COMMUNICATION POLE INSTALLATION GUIDELINE

POLES USED FOR SUPPORTING ANTENNAS

VALMONT RECOMMENDS THIS DOCUMENT BE RETAINED AT THE STRUCTURE SITE FOR POST INSTALLATION REFERENCE.

ASSEMBLY AND INSTALLATION OF VALMONT COMMUNICATION POLES

The following information is intended to be a guide to the installing contractor. This information cannot be comprehensive enough to cover all situations or the details of all structures. Therefore, it is essential that the owner and contractor carefully plan all aspects of the installation process and do not rely solely on these guidelines to determine the steps to be followed. This is general information about standard Valmont products. Special features requested by individual owners may require unique installation methods; for these, the Contractor should be familiar with the owner's plans, specifications and the Valmont drawings included with the delivery of the structure. Due to the varied methods used by contractors in actual field operations, Valmont Industries Inc. cannot be liable for damage occurring during erection and installation.

A prudent step prior to any installation work is to review the site drawings and the Valmont pole drawings for any conflicting or ambiguous information, and resolve any such issues before proceeding with the installation. **If any questions arise concerning the structure, please contact Valmont Customer Service, at 1-800-547-2151.**

1. ANCHORAGE

1.1 An evaluation of local soil conditions should be made by a competent geotechnical engineer. The foundation designer should provide a detailed drawing showing depth, diameter, concrete strength, reinforcing steel and the location of the reinforcing steel.

1.2 Upon arrival at the job site, the template(s) and the threaded portion of the anchor bolts (for poles using a base plate) should be checked for damage. The template(s) should be checked for bending or other damage which might disturb the bolt pattern. Anchor bolt threads should be checked with a nut to be sure the nut can be turned up or down the full length of the threaded portion of the bolt. The bolt circle and anchor bolt dimensions should be checked to verify they match the foundation design drawing prior to installation.

1.3 Concrete for anchor based pole foundations should be installed well ahead of the installation of the structure. Valmont recommends a 7 day minimum wait after concrete is poured before the structure is placed on the anchor bolts. If a shorter time is needed, the foundation designer should be contacted.

1.4 In designing and installing the foundation, consideration should be given to the need for underground wiring and grounding as required by the owner.

1.5 The anchor bolts must not be welded to the reinforcing steel.

1.6 Projection of the anchor bolts should allow for the thickness of the base plate, nuts, (including the top nut(s) and the leveling nut) and for plumbing the structure. Valmont has calculated the projection; it is shown on any Valmont foundation design and Anchor Bolt Cage Assembly drawing. The threaded portion of the anchor bolt projection should be protected from concrete splatter that may inhibit the turning of a nut on the bolt. Wrapping the threads with heavy duct tape sometimes is a viable option to provide this protection.

1.7 The orientation of the anchor bolts in relation to the desired antenna and base port azimuths must be checked carefully using data from the Valmont drawings and the owner's plans.

1.8 Care must be taken to place the anchor bolts vertically and not to disturb their position while pouring concrete.

1.9 Leveling nuts should be adjusted before installing the pole. They should be in a horizontal plane, turned down on the threading to provide enough room on the bolts for the base plate thickness, the top nut(s) and at least an inch of projection for possible adjustment.

1.10 If the structure utilizes an embedded base, the installation must be modified from that described in previous Sections. Typically, the bottom (embedded) section of the pole is installed in the ground first. Prior to placement of the embedded section, the finish should be inspected and touched up as needed. The base section should be supported while the backfill (soil, rock or concrete as specified on the foundation design drawing) is placed and compacted (as necessary). The section should be checked periodically during this process to ensure the section remains plumb. Temporary guys or attachment to a crane may be used to supply this support, because there is no adjustment to this type of structure as there is with the leveling nuts on anchor bolt based poles. Care should be taken to ensure that the bottom section is vertical before proceeding with the erection of the rest of the pole.

2. ASSEMBLY (Figure 1)

2.1 General

2.1.1 When space around the foundation and lifting capabilities permit, it is preferable to assemble the completed structure on the ground and erect it as a unit (embedded structures are an exception described in Section 1.10). The sections of the pole should be aligned on the ground and supported, typically with wooden blocks, in such a manner that they will readily fit together. Care should be taken to prevent dirt, stones, etc. from getting trapped between the mating surfaces.

