

# Ø4" x 127' TOWER INSTALLATION MANUAL

**ARE** 4" Tilt-up, Guyed, Pipe Towers for Wind Turbines  
Version 3.3



*Manufactured in the USA by:*



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## Contents

1) Introduction	1
2) Site Selection and Preparation	1
3) Tools List	3
4) Parts List	4
5) Tower Foundations	6
6) Tower Section Preparation	8
7) Lightning and Grounding Protection	8
8) Tower Raising Options	9
9) Tower Assembly	10
Step 1 (Base Installation and Anchor Setup)	11
Step 2 (First Tower Section Installation & Raising)	12
Step 3 (Prepare the Gin Pole)	14
Step 4 (Raising the Gin Pole)	18
Step 5 (Gin Pole Guy Cable Attachment)	18
Step 6 (Tower Assembly)	18
Step 7 (Guy Cable Attachment)	19
Step 8 (First Tower Raising)	23
Step 9 (Tower Adjustment)	25
Step 10 (Tower Lowering)	27
Step 11 (Re-Raising the Tower)	28
Step 12 (Final Raising of the Tower)	28
Step 13 (Final Check)	31
10) Tower Maintenance	31
Appendix – Drawings	
Tower Profile in Operating Position	D1
Tower Profile in Tilt Down Position	D2
Foundation Layout Overview	D3
Anchor Position, Right and Left Side	D4
Anchor Position, Outer Hoist and Down Side	D5
Anchor Position, Inner Hoist	D6
Foundation, Inner and Outer Hoist	D7
Foundation, Left, Right and Down Side	D8
Tower Base Anchors, Center Foundation	D9
Bent Anchor Bolt and Tower Base	D10
Center Foundation Reinforcement	D11
Guy Anchor Foundation Reinforcement	D12
Winch Foundation Reinforcement	D13
Winch Foundation Position	D14
Gin Pole Base Section, 4 Inch Pipe	T-36-04-40-051
Gin Pole End Section, 4 Inch Pipe	T-36-04-40-052
Tower Base Section, 4 Inch Pipe	T-36-04-40-053
Tower Top Section, 4 Inch Pipe,	T-36-04-40-054

**NOTE:** Please read the entire installation manual before beginning the project.

## 1) Introduction

This installation manual pertains to Ø4" x 127'H tilt-up, guyed pipe towers designed and manufactured by **ABUNDANT RENEWABLE ENERGY (ARE)**. These towers are based on **galvanized Ø4" Schedule-40, ASTM A53 Grade-A steel pipe** sections (21' long), joined together by couplers. These couplers are the attachment points for the guy cables, with the exception of the topmost guy attachments, which are made below the wind generator to allow for blade clearance. The 127' tower utilizes a 42-foot long gin pole – comprised of two 21-foot sections – which acts as a lever arm to raise and lower the tower. The tower is secured by guy cables connected to four (4) anchors located in a 54 foot radius from the base of the tower and to the gin pole at a fifth location. There are six (6) concrete foundations: one (1) for the tower base, one (1) for the gin pole anchor and four (4) for guy cable anchors.

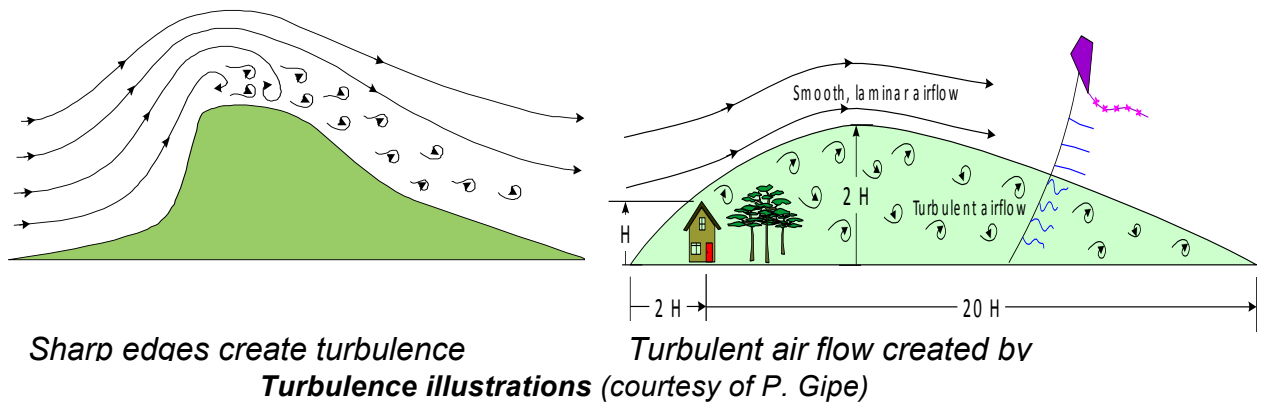
***PLEASE NOTE: Tilt-up towers are NOT designed to be climbed at any time.***

**Important Note: The 127 foot 4 inch pipe tower covered in this manual is inherently structurally unstable during the last few degrees of raising and the first few degrees of lowering unless the back haul winch is used properly.** It is essential that the use of the haul back winch and the hand held back tension leash on the top guy be clearly understood and utilized. If you are not experienced or have any doubts about the proper execution of this procedure, **obtain the assistance of an experienced installer.** ARE can provide this support or direct you to others who can do so. This procedure works well if it is done properly. If it is ignored or not done properly there is risk to the tower, the wind generator, and personnel. Risk to personnel is minimized if the proper safety procedures contained in Step 8 are followed. This tower is not an appropriate choice for an amateur or inexperienced installer to install without experienced assistance. Once the tower is up and all the guys are in tension it is very strong and stable.

## 2) Site Selection and Preparation

The ideal site for a tower is a flat, level field. However, any reasonably level space, in which there is sufficient room for the foundations, can be utilized. A hillside can also be usable if a line in the terrain can be located, permitting the side guy anchors and the base to be level with each other.

To ensure satisfactory performance from the wind generator, care must be taken in the choosing the site for the machine. Buildings, trees, and rocky outcrops can disrupt the smooth flow of wind, causing turbulence. This results in significantly lower wind velocities and higher turbulence near the ground. Turbulence is detrimental to wind turbines, as the swirling air causes the turbine to yaw continually, which unduly stresses mechanical components, greatly increases wear and tear, and reduces the useful life of equipment.



**Figure 1**

As a general rule, therefore, wind turbines should be mounted at twice the height of any “bluff body” obstructions. Alternatively, locate the turbine 10 meters (30 feet) plus the blade length above the tallest trees, buildings, or other (non-bluff body) obstructions within 150 meters (500 feet). The power ( $P$ ) obtainable from the wind is proportional to the cube of the wind speed ( $v^3$ ), and wind speed increases with height ( $H$ ) from the ground. [ $P \propto v^3$  and  $v \propto H$ ]. According to this principle, a 26% increase in wind speed from a higher tower will yield a 100% increase in power from the turbine. *A little more money spent on a taller tower harvests the same power as two machines!*

Preference should be given to the prevailing wind direction, but please note that tall features downwind of the generator can also slow wind flow passing through the turbine’s blades.

The tower anchors are approximately 54 feet from the base. See Appendix for exact dimensions. The site should be free from obstructions (e.g. trees, buildings) and the tower height should extend at least 35’ above any obstacles within a 500’ radius from the tower (remember that trees grow). See the wind generator installation manual for more information on siting.

The tower site must be cleared of all trees and brush to allow for the assembly and raising of the tower. The radius from the center foundation to the outside of the guy foundations is approximately 58 feet. An additional strip of land at least 140’ long must be cleared on the “down-side” (opposite the hoist-side) for the tower when it is in the “down” position.

Drawings D3, D4, D5 and D6, in the appendix can be used to help determine how to select and lay out your site.

### 3) Tools & Materials List

#### **Foundation:**

- Gloves
- Shovel
- Tape measure (50-100 ft.)
- 3' or 4' level & laser level or string
- Site level or transit
- Masonry mortar type "S"
- Clamps
- Rebar bender
- Rebar or wire mesh (see Section 5 "Tower Foundations")
- Wire ties

#### **Tower Installation:**

- Concrete (minimum 12 yards)
- Pliers/channel locks
- Combination wrenches or nut drivers for saddle clamps (7/16" & 1/2"), pivot and pin bolts (3/4", 15/16", 1-1/16"), and turnbuckles (7/8" & 9/16")
- Torque wrenches to cover the range of 8 to 95 lb-ft (more than one may be needed)
- Round file (Ø1/8" – 3/8" range)
- Cable cutters (for steel wire rope)
- Galvanizing spray (zinc-rich spray paint, such as Rust-Oleum Bright Galvanizing Compound, V2117838)
- Heavy hammer & block of wood
- Rope
- "Come-A-Long"
- Winch or Grip-Puller/GripHoist

#### 4) Tower Parts List

The complete tower kit contents are listed in **Table 1** below.

<b>Part</b>	<b>Qty.</b>
<b><i>Foundation kit</i></b>	
Anchor, Screw - 54"L x 4" helix ( <i>galv.</i> )	5
J-Bolt - 5/8"-11 x 8" ( <i>galv.</i> )	4
Nut - 5/8"-11 ( <i>galv.</i> )	8
Washer - 5/8" ( <i>galv.</i> )	4
Eye Bolt 1/2"-13 x 8" ( <i>galv.</i> )	3
Nut - 1/2"-13 ( <i>galv.</i> )	6
Washer - 1/2" ( <i>galv.</i> )	3
4" Tower Base Plate Template ( <i>paper</i> )	1
<b><i>Tower &amp; Guy Wire Attachments</i></b>	
End Fitting - 6-Hole Gin Pole	1
Flange Fitting - Top	1
Tang - Top Guy	4
Shackle - 1/2"	4
Bolt - 5/8" x 7"	2
Nut - Nylok 5/8"	2
Turnbuckle - Jaw-Jaw 1/2" x 12"	25
Turnbuckle - Jaw-Jaw 5/8" x 12"	1
Thimble - 1/4"	20
Thimble - 5/16"	6
Saddle Clamp - 1/4"	75
Saddle Clamp - 5/16"	18
<b><i>Tower &amp; Anchor Attachments</i></b>	
Tower Base	1
Gusset - Gin Pole	2
Bolt, Pivot - 3/4" x 8"	1
Nut, Pivot - Nylok 3/4" (may be 2 hex nuts to lock together)	1
Washer, Pivot - 3/4"	2
Bolt, Pin - 1/2" x 6"	5
Nut, Pin - Nylok 1/2"	5
Washer, Pin - 1/2"	10
Shackle - 5/8"	5
Equalizer Plate - 6-Hole	3
Equalizer Plate - 4-Hole (Gin Pole)	1

<b>Back Haul</b>	
Back Haul Cable - Ø3/16" x 220' w/ end ferule	1
Wire leash - Ø5/16" x 4' w/ crimped eye	1
Pulley - 3"	1
Winch, worm gear w/ 3/8" drill attachment	1
Saddle Clamp - 3/16"	3
Saddle Clamp - 5/16"	3
Anchor Bolt - 3/8" w/ nut	3
<b>Gin Pole Coupler, Guy Wires, &amp; Hardware</b>	
Coupler - no attached wires	1
Wire - Ø3/16" x 75' w/ crimped eye	2
Bolt, Pin - 1/2" x 6"	2
Nut, Pin - Nylok 1/2"	2
Washer, Pin - 1/2"	4
Saddle Clamp - 3/16"	6
Shackle - 1/2"	1
<b>Tower Couplers, Guy Wires, &amp; Leashes</b>	
Coupler w/ (4) Ø1/4" x 64' wires attached	1
Coupler w/ (3) Ø1/4" x 75' wires attached & 1 thimble	1
Coupler w/ (3) Ø1/4" x 90' wires attached & 1 thimble	1
Coupler w/ (3) Ø1/4" x 105' wires attached & 1 thimble	1
Coupler w/ (3) Ø1/4" x 124' wires attached & 1 thimble	1
Wire - Ø1/4" x 65' w/o crimped eye	1
Wire - Ø1/4" x 83' w/o crimped eye	1
Wire - Ø1/4" x 100' w/o crimped eye	1
Wire - Ø1/4" x 120' w/o crimped eye	1
Wire - Ø5/16" x 135' w/o crimped eye	1
Wire - Ø5/16" x 140' w/ crimped eye	4
<b>Optional - 4" Tower Pipe Sections (may be purchased locally)</b>	
Tower Base Pipe Section (dwg T-36-04-40-053)	1
Tower Middle Pipe Section (dwg N/A no drilling required)	4
Tower Top Pipe Section (dwg T-36-04-40-054)	1
Gin Pole Base Pipe Section (dwg T-36-04-40-051)	1
Gin Pole End Pipe Section (dwg T-36-04-40-052)	1

Table 1

## 5) Tower Foundations

The typical foundations are concrete blocks 4' x 4' square by 4' deep, (check your drawings for deviations for your turbine and site) using steel anchors and reinforcing rebar or wire mesh. The foundations are cast in holes dug in the ground. The minimum concrete strength is 2,500 psi. In places where the ground freezes deeper than the foundation's depth (show in the drawing appendix) the dimensions must be modified to extend below the frost line. If excavating becomes difficult within the designated footprint, the foundation may be drilled. Concrete forms are required for foundations only if the foundation must extend above the soil surface (in order to have guy foundations level with the base). Even when using forms, the hole depth should remain the minimum called for in the drawings and extend below frost line.

***NOTE: concrete poured directly into holes in the earth has better retention properties than when poured into wooden forms and backfilled with soil.***

### ***Center Foundation***

The center foundation is reinforced using wire mesh or a rebar lattice. Use #3 or #4 rebar (3/8" or 1/2" diameter) for the lattice. Wire mesh may be 4 x 4 (W1.4 x W1.4) to 6 x 6 (W4.0 x W4.0).

The center foundation must be reinforced on all side and top faces of the concrete block. Locate the reinforcement 3 to 5 inches to the interior of each concrete face. See drawing D11 in the manual appendix for a typical rebar lattice layout. The center foundation supports the tower base. It is anchored to the foundation using Bent Anchor Bolts (5/8" x 8"). See drawings D9 and D10 in the manual appendix for J-bolt locations. The tower base or a pattern of the bolt holes should be used to properly set J-bolt locations.

### ***Guy Cable Anchor Foundations***

The four (4) guy wire anchor foundations and the one (1) gin pole anchor foundation are also reinforced using rebar or wire mesh. Drawing D12 of the manual appendix illustrates a typical rebar lattice for these foundations. The left, right and down side anchor foundations are attached to guy wires connected to each level of the tower. The gin pole is also connected to each level of the tower by guy wires and is attached to the inner hoist anchor foundation by a turnbuckle. The remaining anchor foundation, the outer hoist anchor foundation, is different in that it only attaches to the top guy wire on that side of the tower. See drawing D1 for a tower profile. Note that the outer hoist anchor foundation is slightly smaller than the 4 other guy anchor foundations due to the reduced number of guy wires attached. The steel anchors for the tower guy wires are cast in the concrete at the angle indicated in drawings D7 and D8.

See drawings D3, D4, D5 and D6 in the manual Appendix for anchor locations.

Each anchor should be buried as deeply in the concrete as possible while maintaining proper height and placement. It is acceptable to increase the excavation size or depth to seat the anchor more fully in the concrete. If necessary, use a form to raise the foundation height above the soil level to fully bury the anchor in the foundation. Maintain the minimum foundation size determined in the appendix drawings below the soil surface. The center of the anchor's eye should be no more than 4" above the foundation's surface.



### ***Hoist Anchor***

See drawing D6 in the manual appendix for possible inner hoist anchor locations. A set of holes are provided in the gusset plates to adjust for higher or lower placement of the anchor. Each hole is a 5° adjustment and moves the gin pole's end vertically 44" at the hoist anchor. More extreme variations may be accommodated, especially for lower hoist anchor placement: A longer hoist turnbuckle leash and hoist cable will be required in order to move the hoist anchor further from the base while keeping the angle correct. Consult with **ARE** for this or other difficult installation adjustments.

### ***Down-side Anchor***

The down-side anchor eye's height is less critical than on the hoist side. The anchor may vary (higher or lower) from the tower base by as much as 12". Please consult **ARE** if larger variations are required. One eyebolt is placed on either side of the down side anchor in the down-side foundation to be used with the back haul cable (position shown in drawing D4).

### ***Left- and Right-side Anchors***

The left- and right-side anchor eyes should be at the same height as the tower base pivot pin. The side anchors are **offset by 4" toward the down-side** anchor from the centerline of the center foundation. See drawing D4 of the manual appendix. This offset permits the side guy cables to become slack during the lowering of the tower and minimizing the likelihood of over-tensioning the cables during lowering.

The eyebolts for the gin pole guy cables are located on the left- and right-side foundations. In contrast to the anchor eyes, the eyebolts are **offset by 4" toward the hoist-side** anchor from the centerline of the center foundation for the same reason. See drawing D4 in the manual Appendix. These offset locations are important and should be held to within  $\pm 1"$ .

### ***Pouring the Concrete***

As realignment of anchors, bolts, and rebar may be difficult or impossible after the concrete is poured, it is **imperative** that all components are securely located prior to the pour. If pouring from a mixing truck, concrete should be poured directly over the anchor to avoid displacement.

The foundation should cure for 4 weeks (28 days) before any significant loads are placed on them (including tightening the nuts on the base plate anchor bolts). Consult **ARE** if shorter curing times are necessary.

## **6) Tower Section Preparation**

If the **ARE** tower kit is purchased without pipe, then **galvanized Ø4" Schedule-40, ASTM A53 Grade-A steel pipe** sections (21' length) must be provided by the customer. Use of other pipe sizes or material is not permitted, as doing so will compromise the tower design. ***PLEASE NOTE: In this case, a sample (approx. 2" width) cut from the locally purchased pipe must be provided to ARE in order to verify proper fits between pipe and couplers.***

Inspect the pipe sections carefully for dents, belled ends, and/or general bowing curvature. Do not use pipe which is bowed or significantly damaged. Consult **ARE** with any questions regarding the use of slightly damaged pipe. If pipe is purchased separately by the customer, some holes will need to be drilled in the pipe prior to tower assembly and installation. See **Table 2** below for pipe-drilling.

Pipe Section	Drilling Reference
Tower base	Drawing T-36-04-40-053
Tower middle	N/A (no drilling required)
Tower top	Drawing T-36-04-40-054
Gin pole base	Drawing T-36-04-40-051
Gin pole end	Drawing T-36-04-40-052

Table 2

As hole alignment between pipe ends and gusset plates is important, the following **drilling procedure** is advised:

- Lay a piece of angle iron at least 2 feet long on the pipe lengthwise. Mark a line on the pipe along one side of the angle iron. This line should start at the end of the pipe and extend beyond the furthest hole location. Measure, mark, and center-punch holes along the line.
- On both ends of the line, measure half way around the pipe and mark it.
- Use the angle iron to draw a line between your marks. Measure, mark, and center-punch the holes on the new line.
- Drill pilot holes then finish holes at each location.
- Remove burrs from the edges of the holes and paint with galvanizing spray (zinc-rich spray paint).

## 7) Lightning and Grounding Protection

### **Grounding**

The tower should be grounded at each foundation point. Legal requirements in most areas only require grounding of the tower, but guy-cable grounding is advised as well. Five (5) 8'-long grounding rods and 4-8 AWG, single strand, bare copper wire will be required (not provided by **ARE**). Embed a grounding rod in the ground near each of the foundations, so the top of the rod is a minimum of 6" below the surface. Connect a ground wire between each of the outer grounding rods, making a circle around the center foundation. Next, make a connection between one of the outer grounding rods and the center grounding rod. These connecting wires must be buried a minimum of 18" below the ground surface (check your local regulations). At each guy cable foundation, attach a ground wire from the grounding rod to the guy cables just above the saddle clamps near the turnbuckle. Never attach the copper grounding wire directly to the working part of a guy cable – instead, chain one of the guy cable ends between each of the guy cables with saddle clamps (See **Figure 7.1** below). Attach the end of this guy cable to the copper ground wire. Attach a ground wire between the tower base section or gusset and the center grounding rod.

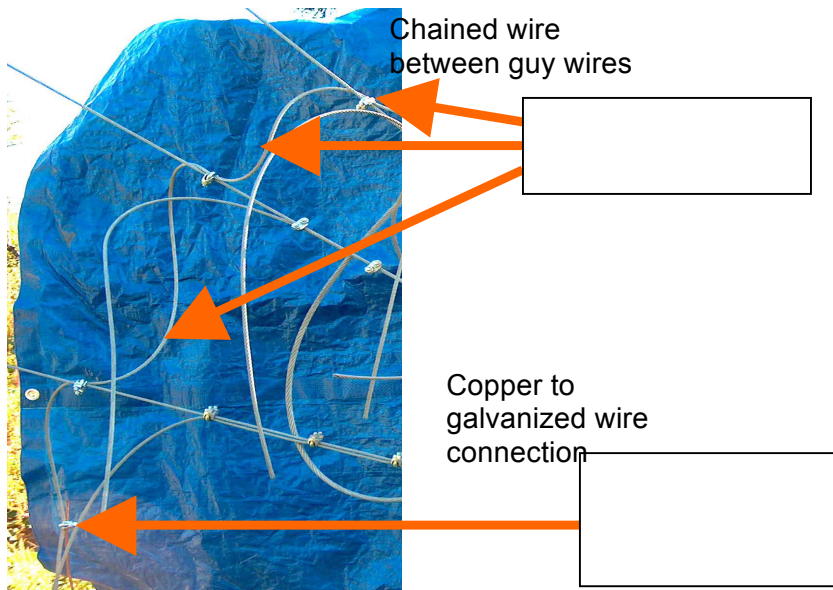


Figure 7.1

### ***Junction Box***

Use of a junction box at the base of the tower is recommended for access to the wires running between the power controls and the generator wires in the tower. This allows a convenient location for maintenance between the generator and power controls. If the generator does not have a slip-ring yaw head, this also provides a location where tower wire twists (which may occur over time due to wind generator rotation) can be easily unwound. Additionally, an onsite brake switch may be located in this junction box. For safety reasons, a lockable enclosure is advised. Consult **ARE** for available brake switch designs.

