professional Skills are taught as an integral part of the Electrical and Power Transmission Installation program.

**The Technical Skills Assessment for Electrical and Power Transmission Installation is available SY2022-2023.**

Note: In this document i.e. explains or clarifies the content and e.g. provides examples of the content that must be taught.

## STANDARD 1.0 MAINTAIN A SAFE WORK ENVIRONMENT IN ACCORDANCE WITH OSHA (OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION) REGULATIONS]

- 1.1 Define fall hazard
- 1.2 Recognize major types of fall hazards in construction (e.g., improper scaffold construction, leading edges, roof/floor openings, structural steel, unprotected roof edges, and unsafe portable ladders)
- 1.3 Recognize how to protect workers from fall hazards (e.g., safe ladder use, training, and fall protection equipment)
- 1.4 Recognize employer requirements to protect workers from falls (e.g., ladder use and condition, proper scaffold construction, provide fall protection, training, and worksite maintenance)
- 1.5 Define caught-in or caught-between hazards
- 1.6 Recognize common types of caught-in or caught-between hazards in construction (e.g., buried-in or -by, machinery with unguarded moving parts, pinned between)
- 1.7 Recognize how to protect workers from caught-in or caught-between hazards in construction (e.g., ensure machinery is supported, protect workers from being pinned between equipment, protect workers on excavation sites, secured or otherwise made safe, training, and properly guarded machinery)
- 1.8 Recognize employer requirements to protect workers from caught-in or caught-between hazards in construction (e.g., designate a competent person; provide guards on power tools and other equipment with moving parts, a means to avoid the collapse of structures scaffolds, a means to avoid workers being crushed by collapsing walls, protection for workers during trenching and excavation work, and training for workers; support, secure, or otherwise make safe equipment with parts; take measures to prevent workers being crushed by heavy equipment; and take measures to prevent workers from being pinned between equipment)
- 1.9 Define struck-by hazards
- 1.10 Recognize common types of struck-by hazards in construction (e.g., falling, flying, rolling, and swinging objects)
- 1.11 Recognize how to protect workers from struck-by hazards in construction [e.g., general safe work practices, heavy equipment, motor vehicles, and personal protective equipment (PPE)]
- 1.12 Recognize employer requirements to protect workers from struck-by hazards in construction [e.g., general requirements for protecting workers, heavy equipment, motor vehicles, provide personal protective equipment (PPE), and training]
- 1.13 Define an electrocution hazard
- 1.14 Recognize the major types of electrocution hazards (e.g., contact with energized sources, contact with power lines, and improper use of extension and flexible cords)
- 1.15 Recognize how to protect oneself from electrocution hazards [e.g., follow lockout/tagout (LOTO) procedures, inspect portable tools and extension cords, maintain safe distance from overhead power lines, use ground-fault circuit interrupters (GFCI), use power tools and equipment as designed]

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- 1.16 Recognize employer requirements to protect workers from electrocutions [e.g., enforce lockout/tagout (LOTO) safety-related work practices; ensure overhead power line safety, power tools maintained in safe condition, proper guarding, and proper use of flexible cords; establish and implement an Assured Equipment Grounding Conductor Program (AEGCP), isolate electrical parts, provide training, supply ground-fault circuit interrupters (GFCI)]
- 1.17 Use basic protective equipment (PPE) appropriate for the job (i.e., safety glasses/goggles, hard hats, gloves, safety vests, work boots, etc.)

## **STANDARD 2.0 EXAMINE ELECTRICAL THEORY**

- 2.1 Examine electrical theory (e.g., generation, transmission to distribution, consumption)
- 2.2 Distinguish between alternating current (AC) and direct current (DC)
- 2.3 Define grounding, grounded, and bonding
- 2.4 Define three-phase and single-phase power supply [e.g., voltage (120 to 480)]
- 2.5 Summarize the purpose of a transformer
- 2.6 Identify wire sizes [i.e., circular mills (CM), American Wire Gauge (AWG) #14 to 4/0, etc.]
- 2.7 Identify wire types (i.e., copper, aluminum, solid, stranded, insulation, etc.)
- 2.8 Differentiate devices (e.g., switches and resistors/receptacles)
- 2.9 Summarize the purpose of Ground Fault Circuit Interrupters (GFCIs), Arc Fault Circuit Interrupters (AFCIs), and service panel breakers/fuses
- 2.10 Explain Ohm's Law

