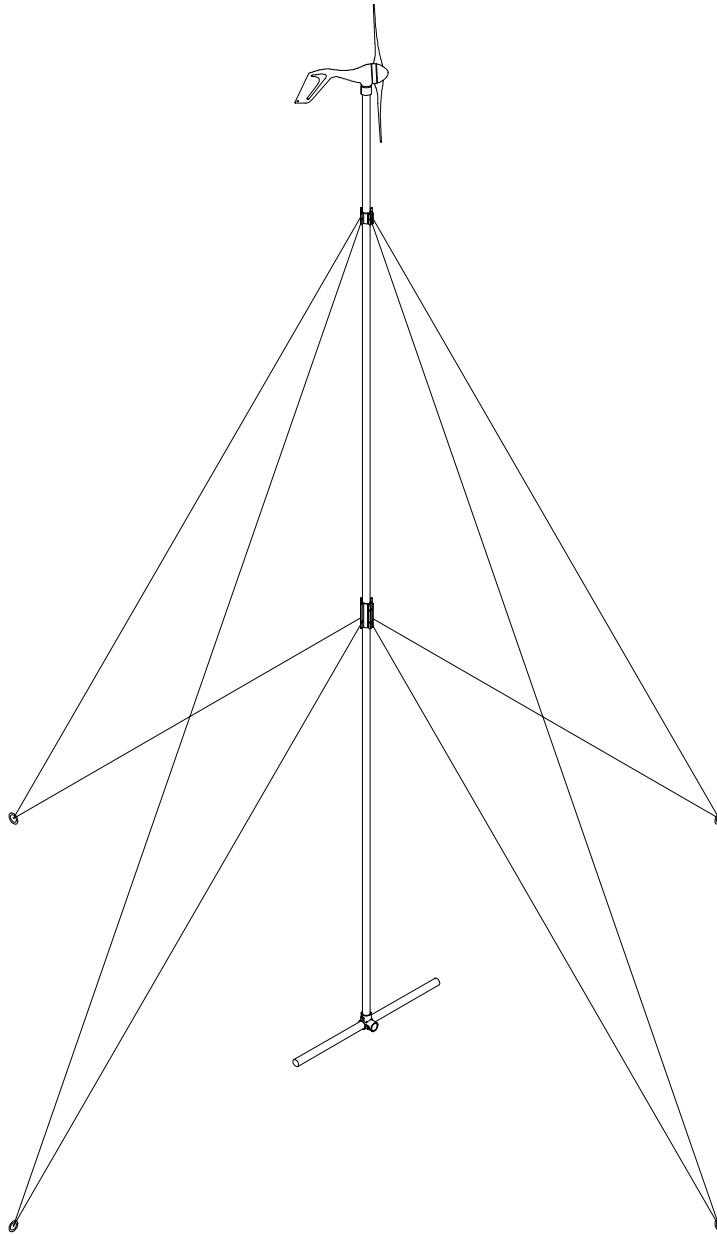


**45 FOOT LAND TOWER KIT**  
**For AIR<sub>m</sub> WIND MODULE**



**Made in the USA by:**  
***Southwest Windpower***  
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Flagstaff, AZ 86004  
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*AIR* is a trademark of Southwest Windpower Inc.

## 45 Foot LAND TOWER KIT

CONGRATULATIONS! You have just received the simplest, most economical tower kit available for your AIR wind turbine. This kit is designed to be very easy to assemble and erect, however it is important that you read this manual thoroughly before beginning assembly. If you have any questions on proper installation or usage please call either Southwest Windpower or your dealer for more information.

*Notice: This information is believed to be reliable; however, Southwest Windpower assumes no responsibility for inaccuracies or omissions. The user of this information and product assumes full responsibility and risk. All specifications are subject to change without notice.*

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## Introduction

This tower kit is designed specifically for the Southwest Windpower “AIR” 303 and 403 wind turbines. To our knowledge this is the most economical and user friendly tower kit available for the “AIR” wind turbines. Two level, guy wire supported construction allows the use of lightweight tubing while providing plenty of strength, even in high wind conditions. Two people can easily erect the kits in a few hours. Since the turbine and the tower kit are light in weight, no winches, vehicles or beasts of burden are needed to erect the tower. All that is required is the necessary tubing, the proper anchors for your soil, and a little bit of “elbow grease”. We recommend that at least two people be present when the tower is raised, although it is conceivable that a single person could actually raise a tower on their own.

The AIR tower kit includes a simple yet effective elbow/tee for its base. Combined with a short length of tubing this type of base eliminates the need for a concrete pad, base plate and a swivel for the base of the tower.