### ***Lightning Suppressors***

It is advised that lightning arrestors be installed in the wiring of the system – one in a junction box at the tower base and one in the power room. Consult **ARE** for available lightning protection packages.

## **8) Tower Raising Options**

**ARE**'s Ø4" x 127' tilt-up tower should be raised and lowered with a winch (manual or electrical) or a grip-pulling device (not with a vehicle), as extra care is required to maintain a slow, steady lift/descent. See **Figure 12** for a visual overview of important points while raising and lowering the 127' tilt-up tower. Electric hoist winches and grip-pulling devices are available for purchase through **ARE** for your tower raising requirements. A small back haul winch—driven with an electric drill—is provided with 127' towers.

Whichever hoisting method is chosen, make certain that the pulling means is sufficiently rated for the applicable load. The approximate straight-pull loads are listed below in **Table 3**. Use of pulleys will reduce the force but increase the required cable length.

**Table 3**

	<b>Number of parts in the pulley system</b>	<b>Hoist System Load</b>
<b>Straight-Pull Load:</b> 4,500 lbs	1	4,500 lbs
	2	2,250 lbs
(Based on the heaviest turbine's hoist load: actual loads may differ)	3	1,500 lbs
	4	1,125 lbs
	5	900 lbs

## 9) Tower Assembly

### Handling Wire Rope

When wire rope is received, care should be taken to prevent damage in handling it prior to actual installation, or operation in service.

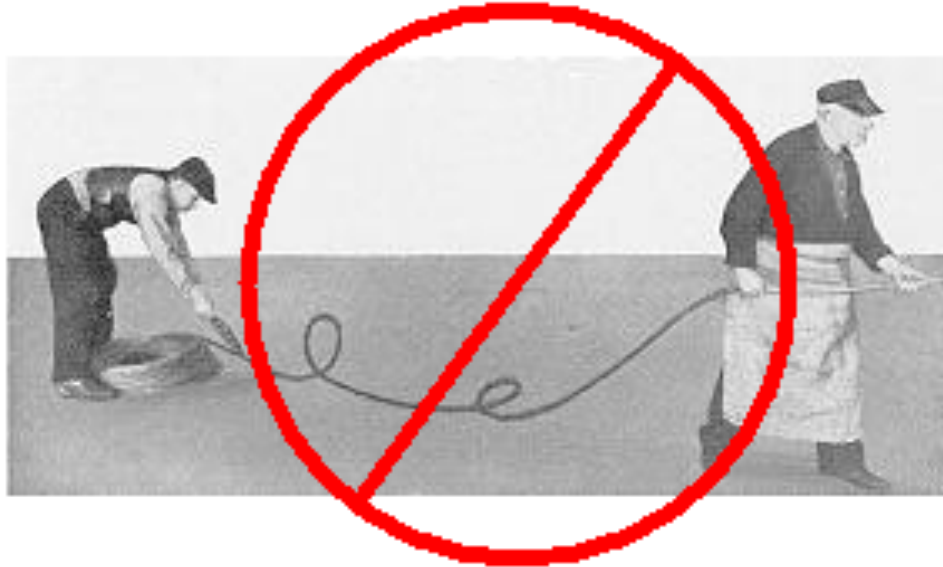


Figure 9.1 - Wrong Way

When the wire rope is received in coils, **do not** lay the coil flat and pull the rope from the coil as is shown in **Figure 9.1**. This method will produce a spiral effect-many ropes are ruined in this way.



Figure 9.2 - Correct Way

The coil should be unrolled like the rolling of a hoop as illustrated in **Figure 9.2** and straightened out its full length before use.

### Step 1 (Base Installation and Anchor Setup)

#### Base Installation

Tower assembly begins with the base plate. Mount the base plate on the center tower foundation bolts and level it. Use 5/8" nuts on bolts beneath the base plate, adjusting them to level the base. Next, install the base plate with 5/8" washers—one on each side of the plate—and a 5/8" nut on top. Tighten the nuts, check for level, and readjust until level. Use a non-shrinking grout under the base plate to make a solid support. See drawing D10 in the manual appendix and **Figure 9.3** below.

Gin pole

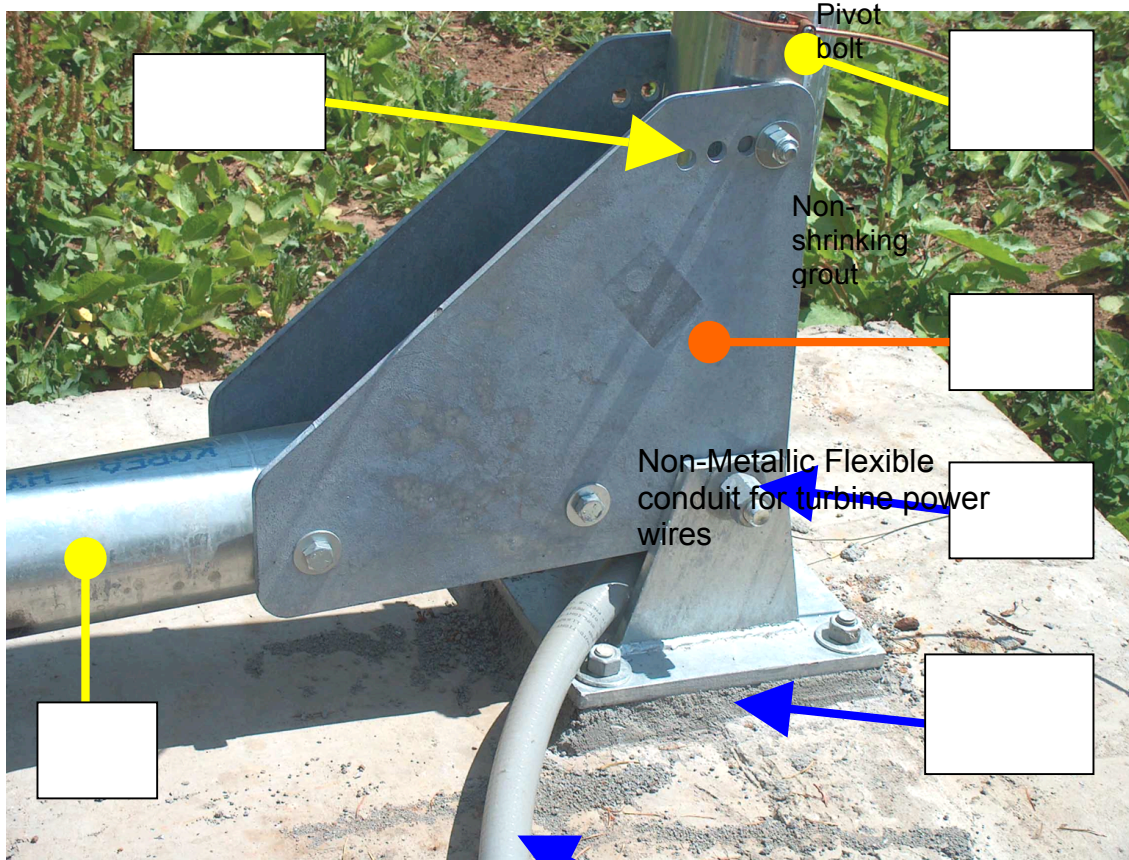


Figure 9.3



#### Anchor Set Up

Attach the **6-hole equalizer plates** to the left-, right-, and down-side anchors using 5/8" shackles. Make sure that the short side is up as shown in **Figure 9.4**. Attach the turnbuckles to the equalizer plate with the top turnbuckle in top hole (position 6) of the equalizer plate. There is one (1) turnbuckle per tower section thus the 127 foot tower has six (6) turnbuckles. Adjust turnbuckles to slightly more than halfway open for the left-, right-, and down-side foundations. Orient the turnbuckles so that the "L" on the buckles is located near the equalizer plate. This allows all the buckles to rotate in the same direction during the tower adjustment phase.

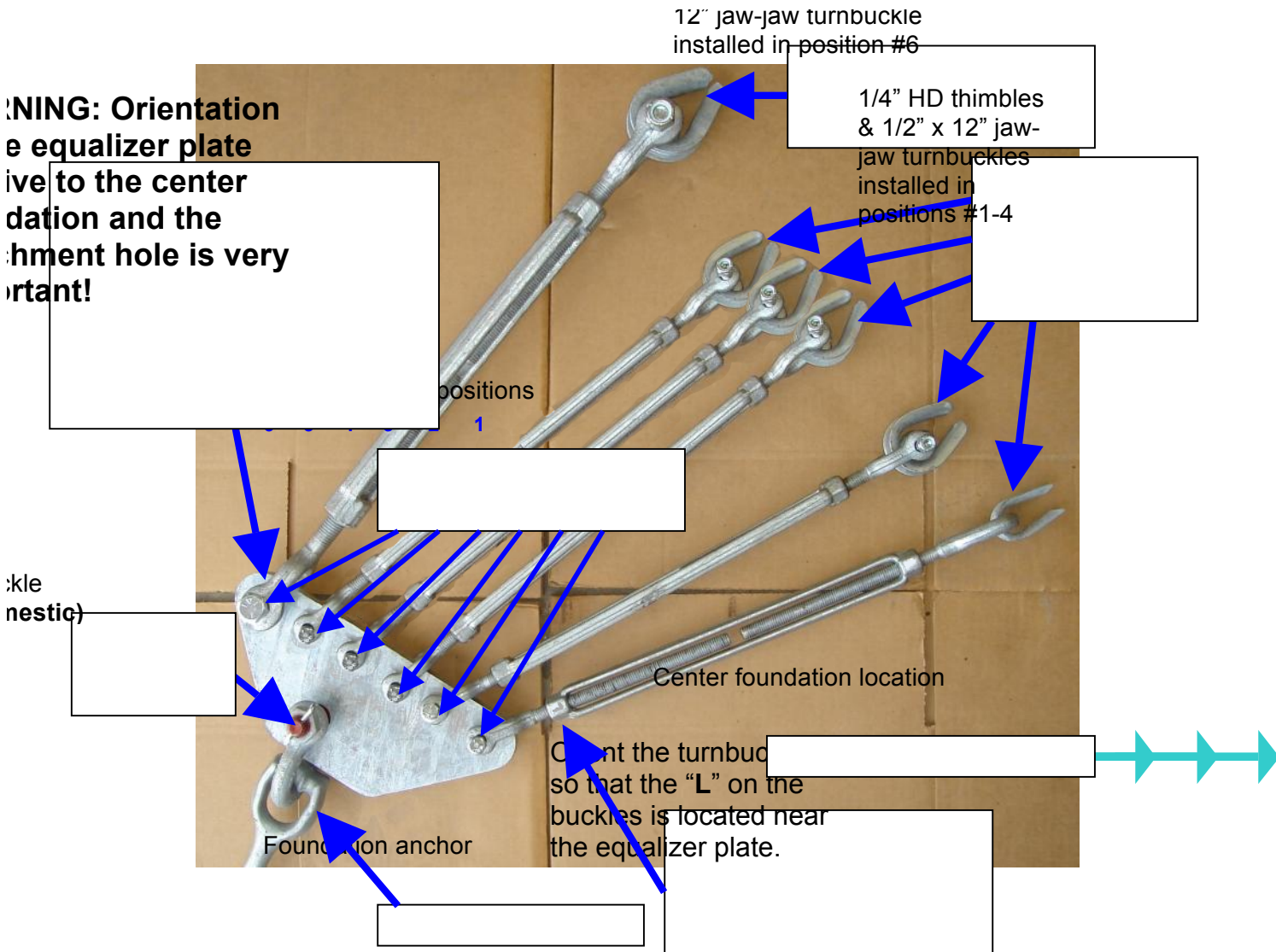


Figure 9.4

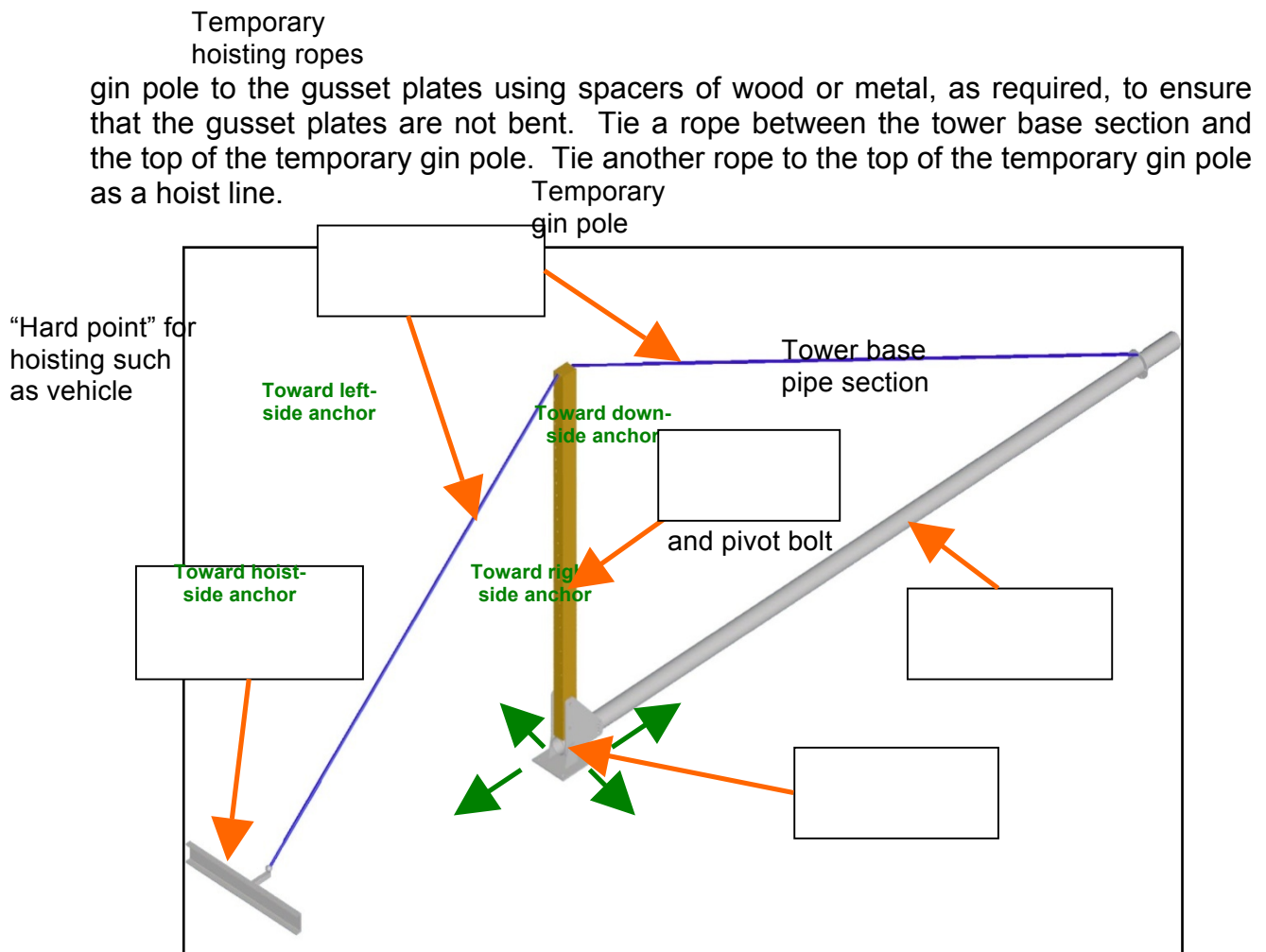
**Step 2 (First Tower Section Installation & Raising)**

Lay the **tower base pipe section** out horizontally between the down-side anchor and the tower base foundation. Insert the first tower coupler (attached with 65' guy cables) into the top of the base tower section. *Note: This is the only coupler with all four cables already attached.* Attach a separate rope to the coupler, which will be used to hoist the gin pole into position later (Step 4).

Attach the tower base pipe and the two (2) **side gussets** to the base plate with the 3/4"-10 x 8" pivot bolt and washers on both sides of the bolt. Tighten a 3/4"-10 Nylok hex nut until snug against the adjacent washer, then unscrew the nut 1/2-turn. This will secure the bolt's position but allow the tower to pivot about the bolt. Install a bolt (1/2" x 6") through one of the four (4) gusset adjustment holes, including a washer on the outside of each gusset plate. Secure with a 1/2" Nylok nut and tighten until snug (see **Figure 9.3** above).

Use drawing D6 in the manual appendix to determine appropriate gin pole and hoist anchor positioning and gusset plate adjustment hole selection.

Use a 10'-long 4x6 or similar piece of lumber or a lightweight pipe section as a temporary gin pole to raise the first tower section (see **Figure 9.5**). Bolt this temporary



**Figure 9.5**

Attach the tower coupler’s guy cables to the 1<sup>st</sup> position 1/2” x 12” turnbuckle at the left- and right-side foundations. Place a 1/4” HD thimble in the jaw of the turnbuckle before installing cable and saddle clamps. Pull guy cables taut then slack off approximately 6” before securing with three (3) 1/4” saddle clamps. Refer to the saddle clamp installation procedure and the illustration in **Figure 9.7**. NOTE: As guy cables will be readjusted later during Step 9 (tower adjustment process), it is not necessary to fully tighten saddle clamps at this time. They should, however, be tight enough to deform the cable and provide some clamping force.

Ensure that the tower base pipe section remains square with the base plate as the guy wires are attached, ensuring the tower base section will be approximately vertical when erected.

Pull the down-side guy cable to either the left- or right-side guy anchor and mark the distance on the cable with tape. This will be the reference for attaching the guy cable to the down-side anchor. Take care to not cross or tangle the guy cables while measuring and marking, as this could damage the guy cables and/or prevent the tower from being raised properly.

Attach the down-side guy cable in the same manner as the left- and right- side guys, *but do not add 6” to the tape mark*. The length of the guy cable may need to be adjusted to account for differences in elevation between the down-side guy anchor and the left- and right-side guy anchors. If the down anchor is lower than side anchors,

guys will be too short, but they can be adjusted after the tower is raised. If, however, the down anchor is higher than the side anchors, the guys will be too long; thus, adjustments to shorten the cable should be made before raising the tower. Secure the guy cable with saddle clamps.

**Raise the tower base pipe section with the temporary gin pole:** Carefully use the rope tied to the temporary gin pole to pull the base pipe section to the vertical position. Follow the safety recommendations in **Step 8** below.

***A vehicle may be used during this procedure in the following manner:***

- Park a vehicle **about 10' (equal to the height of the temporary gin pole) from the tower base towards the hoist-side foundation** (see **Figure 9.5**). This will provide the hard point for raising the gin pole. Ensure the vehicle will not be in the way of the guy wires or the gin pole as the base tower section is raised.
- Standing at the base of the tower, attach the rope tied to the top of the temporary gin pole. Attach a winch cable as far up the rope as is reachable. Alternatively, two (2) hand-ratchet cable pullers ("come-a-longs") can be used in series. Attach the opposite end to the vehicle.
- Use the winch to pull on the **top of the temporary gin pole and lift the tower base section**.

**Warning:** Once the tower base pipe section is vertical it is **essential** to **secure the hoist rope** and adjust the left-, right-, and down-side guy wires as required to make the section secure. This will allow the tower to be stable while transitioning from the temporary gin pole to the permanent gin pole.

### **Step 3 (Prepare the Gin Pole)**

Remove the temporary gin pole from the gusset plates. Locate and install the gin pole base pipe section to the gusset plates. Use 1/2" x 6" bolts, nuts, and washers (see **Figure 9.3**). Tighten nuts until snug, but do not over-tighten. Install the **gin pole coupler** and **gin pole end pipe section** and secure.

Install the **gin pole end fitting** into the **gin pole**. Orient the gin pole end fitting as shown in **Figure 9.6**. Secure with a 1/2" x 6" bolt, nut, and washers. Tighten nuts until snug.

Attach the turnbuckles to the top side of the **gin pole end fitting**, as shown in **Figure 9.6** below. There is one (1) turnbuckle per tower section thus the 127 foot tower will have 6 turnbuckles. See **Figure 9.4** for turnbuckle order. Adjust turnbuckles to slightly more than halfway open.

Attach the hoist equalizer plate (uneven triangles with holes) to the hoist anchor with a 5/8" shackle.