2.1.2 If the structure is assembled vertically, extra care may be needed to ensure that all joints are properly assembled as indicated in the following sections. The weight of the sections should not be substituted for the jacking force required to make a joint.

2.1.3 Proper alignment of the pole sections is facilitated by the location of the identification tags. These are positioned on the sections so that aligning them on the same side for the entire pole length will ensure proper orientation of all components.

2.2 Slipover Joints (Figure 2)

2.2.1 To facilitate the assembly, mating surfaces may be lubricated. Care should be taken not to use a lubricant that will later leak from the joint and stain the pole. Soapy water has been used with marginal success, but a heavier lubricant like water soluble clear grease works well.

2.2.2 The drawings indicate the amount of overlap required. There are three values listed: minimum, design and maximum. The target value is the design splice value. The amount of overlap can be calculated by taking the maximum splice value and subtracting the measurement between the top of the ID tag (near the top of a section) to the bottom of the upper section. A good splice has an overlap value somewhere in between minimum and maximum overlap.

2.2.3 A number of methods may be considered for applying the necessary force to achieve a tight joint. The method selected may depend upon the size of the pole sections, the type of pole design and the equipment available to the contractor. The two most common methods are:

2.2.3.1 Use of two ratchet chain hoists or similar devices on opposite sides of the pole shaft. These may pull on cables secured to the pole sections with a choker type hitch or attached to 1" bolts installed in the jacking nuts. Equal forces should be applied by the two hoists simultaneously. If the jacking nuts are used, forces must be applied more than 1.5 inches from the surface of the pole shaft and the forces must be distributed equally across all the jacking nuts at each joint. **Although a common method, this technique should be limited to only the smallest poles. The diameter at the joint is used to indicate which sections can be assembled (i.e. poles with a diameter of approximately 12.0 inches or less at the joint) using these pulling devices.** Each device should have a minimum capacity of 12,000 pounds (6 tons) each.

2.2.3.2 Use of a hydraulic jacking device (Figure 3). These devices are available for rent or purchase from Valmont. Other sources such as contractors or electric utilities may have hydraulic jacking devices available. These devices have proved to be very useful for making sound, high quality joints. These devices generally have a large capacity (up to 90,000 pounds) to ensure proper seating of the sections even if the sections are slightly out of round or not aligned precisely. For these reasons, Valmont recommends the use of such a device for

making slip joints. Further information on hydraulic jacking devices can be found in Valmont specification: *I-13 Hydraulic Jacking Device*.

2.2.4 Both methods described above call for the forces to be applied as a slow steady pull. Joint tightening will be facilitated by oscillating the advancing section with a crane or forklift, or by striking the pole in the joint area with a hammer using a cushioning wooden block.

The jacking forces should be applied until the joint is tight with no more than small gaps (which can sometimes be caused by a slight mismatch in the shapes of the mating sections), if any exist. Generally, any gaps should be small, certainly less than 0.25". Gaps are more likely at the "points" or bend lines of the shaft (especially the points at the seam weld location(s)). Gaps are only an indication of a loose joint. The real test of a tight joint occurs when increasing the jacking force does not result in a further engagement between the sections. For example, suppose an installer applies 30,000 pounds of jacking force and notices that the joint has stopped moving (engaging further). If 31,000 pounds is applied and no further engagement is noticed then the joint is tight. Under this condition we would not expect to see gaps that exceed 0.125" except perhaps at the seam weld.

A final check should be made to ensure the specified minimum overlap has been achieved. Anywhere between minimum and maximum splice is considered an acceptable joint provided that a tight joint is achieved.

There may be other methods to generate and apply the force needed to make a slip joint, but regardless of the method used some judgment about the quality of the joint is required of the installer. Valmont's definition of an adequate slip joint includes these items:

2.2.4.1 The joint must reach at least minimum slip and no more than maximum slip (as indicated on the drawings).

2.2.4.2 At least the minimum jacking force should be applied (indicated on the erection drawing, usually 25,000 pounds).

2.2.4.3 The joint must be tight as indicated by the lack of any movement on the joint under the applied jacking load with no excessive gaps.