## **STANDARD 3.0 EXAMINE STANDARD ELECTRICAL TOOLS**

- 3.1 Identify the use of basic hand tools (i.e., nut driver set, insulated tools, torque wrench, crimper, etc.) (e.g., manual pipe bender, tape measure, hacksaw, wire stripper, screwdriver set, side cutting pliers, lineman's pliers, adjustable pliers/wrenches, utility blade, spirit level, hammer, etc.)
- 3.2 Identify the use of basic power tools [i.e., band saw, reciprocating saw, drills (cordless and corded), etc.]
- 3.3 Identify the use of multimeters and non-contact voltage testers
- 3.4 Inspect, set up, and use A-frame and extension ladders

## **STANDARD 4.0 EXAMINE UNDERGROUND INSTALLATION METHODS**

- 4.1 Relate information on Construction Documents or Technical Drawings (blueprints) to actual physical locations underground
- 4.2 Identify underground raceways [i.e., Polyvinyl Chloride (PVC) schedule 40/80, Galvanized Rigid Conduit (GRC), Intermediate Metallic Conduit (IMC), etc.]
- 4.3 Identify underground enclosures (i.e., floor boxes, handholes, Christy boxes, underground junction boxes, etc.)
- 4.4 Identify underground fittings [i.e., 22s, 30s, 45s, 90s, couplings, female adapter (FA), male adapter (MA), etc.]
- 4.5 Identify proper tools for installing underground raceways and fittings (i.e., tape measure, hacksaw, pliers, reamer, etc.)
- 4.6 Measure, cut, and join an underground raceway
- 4.7 Determine physical distance of installed conduit run using a vacuum or fish tape, mule tape, or true tape
- 4.8 Prepare to pull wire (i.e., basketing, half-hitching, pulling soap, etc.)
- 4.9 Pull wire to enclosure without damaging wire or raceway

## **STANDARD 5.0 EXAMINE ROUGH-IN METHODS**

- 5.1 Relate information on Construction Documents or Technical Drawings (blueprints) to actual physical locations above ground
- 5.2 Identify above-ground raceways according to the National Electric Code (NEC) [i.e., Electrical Metallic Tubing (EMT), Polyvinyl Chloride (PVC) schedule 40/80, Metal Clad (MC), Non-Metallic Cable (NM), flexible conduit, Galvanized Rigid Conduit (GRC), Intermediate Metallic Conduit (IMC), etc.]
- 5.3 Identify above-ground fittings (i.e., connectors, couplings, condulets, etc.)
- 5.4 Distinguish above-ground boxes/enclosures per National Electrical Manufacturers Association (NEMA) (i.e., plastic boxes, metal boxes, junction boxes, etc.)
- 5.5 Identify proper tools for installing above-ground raceways and fittings (i.e., tape measure, hacksaw, pliers, reamer, level, pipe bender, etc.)
- 5.6 Install boxes/enclosures and measure, cut, and join and support above-ground raceway

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- 5.7 Select and install mud rings
- 5.8 Determine physical distance of installed conduit run using a vacuum or fish tape, mule tape, or true tape
- 5.9 Prepare to pull wire or install Non-Metallic Cable (NM) (i.e., basketing, half-hitching, pulling soap, etc.)
- 5.10 Pull wire to boxes/enclosures without damaging wire or raceway

#### **STANDARD 6.o EXAMINE TRIM METHODS**

- 6.1 Interpret symbols and legends on Construction Documents or Technical Drawings (blueprints)
- 6.2 Demonstrate secure wire connections per manufacturer (i.e., device terminals, wire nuts, Wagos, etc.)
- 6.3 Wire switches (e.g., single pole, three-way, and four-way)
- 6.4 Wire receptacles [e.g., Ground Fault Circuit Interrupters (GFCIs), standard, 15/20-amp 120-volt duplex receptacles, 240-volt receptacles]
- 6.5 Wire luminaries and mount level and plumb
- 6.6 Install covers level and plumb (i.e., switches, receptacles, luminaries, etc.)

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