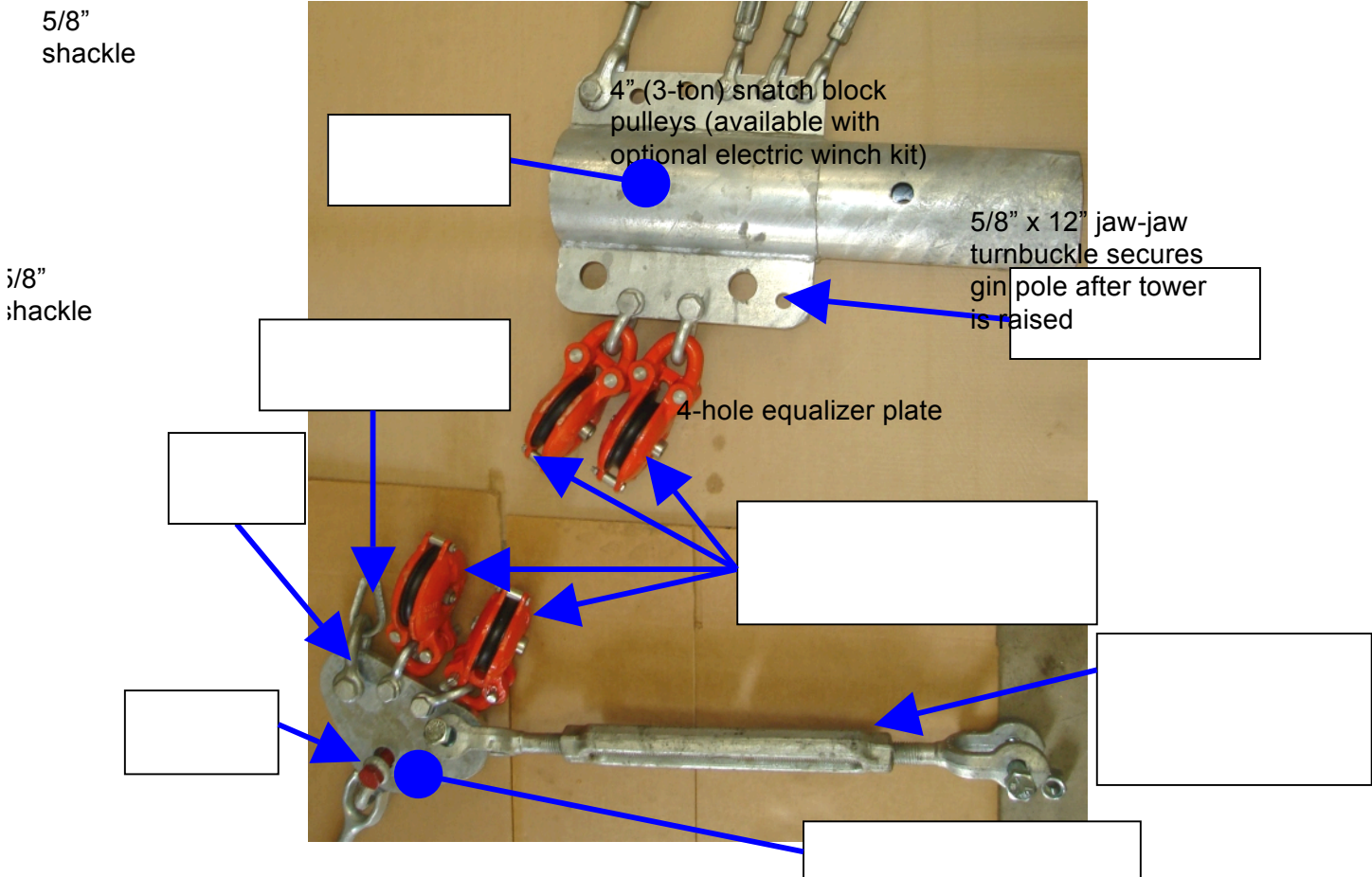
**For Optional Electric Winch Kit:** Arrange pulleys in the equalizer plate holes and gin pole end fitting, as required, to permit a clear cable path. Attach pulleys with 1/2" shackles, and attach the crimped-eye end of the hoist cable with a 5/8" shackle, as shown in **Figure 9.6**. See **Table 4** below for hoist cable end attachment and pulley locations. The arrangement pictured works well if the winch pulls from 45 to 90



degrees from the gin pole. If you want to pull in line with the gin pole, place the cable end between the pulleys and add a second shackle for the outside pulley to give a better lead in the direction of the pull.

Tower Height	Total Pulley Qty.	Hoist Cable End Attachment Location	Gin pole guy cables go here.	Pulley Qty. (EQ Plate)	Pulley Qty. (GP End Fitting)
129 foot	4	Equalizer Plate		2	2

Attach end of hoist cable here  
**Table 4**



**Figure 9.6:** Hoist Rigging Example

**Attach Guy Cables to Gin Pole**

Attach the one 5/16" tower guy wire without an eye at either end to the jaw of the turnbuckle that is farthest away from the center foundation. Use a 5/16" thimble. After placing this and all other thimbles, squeeze it closed before installing the wire and saddle clamps. Secure with three 5/16" saddle clamps. Refer to saddle clamp installation procedure in **Figure 9.7**, and make the dead end 30 inches long.

Attach both gin pole guy wires to the gin pole end fitting with a 1/2" shackle. Use the end with the crimped eye.

Attach the guy wire that is already attached to the first tower coupler to the turnbuckle closest to the tower base. Pull this wire snug before securing with three 1/4" saddle clamps and a 1/4" thimble; refer to the wire rope installation procedure and the illustration in **Figure 9.7**. Attach the remaining 1/4" guy wires that are not attached to

the tower couplers to the remaining turnbuckle eyes using 1/4" thimbles. Secure with three 1/4" saddle clamps per guy wire. Install the shortest closest to the tower base and then work outward with successively longer wires. Finally attach the top guy wire which is 5/16" with a 5/16" thimble and saddle clamps. See Drawings D1 and D2. Refer to the saddle clamp installation procedure in **Figure 9.7**, and make the dead end 30 inches long.

Attach the two (2) Ø3/16" x 75' **side guy cables** (with crimped eye) to the **gin pole end fitting** with a 1/2" shackle where indicated in **Figure 9.6**.

NOTE: As guy cables will be readjusted later during Step 10 (tower adjustment process), it is not necessary to fully tighten saddle clamps at this time. They should, however, be tight enough to deform the cable and provide some clamping force.

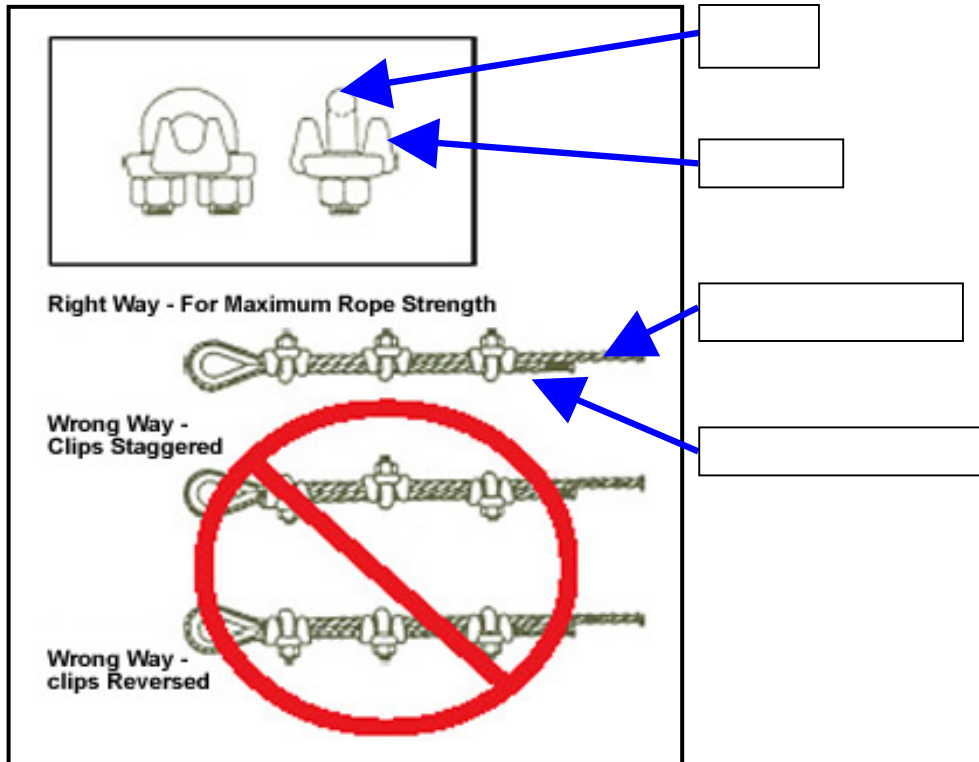
## Saddle clamp Installation Procedure

1. Locate the first clip as near as possible to the thimble with the U-bolt over the “dead” end and the “live” end in the clip’s saddle.

See **Figure 9.7** below.

2. Install two additional clips at 6” intervals (3 clips total).
3. Do not over tighten and damage the wire. Cable Recommended torque and proper use for each size saddle clamp is shown in **Table 5**.

A nut driver may be used during set-up and while adjusting the tower to vertical. All saddle clamps should then preferably be tightened with a thread-locking compound.



**Figure 9.7**

**Table 5: Proper use of Saddle Clamps**

Wire Rope or Cable and Saddle Clamp Size		Minimum Number of Clips	Length of Wire Rope or Cable Turn Back		Recommended Torque (ft-lb)
In	mm		In	mm	
1/8	3	2	3-1/2	89	3
3/16	5	2	4	102	8
1/4	6	2	5	127	15
5/16	8	2	5-1/2	140	30
3/8	10	2	6-1/2	165	45
7/16	11	2	7	178	65
1/2	13	3	11-1/2	292	65
9/16	14	3	12	305	95
5/8	16	3	12	305	95
3/4	19	4	18	457	130

#### Step 4 (Raising the Gin Pole)

Adjust the hoist-side guy cable to hold the gin pole's weight. Ensure the tower is plumb, using turnbuckles to make small adjustments, as required. For larger adjustments, loosen saddle clamps and adjust the cable length accordingly. The hoist- and down-side guy cables will be tight (without slack) due to the gin pole weight being supported. The left- and right-side guy cables should each have approximately 2" of sag.

Lift the gin pole to a vertical position using the rope attached to the coupler (in Step 2), and let out the hoist cable simultaneously. A small winch or grip-pulling device may be used to assist in this step. Once at around 60°, the gin pole will reach its balance point with the base tower section. Maintain control by feeding the hoist cable slowly and gently lowering the tower base pipe to the ground. When the tower base pipe is horizontal, secure the hoist cable to maintain the gin pole's position as the remainder of the tower is assembled.

#### ***A vehicle may be used during this step in the following manner:***

- Park a vehicle **near the down-side foundation and the tower base**. This will provide the "hard point" for raising the gin pole. Ensure the vehicle will not be in the way of the guy wires as the gin pole is raised.
- Standing at the base of the tower, take the rope tied to the top of the tower base section. Attach a winch cable as far up the rope as is reachable. Alternatively, two (2) hand-ratchet cable pullers ("come-a-longs") can be used in series. Attach the opposite end to the vehicle.
- Use the winch to pull on the **top of the tower base section and lift the gin pole**, playing out the hoist cable simultaneously.

#### Step 5 (Gin Pole Guy Cable Attachment)

Attach the gin pole side guy cables to their anchors at the left- and right-side foundations. Use three (3) 3/16" saddle clamps at each location. Refer to the saddle clamp installation procedure and the illustration in **Figure 9.7**, except that you will not use thimbles in this location. Use a level to plumb the gin pole with tension adjusted so there are about 2" of sag in each cable.

#### Step 6 (Tower Assembly)

##### ***Lay Out***

Place all of the remaining tower pipes, tower couplers, and guy cables on the ground in assembly order. The assembly consists of the tower base pipe, as many middle pipes as are required for your tower height—each connected by a tower coupler—and finally a tower top pipe. Lay out the tower horizontally level and perpendicular to the line of side guys, if possible, as this will result in a nearly vertical tower on the first raising. See drawings D1 and D2 in the manual appendix for a general diagram of the assembled tower.

##### ***Assembly***

Install the second tower pipe onto the first coupler and the second coupler into the second pipe. Position the coupler so that the hole with no cable is on top and aligned

with the gin pole. This is the location where the hoist-side guy cables will attach to in a later step.

Install the next pipe section onto the coupler and repeat the procedure until the tower is assembled on the ground. The tower sections may need to be supported above the ground in order to facilitate assembly.

**TOWER WIRING NOTE:** It is generally a good practice to run the turbine power cables during the assembly of the tower, as it is significantly easier to pull wire through 21' of pipe several times than through the entire tower length at once. In addition, the wire can be pulled through the couplers individually before they are installed in the tower.

## Step 7 (Guy Cable Attachment)

### ***Couplers to Foundations***

Attach the second tower coupler's attached guy cables to the 2<sup>nd</sup> position turnbuckles at the left- and right-side foundations. Place a 1/4" HD thimble through the jaw of the turnbuckle. Pull guy cables taut then slack off approximately 6" before securing with three (3) 1/4" saddle clamps.

Refer to the saddle clamp installation procedure and illustration in **Figure 9.7**. NOTE: As guy cables will be readjusted later during Step 9 (tower adjustment process), it is not necessary to fully tighten saddle clamps at this time. They should, however, be tight enough to deform the cable and provide some clamping force.

Ensure that the tower pipe sections remain square with the base plate, so the tower will be approximately vertical when erected.

Next pull the down side guy wire to one of the side guy anchors and mark the distance on the cable with tape. This will be the reference for attaching the guy cable to the down-side anchor. Take care to not cross or tangle the guy cables while measuring and marking, as this could damage the guy cables and/or prevent the tower from being raised properly.

Attach the down-side guy cable in the same manner as the left- and right- side guys, *but do not add six" to the tape mark*. The length of the guy cable may need to be adjusted to account for differences in elevation between the down-side guy anchor and the left- and right-side guy anchors. If the down anchor is lower than side anchors, guys will be too short, but they can be adjusted after the tower is raised. If, however, the down anchor is higher than the side anchors, the guys will be too long; thus, adjustments to shorten the cable should be made before raising the tower. Secure the guy cable with three (3) 1/4" saddle clamps and 1/4" HD thimbles.

Repeat the above procedure with each coupler, working gradually upward on the equalizer plates and toward what will eventually be the tower top.

**Mark distances before raising:** Once the tower has been raised the guy wires are required to have specific tensions. In order to measure the tension there are 2 methods readily available (**See Step 9: Tensioning Cables**). If *Method 2* is chosen,

Guy cable “live” end on top and “dead” end on bottom marks on the tower must be placed at distances shown in **Table 7** before raising the tower.



**Figure 9.8**

#### ***Gin Pole Guy Wires to Tower Connection***

With the first two tower sections level, attach the first free  $\text{Ø}1/4$ " guy cable between the gin pole end fitting and the thimble in the second tower coupler. Pull the guy cable tight and secure with three (3)  $1/4$ " saddle clamps.

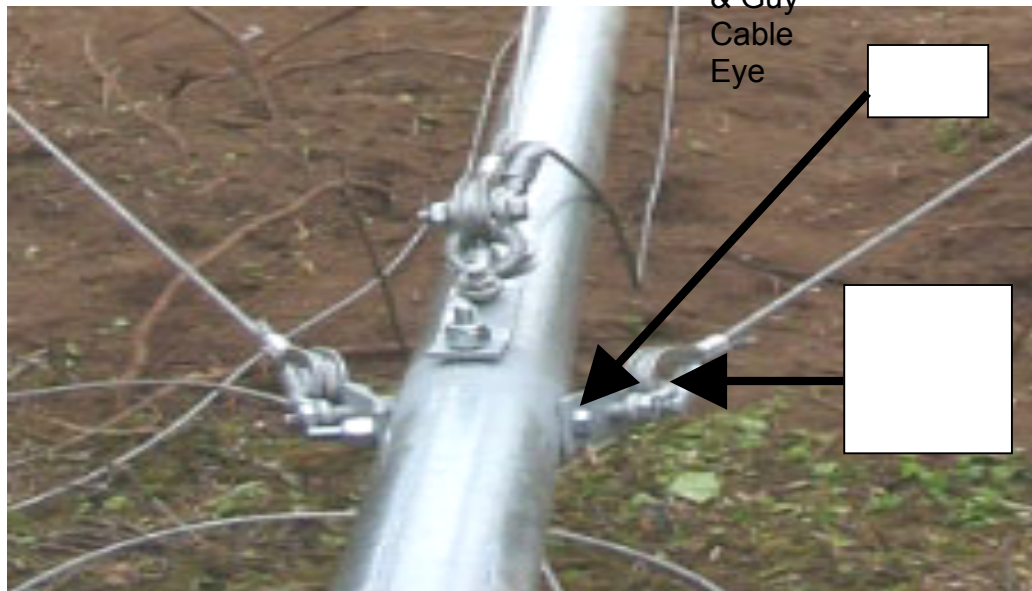
**NOTE:** *There will be excess cable at this time, which can be trimmed after the tower has been adjusted.* Refer to the wire rope installation procedure and the illustration in **Figure 9.7**. It will be easier to tighten saddle clamps if the guy cable is led through the coupler from above and fed back on the lower side nearest the tower base (see **Figure 9.8**).

Repeat the above procedure for the remaining  $\text{Ø}1/4$ " guy cables attached to the gin pole. Lift or block each tower pipe section to ensure levelness then pull the guy cable tight. This will allow the tower to lift evenly.

#### ***Guy Cables to Top Tangs***

The top guy cables are attached near the top of the top tower pipe section with four (4) “tang”. Install the short leg of each tang to the tower with the two (2) bolts ( $5/8 \times 7$ ") and two (2) Nylok nuts. See **Figure 9.9**. *Note: The bolts fit tightly through the holes in the tower and tangs.* Tighten nuts snugly. Attach the left-, right-, down- and outer hoist-side  $5/16$ " guy cables (with crimped eyes) to the tangs using  $1/2$ " shackles. Attach the inner hoist-side cable (without a crimped eye and already attached to the gin pole) to the same shackle as the outer hoist-side cable. Use three (3)  $5/16$ " saddle clamps and one (1)  $5/16$ " HD thimble to attach the inner hoist-side cable.

Attach the opposite guy cable ends to turnbuckles at the left-, right-, and down-side for each cable's respective foundation using three (3) 5/16" saddle clamps and one (1) 5/16" HD thimble at each location. One end of the outer hoist foundation cable will remain free until the tower is raised for the final time with the turbine installed.



**Figure 9.9**

*Note: To assist (later) in Steps 8 & 11, attach the shorter “leash” (4’ long, provided—see **Figure 9.10**) approximately halfway up the top down-side guy cable. A rope—tied to the leash—will be used (from a safe location) to control the guy cable tension (see **Figure 12**). On 127’ towers, similarly attach the back haul winch cable (220’ long) to the third-from-top down-side guy cable at 25 feet from the tower to cable connection. This cable should run through a pulley then to the tower’s hoist-side, where it should be reeled onto the small, worm gear back haul winch (provided). See **Figure 12** for a visual overview of important points while raising and lowering **ARE** 127’ towers.*

Orient the top flange fitting so this bolt can be installed



Figure 9.10

### Top Flange Fitting to Tower

Install the **top flange fitting** in the end of the tower top section. Orient the fitting so that the bolt can be installed through the fitting and the top pipe (see **Figure 9.11**). Install one (1) 1/2" x 6" bolt with washers and nuts in the hole provided. This bolt may be used to support a cable grip for the electrical wires.

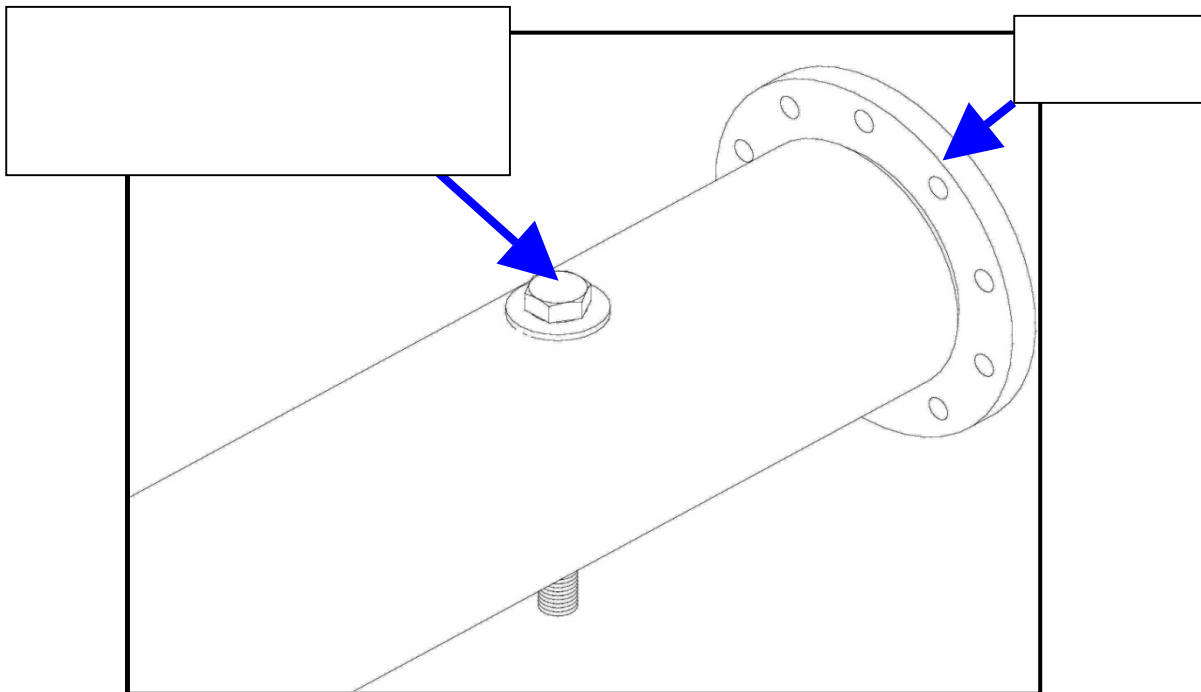


Figure 9.11



## Step 8 (First Tower Raising)

The tower should now have four (4) guy cables at each coupler and five (5) guy cables attached to tangs on the tower top pipe. All guy cables should also be attached to their foundations or to the gin pole except for the 5<sup>th</sup> cable attached to the tangs at the top of the tower which will be connected later to the outer hoist-side anchor after the tower has been raised for the final time with the generator installed.

The purpose of the first lift is to check and adjust the rigging prior to attachment of the wind generator. **DO NOT INSTALL THE WIND GENERATOR AT THIS TIME.** The hoist winch or grip-puller is used to raise the tower. Ensure that all guy cables are securely attached and run clear with no tangles or kinks.