WARNING:

FAILURE TO MEET THESE CRITERIA MAY VOID THE MANUFACTURER'S WARRANTY. **THE PROPER JACKING FORCE IS NOT DEFINED OR LIMITED BY THE CAPACITY OF THE JACKING SYSTEM UNTIL THE APPLIED FORCE MEETS 90,000 POUNDS** (OR 24,000 POUNDS FOR DIAMETERS LESS THAN 12 INCHES).

2.3 Electrical Wiring

2.3.1 Prior to the attachment of any equipment at the top of the pole, any required wiring should be strung through the pole.

2.3.2 Antenna poles incorporate one or more wire supports, such as hooks, that carry the load of the wires running down the structure. These wire supports are typically accessible through hand holes and located inside the structure.

2.4 Attachment of Antenna Mounting Assemblies

2.4.1 The bolts for these connections should be tightened to a snug tight condition, as described in Section 5.2, or as specified by the antenna mount manufacturer.

2.5 Pole Steps

2.5.1 Standard Steps Used by Valmont (Figure 4)

2.5.1.1 Screw one nut on to each step as far as possible.

2.5.1.2 Insert the other nut behind the lug on the pole and screw the step in until the step touches the surface of the pole shaft.

2.5.1.3 Tighten the outer nut against the lug sufficiently to prevent it from loosening. **Caution:** Do not over-tighten the step to the point of damaging the threads or the lug.

2.5.2 Other steps requested by the owner.

2.5.2.1 A wide variety of steps are available. Generally, the step selection is worked out between the owner and Valmont before fabrication of the pole begins. It is important that the step and the lug welded to the pole are matched. **If the step cannot be fully inserted into the lug, or the step has excessive play when inserted in the lug, call Valmont immediately, certainly before any climbing is done.**

2.6 Safety Climb Device

2.6.1 Lugs for attachment of the safety cable are located near (usually 12 feet above) the base of the pole and near the top of the pole.

2.6.2 Lugs for mounting the safety cable guides are located along the pole, typically at 21 to 28 foot intervals. The hard rubber guides should be installed on these lugs and the safety cable installed through each guide.

2.6.3 Installation instructions will be furnished by the supplier of the safety climb device that attaches to the cable. Read and follow those instructions.

3 CORROSION PROTECTION

3.1 After assembly, any damage to the protective coating on the structure should be repaired. This can be accomplished with zinc rich paint or "hot stick" for galvanized structures, or touch-up paint for painted structures. "Hot stick" is preferred since it more nearly matches the performance of the original galvanized finish. "Hot stick" may be purchased under the brand name "Galv-Alloy" where welding supplies are sold. Zinc rich paints (96% zinc) such as the brand names "Zinc Bright" and "ZRC" can be purchased at welding supply stores, industrial supply stores or paint stores.

3.2 Welding in the field on a galvanized surface should be done only with extreme caution. **If the weld material is contaminated with zinc it does not provide a structural weld.** Welding can also damage the finish on the opposite side of the surface being welded. If welding is unavoidable, it should be done by an AWS qualified welder who has experience welding on galvanized surfaces. After welding, the damage to the finish should be repaired. Lastly, welding on a galvanized surface creates some unique problems for the welder. There is more splatter and sparks compared to welding black or unfinished steel. **The fumes created from welding on a galvanized surface can be hazardous.** The welder should be aware of these characteristics and take steps to ensure their safety and the safety of others in the area. **Unauthorized welding will void the manufacturer's warranty.**

4 ERECTION (Figure 5)

As stated previously, there are 2 common methods of erection: 1) assembly of the structure on the ground and lifting the entire structure or 2) lifting the section(s) and making a joint in the air. The amount of room and the size of the equipment available will dictate the best method of erection. Either method can be used for anchor based or embedded poles. There are some precautions that should be taken:

4.1 Prior to lifting the structure, any slipover joint below the crane attachment point should be securely lashed to prevent any possibility of separation during lifting. This is usually accomplished by bolting a bar across the slipover joint using the 1 inch jacking nuts on both sides of the sections. For additional safety, a hook capable of supporting the entire weight can be attached to the hand hole opening and connected to the crane attachment point.

