

### Segment 3: Framing and Setting Steel Poles – De-energized

Installing a utility pole safely requires advanced planning, the ability to use several types of equipment, and knowledge of rigging to lift and control heavy loads. The type of equipment used will vary from company to company and with the conditions found at the job site.

*Figure 3-1* illustrates a job site where the steel pole will be set using a digger derrick.

#### OBJECTIVES:

- Describe the calculation for determining the size of a hole for direct pole embedment.
- Describe the process for drilling two holes in a steel pole on opposing sides of the pole.
- Demonstrate the safe work procedures for setting a steel pole in a de-energized environment.



*Figure 3-1: Job Site Accessible by Digger Derrick*

## *OSHA Regulations Snapshot*

### **1926.953(b) Pole hauling.**

- (1) During pole hauling operations, all loads shall be secured to prevent displacement and a red flag shall be displayed at the trailing end of the longest pole.
- (2) Precautions shall be exercised to prevent blocking of roadways or endangering other traffic.
- (3) When hauling poles during the hours of darkness, illuminated warning devices shall be attached to the trailing end of the longest pole.

### **3.1 Job Planning and Personal Protective Equipment**

During the tailgate session, the crew plans how the job will be done, work assignments are made, hazards are identified, and required personal protective equipment (PPE) is reviewed. *Figure 3-2* shows a Pre-Job or “Tailgate” meeting being conducted with all members of the crew prior to any work beginning.



*Figure 3-2: Pre-Job or "Tailgate" Meeting*

As with any distribution job, the appropriate personal protective equipment should always be worn, including work gloves, eye protection, proper footwear and hard hat.

## *OSHA Regulations Snapshot*

### **1910.134 (f) Training.**

- 1) The employer shall provide training to each employee who is required by this section to use PPE. Each such employee shall be trained to know at least the following:
  - (i) When PPE is necessary;
  - (ii) What PPE is necessary;
  - (iii) How to properly don, doff, adjust, and wear PPE;
  - (iv) The limitations of the PPE; and,
  - (v) The proper care, maintenance, useful life and disposal of the PPE.

### **3.2 Framing the Steel Pole**

In this example, the crew has decided that two of the men will dig the hole while the others frame the pole and prepare it to be erected.

Because steel poles are consistent in size, the hardware needed for framing them can be predetermined, with no need to allow for the dimensional variability found in wooden poles. This simplifies the lineworkers' job as they frame the pole. Figure 3-3 shows a pole framed out. Note: *Framing a steel pole on the ground should only be attempted when erecting the pole in a non-energized environment.* If nearby lines and equipment are energized, it is important to wait until the pole is safely erected before attempting to frame it.



*Figure 3-3: Pole Framed out on the Ground*

Steel poles can be framed using the same hardware as a wooden pole, with a few minor differences. For instance, cleated grid gains (typically used on wood poles) should be

replaced with smooth gain plates. Fortunately, the size of steel poles does not vary with environmental conditions, so hardware rarely needs to be re-tightened over time. In general, the standard types of arms and hardware used on wood poles can also be used on steel poles. Arms made of steel, wood, fiber-reinforced polymers (FRP), or fiberglass can be used. *Figure 3-4* illustrates the installation of an FRP crossarm.



*Figure 3-4: Workers Installing an FRP Crossarm*

FRP arms are being used more frequently because they are made of a non-conductive material and thus can mitigate some of the typical problems caused by wildlife and outages. Additional benefits of FRP crossarms are that they outlast wooden crossarms and are easier to handle since they weigh less than their wooden counterparts. Regardless of the crossarm chosen, it is installed on the pole using a typical “through-bolt.”

An oversized washer is used on the opposite side of the crossarm to help distribute the load over a larger area of the steel pole. These washers are either curved or flat, depending on the cross-section geometry of the pole being used. There has been some discussion concerning how much torque to use in tightening a steel pole bolt. Experience has shown that the best technique is to make the bolts “snug tight,” but there is little risk to over-tightening them. Most steel poles are stiff enough to avoid distorting the pole’s shape by applying too much torque to a bolt. *Figure 3-5* shows the crewman tightening a bolt “snug tight.”

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*Figure 3-5: Crewman Tightening Bolt “Snug Tight”*

Steel poles are often pre-drilled at the factory for framing and climbing, but they may also be easily and quickly drilled for a custom fit at the job site. In this case, the crew needs to drill a new hole to install additional equipment after the pole is erected. Poles constructed of thinner steel may be drilled using a battery-powered or electric drill with a stepped or “Christmas Tree” bit (*Figure 3-6*). In most cases, a titanium bit is recommended.