**NEVER** raise or lower a tower in high winds.

### **IMPORTANT SAFETY REQUIREMENTS:**

- **All people must remain clear of the tower during hoisting. No one should walk under the tower or rigging during hoisting.**
- **It is critical to raise and lower the tower very slowly and steadily, as this allows careful monitoring of equipment and personnel.**
- **Side guy cable tension must be continuously monitored. Guy cables should consistently show visible sag/slack throughout the tower raising. If slack is not visible, it is difficult to determine the amount of tension in the cables; as a result, the cables may become too tight. Over-tensioned cables can break and cause the tower to fall.**
- **Gin pole guy cable tension should also be monitored, but the gin pole guys should have increased sag as the tower is raised.**
- **Remain in contact with all members of the lifting team during the entire process to ensure that problems can be immediately responded to. Each member of the lifting team should be authorized to call a “stop” at any time.**

As the tower is hoisted, watch for any tangled, snagged, or misled guy cables. This most commonly occurs in the down-side guy cables. Ensure that guy cables and thimbles lead properly from each attachment on the tower and at the anchors. During the last 20° of the tilt-up, the back haul cable should be nearly tight but not under tension (see **Figure 12**). **If you pull strong tension on both the hoist winch and the back haul winch you can compress and collapse the tower.**

**It is critical to have an observer at one of the side anchors watching the tower.** From the hoist location it is not possible to tell if the tower is **bowing toward the hoist side** in the middle and in danger of buckling. If this happens it is **necessary** to take up more tension on the back haul until the tower straightens. It is also helpful to reduce tension on the top guy wire leash. As the tension on the back haul is increased the tower will pop back into a straight condition. If the tower is bowing below the back haul attached guy wire then there is tension on both the hoist and the back haul and they are compressing the tower. The tower will take on an S shape. In this case it is **critical** to slack either the hoist winch or the back haul winch. Always make slow and careful adjustments and make sure the correction is having the desired effect.

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As the tower nears vertical, the weight of the gin pole will start to balance with the tower weight. At this point the tension will transfer to the back haul winch and it will control the tower position as it settles into the fully raised position. Keep taking up the slack on the hoist winch as this occurs. At the same time one team member should take hold of the top down-side guy cable leash and pull lightly to the side. This step is most effectively achieved by pulling (from a safe location) on the rope tied to the “leash” (attached to the top down-side guy wire at the end of Step 6) to control the guy cable tension and prevent slapping as the tower arrives at the vertical position. Let the winch do most of the work just keep tension on the leash to steady the top of the tower.

When the tower is vertical, secure the gin pole by installing a 5/8” x 12” jaw-jaw turnbuckle between the equalizer plate and the gin pole end fitting. See **Figure 9.6**. A set of holes are provided in the gusset plates to adjust for higher or lower placement of the anchor. Each hole is a 5° adjustment (See Drawing D6).

When in its upright, vertical position, the tower may appear crooked, due to imperfect adjustment in the guy cables. This is normal at this step and should not be a concern.

### **Step 9 (Tower Adjustment)**

This step will result in the tower being vertically straight and secure. Start by checking the lower tower pipe with a level to ensure vertical positioning in both directions (side to side and front to back). Adjust the guy cable tension so that there is about one inch of sag in the side guys of the first guy cable set, while maintaining the lower section’s vertical position.

Small adjustments can be made with the turnbuckles, but larger adjustments will require loosening the saddle clamps and taking up slack or letting out cable. Whenever saddle clamps are moved be certain to maintain tension on the guy cable.

The lowest hoist and down-side guy cables are unique in that they hold the gin pole from falling into the hoist foundation. As a result, these cables are tight with little or no sag compared to the other guy cables. Adjust the lowest hoist-side guy cable so that it is just tight enough to support the weight of the gin pole and to prevent weight of the gin pole from resting on the two (2) bolts in the gusset plates. Adjust the down-side guy until the tower base pipe is vertical. If the turnbuckle between the gin pole and the hoist anchor is in place, it may need to be adjusted to provide slack during this procedure.

Continue by adjusting the other sections so that the rest of the tower is visibly in line with the lower section. Allow the amount of sag to increase in each higher guy cable. The longer the guy cable, the more sag there will be for the same tension. Tower adjustments may need to be made several times until all the sections are aligned vertically. View tower upward along the pipe for best results. Start with couplers that are most out of line.

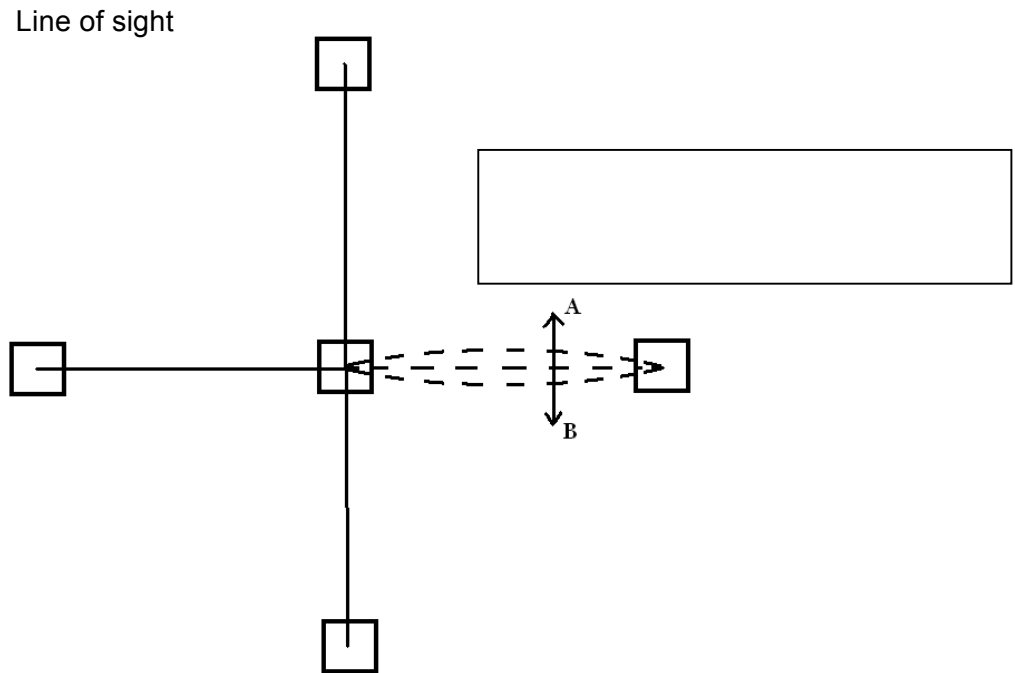
### ***Tensioning Cables***

Adjust the guy wire tension according to the **Table 6** and **Table 7** while maintaining the lower section’s vertical position.

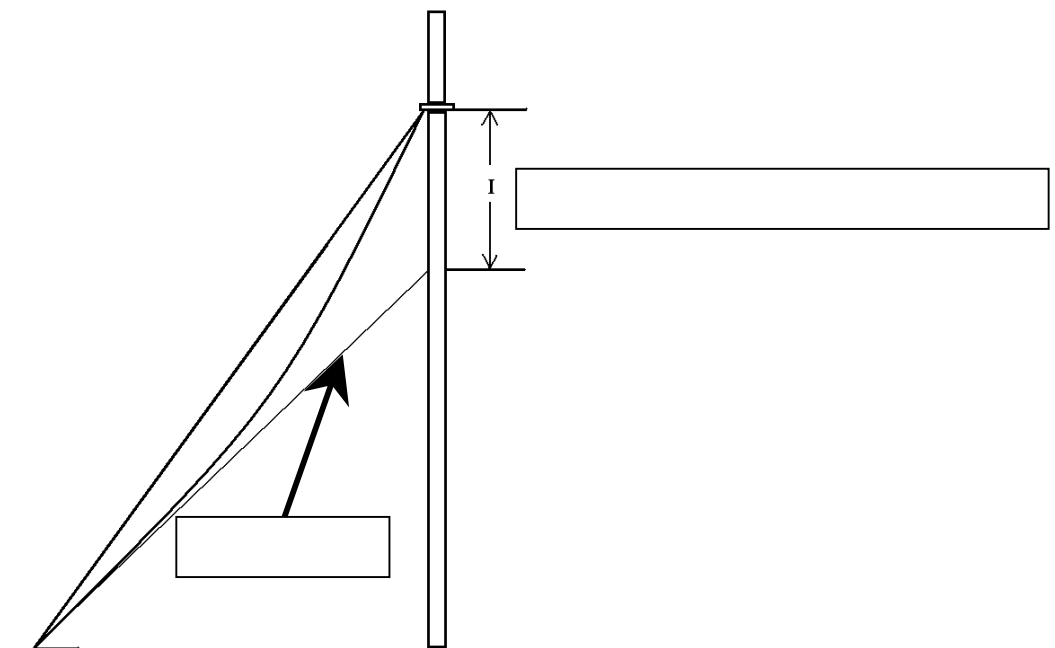
**Method 1:** To determine a cable's tension, swing it freely from side to side while timing N complete swings per second. If the number of swings each second is lower than the required number in **Table 6** the cable is too loose and should be tightened. If the number of swings each second is too high, loosen the cable and try again.

**Method 2:** Cable tension can also be determined by sighting along the bottom of the cable at its anchor point (see **Figure 9.12** and **Figure 9.13**). The distance (I) between the cable's upper attachment point and the line of sight relates to the cable's tension.

**NOTE:** When using method 2: **Mark the tower before it is raised** at the distances shown in **Table 7** from each of the cable's tower attachment points so that there is something to sight to when tensioning the cables.



**Figure 9.12**



**Figure 9.13**

**Table 6: Using Method 1: “Swing Method”**

Pulses per second (N)	127 foot tower	127' tower tension
<b>N 1st guy wire</b> (lowest)	3.3	490 lbs
<b>N 2nd guy wire</b>	2.8	490 lbs
<b>N 3rd guy wire</b>	2.3	490 lbs
<b>N 4th guy wire</b>	1.9	490 lbs
<b>N 5th guy wire</b>	1.6	490 lbs
<b>N top guy wires</b>	1.3	686 lbs

**Table 7: Using Method 2: “Tangent Intercept Method”**

Tangent Intercept (I) In	127 foot tower	127' tower tension
<b>I 1st guy wire</b> (lowest)	4 in	490 lbs
<b>I 2nd guy wire</b>	6 in	490 lbs
<b>I 3rd guy wire</b>	9 in	490 lbs
<b>I 4th guy wire</b>	13 in	490 lbs
<b>I 5th guy wire</b>	18 in	490 lbs
<b>I top guy wires</b>	27 in	686 lbs

Each turnbuckle must have room for adjustment. Adjust the saddle clamps to accomplish this, if required. Permanently secure all saddle clamps tightening to the proper torque prior to proceeding to Step 10.

*NOTE: As the tower is stressed in service, things will settle in and stretch. The guy cables will need to be adjusted after a couple of months or after the first significant windstorm. It should be possible to make these adjustments with turnbuckles only.*

## **Step 10 (Tower Lowering)**

Once the tower is vertically aligned, it can be lowered. See **Figure 12** for a visual overview of important points while lowering **ARE** 127' towers.

Before beginning the tower lowering process, make certain that the hoist cable and pulleys are attached and not tangled, snagged, or blocked. The end of the hoist cable must be securely attached to the winch or grip-puller with minimal slack to prevent an uncontrolled situation.

To begin, release the gin pole turnbuckle and gently pull on the top down-side guy cable (with the rope attached to the top “leash”) while pulling with the back haul winch (see **Figure 12**). Let the back haul winch do most of the work. The tension on the top guy leash will get the wind turbine (if installed) tilting with the tower. Once the turbine starts over its weight will do the rest unless there is an opposing wind and then care must be taken until the tilting process is well established. Do not rock the tower – provide steady tension that does not induce any vibrations. Provide slack on the hoist winch or grip-puller only as needed. Tension must be maintained on the back haul

winch with minimum slack on the hoist winch until the tower reaches the balance point and the weight transfers to the hoist winch. At that point the roles transfer and the hoist winch controls the decent and the back haul winch stabilizes the tower from buckling in the middle.

**It is critical to have an observer at one of the side anchors watching the tower.** From the hoist location it is not possible to tell if the tower is **bowing toward the hoist side** in the middle and in danger of buckling. If this happens it is **necessary** to take up more tension on the back haul until the tower straightens. It is also helpful to reduce tension on the top guy wire leash. As the tension on the back haul is increased the tower will pop back into a straight condition. If the tower is bowing below the back haul attached guy wire then there is tension on both the hoist and the back haul and they are compressing the tower. The tower will take on an S shape. In this case it is **critical** to slack either the hoist winch or the back haul winch. Always make slow and careful adjustments and make sure the correction is having the desired effect.

Once the tower has tilted past 20° from vertical, the weight of the tower pipe against gin-pole guy cables will provide adequate tension and stability to safely tilt the tower to the horizontal position, using the hoist winch or grip-puller.

When lowering the tower, use the same caution as when raising it. Monitor the tension of the side guy cables to prevent over-tension. If foundation attachments are properly placed, the side guys should have increasing slack as they are lowered. This allows the tower to raise and lower without adjusting the guy cables.

The gin pole guy cables should tighten as the gin pole goes up. Monitor cables carefully and give them additional slack if necessary. If adjusted, check the gin pole for vertical, and do not remove this additional slack when next raising the tower.

Once the tower is down, ensure all saddle clamps are properly tightened with thread-locking compound and proper torque (see **Table 5**).

### **Step 11 (Re-Raising the Tower)**

At this point, it is recommended that a test lift be performed without the generator, following the instructions of Step 8. If the tower is vertically straight upon re-raising—without the need to adjust guy cables—the tower may be re-lowered and the wind generator installed.

### **Step 12 (Final Raising of the Tower)**

Approximately 4 feet from the end (top), block the tower 3 to four 4 above the ground. This will provide adequate clearance for attaching the wind turbine. Follow the instructions in the wind turbine Owner's Manual to assemble and attach the turbine to the tower.

When the generator is attached and ready, slowly and cautiously raise the tower again, per Step 8. *Note: The tower's balance point will occur at a different angle, now that the wind generator is attached, and wind will have a larger impact on the balance point.*

### ***Connect Final Guy Wire to the Outer Hoist Anchor***

Attach the free end of the final Ø5/16" guy wire to the outer hoist anchor turnbuckle with a 5/16" HD thimble through the jaw of the turnbuckle. Pull the guy cable taut and secure it with three (3) 5/16" saddle clamps. Refer to the saddle clamp installation procedure and illustration in **Figure 9.7**.

Tension this wire in the same way the other guys were tensioned in Step 9 (tower adjustment). Refer to **Table 6** and **Table 7** for tension values. Then slack the Ø5/16" guy wire that attaches to the gin pole end as it is now redundant and the load should be carried by the outer-hoist guy wire and foundation.

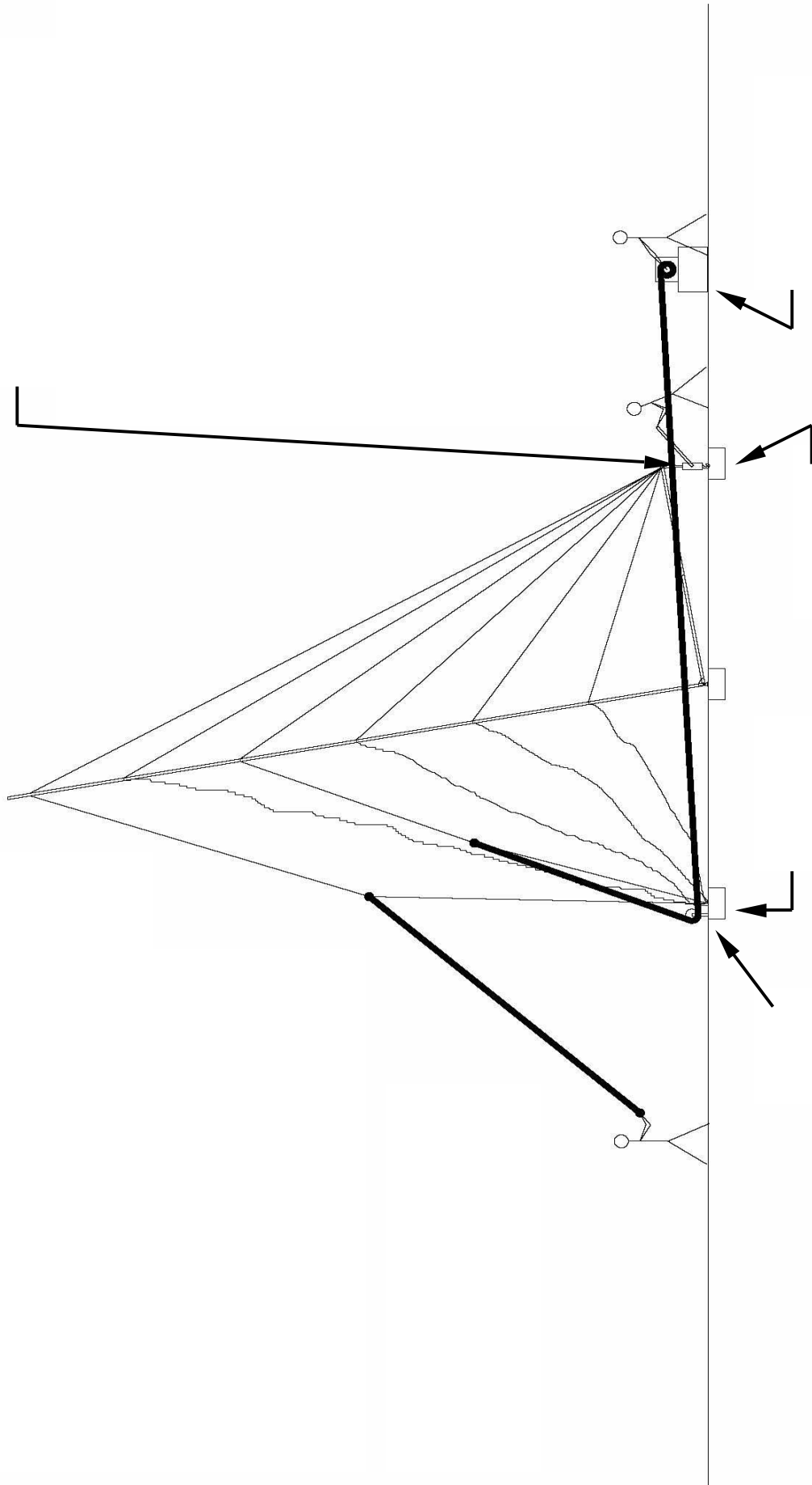


Figure 12



**VERY IMPORTANT**

**NOTE:** Weave guy cable “dead” end through turnbuckle eyes and bodies to prevent inadvertent loosening of turnbuckles

**Step 13 (Final Check)**

Before leaving the site, make a final check of all cables and hardware. Ensure that each shackle is secured with a nut and cotter pin. All turnbuckle jaw bolts should have bolts with Nylok nuts, securing the jaw ends.

**VERY IMPORTANT NOTE:** Weave the “dead” end of one guy cable through the turnbuckle eyes and bodies to prevent loosening at each equalizer plate **and** for the outer hoist anchor turnbuckle (see **Figure 13.1**).

**If a turnbuckle loosens, it may result in a catastrophic tower failure.**

Although it is advised that the gin pole guy cables be left in place, these are a tripping hazard – as they are near to the ground – and should be marked with surveyors tape. If the gin pole guy cables must be removed, cable lengths should be marked for accurate reassembly. **Never lower or raise the tower without the gin pole guy cables attached.**

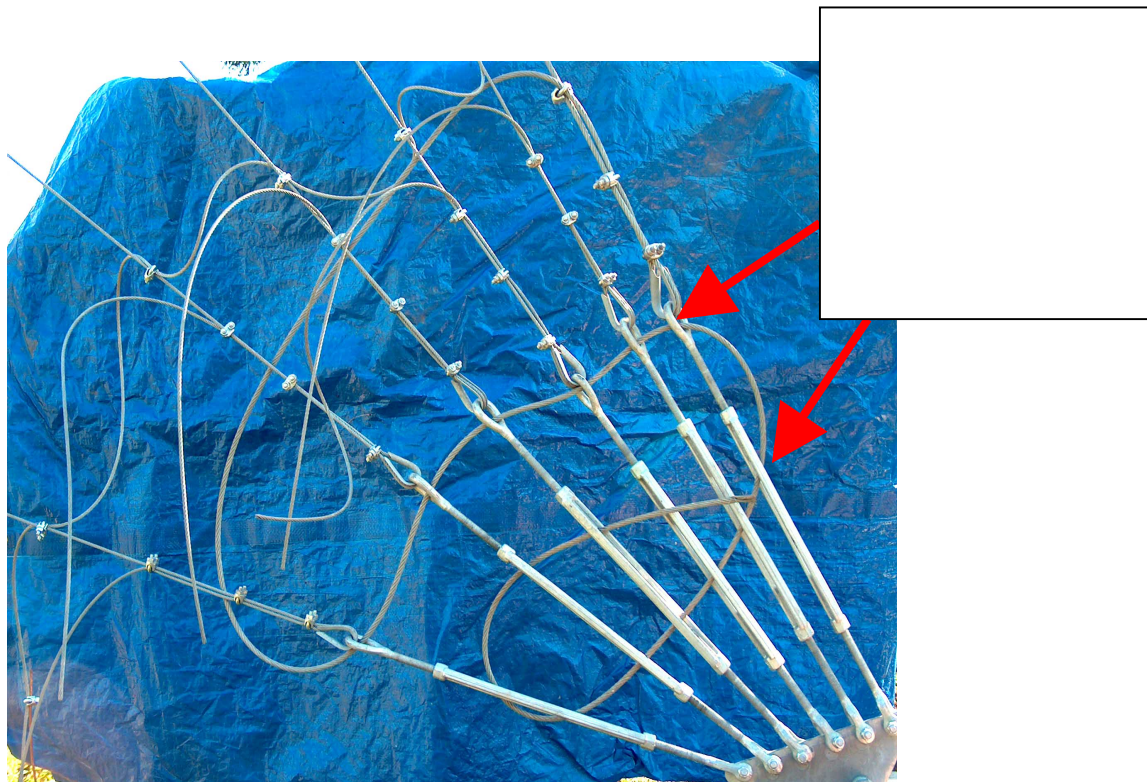


Figure 13.1

**10) Tower Maintenance**

The tower should be inspected every six (6) months at minimum:

- Ensure that all hardware is tight.
- Ensure proper tension in the guy cables.
- Inspect for corrosion; if found, remove any scale, clean, and add paint.