4.2 The lifting crane must be attached:

4.2.1 To the main pole member, not to appurtenances such as pole step lugs, the pole top strap, etc.

4.2.2 Above the center of gravity of the entire assembly including the weight of all equipment mounted on the structure before erection.

4.2.3 As high as possible since higher attachment will result in more nearly vertical alignment of the assembly while suspended above the foundation or the mating section.

4.3 Care should be taken to operate the crane very smoothly since jerkiness will cause impact loads which could damage some portion of the assembly.

4.4 If the structure is anchor based, the top nuts should be turned down as quickly as possible after placement on the leveling nuts. If the pole is eccentrically loaded, the nuts on the side opposite the direction of eccentricity should be installed first.

4.5 Embedded poles can be installed by placing the embedded portion in the hole and holding the structure with the crane. The structure can then be plumbed and the hole backfilled while being supported by the crane. Temporary guying has also been used to support the structure while the backfill is placed. The guys offer some opportunity to make adjustments to maintain the plumbness of the structure.

4.6 The structure should be measured after placement on (or in) the foundation to be sure it is plumb. Ideally, the top of the pole should be directly over the bottom of the pole, making the maximum deviation of the pole shaft from a true vertical line occur somewhere in the middle of the pole. The leveling nuts can be adjusted to accomplish this alignment by raising the leveling nuts on the anchor bolts in the direction the pole is "leaning". Note that a small amount of rotation of a nut will represent a number of inches of movement at the top of the pole. The taller the pole the more sensitive the adjustment of the leveling nuts will be.

4.7 After plumbing the structure, all anchor bolt nuts should first be uniformly snugged against the base plate (both the top nuts and the leveling nuts). Then some provisions may be made to prevent unauthorized loosening of the nuts. The two most common methods are:

4.7.1 A slight amount of additional tightening (beyond snug tight) of each top nut.

4.7.2 Peening or slight deformation of the threads to prevent the turning of the nut on the anchor bolt.

4.8 Valmont's design generally does not require grouting under the base plate. Grouting is sometimes specified by the foundation designer. If this is the case, there will be a note on the foundation drawing. If the owner decides the structure needs to be grouted, provisions to vent the inside of the

structure and to prevent standing water (from either condensation or precipitation) inside or underneath the pole should be made. **Grouting should be done only after the owner is satisfied with the structure and the installation. Covering the leveling nuts with grout removes access to the only adjustment method you have to plumb the structure**.

5 ATTACHMENT OF EQUIPMENT

5.1 Components of these assemblies may be affected by vibrations induced aerodynamically or from other sources. Although rare, these vibrations can be severe enough to cause damage. This is believed to be more likely to happen when a structure is installed without the equipment it is intended to support. All such equipment contributes damping to the system. It is considered good practice for installers to attach at least some equipment on the structure at the time of installation.

5.2 Valmont requires that all our tower/monopole bolted connections (ASTM A325, SAE Gr. 5 and anchor bolts) be tightened to a snug tight condition, defined as follows:

"A snug tight condition is defined as the tightness that exists when all plies in a joint are in firm contact. This may be attained by a few impacts of an impact wrench or the full effort of a man using an ordinary spud wrench." ("Specification for ASTM A325 or A490 Bolts," Manual of Steel Construction – Allowable Stress Design, AISC, 9th Edition, 1989, p. 5-273.)

This is our typical and default requirement. Any special tightening requirements will be specifically called out on the installation drawing.

5.3 Galvanized A325 bolts shall not be reused. Other A325 bolts may be reused if approved by the engineer responsible. Retightening previously tightened bolts that may have been loosened by the tightening of adjacent bolts shall not be considered as a reuse.