*Figure 3-6: “Christmas Tree” Drill Bit*

Heavier poles may require the use of magnetic drills with hole saws. In either case, new holes are generally drilled in 30 seconds or less.

Because steel poles have a hollow cross-section, the most common method is to drill two new holes in the pole, 180 degrees apart from one another. In some cases, a long-bit extension may be used to drill completely through the pole from one side to the other. The lineworker first measures and marks the location of the first hole to be drilled. *Figure 3-7* illustrates this marking process.



*Figure 3-7: Lineworker Marking the First Hole to be Drilled*

After the first hole is drilled, the same measurement is taken on the opposite side of the pole using the “string method.” The string method entails wrapping a string around the circumference of the pole and then folding it in half, with one end placed at the center of the first hole. The length of string is used to determine the position of the rear hole from the center of the first hole already drilled. The crewman makes the mark for the second hole and drills the hole on the opposite side of the pole. In this manner, the holes are lined up perfectly to install a bolt. *Figure 3-8* illustrates alignment of the second hole.



*Figure 3-8: Lineworkers Marking the Second Hole Using the “String” Method*

Another common method for attaching hardware to a steel pole is to use steel banding. Since steel poles do not swell or shrink with temperature and moisture, a properly installed steel band remains tight and works very well. Although less common, welded attachments may also be used on steel poles.

### ***3.3 Setting the Steel Pole – Direct Embedment***

The most common type of foundation for a steel pole is direct embedment, which uses techniques that are familiar to those who have installed wooden poles. The first step is to determine the size of the hole to be drilled. In this example, the pole is 50 feet long. The crewmen know that the depth required for a steel pole is the same as a wooden pole of the same length, so they use the standard “rule of thumb” that the hole should be 10% of the length of the pole, plus two feet. So, in this case, the depth of the hole should be 10% of 50 feet, which is 5 feet, plus 2 feet, which means the hole should be dug to a depth of 7 feet.

Next, the lineworkers determine the diameter of the hole. While the diameter of a wooden pole may vary as much as several inches from one pole to another, steel poles are consistently the same based on the engineering specifications. This means that in most circumstances, the hole diameter is about the same as the American National Standards Institute (ANSI)-specified minimum diameter for a wooden pole of equivalent strength. This minimizes the amount of backfill needed for the pole. *Figure 3-9* shows the crew digging the hole using the digger derrick.

### ***OSHA Regulations Snapshot***

#### **§1926.952 Mechanical Equipment**

- (a) General.
  - (1) Visual inspections shall be made of the equipment to determine that it is in good condition each day the equipment is to be used.
  - (2) Tests shall be made at the beginning of each shift during which the equipment is to be used to determine that the brakes and operating systems are in proper working condition.
  - (3) No employer shall use any motor vehicle equipment having an obstructed view to the rear unless:
    - (i) The vehicle has a reverse signal alarm audible above the surrounding noise level or
    - (ii) The vehicle is backed up only when an observer signals that it is safe to do so.



*Figure 3-9: Crew Digs the Hole for the Steel Pole Direct Embedment using Digger Derrick*

The crewmen have finished digging the hole and have stowed the auger back on the boom. They are now ready to lift the pole. Steel poles can be lifted up in most cases from a single-point pickup. The balance point of the pole needs to be determined so that it can be rigged properly. Unlike wooden poles, steel poles are not butt-heavy and have a more consistent weight over the length of the pole.

### ***OSHA Regulations Snapshot***

#### **1910.269 (a) (3). Existing Conditions**

Existing conditions related to the safety of the work to be performed shall be determined before work on or near electric lines or equipment is started. Such conditions include, but are not limited to, the nominal voltages of lines and equipment, the maximum switching transient voltages, the presence of hazardous induced voltages, the presence and condition of protective grounds and equipment grounding conductors, the condition of poles, environmental conditions relative to safety, and the locations of circuits and equipment, including power and communications lines and fire protective signaling circuits.

The crewman mounts a sling just above halfway down the pole to account for the weight of the hardware mounted onto the pole. It is recommended to use a double-choke in the sling to help prevent slippage. *Figure 3-10* illustrates the proper rigging.