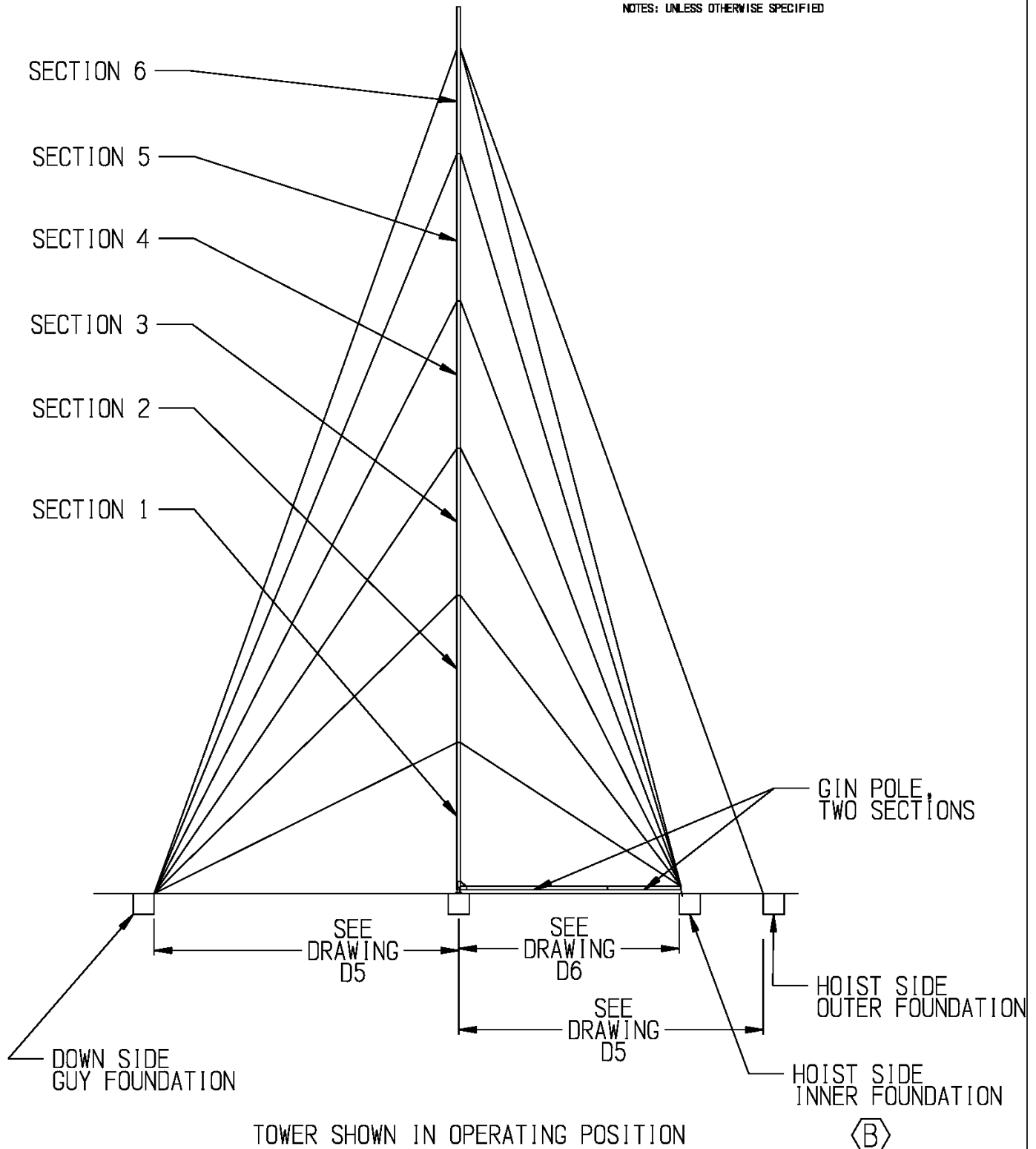
## Appendix: Drawings



# 4 INCH PIPE TOWER

DRAWING NO. D1-127			REV B
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HAMMOND
B	ADDED HOIST SIDE INNER FOUNDATION	07/13/09	A. HAMMOND

NOTES: UNLESS OTHERWISE SPECIFIED



UNLESS OTHERWISE SPECIFIED:  
 DIMENSIONS ARE IN INCHES  
 TOLERANCES:  
 LINEAR  
 FRACTION  $\pm 1/16"$   
 .XX  $\pm .02$   
 .XXX  $\pm .005$   
 ANGULAR  
 $\pm 1.0^\circ$

MODEL NUMBER: 4 IN. GPT	DATE 06/22/09
WIND TURBINE: ARE110	DATE 06/22/09
LEGEND ○ REVISION ○ ITEM ▭ NOTE	DATE 06/22/09
DRAWN A. HAMMOND	DATE 06/22/09
CHECKED E. DRAPER	DATE 06/22/09

ABUNDANT RENEWABLE ENERGY	
DRAWING TITLE TOWER PROFILE IN OPERATING POSITION, 127 FT	
SCALE NONE	THIS DRAWING IS THE PROPERTY OF ABUNDANT RENEWABLE ENERGY. ALL RIGHTS OF DESIGN OR INVENTION RESERVED. REPRODUCTIONS ARE FORBIDDEN WITHOUT WRITTEN CONSENT.
DRAWING NO. D1-127	SHEET 1 OF 1
	REV B

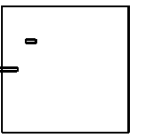








4 INCH PIPE TOWER

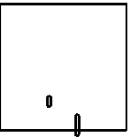


DOWN SIDE FOUNDATION  
POSITION: D5  
FOUNDATION: D8, D12

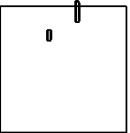
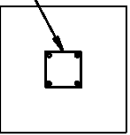
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANNOUD
B	ADDED WINCH FOUNDATION, HOIST SIDE INNER FOUNDATION AND SUPPLIED DRAWING CALLOUTS	07/19/09	A. HANNOUD

NOTES: UNLESS OTHERWISE SPECIFIED

LEFT SIDE FOUNDATION  
POSITION: D4  
FOUNDATION: D8, D12



CENTER FOUNDATION  
FOUNDATION: D9, D10, D11

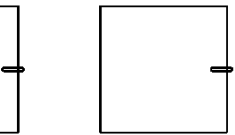


RIGHT SIDE FOUNDATION  
POSITION: D4  
FOUNDATION: D8, D12

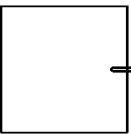
TOWER BASE



WINCH FOUNDATION  
POSITION: D14  
FOUNDATION: D13



HOIST SIDE INNER FOUNDATION  
POSITION: D5, D6  
FOUNDATION: D7, D12



HOIST SIDE OUTER FOUNDATION  
POSITION: D5  
FOUNDATION: D7, D12

UNLESS OTHERWISE SPECIFIED,  
DIMENSIONS ARE IN INCHES

MODEL NUMBER:  
4 IN. GPT

WIND TURBINE:  
ARE110

ABUNDANT RENEWABLE ENERGY  
DRAWING TITLE  
FOUNDATION LAYOUT OVER VIEW 127 FT

FRACTION ± 1/16"

.XX ± .02

.XXX ± .005

ANGULAR  
± 1.0°

LEGEND  
ITEM NOTE

DATE	DATE	DATE
06/22/09	06/22/09	06/22/09
A. HANNOUD	E. DRAPER	
DRAWN	CHECKED	APP

SCALE  
NONE

DRAWING NO. D3-127

SHEET 1 OF 1 B

THIS DRAWING IS THE PROPERTY OF ABUNDANT RENEWABLE ENERGY. ALL RIGHTS OF DESIGN OR INVENTION RESERVED. REPRODUCTION AND TRANSMISSION IS STRICTLY PROHIBITED WITHOUT CONSENT.

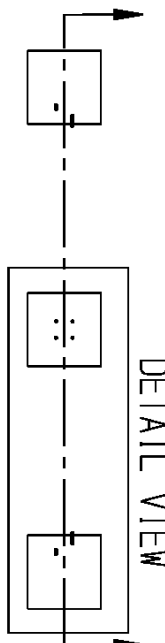
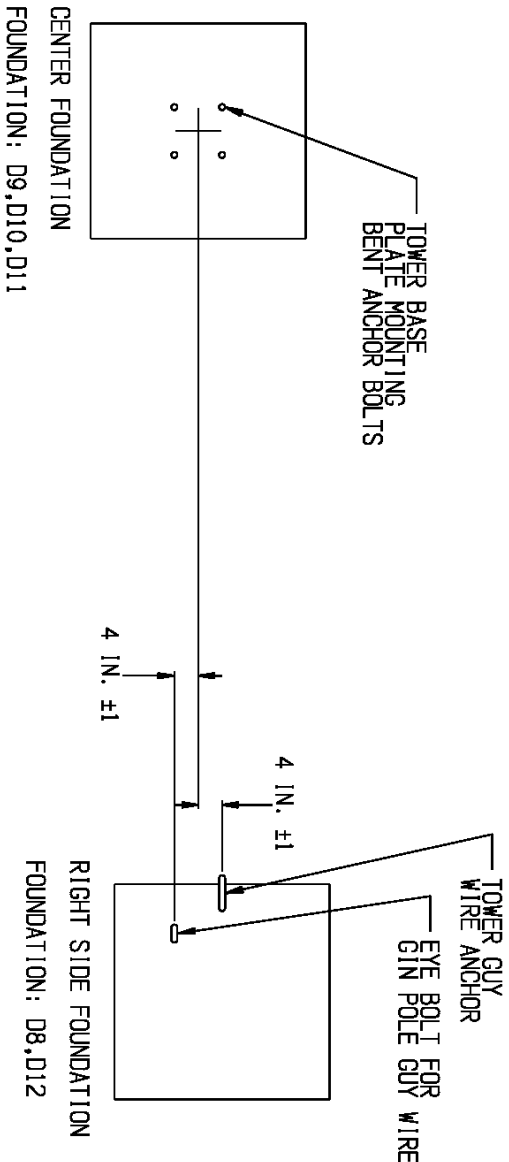


4 INCH PIPE TOWER

RIGHT SIDE SHOWN  
LEFT SIDE OPPOSITE  
DOWN SIDE  
HOIST ANCHORS ARE CENTERED



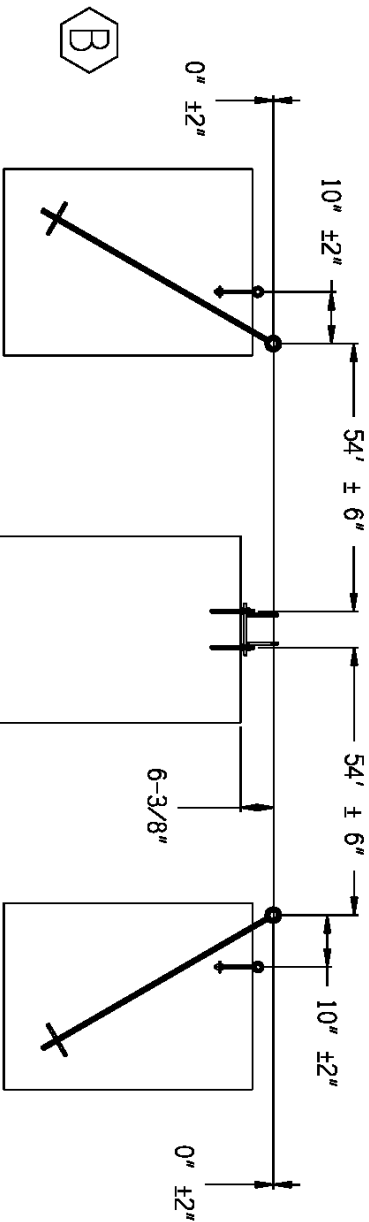
1. NOT TO SCALE
2. HOIST SIDE INNER AND OUTER ANCHORS ARE CENTERED WHEN VIEWED FROM THE TOP, THERE IS NO 4" OFFSET.
3. DOWNSIDE ANCHOR EYEBOLTS CAN BE ON EITHER SIDE OF THE ANCHOR



LEFT SIDE FOUNDATION  
FOUNDATION: D8, D12

CENTER FOUNDATION

RIGHT SIDE FOUNDATION



UNLESS OTHERWISE SPECIFIED,  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .003  
ANGULAR ± 1.0°

MODEL NUMBER:  
4 IN. GPT  
WIND TURBINE:  
ARE110

DATE: 06/22/09  
BY: A. HANNOUD  
CHECKED: E. DRAPER

ABUNDANT RENEWABLE ENERGY  
DRAWING TITLE  
ANCHOR POSITION, RIGHT AND LEFT SIDE, 127 FT  
SCALE: NONE

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANNOUD
B	COMBINED 04-127 AND 05-127	07/19/09	A. HANNOUD

DRAWING NO. D4-127 SHEET 1 OF 1

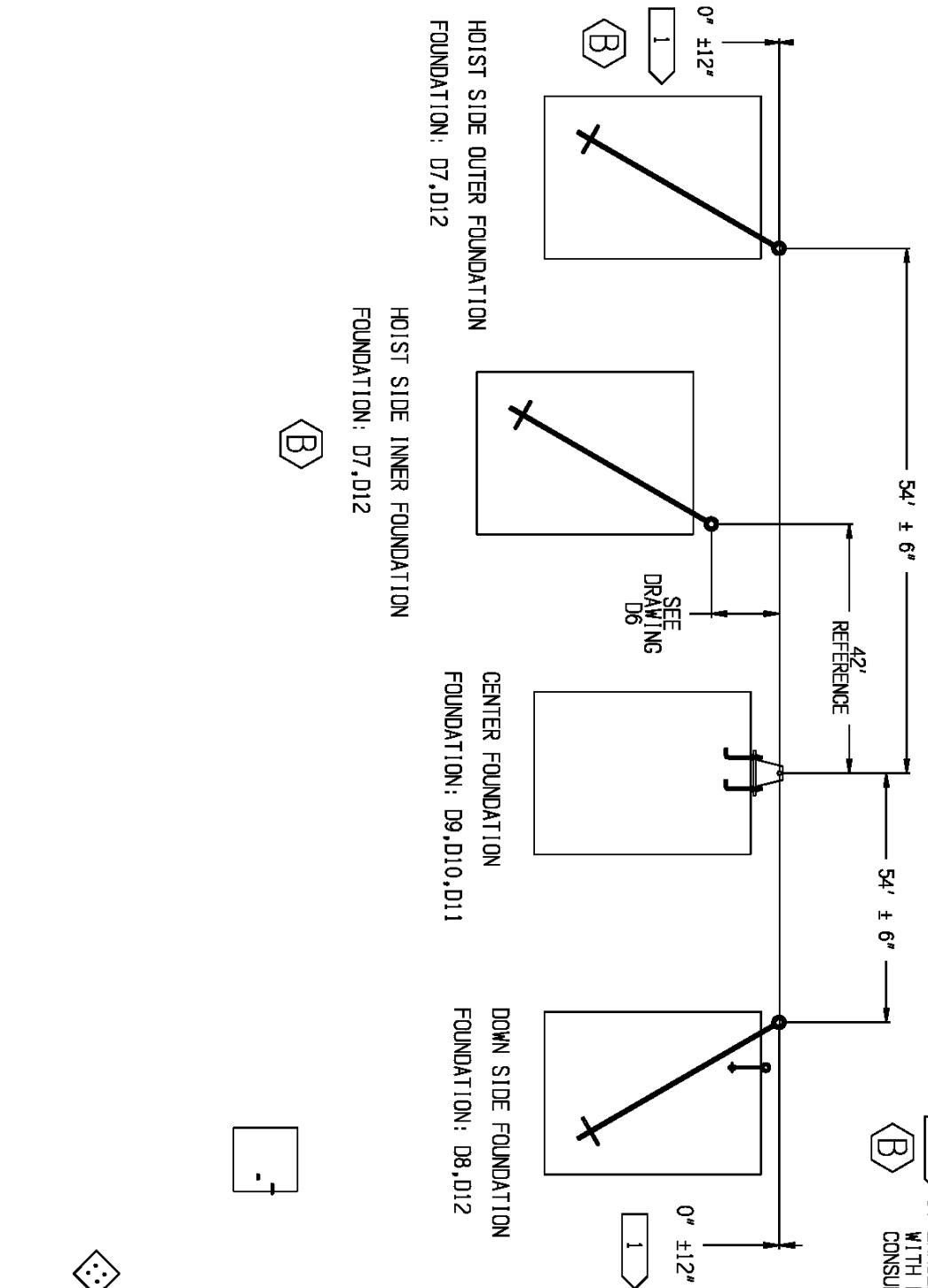


4 INCH PIPE TOWER

DRAWING NO. 05-127		REV. BY	B
REV. A	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HAMMOND
B	ADDED HOIST SIDE INNER FOUNDATION.	07/13/09	A. HAMMOND
	ADDED NOTE 1. DRAWING NAME WAS 05-127		

NOTES: UNLESS OTHERWISE SPECIFIED

1. LARGER VARIATIONS ARE PERMISSIBLE WITH HORIZONTAL PLACEMENT ADJUSTMENTS. CONSULT ARE FOR SPECIAL CASES.



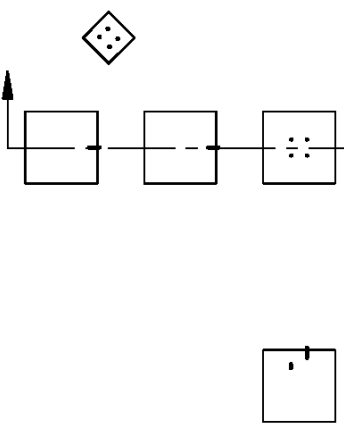
HOIST SIDE OUTER FOUNDATION  
FOUNDATION: D7, D12

HOIST SIDE INNER FOUNDATION  
FOUNDATION: D7, D12

CENTER FOUNDATION  
FOUNDATION: D9, D10, D11

DOWN SIDE FOUNDATION  
FOUNDATION: D8, D12

DETAIL VIEW



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR ± 1/16"  
FRACTION ± .02  
XXX ± .005  
ANGULAR ± 1.0°

MODEL NUMBER: 4 IN. GPT	WIND TURBINE: ARE110	DRAWN BY: A. HAMMOND	DATE: 06/22/09
LEGEND	REVISION ITEM	DESIGNED BY: D. BARBER	DATE: 07/22/09

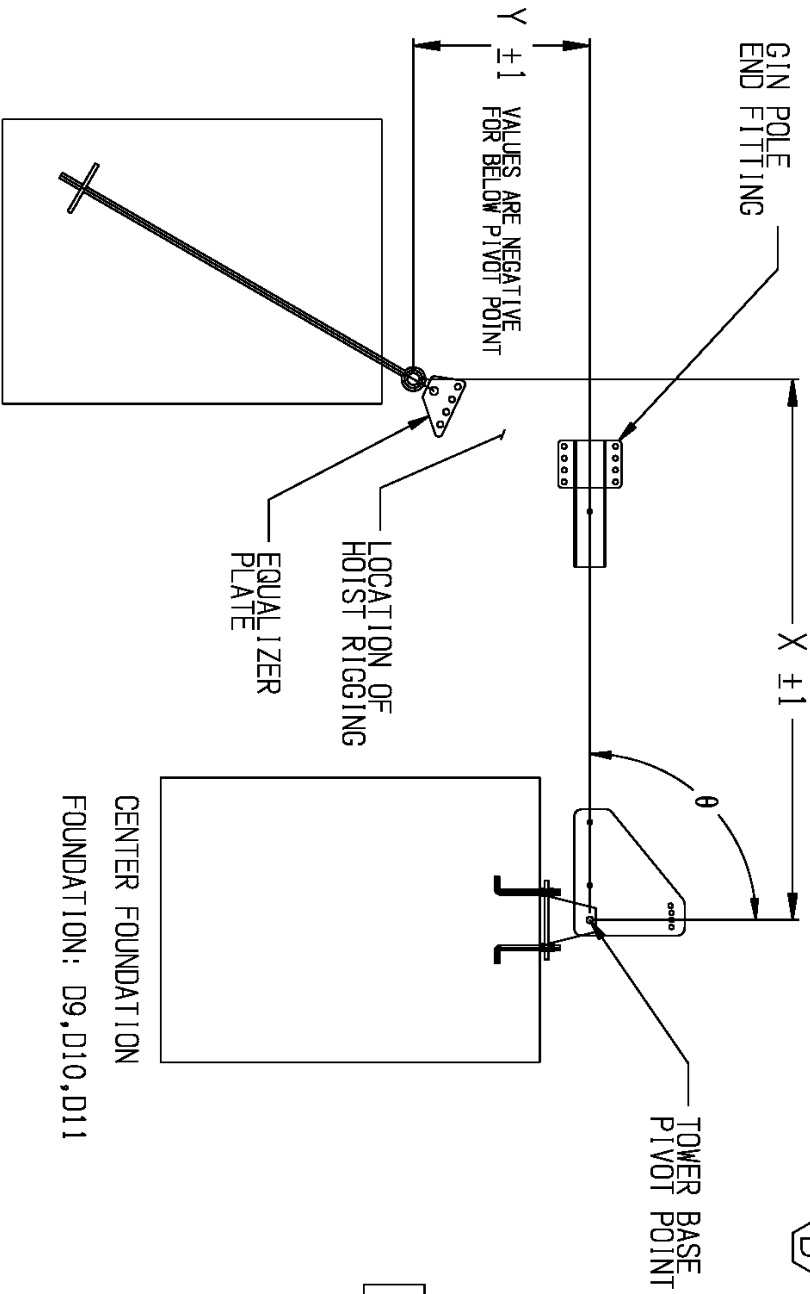
ABUNDANT RENEWABLE ENERGY  
DRAWING TITLE  
ANCHOR POSITION, OUTER HOIST & DOWN SIDE, 127 FT  
SCALE NONE  
DRAWING NO. 05-127  
SHEET 1 OF 1