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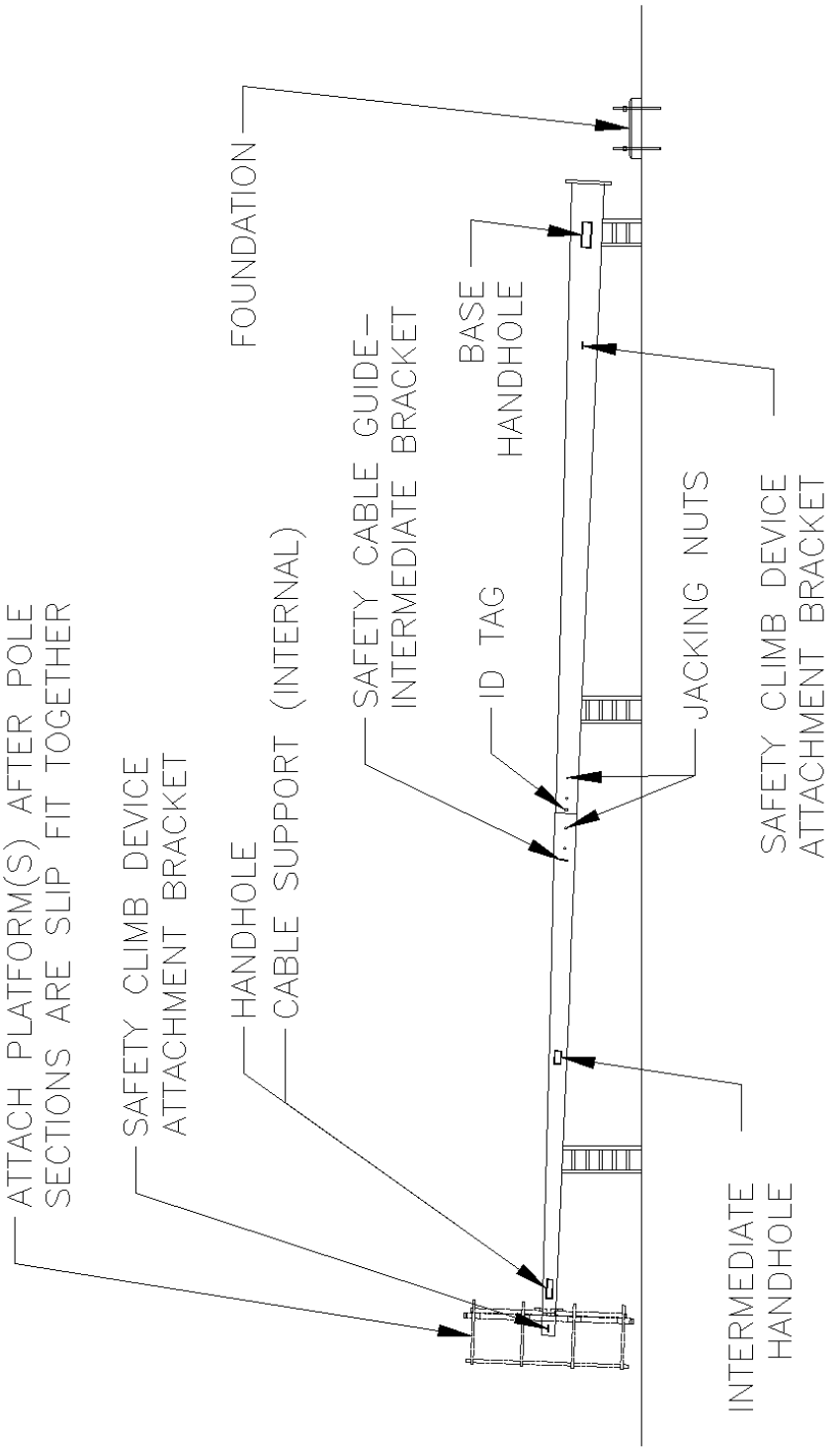