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*Figure 3-10: Rigging the Steel Pole for Lifting*

As the pole is lifted, the lineworker tests the balance of the pole to ensure that it is slightly butt-heavy and will rotate to a vertical position as it is raised. The digger operator opens the jaws on the hydraulic pole grabbers on the end of the boom and adjusts the pole grabber angle to receive the pole. The pole is slowly raised with the wench lines. As it goes up, it swings into a vertical position as the crewman on the ground guides and stabilizes the pole. *Figure 3-11* shows the digger operator and the ground worker slowly manipulating the steel pole into position to set.



*Figure 3-11: Digger Operator and Ground Worker Maneuvering Pole*

When the pole is fully vertical, the pole grabbers are closed to prevent it from swinging uncontrollably. The butt of the pole is now directly over the hole. The digger operator lets out the winch line as the worker on the ground guides the pole into the hole.

The crewman on the ground observes the pole from two different positions to ensure that the pole is plumb, and provides hand signals to the boom operator as needed to adjust the pole's vertical position. The lineworker uses a nylon strap to turn the pole and adjust its alignment. When the crew is satisfied with the pole's alignment, the boom is used to hold the pole in position as the crew backfills the hole. The placement of backfill around a steel pole is generally no different than placement around a wooden pole, but good tamping procedures should be used and care should be taken not to damage the protective coating, if applied. *Figure 3-12* shows crewmen tamping backfill into the hole around the pole base.



*Figure 3-12: Crewmen Tamping Backfill Around Pole Base*

### ***OSHA Regulations Snapshot***

#### **1910.269(q)(1)(iv) Hazards Around Pole Holes**

To protect employees from falling into holes into which poles are to be placed, the holes shall be attended by employees or physically guarded whenever anyone is working nearby.

In some cases, poles may be set in a confined space with obstacles such as trees, walls, fences or traffic work zone areas that restrict positioning the new pole during installation. The lighter weight of steel poles makes them easier to handle in these cases. They can be placed on a mini-derrick and maneuvered into the rear-lot site, or even hauled to the site on the shoulders of a gang of strong lineworkers. *Figure 3-13* shows an EZ Hauler Mini-Derrick carrying a steel pole to an obstructed job site.



*Figure 3-13: Steel Pole Being Carried by a Remote-Controlled Mini-Derrick*

### **3.4 Grounding a Steel Pole**

There are a few important differences to note when it comes to grounding a steel pole. First, it's important to remember that like wood, steel is a conductive material. This actually has several advantages, such as the steel pole itself becoming a ground for lightning strikes and other faults. Another clear advantage is that there is no need to run a copper ground wire from the top to the bottom of the pole. This saves time and money and also eliminates the risk of copper theft. A discussion of safe work procedures for correctly installing pole grounds follows.

#### ***OSHA Regulations Snapshot***

**1910.269 (n)**

**(4) Protective grounding equipment.**

- (i) Protective grounding equipment shall be capable of conducting the maximum fault current that could flow at the point of grounding for the time necessary to clear the fault. This equipment shall have an ampacity greater than or equal to that of No. 2 AWG copper.

For the job illustrated in the accompanying video, the lineworker needs to ground pole top equipment. He does this by inserting a grounding nut on the pole at a point near the equipment. *Figure 3-14* illustrates a grounding nut installed on a steel pole.



*Figure 3-14: Grounding Nut*

Threaded inserts or grounding nuts can be placed anywhere along the pole where grounding attachment needs to be made. Since the base of most steel poles has a protective barrier coating on the embedded portion, it is considered to be electrically insulated from the soil. Therefore, some means must be provided to ground the base of the pole.

One method is to drive a copper ground rod into the ground soil and connect it to the pole via a short ground lead to a grounding nut welded to the pole just above the ground base soil line. *Figure 3-15* illustrates the pole base ground lead into the soil.



*Figure 3-15: Pole Base Ground Lead*

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Another method is to simply refrain from using an insular barrier coating on a short section of the bottom of the pole, or bearing plate. These types of grounding provisions are referenced in the guidelines of the National Electrical Safety Code (NESC). However, before doing this, workers should consider the long-term consequences for pole corrosion near and below the soil.

### *OSHA Regulations Snapshot*

#### **1910.269 (w) (7) Backfeed.**

If there is a possibility of voltage backfeed from sources of cogeneration or from the secondary system (for example, backfeed from more than one energized phase feeding a common load), the requirements of paragraph (l) of this section apply if the lines or equipment are to be worked as energized, and the requirements of paragraphs (m) and (n) of this section apply if the lines or equipment are to be worked as de-energized.

