**Electronics Technicians Association, International**
**COMPETENCY REQUIREMENTS**

# COMMUNICATIONS SITE INSTALLATION INSPECTOR
# CSII/R56 Installer VERSION
## 2009

The following is a listing of each topic considered necessary to be included in a course of study towards the education of technicians performing **Communications Site Installation Inspections**. There are 7 major categories, 167 competencies of training. This COMPETENCY listing is supplied to provide a detail syllabus with an identification of each individual subject, in which the technician must be knowledgeable and skilled.

Technicians seeking the ETA® Communications Site Installation Inspector certification are required to have a basic education in fundamental electronics. The basic electronics knowledge is to be assessed with the ETA Associate CET examination. The Communications Site Installation Inspector certification is a Journeyman level certification and counts towards the requirements for Master certification (CETma).

The **R56 Installer** is a non-Auditor certification, which validates examinees knowledge of the core concepts required in the installation of a communications site, based on the R56 industry codes and standards. It should be attempted by installation contractors, service shops, project supervisors, project managers, site construction teams, and electrical contractors involved with communications site installation and construction. Examinees must complete a Motorola approved Communications Site Installer (R56) training course. The R56 Installer is a stand-alone and does NOT require the Associate CET certification.

## CSII/R56 INSTALLER COMPETENCIES

### 1.0 Communication Site Building Design and Installation

- 1.1 Describe the different site categories:
  - 1.1.1 Modules within a single rack
  - 1.1.2 Dedicated radio room within a new or existing building
  - 1.1.3 Pre-fabricated equipment shelter of concrete/fiberglass construction
  - 1.1.4 A shipping container
  - 1.1.5 Renovation
  - 1.1.6 A new “green site” on undeveloped land
- 1.2 Identify the differences between a building, shelter, vault, equipment cabinet/enclosure and rack
- 1.3 Determine ceiling height requirements with respect to an equipment cabinet or rack and a cable runway system
- 1.4 Describe cable runway system installation requirements:
  - 1.4.1 Design and safety
  - 1.4.2 Placement with respect to smoke detectors and sprinkler heads
  - 1.4.3 Minimum separation requirements
  - 1.4.4 Support requirements
- 1.5 Describe floor loading and sealing requirements
- 1.6 List the different types of cable entry ports and explain how each is to be weather sealed
- 1.7 Explain adequate lighting requirements
  - 1.7.1 Describe how illumination levels are to be measured

1.8 Describe how ambient temperature is to be measured
  1.8.1 List the temperature and relative humidity requirements for the HVAC system
1.9 Explain the basic uses for exhaust fans and how the exterior opening needs to be protected
1.10 List the minimum fire suppression equipment requirements
  1.10.1 Explain the installation requirements for a portable and a fixed total flood system
1.11 Define an approved first aid kit and relate where it needs to be located
1.12 List the personal protective safety equipment requirements for servicing batteries and identify when this equipment is required at the site
1.13 Describe the types of on-site communication equipment that needs to be available at the site
1.14 Identify phone numbers of importance that need to be posted at the site
1.15 List minimum required signage that needs to be posted at the site and additional signage that may be required

**2.0 Grounding System Inspection Equipment**

2.1 Describe the uses of a clamp-on ground resistance tester
2.2 Explain how the clamp-on ground resistance tester works
2.3 Identify the prerequisites for using a clamp-on ground resistance tester
2.4 Describe testing a single grounding electrode conductor
2.5 Describe testing multiple grounding electrode conductors connected to a single grounding electrode
2.6 Explain the procedure for testing of multiple grounding electrode conductors connected to parallel grounding electrodes
2.7 Explain where the correct location is for measuring the ground resistivity of a communication site
2.8 Describe how to measure the ground resistivity of the communication site:
  2.8.1 Before the AC utility is installed
  2.8.2 When the AC utility is installed
2.9 Explain how the clamp-on ground resistance tester can check bonding continuity
2.10 Explain how to use a jumper wire to verify bonding continuity to a common grounding electrode system