Figure 1: Assembly

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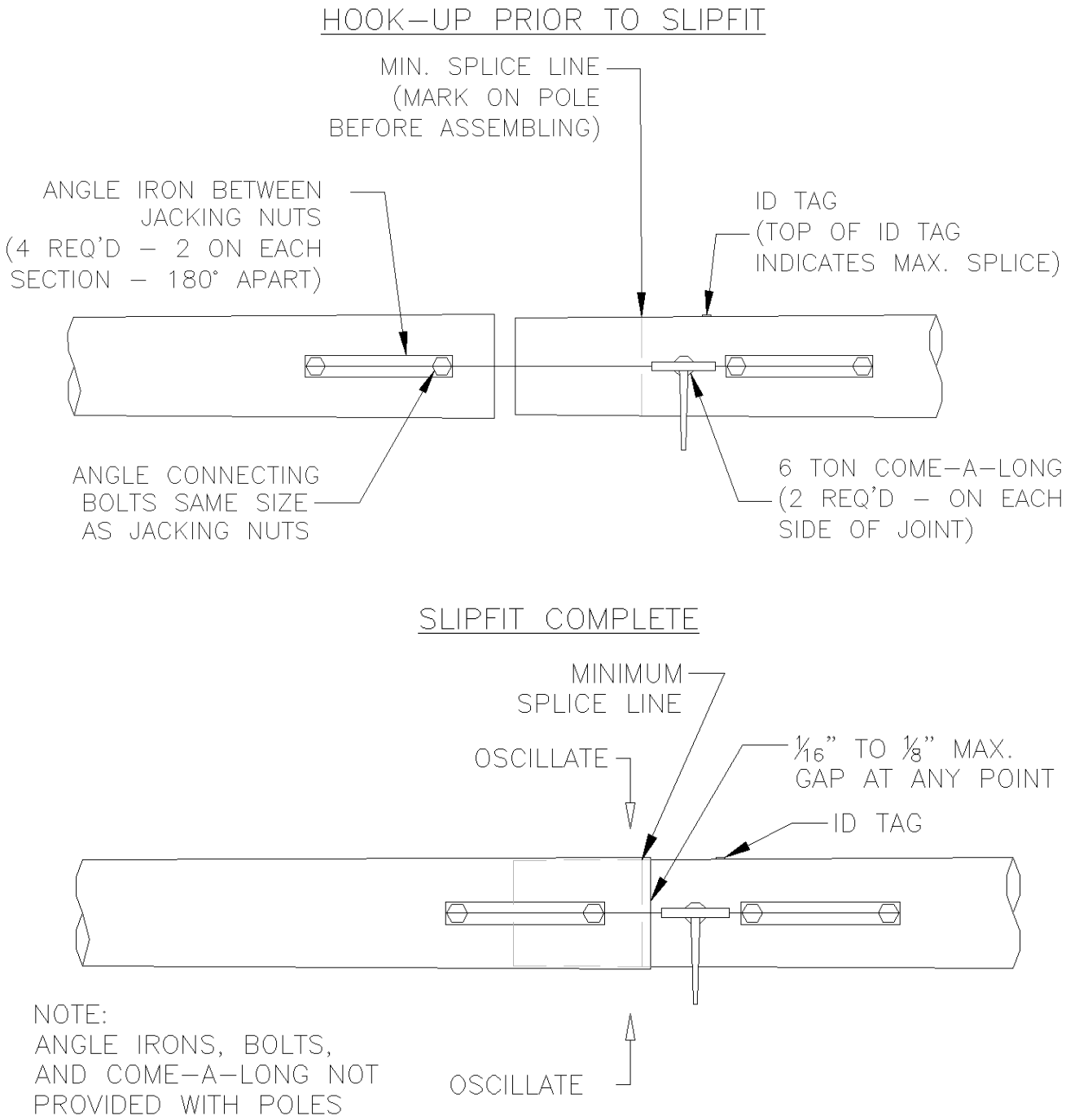

