City of Colorado Springs Traffic Signal

Grounding Methods

October 30, 2014
Revision 1
1.0 New Construction and Reconstruction Grounding Methods

1.1 Metered Service

- Conflicting grounding methods in the “Colorado Springs Utilities Electric Line Extensions & Service Standards” document from CSU supercede this section (section 1.1)
- Install at least two grounding electrodes (ground rods), at least six feet apart
  - Drive 5/8in. x 8ft. copper grounding electrodes to a minimum depth of 6 inches below final grade (top of rod 6 inches below grade)
  - Measure grounding effectiveness of interconnected grounding electrodes using an earth ground meter
  - If greater than 25Ω then install up to two additional grounding electrodes (maximum of four) at least six feet apart
- The Grounding Electrode Conductor (GEC) from the grounding electrodes to the service must be at least 6 gauge, solid copper
- All pole and cabinet Equipment Grounding Conductors (EGCs) must be brought to the service
- The ground bus bar at the service must be large enough for all EGCs, service neutral and the GEC
1.2 Metal Poles with Nominal Voltage (50-120VAC) Apparatuses

- Ground pole using Ufer ground
  - Grounding Electrode Conductor (GEC) – at least 6 gauge, bare, stranded copper
  - Connect to rebar cage (must have a combined rebar length of 20 feet) of concrete foundation using clamp suitable for submersion in concrete
- Connect Equipment Grounding Conductor (EGC) between pole and metered service
  - Use at least 10 gauge, insulated, green, stranded copper
  - Connect to pole's grounding point using properly crimped ring terminal (see above)
  - Rout to metered service and connect to its ground bus bar
- If used, the messenger wire, of a span & tether configuration, must be bonded to each pole
  - Use at least 6 gauge, stranded copper
  - Connect to messenger (span) wire using a clamp
  - Connect to ground point (i.e. anchored/bonded stud) of pole using properly crimped ring terminal*
    - Remove all paint/coating to bare metal
    - Sandwich ring terminal between washers
1.3 Metal Poles with Low Voltage (less than 50V AC/DC) Apparatuses

- If pole’s foundation has rebar cage, ground pole using Ufer ground (see section 1.2)
- Otherwise, if pole has solar panel(s) or is greater than 8 feet tall, ground pole using a grounding electrode (ground rod)
  o Drive a 5/8in. x 8ft. copper grounding electrode to a minimum depth of 7.5 feet within a handhole enclosure (pull box)
  o Grounding Electrode Conductor (GEC) – at least 6 gauge, bare, stranded copper
  o Connect to grounding electrode using suitable clamp
  o Connect to pole’s grounding point using properly crimped ring terminal (see section 1.2)*
    - Remove all paint/coating to bare metal
    - Sandwich ring terminal between washers

1.4 Controller Cabinets

1.4.1 Base Mount

- **DO NOT** use grounding electrode (ground rod) or Ufer ground
- Connect Equipment Grounding Conductor (EGC) between cabinet and metered service
  o Use at least 6 gauge, insulated, green, stranded copper
  o Connect to cabinet’s ground bus bar
  o Rout to metered service and connect to its ground bus bar

1.4.2 Pole Mount

- **DO NOT** intentionally bond cabinet to pole (this will cause a ground loop [noise])
- Connect Equipment Grounding Conductor (EGC) between cabinet and metered service
  o Use at least 6 gauge, insulated, green, stranded copper
  o Connect to cabinet’s ground bus bar
  o Rout to metered service and connect to its ground bus bar

1.5 Pole Mount Apparatuses

1.5.1 Auxiliary Equipment, Metal Cabinets

- Connect Equipment Grounding Conductor (EGC) between cabinet and pole, these cabinets are getting power from the traffic signal cabinet (sub-panel) need to equalize potential between the cabinet and pole.
  o Use at least 10 gauge, insulated, green, stranded copper
  o Connect to cabinet’s internal panel/rack that is bonded to the cabinet’s shell
• Connect to ground point (i.e. anchored/bonded stud) of pole using properly crimped ring terminal (see section 1.2)*
  ▪ Remove all paint/coating to bare metal
  ▪ Sandwich ring terminal between washers

• If cabinet has nominal AC supplied as a sub-service (i.e. from controller cabinet)
  o Make sure sub-service’s equipment ground is ISOLATED from the cabinet’s shell and panel/rack (i.e. use plastic outlet box)
  o Connect EGC between isolated outlet(s) and sub-service source using at least 10 gauge, insulated, green, stranded copper
  o Sub-service’s EGC (i.e. EGC from controller cabinet) and pole’s EGC must go to the same metered service

• If cabinet has nominal AC supplied from metered service
  o Connect EGC between cabinet and metered service
    ▪ Use at least 10 gauge, insulated, green, stranded copper
    ▪ Connect to cabinet’s panel/rack
    ▪ Rout to metered service and connect to its ground bus bar
  o Cabinet’s EGC and pole’s EGC must go to the same metered service

1.5.2 Solar Powered Equipment, Metal Cabinets

• Connect Equipment Grounding Conductor (EGC) between cabinet and pole
  o Use at least 10 gauge, insulated, green, stranded copper
  o Connect to cabinet’s internal panel/rack that is bonded to the cabinet’s shell
  o Connect to ground point (i.e. anchored/bonded stud) of pole using properly crimped ring terminal*
    ▪ Remove all paint/coating to bare metal
    ▪ Sandwich ring terminal between washers