A simple extruded aluminum, coupling clamp allows the use of a wide selection of different kinds of tubing, depending on availability, site requirements and customer preference. Threaded coupling points are eliminated, allowing lighter materials to be used with the same or greater strength than a threaded pipe tower. The upper guy wire attachment clamps onto the upper mast section. This reduces the number of pieces of tubing used to construct the tower and reduces the stresses concentrated at this point. While this method is easier to assemble, the main benefit is an increase in the fatigue strength of the tower, which allows lighter weight materials to be used with greater safety. Pre-cut and swaged guy wires eliminate wire measuring and cutting.

We believe this kit and assembly method is the easiest way possible to put the “AIR” wind module up in the air. Thank you for purchasing our products and for your interest in renewable energy. We expect that you will enjoy the benefits of your wind powered electrical system for many years to come. If, after reading this manual, you have any further questions please contact your local dealer or Southwest Windpower and we will do our best to assist you.

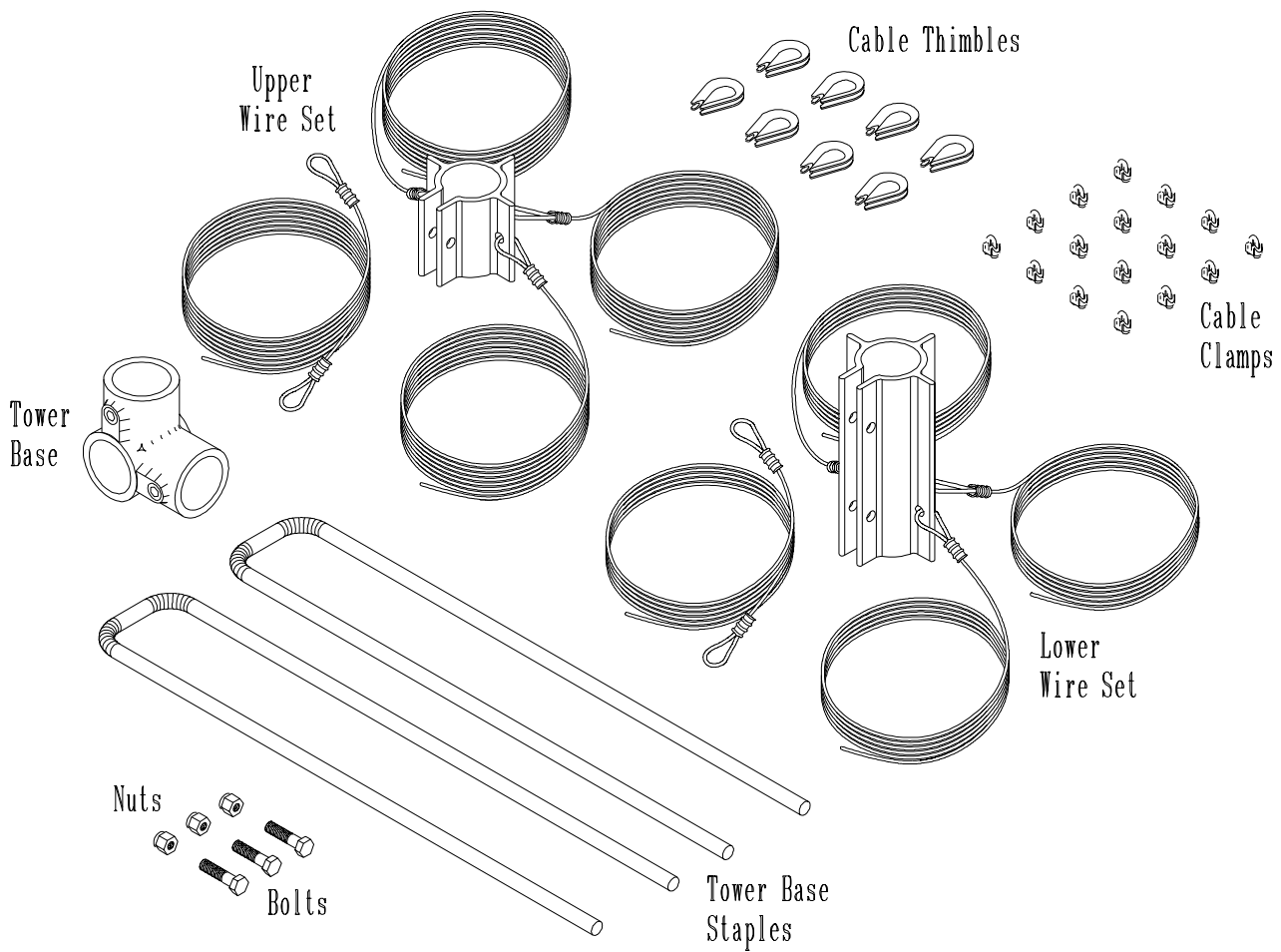
### Safe Installation

**Safety is the most important consideration to take into account when installing a tower and wind turbine.** It is very important to remember that any wind turbine has high speed spinning parts and can be very dangerous if not installed properly! Be sure that the tubing or pipe used for the tower is of adequate strength, that all bolted connections are tight and that the guy wire anchors are suitable for your terrain. All of these elements are explained in further detail later in this manual. **Important! Choose a very calm day to do your installation. A gust of wind at the wrong moment could cause SERIOUS PROBLEMS!**

**PLEASE....READ ALL OF THIS MANUAL BEFORE DOING ANYTHING !**

## 45 Foot Tower Kit Parts List

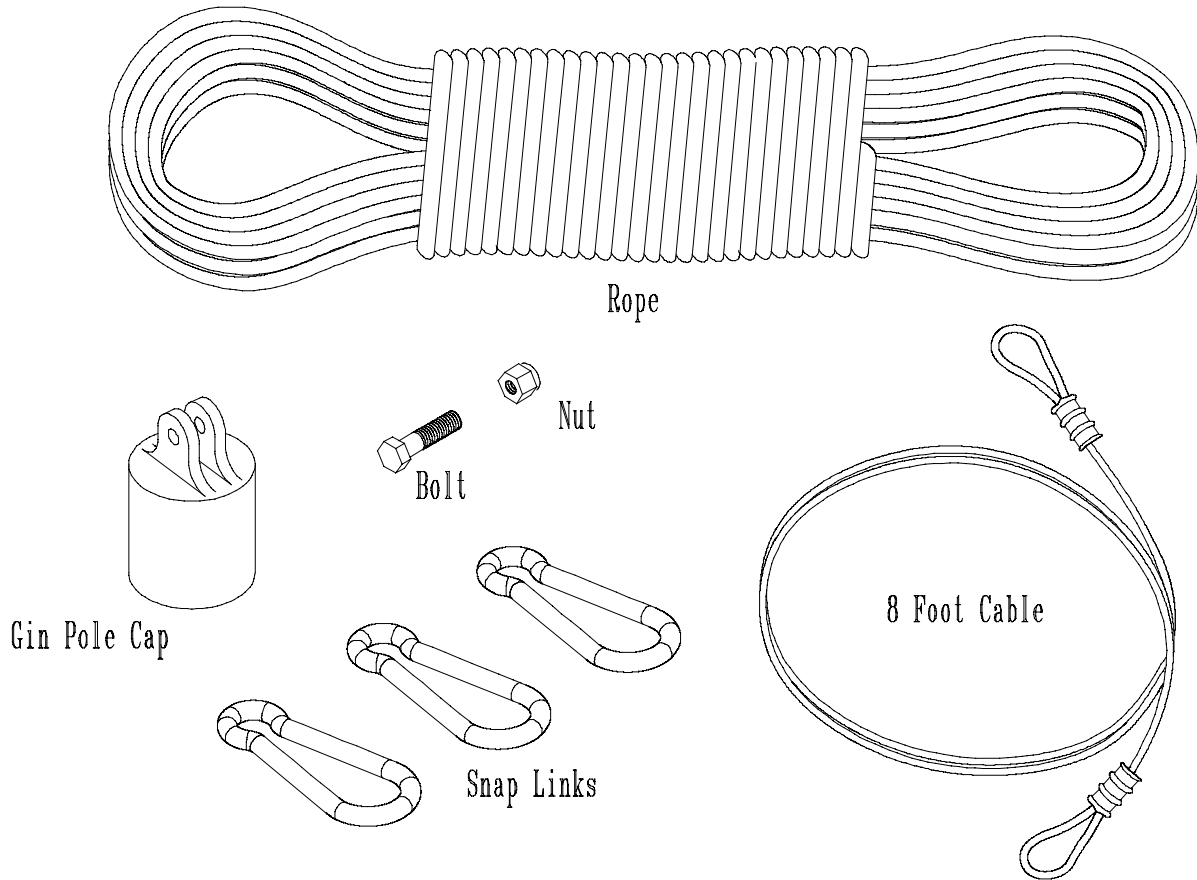
<u>Your tower kit includes:</u>	<u>Quantity</u>
Tower Base	1
Upper Wire set	1
Lower Wire Set	1
Tower Base Staples	2
3/8" x 1 1/2" Bolts	3
3/8" Lock-nuts	3
Cable Thimbles	8
Cable Clamps	16