Figure 2: Slip Fit Connection

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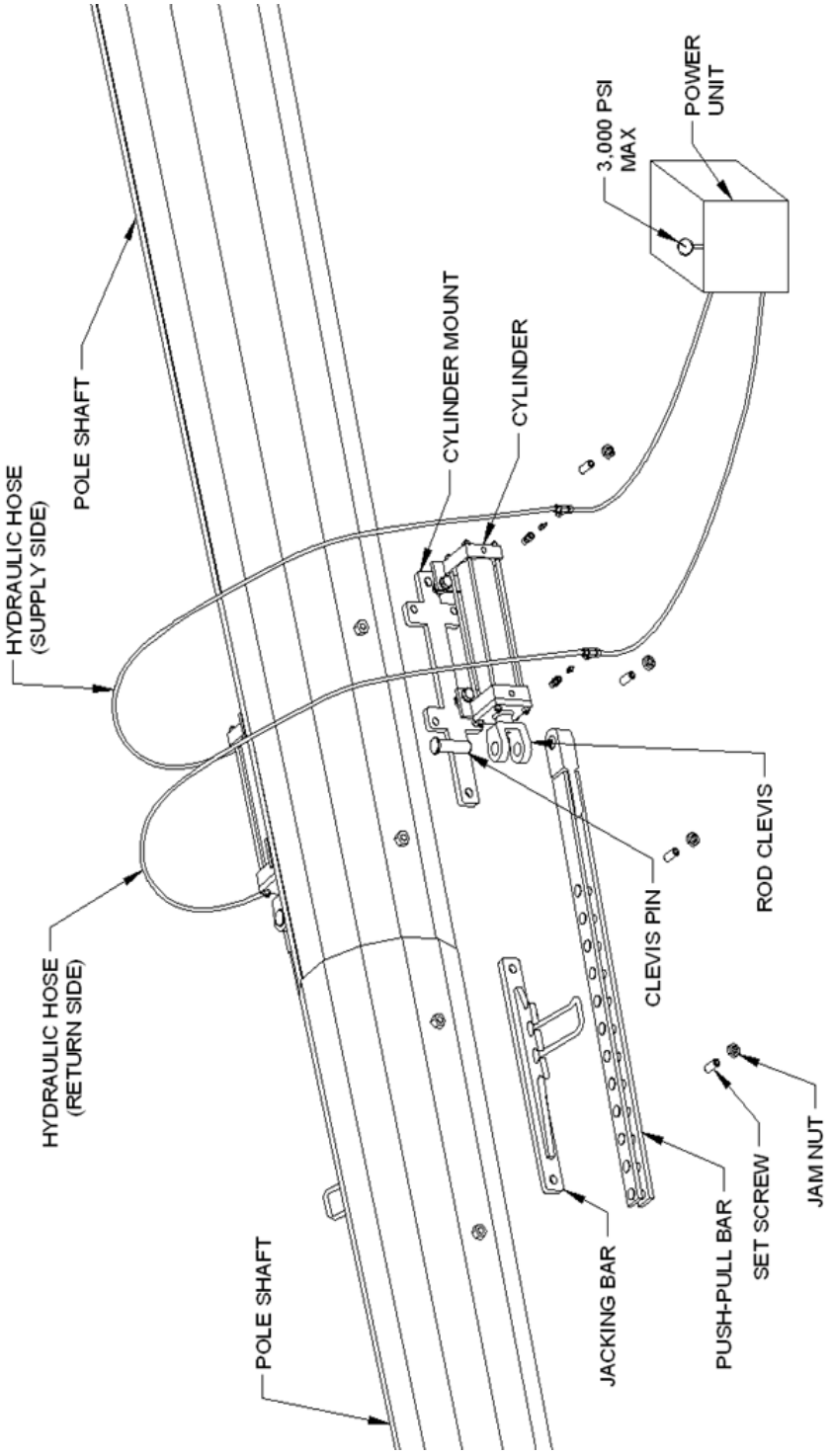