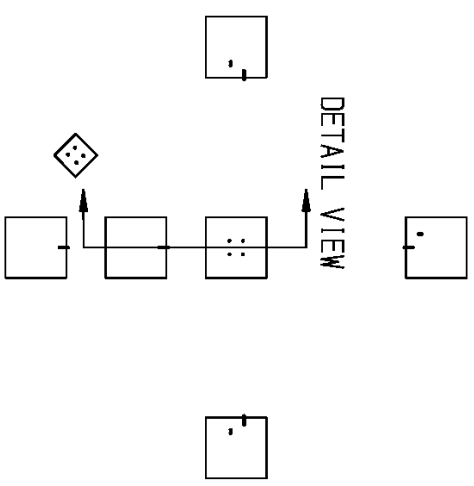
4 INCH PIPE TOWER

**B** 1 POSSIBLE LOCATIONS FOR HOIST ANCHOR

X ±2"	Y ±2"	GIN POLE GUSSET HOLE	θ
42' 8"	+5' 6"	1	80°
43' 3"	+1' 10"	2	85°
43' 5"	-1' 10"	3	90°
43' 2"	-5' 7"	4	95°



- NOTES: UNLESS OTHERWISE SPECIFIED
- 1. WHEN LAYING FOUNDATION: POSITION THE EYE BOLT IN ONE OF THE 4 AVAILABLE POSITIONS AS DETERMINED BY THE TABLE. NOTE THE HOLE NUMBER THAT RELATES TO THE CHOSEN POSITION.
  - 2. GUSSET HOLE #3 CREATES A 90° ANGLE BETWEEN THE GIN POLE AND THE TOWER BASE SECTION (SHOWN)



HOIST SIDE  
INNER FOUNDATION  
FOUNDATION: D7, D12

CENTER FOUNDATION  
FOUNDATION: D9, D10, D11

UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES

TOLERANCES:  
LINEAR FRACTION ± 1/16"  
ANGULAR ± 1.0°

MODEL NUMBER: 4 IN. GPT	DATE: 06/22/09
WIND TURBINE: ARE110	DATE: 06/22/09
LEGEND	DATE: 06/22/09
REVISION	DATE: 06/22/09

ABUNDANT RENEWABLE ENERGY

ANCHOR ELEVATION, HOIST SIDE, 127 FT

SCALE NONE

DRAWING NO. D6-127

SHEET 1 OF 1

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A.HAMMOND
B	ADDED NOTE 1, PREVIOUS NOTE 1 IS NOW NOTE 2	07/13/09	A.HAMMOND

DRAWING NAME WAS D7-127

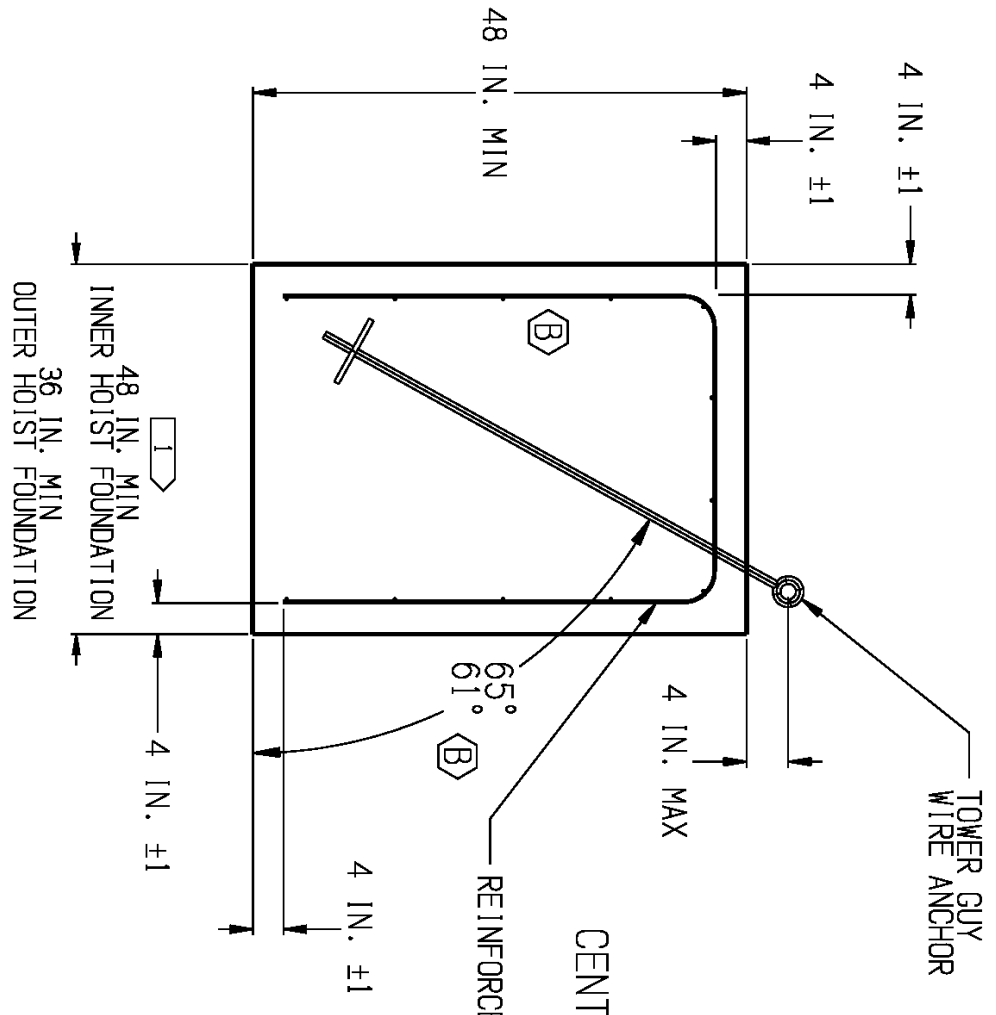




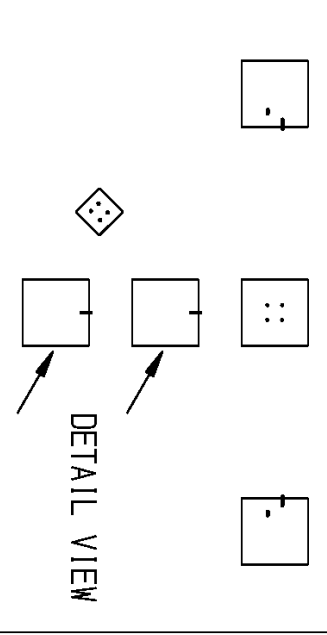
4 INCH PIPE TOWER

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANMOND
B	REINFORCEMENT WAS L-SHAPED, ANGLE WAS 60°	07/13/09	A. HANMOND
	DRAWING NAME WAS D8-127		

- NOTES: UNLESS OTHERWISE SPECIFIED
- FOUNDATION DEPTH IS A MINIMUM OF 4 FEET OR MAXIMUM FROST DEPTH WHICH EVER IS GREATER AND 4 FEET SQUARE FOR INNER HOIST ANCHOR FOUNDATION AND 3 FOOT SQUARE FOR OUTER HOIST ANCHOR FOUNDATION.
  - MINIMUM CONCRETE STRENGTH 2500 PSI
  - ALLOW CONCRETE TO SET 28 DAY
  - CAST CONCRETE INTO HOLE WITH UNDISTURBED SOIL
  - FOR NORMAL COHESIVE TYPE SOIL WITH A HORIZONTAL BEARING CAPACITY OF 250 POUNDS PER SQUARE FOOT PER LINEAL FOOT OF DEPTH AND VERTICAL BEARING CAPACITY OF 2500 POUNDS PER SQUARE FOOT. ROCK NON-COHESIVE SOILS, OR SATURATED OR SUBMERGED SOILS ARE NOT TO BE CONSIDERED NORMAL.



CROSS-SECTION OF INNER AND OUTER HOIST SIDE GUY WIRE ANCHOR FOUNDATIONS



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .005  
ANGULAR ± 1.0°

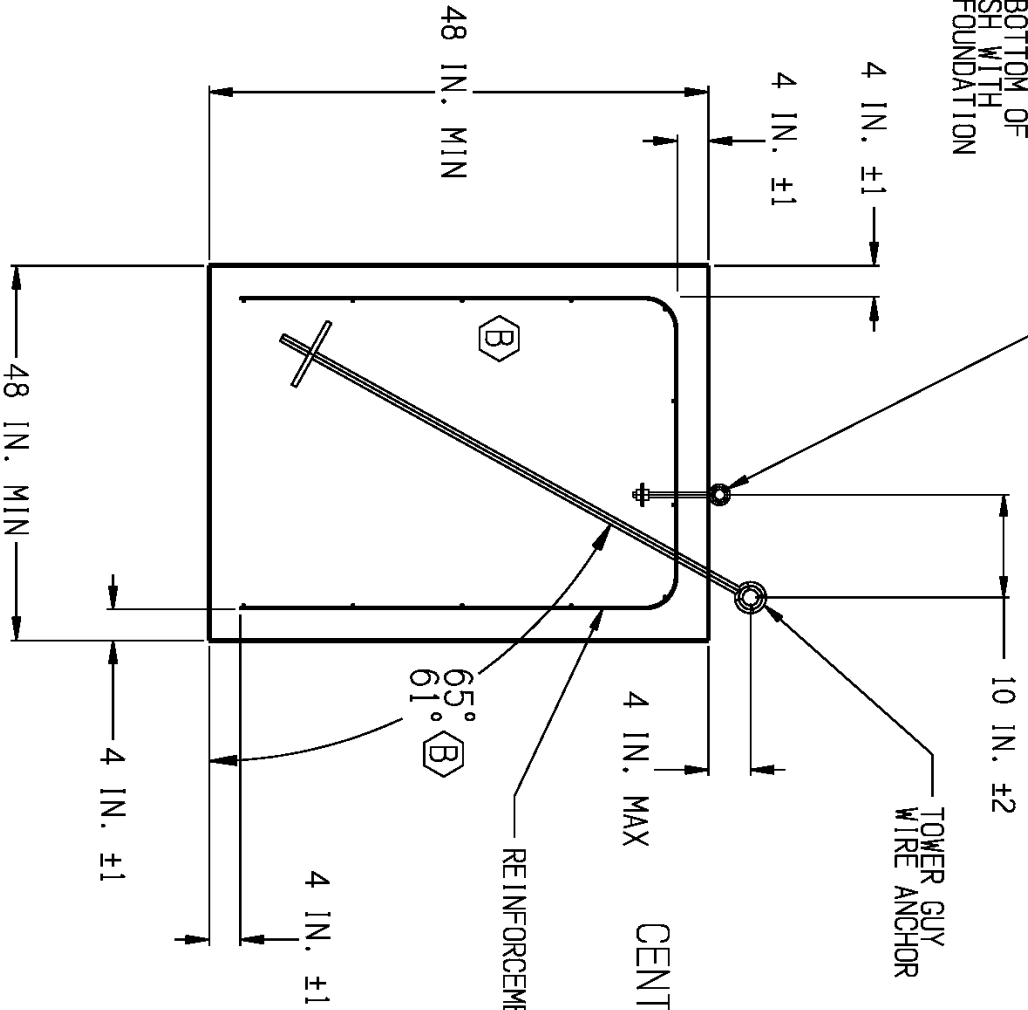
MODEL NUMBER: 4 IN. GPT AND TURBINE: ARE 110	LEGEND	NOTE
REVISION 1	1784	

ABUNDANT RENEWABLE ENERGY	
DRAWING TITLE	FOUNDATION, INNER AND OUTER HOIST SIDE, 127 FT
SCALE	NONE
DRAWING NO.	D7-127
SHEET 1 OF 1	B



4 INCH PIPE TOWER

1/2" X 8" EYE BOLT  
GIN POLE GUY WIRE ANCHOR  
LOCATE BOTTOM OF  
EYE FLUSH WITH  
TOP OF FOUNDATION

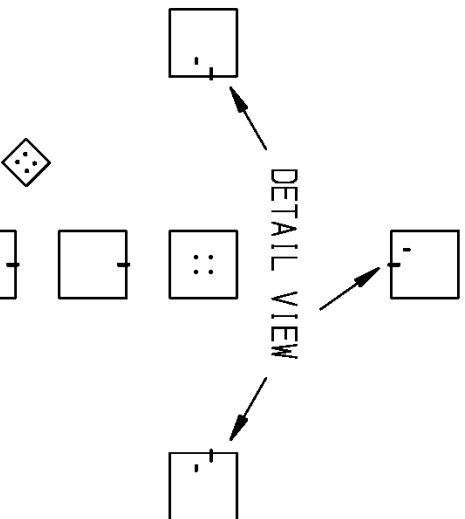


CENTER FOUNDATION

REINFORCEMENT DRAWING: D12

- NOTES: UNLESS OTHERWISE SPECIFIED
1. FOUNDATION DEPTH 15A MINIMUM OF 4 FEET OR MAXIMUM FROST DEPTH WHICH EVER IS GREATEST AND 4 FEET SQUARE
  2. MINIMUM CONCRETE STRENGTH 2500 PSI
  3. ALLOW CONCRETE TO SET FOR 28 DAYS
  4. CAST CONCRETE INTO HOLE WITH UNDISTURBED SOIL
  5. FOR NORMAL COHESIVE TYPE SOIL WITH A HORIZONTAL BEARING CAPACITY OF 250 POUNDS PER SQUARE FOOT PER LINEAL FOOT OF DEPTH AND VERTICAL BEARING CAPACITY OF 2500 POUNDS PER SQUARE FOOT. ROCK NON-COHESIVE SOILS, OR SATURATED OR SUBMERGED SOILS ARE NOT TO BE CONSIDERED NORMAL.

CROSS-SECTION OF  
LEFT & RIGHT AND DOWN SIDE  
TOWER GUY WIRE ANCHOR FOUNDATIONS



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR  
FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .005  
ANGULAR  
± 1.0°

MODEL NUMBER:  
4 IN. GPT  
WIND TURBINE:  
ARE110

LEGEND  
REVISION ITEM

DATE 06/22/09  
A. HANMOND  
E. DRAPER

ABUNDANT RENEWABLE ENERGY

DRAWING TITLE  
FOUNDATION, LEFT, RIGHT AND DOWN SIDE, 127 FT

SCALE NONE

DRAWING NO. D8-127

SHEET 1 OF 1

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANMOND
B	REINFORCEMENT WAS L-SHAPED, ANGLE WAS 90° DRAWING NAME WAS D8-127	07/13/09	A. HANMOND

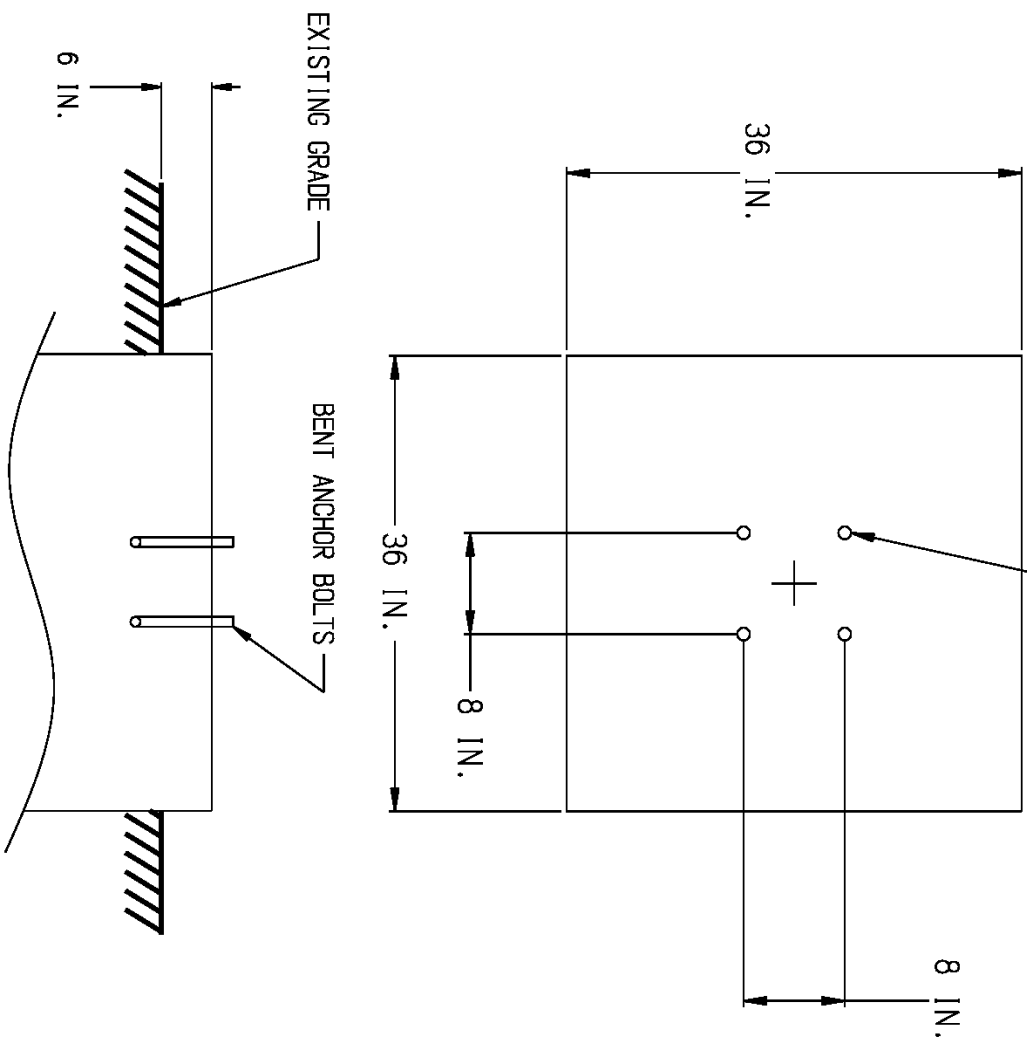


4 INCH PIPE TOWER

CENTER FOUNDATION

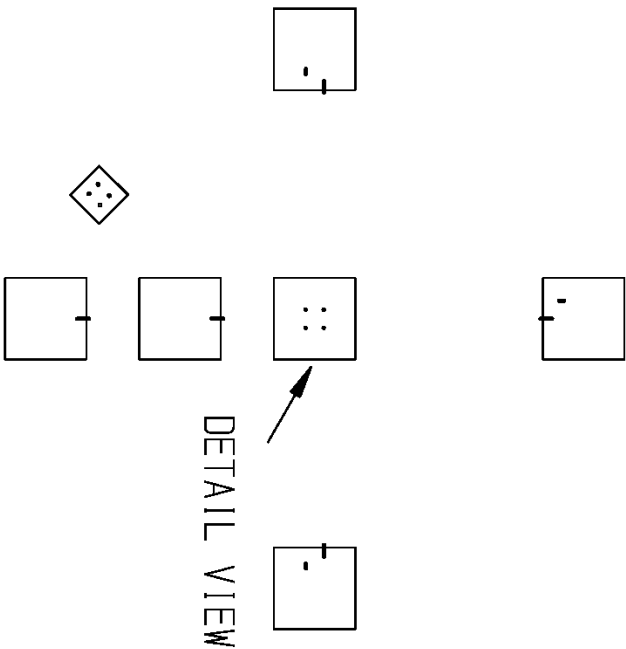
SEE DRAWINGS D10, D11

TOWER BASE ANCHORS  
4X 5/8" DIA X 8"  
BENT ANCHOR BOLTS



NOTES: UNLESS OTHERWISE SPECIFIED

1. ENSURE THAT BENT ANCHOR BOLTS ARE PLACED SO THAT THE TOWER BASE WILL BE SQUARE TO THE OTHER FOUNDATIONS
2. FOUNDATION DEPTH IS 4 FEET OR MAXIMUM FROST DEPTH WHICH EVER IS GREATEST AND 3 FEET SQUARE
3. FOR NORMAL COHESIVE TYPE SOIL WITH A HORIZONTAL BEARING CAPACITY OF 250 POUNDS PER SQUARE FOOT PER LINEAL FOOT OF DEPTH AND VERTICAL BEARING CAPACITY OF 2500 POUNDS PER SQUARE FOOT. ROCK NON-COHESIVE SOILS, OR SATURATED OR SUBMERGED SOILS ARE NOT TO BE CONSIDERED NORMAL.