**3.0 External Grounding**

3.1 Explain the purpose for external grounding
3.2 Describe common grounding
3.3 Identify the different grounding electrode system components that need to be bonded together to form a common grounding electrode system
3.4 List the different ground resistance requirements between a Type “A” and Type “B” site
3.5 Define the Motorola recommended design goal for ground resistance at Type “B” sites
3.6 Explain what needs to be done if the ground resistance goals cannot be achieved at a Type “A” or Type “B” site

3.7 Identify acceptable grounding electrodes and define their minimum requirements
3.8 Describe supplemental grounding
3.9 Explain sphere-of-influence for a grounding electrode and define minimum grounding electrode spacing requirements
3.10 Determine if the grounding electrode system design meets the requirements appropriate for the type of site
3.11 Explain the difference between grounding electrode conductors and grounding conductors and identify their minimum sizing requirements
3.12 List conductor bending and routing requirements
3.13 List requirements for protecting and securing grounding conductors
3.14 Explain the causes for galvanic corrosion and methods to help reduce or prevent it from occurring
3.15 Describe conductor bonding requirements for each item that needs to be bonded to the external grounding system
    3.15.1 Explain exothermic welding requirements
    3.15.2 Explain irreversible high compression crimping requirements
    3.15.3 State the appropriate type of conductive anti-oxidant compound to be applied to a mechanical bonding connection
3.16 Describe and list the requirements for installing an external ground bus bar (EGB)
3.17 Describe the requirements for installing a tower ground bus bar (TGB)
3.18 Explain how grounding conductors must be connected to the EGB and TGB
3.19 Describe how to install grounding kits
    3.19.1 Identify the minimum and recommended installation locations
3.20 Identify braided grounding conductors and explain why they are not be used in the grounding system
3.21 Explain antenna structure grounding requirements for a:
    3.21.1 Guyed tower
    3.21.2 Self-supporting tower
    3.21.3 Monopole tower
    3.21.4 Rooftop tower
    3.21.5 Rooftop or building side mounted antenna mast
    3.21.6 Light pole
    3.21.7 Wooden pole structure
3.22 Describe tower guy wire grounding requirements when the guy anchor locations are located on the earth surface and on a building rooftop
3.23 Explain ice bridge or cable support grounding
3.24 Describe fence grounding requirements
3.25 Identify generator grounding requirements
3.26 List all other metallic items at the site that need to be bonded to the grounding system and describe how they need to be bonded
3.27 Identify special grounding situations and explain grounding conductor sizing requirements

## 4.0 Internal Grounding

- 4.1 Explain the purpose for internal grounding
- 4.2 List examples of common grounding within a building or equipment shelter
- 4.3 Identify the requirements for installing a master ground bus bar (MGB)
- 4.4 Identify the requirements for installing a sub system ground bus bar (SSGB)
- 4.5 List examples of how SSGBs can be utilized in different applications
- 4.6 Explain how conductors need to be connected to the MGB and SSGB
- 4.7 Explain the difference between a ground bus conductor and an equipment grounding conductor
  - 4.7.1 Identify their minimum sizing requirements
- 4.8 Describe conductor bending and routing requirements
- 4.9 Explain how equipment ground bus conductors, ground bus extensions and equipment grounding conductors need to be bonded together
  - 4.9.1 Explain how the bonding connections need to be insulated
- 4.10 Describe the installation requirements for an internal perimeter ground bus (IPGB) system and a Halo grounding system
- 4.11 Identify what can be bonded to the IPGB or Halo grounding systems
- 4.12 List ancillary support items and explain how they need to be bonded to the internal grounding system
- 4.13 Describe how to bond each of the following to the internal grounding system:
  - 4.13.1 Piping systems
  - 4.13.2 Steel roof trusses
  - 4.13.3 Exposed support beams
  - 4.13.4 Drop ceiling grids
  - 4.13.5 Raised flooring systems
  - 4.13.6 Other exposed metallic building materials
- 4.14 Explain how to bond metallic surge protection housings to the internal grounding system
- 4.15 State how different types of separately derived AC electrical systems need to be bonded to the internal grounding system
- 4.16 Describe how a DC power system needs to be bonded to the MGB
- 4.17 Explain what a primary surge protection device is and how it needs to be bonded to the grounding system
- 4.18 Identify where RF surge protection devices need to be installed and describe the different ways they can be bonded to the internal grounding system
- 4.19 Describe additional grounding requirements for primary and RF surge protection devices when they are not located adjacent to the MGB
- 4.20 Relate how different cable runway configurations need to be bonded to the MGB or to a separate equipment room SSGB
- 4.21 Explain when it is necessary to bond cable runway sections together
- 4.22 Describe how to bond separate cable runway sections and supporting hardware together
- 4.23 Describe how an equipment ground bus system needs to be installed and routed back to the MGB or a separate equipment room SSGB in a building and an equipment shelter
- 4.24 Explain how equipment housings and equipment racks need to be bonded