Figure 3: Jacking Device

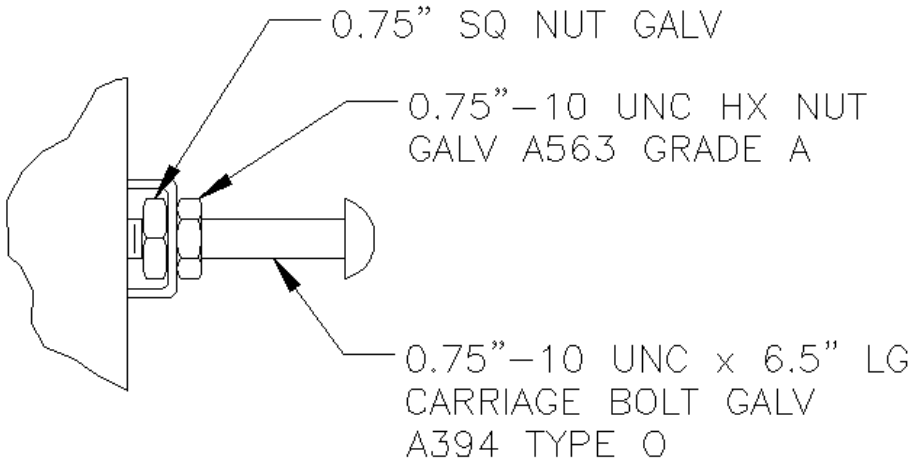

Figure 4: Pole Steps

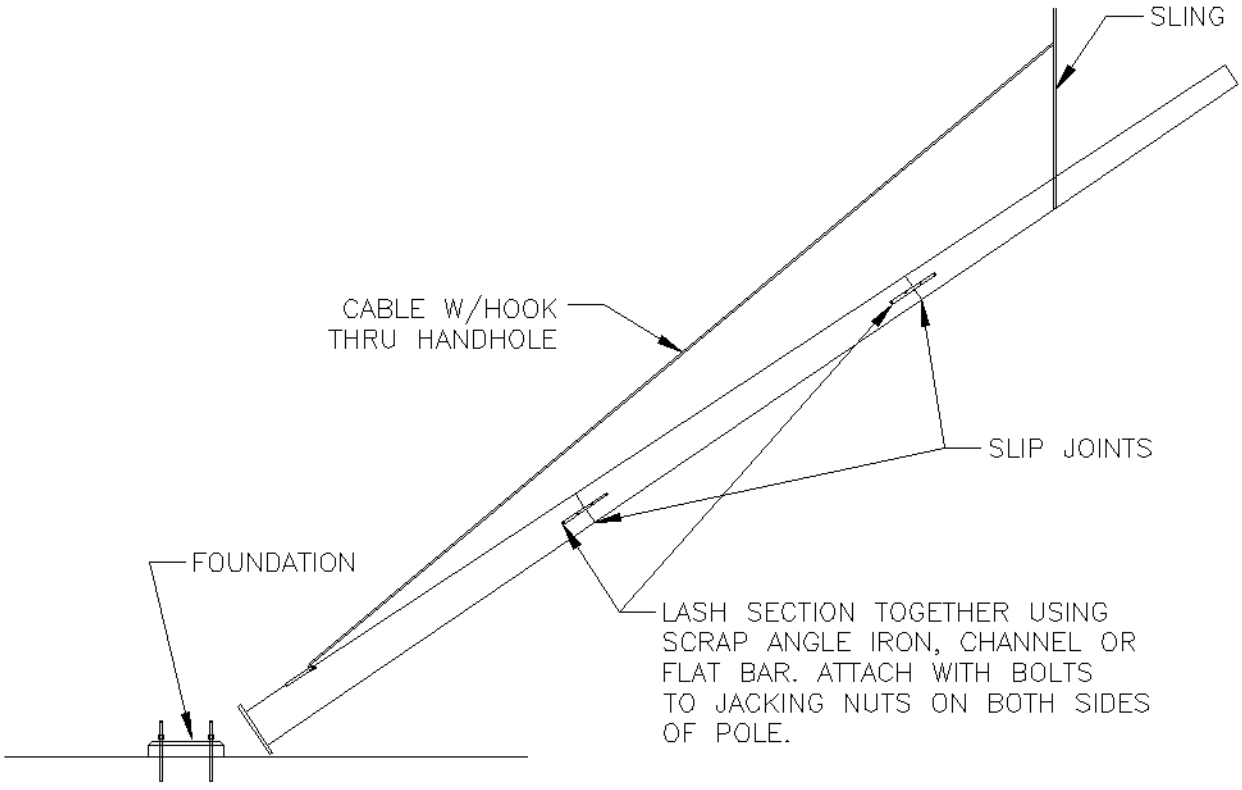

Figure 5: Erection