DETAIL VIEW

UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES TOLERANCES: LINEAR FRACTION ± 1/16" XXX ± .02 .XXX ± .005 ANGULAR ± 1.0°		MODEL NUMBER: 4 IN. GPT WIND TURBINE: ARE110	DATE 06/22/09	DATE 06/22/09	DRAWING TITLE TOWER BASE ANCHORS, CENTER FOUNDATION, 127 FT
LEGEND	NOTE	DATE 06/22/09	DATE 06/22/09	SCALE NONE	THIS DRAWING IS THE PROPERTY OF ABUNDANT RENEWABLE ENERGY. ALL RIGHTS OF DESIGN OR INVENTION RESERVED. REPRODUCTIONS ARE PROHIBITED WITHOUT WRITTEN CONSENT.
REVISION	ITEM	DATE	DATE	DRAWING NO. D9-127	

ABUNDANT RENEWABLE ENERGY

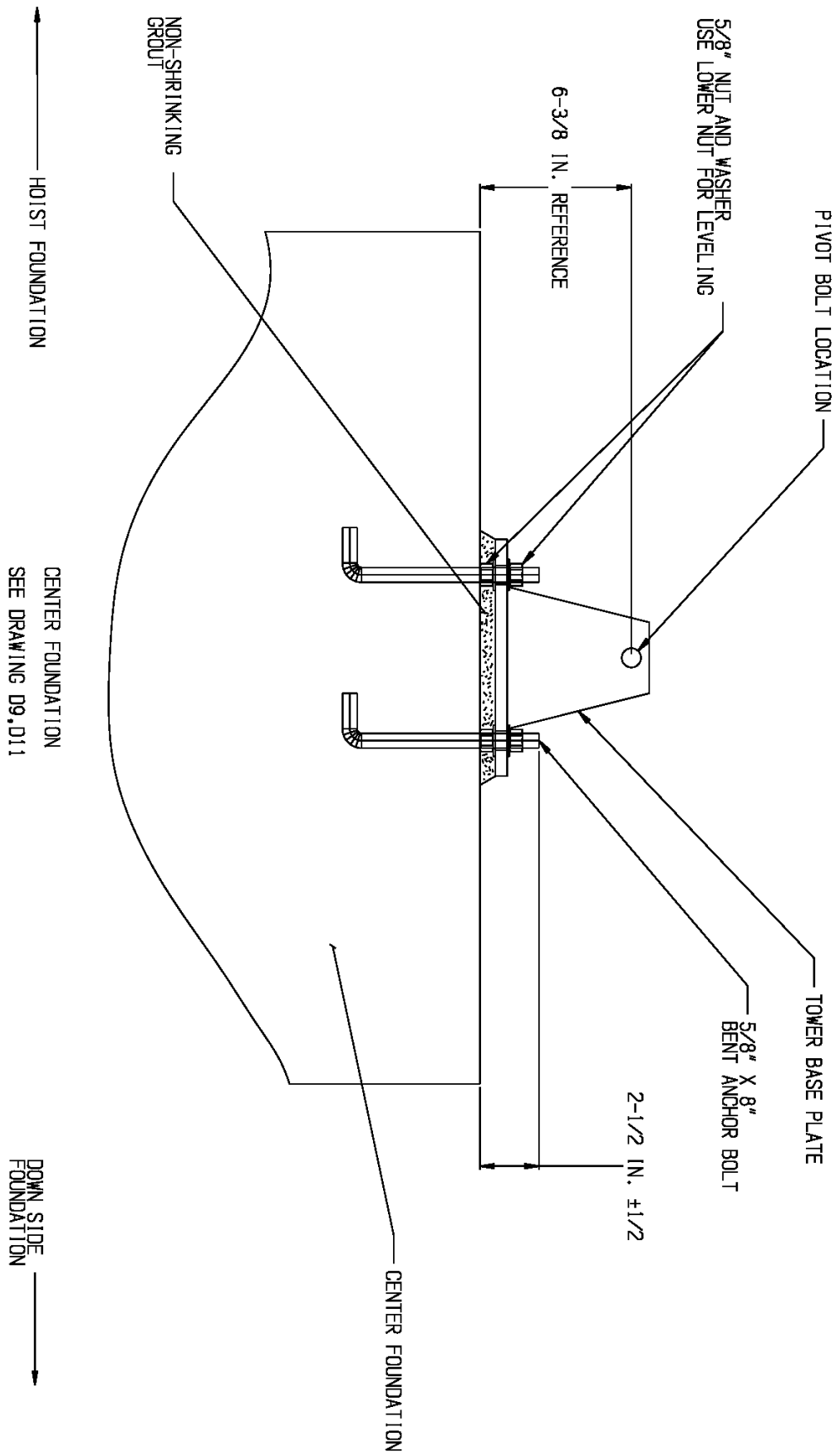
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANMOND
B	ADDED "FOR MAXIMUM FROST DEPTH" TO NOTE 2 DRAWING NAME WAS D10-127	07/13/09	A. HANMOND



4 INCH PIPE TOWER

DRAWING NO.	D10-127	REV	B
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HANMOND
B	HIDDEN LINES WERE NOT SHOWN, DRAWING NAME WAS D11-127	07/13/09	A. HANMOND

NOTES: UNLESS OTHERWISE SPECIFIED



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .005  
ANGULAR ± 1.0°

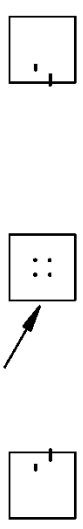
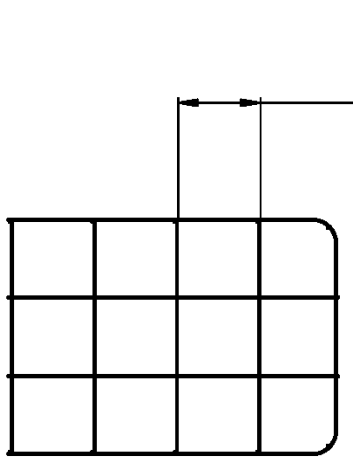
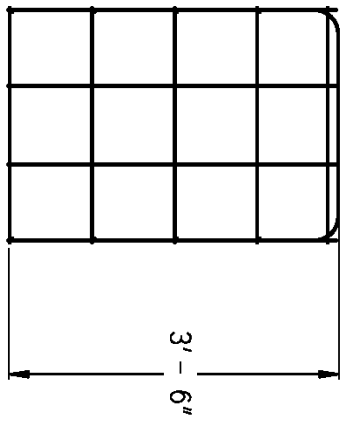
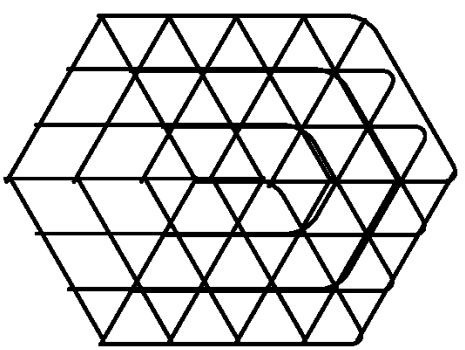
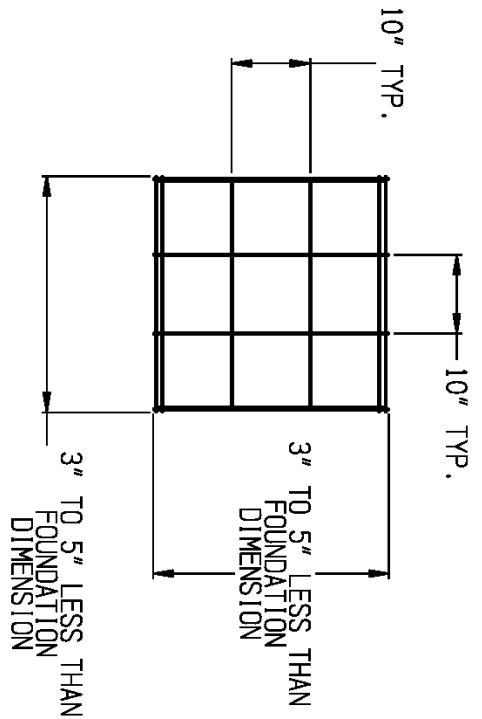
MODEL NUMBER: 4 IN. GP1	WIND TURBINE: ARE110	LEGEND	NOTE
REVISION	ITEM	REV	DATE
		06/22/09	07/22/09

ABUNDANT RENEWABLE ENERGY  
DRAWING TITLE  
BENT ANCHOR BOLT & TOWER BASE, 127 FT  
SCALE NONE  
DRAWING NO. D10-127  
SHEET 1 OF 1





4 INCH PIPE TOWER



FOUNDATION REINFORCEMENT

CENTER FOUNDATION REINFORCEMENT

UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES

TOLERANCES:

LINEAR  $\pm 1"$

ANGULAR  $\pm 1.0^\circ$

MODEL NUMBER:  
4 IN. GPT

MATERIAL:  
#3 OR #4 REBAR  
( $\varnothing 3/8"$  OR  $\varnothing 1/2"$ )

LEGEND  
REVISION ITEM

DRAWN BY:  
A. HAMMOND

DATE:  
06/22/09

DATE:  
06/22/09

ABUNDANT RENEWABLE ENERGY

DRAWING TITLE:  
CENTER FOUNDATION REINFORCEMENT, 127 FT

DRAWING NO. D11-127

- NOTES: UNLESS OTHERWISE SPECIFIED
1. MAXIMUM DIMENSIONS FOR A 4 FOOT DEEP, 3 FOOT SQUARE HOLE ADJUST FOR LARGER HOLES ENSURING THE REINFORCEMENT IS LOCATED 3 TO 5 INCHES FROM ANY SURFACE

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A. HAMMOND
B	DRAWING NAME WAS D12-127	07/13/09	A. HAMMOND

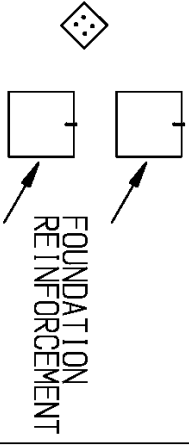
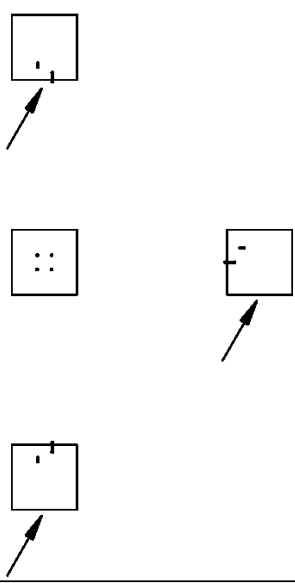
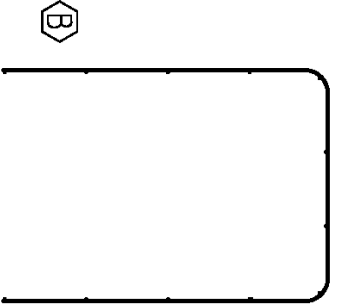
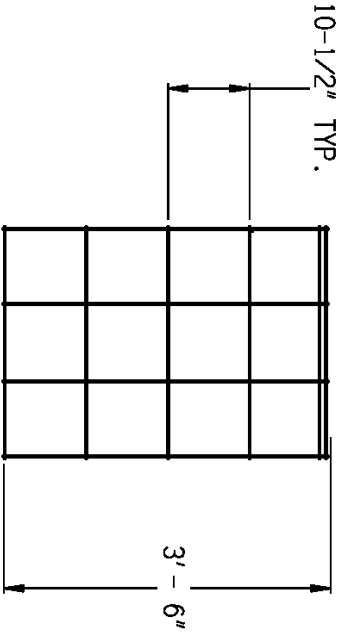
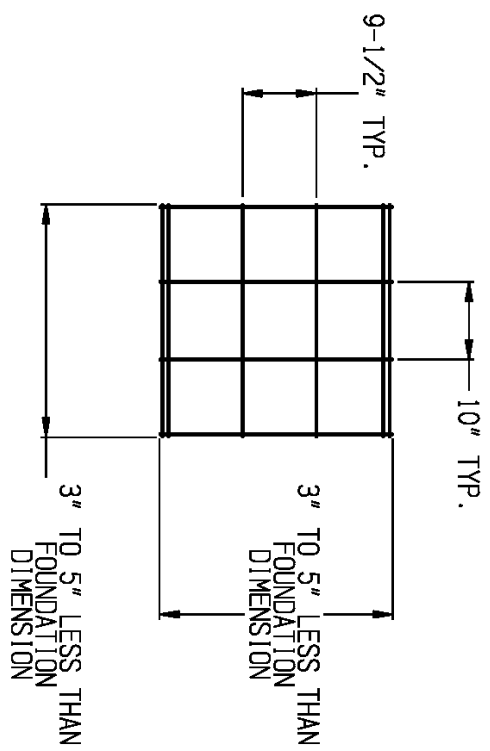
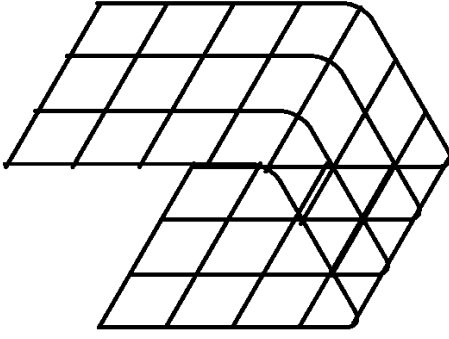


4 INCH PIPE TOWER

DRAWING NO. D12-127	REV B		
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A:HAMMOND
B	REINFORCEMENT WAS L-SHAPED DRAWING NAME WAS D13-127	07/13/09	A:HAMMOND

NOTES: UNLESS OTHERWISE SPECIFIED

1. MAXIMUM DIMENSIONS FOR A 4 FOOT DEEP, 3 OR 4 FOOT SQUARE HOLE ADJUST FOR LARGER HOLES ENSURING THE REINFORCEMENT IS LOCATED 3 TO 5 INCHES FROM ANY SURFACE
2. SEE D7 AND D8 FOR FOUNDATION DIMENSIONS FOR EACH GUY ANCHOR FOUNDATION.



FOUNDATION REINFORCEMENT FOR THE LEFT, RIGHT, DOWN, HOIST INNER AND HOIST OUTER FOUNDATIONS

ABUNDANT RENEWABLE ENERGY

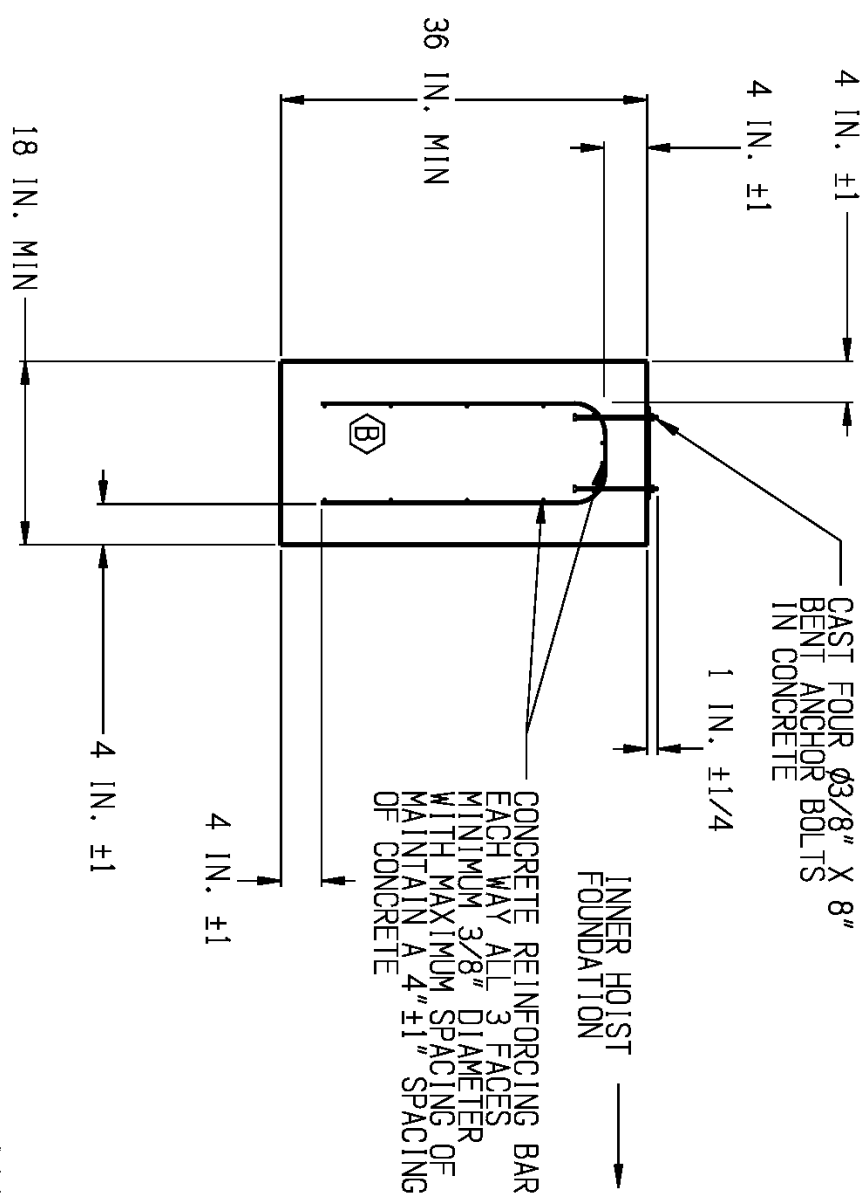
UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES	MODEL NUMBER: 4 IN. GPT
TOLERANCES: LINEAR ± 1" ANGULAR ± 1.0°	MATERIAL: #3 OR #4 REBAR (Ø3/8" OR Ø1/2")
LEGEND	DATE: 06/22/09
REVISION	DATE: 06/22/09
17th	BY: A:HAMMOND
NOTE	BY: DRAPER

DRAWING TITLE	DRAWING NO.	SHEET 1 OF 1
GUY ANCHOR FOUNDATION REINFORCEMENT, 127 FT	D12-127	B
SCALE NONE		
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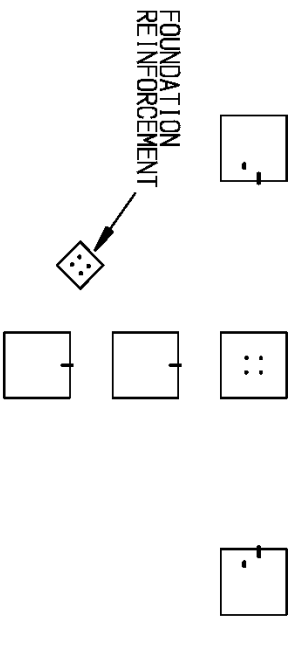


4 INCH PIPE TOWER

THIS FOUNDATION IS ONLY USED WITH AN ARE WINCH KIT. FOR OTHER WINCHES CONSULT MANUFACTURER'S SPECIFICATIONS FOR FOUNDATION REQUIREMENTS.



- NOTES: UNLESS OTHERWISE SPECIFIED
1. FOUNDATION IS A MINIMUM OF 3 FEET DEEP AND 1.5 FOOT SQUARE
  2. MINIMUM CONCRETE STRENGTH 2500 PSI
  3. ALLOW CONCRETE TO SET 28 DAYS.
  4. CAST CONCRETE INTO HOLE WITH UNDISTURBED SOIL.
  5. FOUNDATION MUST EXTEND BELOW FROST LEVEL.
  6. FOR NORMAL COHESIVE TYPE SOIL WITH A HORIZONTAL BEARING CAPACITY OF 250 POUNDS PER SQUARE FOOT PER LINEAL FOOT OF DEPTH, ROCK NON-COHESIVE SOILS, OR SATURATED OR SUBMERGED SOILS ARE NOT TO BE CONSIDERED NORMAL.



CROSS-SECTION OF WINCH FOUNDATION

UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .005  
ANGULAR ± 1.0°

MODEL NUMBER: 4 IN. OPT WIND TURBINE: ARE110	DATE: 06/22/09
LEGEND ITEM	DATE: 06/22/09
REVISION	DATE

DRAWING TITLE ABUNDANT RENEWABLE ENERGY FOUNDATION, WINCH PAD, 127 FT	
SCALE NONE	DRAWING NO. D13-127
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SHEET 1 OF 1	REV B

DRAWING NO.	D13-127	REV	B
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A.HAMMOND
B	REINFORCEMENT WAS L-SHAPED	07/13/09	A.HAMMOND
	DRAWING NAME WAS D14-127		



4 INCH PIPE TOWER

WINCH FOUNDATION IS ONLY USED WITH AN ARE WINCH KIT. FOR OTHER WINCHES CONSULT MANUFACTURER'S SPECIFICATIONS FOR FOUNDATION REQUIREMENTS.

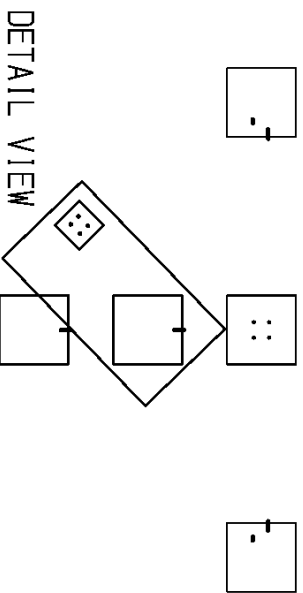


TOWER WINCH FOUNDATION FOR ARE WINCH KIT FOUNDATION: D13

2

REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	06/22/09	A.HANMOND
B	ADDED NOTE 1 AND 2 DRAWING NAME WAS D15-127	07/13/09	A.HANMOND

NOTES: UNLESS OTHERWISE SPECIFIED  
 1) WINCH FOUNDATION MAY BE AT ANY ANGLE RELATIVE TO THE HOIST SIDE ANCHOR FOUNDATION  
 2) THIS DIMENSION APPLIES TO THE WINCH KIT SUPPLIED BY ARE. FOR OTHER WINCHES FOLLOW MANUFACTURER'S RECOMMENDATIONS.



UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES		MODEL NUMBER: 4 IN. GPT	DATE 06/22/09	DATE 06/22/09	DATE 06/22/09
TOLERANCES: LINEAR FRACTION ± 1/16" .XX ± .02 .XXX ± .005 ANGULAR ± 1.0°		WIND TURBINE: ARE110	DATE 06/22/09	DATE 06/22/09	DATE 06/22/09
○	LEGEND	○	○	○	○
○	REVISION	○	○	○	○
○	NOTE	○	○	○	○
DRAWING NO. D14-127		DRAWING TITLE ABUNDANT RENEWABLE ENERGY		DRAWING NO. D14-127	
SCALE NONE		BENT ANCHOR BOLT AND WINCH FOUNDATION LOCATION, 127 FT		SHEET 1 OF 1	
THIS DRAWING IS THE PROPERTY OF ABUNDANT RENEWABLE ENERGY. ALL RIGHTS OF DESIGN OR INVENTION RESERVED. REPRODUCTION AND FURTHER DISTRIBUTION WITHOUT WRITTEN CONSENT.		DRAWN BY A. HANMOND		REV B	
		CHECKED BY E. DRAPER			

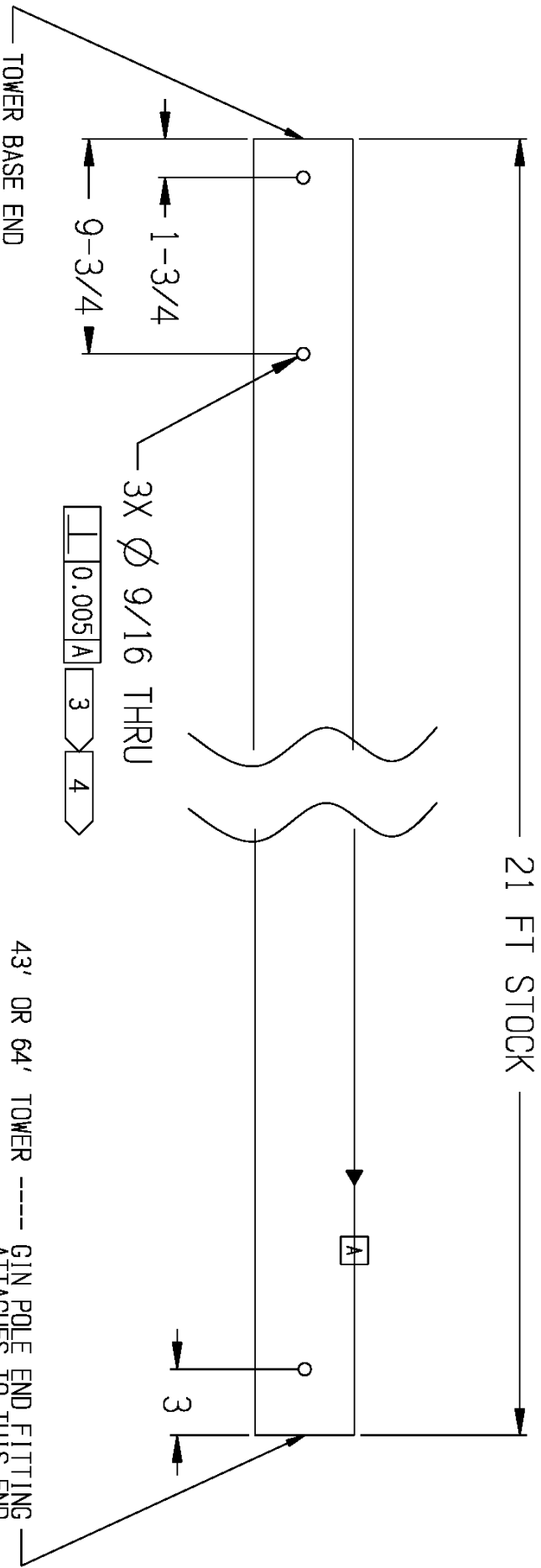
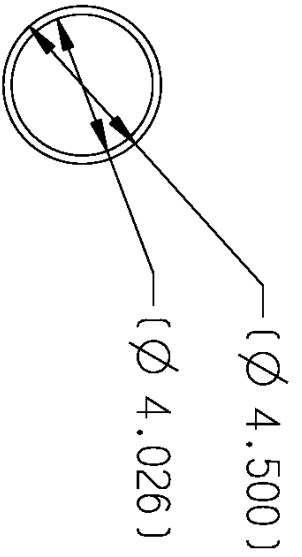




DRAWING NO. T-36-04-40-051		REV. A
REV. A	DESCRIPTION NEW RELEASE	DATE 04/10/08
		REV. BY D. WILLY

NOTES: UNLESS OTHERWISE SPECIFIED  
 1) INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

- 2) PARTS TO BE FREE FROM BURRS AND SHARP EDGES.  
 3) ALL THREE HOLES TO BE DRILLED PARALLEL TO EACH OTHER.  
 4) MACHINED SURFACES AND MINOR TOUCHUP TO BE DONE WITH COLD GALV. SPRAY PART # P-MSC-083.



43' OR 64' TOWER ----- GIN POLE END FITTING ATTACHES TO THIS END  
 85' OR TALLER TOWER - SECOND GIN POLE PIPE ATTACHES TO THIS END

UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES  
 TOLERANCES:  
 LINEAR FRACTION ± 1/16"  
 .XX ± .02  
 .XXX ± .005  
 ANGULAR ± 1.0°

MODEL NUMBER 4" PIPE TOWER	WEIGHT 226 LB
MATERIAL: 4" SCH-40 X 21' L PIPE ASTM A53 GR A GALV.	DATE 04/10/08
LEGEND	DATE 7/27/77
REVISION 1TH	DATE 04/09/09
NOTE	DATE 04/09/09

ABUNDANT RENEWABLE ENERGY  
 DRAWING TITLE  
 4" SCH 40 PIPE, DRILLED FOR GIN POLE BASE  
 SCALE NONE  
 DRAWING NO. T-36-04-40-051 SHEET 1 OF 1



DRAWING NO. T-36-04-40-052		REV	A
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	04/10/08	D. WILLY

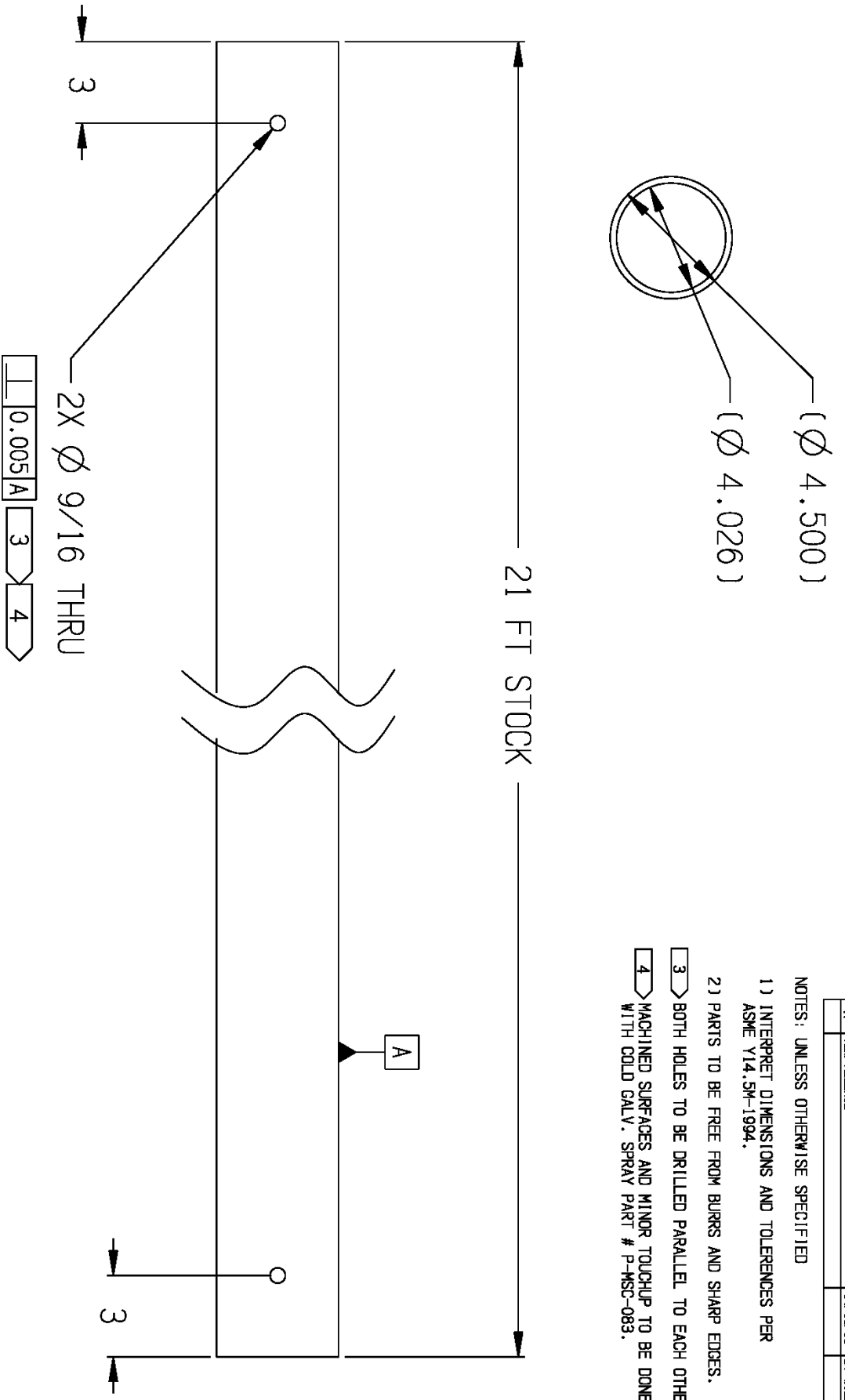
NOTES: UNLESS OTHERWISE SPECIFIED

1) INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

2) PARTS TO BE FREE FROM BURRS AND SHARP EDGES.

3 BOTH HOLES TO BE DRILLED PARALLEL TO EACH OTHER.

4 MACHINED SURFACES AND MINOR TOUCHUP TO BE DONE WITH GOLD GALV. SPRAY PART # P-MS-C-083.



UNLESS OTHERWISE SPECIFIED: DIMENSIONS ARE IN INCHES		MODEL NUMBER: 4" PIPE TOWER	WEIGHT	226 LB
TOLERANCES: LINEAR FRACTION $\pm$ 1/16" XX $\pm$ .02 .XXX $\pm$ .005 ANGULAR $\pm$ 1.0°		MATERIAL: 4" SCH-40 X 21'L PIPE ASTM A53 GR A GALV.	DATE	04/10/08
LEGEND	REVISION ITEM	NOTE	DATE	04/09/08
DRAWING TITLE ABUNDANT RENEWABLE ENERGY		SCALE	DRAWING NO. T-36-04-40-052	
DRAWING NO. T-36-04-40-052		SCALE	SHEET 1 OF 1	
THIS DRAWING IS THE PROPERTY OF ABUNDANT RENEWABLE ENERGY. ALL RIGHTS OF INVENTION RESERVED. REPRODUCTIONS ARE FORBIDDEN WITHOUT WRITTEN CONSENT.		DATE	REV	
		DATE	A	



DRAWING NO. T-36-04-40-053		REV	A
REV	DESCRIPTION	DATE	REV. BY
A	NEW RELEASE	04/10/08	D. WILLY

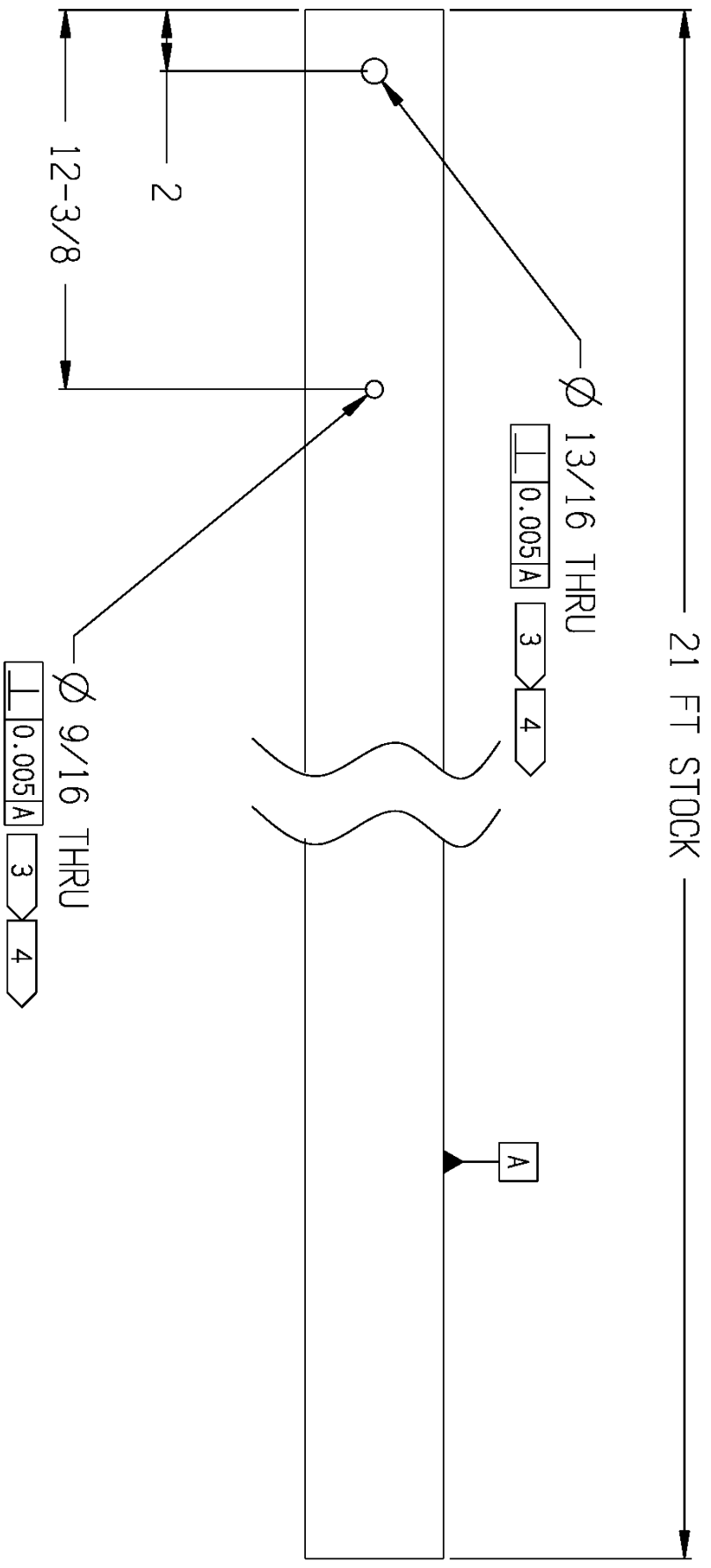
NOTES: UNLESS OTHERWISE SPECIFIED

1) INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.

2) PARTS TO BE FREE FROM BURRS AND SHARP EDGES.

3) BOTH HOLES TO BE DRILLED PARALLEL TO EACH OTHER.

4) MACHINED SURFACES AND MINOR TOUCHUP TO BE DONE WITH COLD GALV. SPRAY PART # P-MSC-083.



UNLESS OTHERWISE SPECIFIED, DIMENSIONS ARE IN INCHES. TOLERANCES:

LINEAR FRACTION  $\pm 1/16"$   
 .XX  $\pm .02$   
 .XXX  $\pm .005$   
 ANGULAR  $\pm 1.0^\circ$

MODEL NUMBER: 4" PIPE TOWER	WEIGHT 226 LB
MATERIAL: 4" SCH-40 X 21' L PIPE ASTM A53 GR A GALV.	DATE 04/10/08
LEGEND O REVISION 178M	DATE 7/7/77
NOTE E. DRAPER	DATE 04/09/09

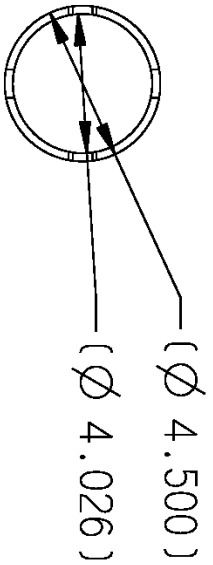
**ABUNDANT RENEWABLE ENERGY**

DRAWING TITLE  
4" SCH 40 PIPE, DRILLED FOR TOWER BASE SECTION

SCALE  
NONE

DRAWING NO. T-36-04-40-053 SHEET 1 OF 1

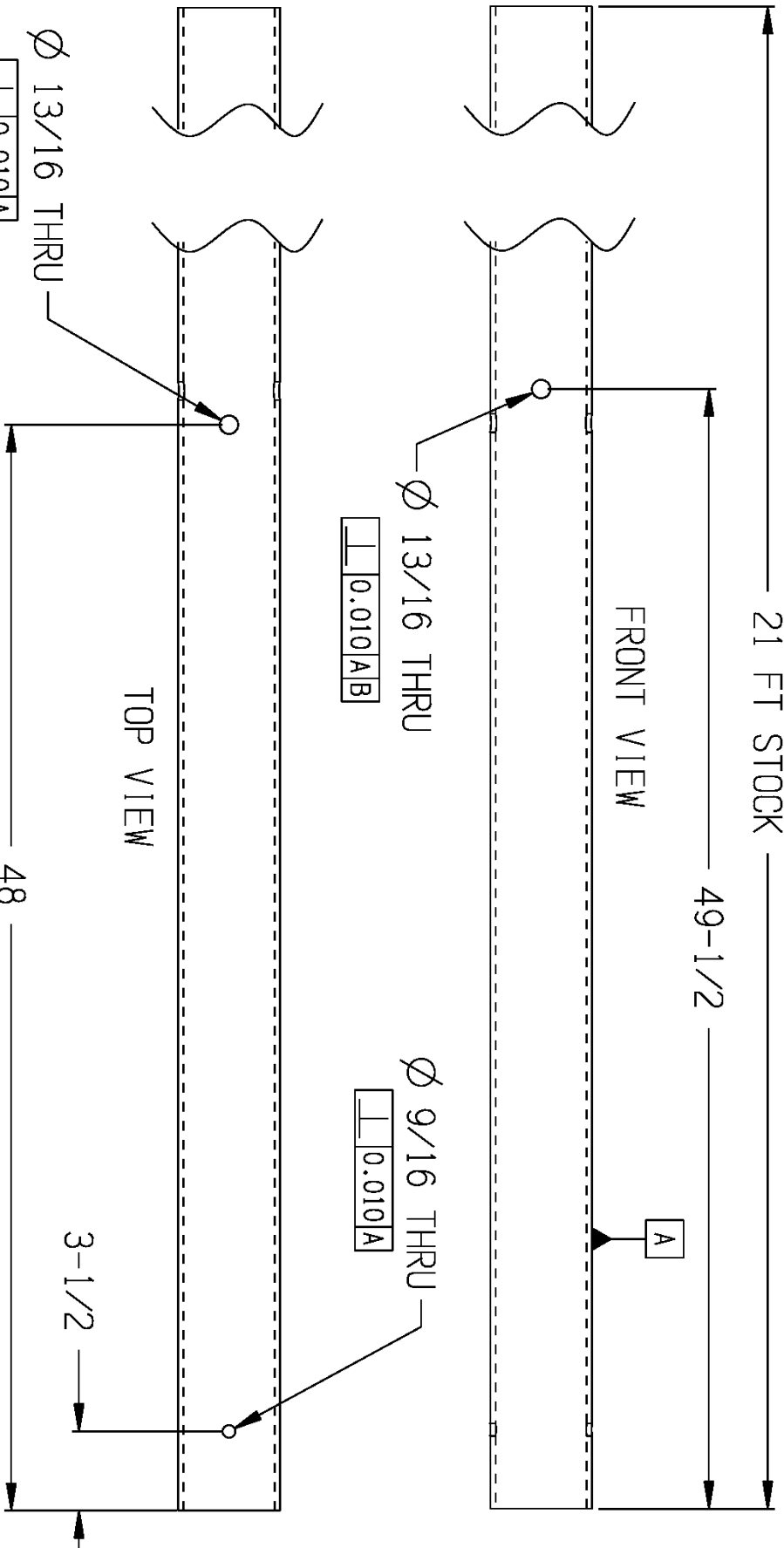




DRAWING NO. T-36-04-40-054		REV. A
REV. A	DESCRIPTION	DATE
A	NEW RELEASE	04/10/08
		D. WILLY

NOTES: UNLESS OTHERWISE SPECIFIED

- 1) INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- 2) PARTS TO BE FREE FROM BURRS AND SHARP EDGES.
- 3) MACHINED SURFACES AND MINOR TOUCHUP TO BE DONE WITH COLD GALV. SPRAY PART # P-MSC-083.



UNLESS OTHERWISE SPECIFIED:  
DIMENSIONS ARE IN INCHES  
TOLERANCES:  
LINEAR FRACTION ± 1/16"  
.XX ± .02  
.XXX ± .005  
ANGULAR ± 1.0°

MODEL NUMBER: 4" PIPE TOWER	WEIGHT 226 LB
MATERIAL: 4" SCH 40 x 21' L PIPE ASTM A53 GR A GALV.	DATE 04/10/08
LEGEND ○ REVISION 1TH	DATE 7/27/77
NOTE DRAWER	DATE 04/09/09

**ABUNDANT RENEWABLE ENERGY**

DRAWING TITLE  
4" SCH 40 PIPE, DRILLED FOR TOWER TOP

SCALE NONE

DRAWING NO. T-36-04-40-054 SHEET 1 OF 1

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