In another example, the lineworkers need to set a pole where other energized lines are a factor. It is important to remember that some specific procedures, such as grounding the pole, may vary between companies. Workers should follow their own company's guidelines.

The first order of business is to select a location for the new pole that will best support the transfer. Since this job requires working around energized lines and equipment, additional hazards are present, and a thorough pre-job briefing is conducted. The crew takes into consideration the insulating protective gear for themselves, for the steel pole and for the equipment they will be near. The crew develops a work plan and assignments for each crew member. The pre-job meeting form they use identifies all the hazards on this job site and explains how they plan to mitigate those hazards to keep everyone, plus the system they are working on, safe.

### *OSHA Regulations Snapshot*

#### **1910.269p (a) (2): Training.**

(i) Employees shall be trained in and familiar with the safety-related work practices, safety procedures, and other safety requirements in this section that pertain to their respective job assignments. Employees shall also be trained in and familiar with any other safety practices, including applicable emergency procedures (such as pole top and manhole rescue), that are not specifically addressed by this section but that are related to their work and are necessary for their safety.

(ii) Qualified employees shall also be trained and competent in: (A) The skills and techniques necessary to distinguish exposed live parts from other parts of electric equipment, (B) The skills and techniques necessary to determine the nominal voltage of exposed live parts, (C) The minimum approach distances specified in this section corresponding to the voltages to which the qualified employee will be exposed, and (D) The proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools for working on or near exposed energized parts of electric equipment. **Note:** For the purposes of this section, a person must have this training in order to be considered a qualified person.

Because of the energized phases, the crew will not frame out the pole until after it is set. Since contact between a steel pole and any energized sources will also energize the pole, insulating cover gear is used on the phases and the system neutral to insulate the work area and the workers are sure to wear the appropriate rubber personal protective equipment. The workers also put insulating pole guard on all areas of the pole that might be exposed to the energized conductors to prevent the pole from contacting the lines as it is being raised into position. *Figure 3-16* illustrates insulating pole guard being applied to the steel pole.



*Figure 3-16: Insulating Pole Guard Applied to the Steel Pole*

Additionally, this company requires that both the truck and the new pole are grounded to the system neutral.

After positioning the pole, the crew adjusts the sling to just above the halfway point for lifting. Again, the workers use a double choke method to ensure that the pole doesn't slip while it's being raised. The operator begins raising the pole. As it is lifted, a worker wearing rubber personal protective equipment maneuvers the pole around any obstacles. *Figure 3-17* shows a protected worker maneuvering the pole.



*Figure 3-17: Protected Worker Maneuvering the Pole*

Once the pole is in place, it is aligned and plumbed in a similar manner as demonstrated earlier. The crew is now ready to frame the pole and move energized phases into place.

In some cases, the pole may need to be set in a confined area with obstacles such as walls, trees, or fences that restrict positioning the new pole during installation. The lighter weight of steel poles makes them easier to handle in these cases, as discussed earlier.

Whenever a crew must set a steel pole near energized lines and equipment, but the nature of the job site does not allow them to do the work safely, the system should be de-energized during the pole-setting phase of the job. In some cases, eliminating electrical hazards may be the only way to mitigate them for the safety of the crew members.

### ***OSHA Regulations Snapshot***

#### **1910.269 (q)(1) Setting Poles Near Energized Lines**

- (ii) When poles are set, moved, or removed near exposed energized overhead conductors, the pole may not contact the conductors.
- (iii) When a pole is set, moved, or removed near an exposed energized overhead conductor, the employer shall ensure that each employee wears electrical protective equipment or uses insulated devices when handling the pole and that no employee contacts the pole with uninsulated parts of his or her body.

## *Section Quiz*

1. **True or False.**  
When installing a steel pole near energized lines and equipment, it is a best practice to frame the pole after it has been safely erected.
  
2. The most common type of drill bit used for thinner steel poles is called the  
\_\_\_\_\_  
**(Christmas tree bit, diamond-tipped bit)**
  
3. **Circle the correct answer(s).**  
OSHA requires that before work begins near energized lines and equipment, the following conditions must be determined:
  - a) Nominal voltages of the lines and equipment.
  - b) The possibility of induced voltage.
  - c) Soil compaction quality.
  - d) Environmental conditions relative to safety.
  - e) Location of nearest fire extinguisher.
  
4. When raising a pole near energized lines, an insulating cover should be placed on the pole, known as:  
\_\_\_\_\_.
  
5. **True or False.**  
OSHA requires a worker to be “qualified” to work near energized lines and equipment.