• Pole must be grounded (see section 1.3)

1.5.3 Cameras, Radios/Antennas, Street Lighting and Lighted Signs

• Connect Equipment Grounding Conductor (EGC) between apparatus (camera, radio/antenna, light, sign, etc.) and ground point (i.e. anchored/bonded stud)
  o Use at least 14 gauge, stranded copper
  o Connect to apparatus’s grounding point
  o Connect to ground point (i.e. anchored/bonded stud) of pole using properly crimped ring terminal (see section 1.2)*
    ▪ Remove all paint/coating to bare metal
    ▪ Sandwich ring terminal between washers

• If apparatus is AC powered then power source must originate from same metered service where pole’s EGC is terminated
1.5.4 Variable Message Sign

- If Variable Message Sign (VMS) has nominal AC supplied as a sub-service (i.e. from controller cabinet)
  - **DO NOT** intentionally bond sign to pole
  - Connect Equipment Grounding Conductor (EGC) between sign’s power panel and sub-service source using at least 10 gauge, insulated, green, stranded copper
  - Sub-service’s EGC (i.e. EGC from controller cabinet) and pole’s EGC must go to the same metered service
- If sign has nominal AC supplied from metered service
  - Connect EGC between sign and pole
    - Use at least 10 gauge, insulated, green, stranded copper
    - Connect to ground point of sign’s power panel
    - Connect to ground point (i.e. anchored/bonded stud) of pole using properly crimped ring terminal (see section 1.2)*
      - Remove all paint/coating to bare metal
      - Sandwich ring terminal between washers
  - Connect EGC between sign and metered service
    - Use at least 10 gauge, insulated, green, stranded copper
    - Connect to ground point of sign’s power panel
    - Rout to metered service and connect to its ground bus bar
  - Sign’s EGC and pole’s EGC must go to the same metered service

2.0 Previously Constructed Grounding Methods

2.1 Metered Service

- Conflicting grounding methods in the “Colorado Springs Utilities Electric Line Extensions & Service Standards” document from CSU supercede this section (section 2.1)
- Mandatory – for all poles and cabinets with Equipment Grounding Conductors (EGCs) that connect to the service, **DISCONNECT** all grounding electrodes (ground rods) **NOT** connected directly to the service to eliminate parallel ground paths (ground loops)
- Mandatory – install at least one grounding electrode with Grounding Electrode Conductor (GEC) connected to service
- Suggested – install two grounding electrodes, at least six feet apart
  - GEC from the grounding electrodes to the service should be at least 6 gauge, stranded copper
  - Measure grounding effectiveness of interconnected grounding electrodes using an earth ground meter
  - If greater than 25Ω then install up to two additional grounding electrodes (maximum of four) at least six feet apart
2.2 Metal Poles with Nominal Voltage (50-120VAC) Apparatuses

- Mandatory if possible – if not grounded via Ufer ground of the foundation, then install at least one grounding electrode (ground rod) and bond it to the pole
- Suggestion – install Equipment Grounding Conductor (EGC) between pole and metered service (see section 1.2)

2.3 Metal Poles with Low Voltage (less than 50V AC/DC) Apparatuses

- Mandatory if possible – if pole has solar panel(s) or is greater than 8 feet tall, then install at least one grounding electrode (ground rod) and bond it to the pole (see section 1.3)

2.4 Controller Cabinets

2.4.1 Base Mount

- Mandatory – DO NOT use grounding electrode (ground rod) or Ufer ground
- Mandatory – connect Equipment Grounding Conductor (EGC) between cabinet and metered service
  - Use insulated, green, stranded copper
  - Connect to cabinet’s ground bus bar
  - Rout to metered service and connected to its ground bus bar

2.4.2 Pole Mount

- Mandatory – DO NOT use grounding electrode (ground rod) or Ufer ground
- Mandatory – DO NOT intentionally bond cabinet to pole
- Mandatory – connect Equipment Grounding Conductor (EGC) between cabinet and metered service
  - Use insulated, green, stranded copper
  - Connect to cabinet’s ground bus bar
  - Rout to metered service and connected to its ground bus bar

2.5 Pole Mount Apparatuses

2.5.1 Auxiliary Equipment, Metal Cabinets

- Mandatory – If cabinet has nominal AC supplied as a sub-service (i.e. from controller cabinet)
  - DO NOT use grounding electrode (ground rod) or Ufer ground
  - DO NOT intentionally bond cabinet to pole
  - Make sure sub-service’s equipment ground is connected to cabinet’s outlet (outlet in the auxiliary cabinet) using insulated, green, stranded copper
- Suggestion – ground as per section 1.5.1
2.5.2 Solar Powered Equipment, Metal Cabinets
   • Suggestion – ground as per section 1.5.2

2.5.3 Cameras, Radios/Antennas, Street Lighting and Lighted Signs
   • Suggestion – ground as per section 1.5.3

2.5.4 Variable Message Sign
   • Suggestion – ground as per section 1.5.4

*Multiple conductors may be crimped in a ring terminal if manufactures crimping recommendations are followed*