4.25 Describe what a rack ground bus bar (RGB) is and how it needs to be installed and bonded to the internal grounding system
4.26 Explain how to bond individual system component chassis equipment to the internal grounding system
4.27 Describe where secondary surge protection devices need to be installed and how they need to be bonded to the grounding system
4.28 Describe how to bond control center and dispatch network operator equipment
  4.28.1 Explain equal potential bonding
  4.28.2 Describe examples of how to establish equal potential bonding at the network operator positions
  4.28.3 List acceptable grounding conductor sizing requirements at the network operator positions

**5.0 Power Sources**

5.1 Describe how distribution panel boards, circuit breakers and electrical receptacles need to be marked for identification
5.2 Identify the clear working space requirements for electrical panels
5.3 Describe how power receptacles need to be securely mounted to the supporting structure
5.4 Explain the need for adequate service receptacle outlets
5.5 Describe why each piece of critical equipment needs to be powered by a dedicated branch circuit
5.6 Explain why power receptacles need to be installed by the equipment and why extension cords are not allowed in the final installation
5.7 Define what GFCI is and where this type protection needs to be installed
5.8 Explain why power strips need to be mounted off the floor and describe the requirements for an approved power strip
5.9 Explain why UPS equipment needs to be installed with adequate clearance from other items
5.10 Identify the location where the main electrical service Neutral-to-Ground bonding connection will be established
5.11 Define how a Neutral-to-Ground bonding connection can be established
5.12 Explain why only one Neutral-to-Ground bonding connection can be established at a location unless a separately derived power source has been installed
5.13 Describe the locations where a Neutral-to-Ground bonding connection can be located when a separately derived power source has been installed
5.14 Define an ACEG conductor and why this type conductor needs to be installed
5.15 Identify the location where ACEG conductor originates and explain how it needs to be routed throughout the electrical distribution system
5.16 Identify the installation requirements for solar panels and wind generators
5.17 Describe the installation requirements for battery systems
5.18 Describe the installation requirements for generators and their fuel tanks
5.19 Identify the minimum adequate spacing requirement for safe serving of a generator
5.20 Identify the minimum recommended spacing requirements for a generator fuel tank and the fence and between the tank and the shelter

5.21 Explain why a main disconnect may be needed in the feeder cable between the generator and the transfer switch
5.22 Describe the minimum electrical panelboard ampacity rating for an electrical panel being served by a generator
5.23 Define the minimum size circuit for communications equipment

