Grounding & Bonding
The First Rule To Live By:
Never Second Guess Electrical Hazards!
If you are ever in doubt about a course of action,

STOP!

Consult a Supervisor, Safety Person and/or Journeyman
Effects of Electrical Contact

- Shock Trauma
- Burns
- Loss of limbs
- Internal injuries
- Psychological Trauma
- Loss of livelihood
How a circuit can become unintentionally energized?

- Switching
- Induction
- Back-feed
- Lightning strikes
- Vehicle Accidents
- Equipment Failure
Key Safety Fundamental

To avoid hazardous differences in electrical potential:

- Insulate yourself from the hazard
- Isolate yourself from the hazard
- Work in a Equal Potential zone
As an alternative but not required....

The employer can use an engineering analysis of the power system under fault conditions to determine whether hazardous step and touch voltages will develop
Safety Fundamental

Voltage

Series

Parallel

Lower Potential

Voltage
Installing and Removing Grounds
Installing Grounds

- When attaching grounds
  - Attach ground end of the cable to a earth ground potential **first**
  - **Always** use a live line tool
Removing Grounds

- When removing grounds
  - The grounding device shall be removed from the normally energized conductor, line or equipment **first**
  - **Always** use a live line tool
Equipment Selection
OSHA Standard

- 1926.962(c) Equipotential zone
  - Temporary protective grounds shall be placed at such locations and arranged in such a manner that the employer can demonstrate will prevent each employee from being exposed to hazardous differences in electric potential.
## Maximum Fault Current Capability for Grounding Cables

<table>
<thead>
<tr>
<th>Cable Size</th>
<th>Clearing Time</th>
<th>RMS Amperes</th>
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</thead>
<tbody>
<tr>
<td>#2</td>
<td>15 Cycles</td>
<td>17,000</td>
</tr>
<tr>
<td></td>
<td>30 Cycles</td>
<td>13,000</td>
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<tr>
<td>1/0</td>
<td>15 Cycles</td>
<td>26,000</td>
</tr>
<tr>
<td></td>
<td>30 Cycles</td>
<td>20,000</td>
</tr>
<tr>
<td>2/0</td>
<td>15 Cycles</td>
<td>33,000</td>
</tr>
<tr>
<td></td>
<td>30 Cycles</td>
<td>26,000</td>
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<tr>
<td>4/0</td>
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<td>53,000</td>
</tr>
<tr>
<td></td>
<td>30 Cycles</td>
<td>41,000</td>
</tr>
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</table>
Applications
Safe Work Practices

- Job Briefing
  - Shall be held with all workers involved before beginning any job to discuss the potential hazards and what protective measures will be used for employee protection and safeguarding of the public and the customer
Distribution-Neutral on Pole
More Than One Span Away

This jumper moves to each phase
Primary Conductors Broken and on the Ground

If possible, make the splices above the ground in an Insulated Aerial lift
Transmission Lines with Distribution Underbuilt

Does not indicate Good line cover
Grounding for Lattice Towers

Insulated shield wire is hazardous
Dead End Structures

If the continuity is maintained with the permanent jumper, one grounding jumper may suffice.

If the continuity is not maintained with the permanent jumper, two grounding jumpers are required.
With Shield Wire
No Shield Wire
Mat

Outer Fence

Rolling Ground

Equipment Bond to mat

Entrance

Insulation Platform

Isolation Platform

Ground Rods (Each corner)
Equipment Grounding

- **Equipment**
  - Approved connection point capable of handling the anticipated fault current

- **Ground Source**
  - To system neutral (or)
  - A pole ground (or)
  - To a grounded structure (or)
  - To a Temporary Ground Rod
    - *driven or screw type*
Bonding
Non-Insulated Aerial Lift
Insulated Aerial Lift
Parallel Ground Sets

- Determine the current carrying capacity of a single ground
- Multiply by 2
  - Reduce by 10% if restrained
  - Reduce by 20% if unrestrained
Barricade

- Grounding a vehicle will not protect workers that may contact the vehicle if the vehicle becomes energized.
Recap
Safety Fundamental

Voltage Series Voltage Parallel

Lower Potential
Key Safety Fundamental

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