**6.0 Transient Voltage Surge Suppression**

6.1 Explain the need for transient voltage surge protection
6.2 Identify transient voltage sources
6.3 List the four major points of entry into a communications site that must be protected
6.4 Identify the protection modules used in a Type 1 AC surge protection device (SPD)
6.5 Identify the protection modules used in a Type 2 AC surge protection device (SPD)
6.6 Describe the proper installation requirements and locations for the Type 1 and Type 2 AC SPDs
6.7 Define the difference between normal mode and common mode protection
6.8 Identify primary SPDs that are used for metallic telephone, control and data lines
6.9 Describe and indicate the proper installation requirements and locations for primary SPDs
6.10 Explain how to tell if the primary SPD meets the proper listing or marking requirements
6.11 Explain what needs to be done with unused cable conductors that are not protected by the primary SPD
6.12 Explain how to identify secondary SPDs that are used for metallic telephone, control and data lines
6.13 Describe and explain the proper installation requirements and locations for the secondary SPDs
6.14 Indicate if the secondary SPD meets the proper listing or marking requirements
6.15 Explain what needs to be done with unused conductors that are not extended through the secondary SPD
6.16 Describe and explain the proper installation requirements and locations for RF SPDs
6.17 Explain what needs to be done with non-terminated or spare transmission lines entering the site
6.18 Describe and explain the proper installation requirements and locations for SPDs that are used to protect tower top amplifier transmission lines and control cables
6.19 Identify the proper installation requirements and locations for tower lighting controllers and their control cables
6.20 Describe and explain the proper installation requirements and locations for SPDs that are required to protect the tower lighting controller power, control and alarm conductors

**7.0 Equipment Installation**

7.1 Explain the minimum spacing and aisle width requirements at an equipment shelter or building

7.2 Describe how you would determine if equipment is installed level, plumb and square with surrounding equipment and walls
7.3 Explain how communications equipment and ancillary items needs to be braced and secured in seismic 3 or greater rated areas
7.4 Explain how to determine if communications equipment cabinets and racks are properly secured to the floor as required
7.5 Describe the appropriate cable group separation and routing requirements for RF lines, power cables, ground conductors and control, data, telephone, alarm and reference cables
7.6 Describe the minimum bending radius requirements for all types of RF cables
7.7 Identify when plenum-rated cables are required at the site and explain how to determine if all types of cabling meet the requirements
7.8 Explain how to determine that cables are sized to length and that excess cabling is not coiled up
7.9 Identify that cables have been adequately secured at the required intervals
7.9.1 Explain why communication cabling cannot be secured to the exterior of any electrical conduit or electrical raceways
7.10 Describe why AC power conductors installed on a cable runway system should meet NFPA 70 requirements.
7.11 List the standard identification requirements for communication cabling
7.12 Describe how distribution frame wiring would conform to the proper punch-down or wire-wrap techniques
7.13 Identify that CAT 5e cabling meets all installation requirements
7.14 Describe how cabling routed under and through a raised flooring system would meet the proper installation requirements
7.15 Explain how cabling shall be supported when it is routed above a suspended or drop ceiling
7.16 List the minimum electrostatic discharge practices that shall be observed for serving communications equipment and storing static sensitive components

**Recommended Study Material**

- *Standards and Guidelines for Communication Sites* (R56) – Available from Motorola Parts (phone number: 800-422-4210, part number: hard copy # 6881089E50 and CD # 9880384V83)
- NFPA 70: *National Electrical Code*® (2008) – ISBN 0877657904
- NFPA 70: National Electrical Code Handbook (2008) – ISBN 0877657939
- Understanding Low-Voltage and Power –Limited Systems – ISBN 1932685200
- *IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems* (IEEE Std 142-1991) – ISBN 1559371412
- *IEEE Recommended Practice for Powering and Grounding Electronic Equipment* (IEEE Std 1100-2005) – ISBN 0738148806
- NFPA 780: *Standard for the Installation of Lightning Protection Systems*
- *Lighting Protection and Grounding Solutions for Communication Sites* – PolyPhaser
- *Lyncole Ground Test Methods* – Lyncole XIT Grounding