*Note: This 45 foot Tower Kit also includes a setup kit to raise the tower. If more than one tower is to be erected a single set up kit can be used for any towers to be installed.*

## Tower Setup Kit Parts List

<b>Your tower setup kit includes:</b>	<b>Quantity</b>
Gin Pole Cap	1
100' Rope	1
Snap Links	3
8-foot Cable	1
3/8" x 1 1/2" Bolt	1
3/8" Lock-nut	1



Please inspect the contents to see that all parts are present and to familiarize yourself with the pieces before beginning assembly.

### Tools Needed:

Round or Half Round File	Pliers
5/16" or 8mm Wrench, Socket or Nut Driver (preferred)	Carpenters Level (optional)
(2) 9/16" or 15mm Wrenches or Sockets	Torque Wrench (optional)
Sledge Hammer	5/16 Allen Wrench (incl./w turbine)

## **Items Not Included In This Kit:**

Anchors (The type of anchors used will depend on the ground makeup at your tower site. This is explained further in the “Anchors” section of this manual.)

Tubing for Tower and Gin Pole

Ground Rod and Clamp

Lightning Arrestor \*

Junction Box and Adapter \*

Flex Conduit and Fitting \*

Electrical Wire

Wire Connectors (preferably copper split bolts)

Pipe Insulation (to prevent wire “rattle” inside pole) \*

Electrical tape

\* optional items (these are explained in detail in their relevant assembly sections)

## **Step 1: Site Selection**

**Site selection is the most important factor affecting the performance of your wind turbine!**

The energy in the wind is the kinetic energy of the moving air mass. What a wind turbine does is convert some of that kinetic energy into rotational energy which can then be converted to electricity. The formula for the amount of power in the wind is a cube function of the wind speed. This means basically that an increase in wind speed of 10% (say from 9 mph to 10 mph) will result in approximately a 37% increase in the power available from the wind and a similar increase in turbine performance. In almost all locations the wind speed increases as you get higher off the ground. This is why a tall tower is very important at most wind sites. As a rule, the turbine should be mounted as high in the air and as far away from obstructions as is possible.

To find the best location to erect your tower and wind turbine, study the area available and take note of how the prevailing (most common) winds blow through it. If there are trees, buildings, hills or other obstructions take note of how high they are and where they are in relation to the prevailing wind direction. The best site for your tower and turbine will be upwind and above any obstructions which may exist. If there are houses or trees in the surrounding area a good rule of thumb is to mount the turbine at least 15 feet any obstructions around it. If the turbine is to be mounted at the crest of a hill or on a beach where winds come from across the water, a smaller tower may be acceptable.

The next consideration in siting your tower and turbine is the distance from the turbine to your batteries. The shortest distance will require the least amount of wire and reduce the amount of power lost through the wiring. If a long distance is required between your tower and the batteries it will be necessary to use heavy gage wire to reduce the resistance of the wire. The power consumed by the wires can be calculated using the formula:

$$\mathbf{Power = Current \times Current \times Resistance}$$

Since the resistance of the wire is directly proportional to its length, making the run shorter will dramatically reduce the amount of power “lost” in the wires.

The other concern with long wires is the voltage drop through the wire. Voltage drop through the wires can be calculated using the formula:

$$\text{Voltage} = \text{Current} \times \text{Resistance}$$

The effect of the voltage drop is most apparent when the turbine has good wind and is actively charging the batteries. The regulator in the turbine, which senses battery voltage, will measure the combined voltage drop from the batteries and from the current passing through the resistance of the wires. This causes the turbine to sense a higher voltage than that of the batteries and regulate its power accordingly to prevent overcharging. When this happens the turbine will not fully charge the batteries. Adjusting the regulation set point of the turbine to compensate for this at higher wind speeds can cause the turbine to overcharge the batteries in lighter wind conditions. If a long distance between the tower and batteries is necessary, using a large wire size will help to address this issue. The person laying out your power system should be aware of these considerations when the system is in the planning stages.

Please refer to the section on “Tower, Base and Anchor Layout”. The amount of space available to assemble and raise the tower may also affect where your tower can be placed

## **Step 2: Mast and Hardware Selection**

Due to the high cost of shipping and the widespread availability of the tubing or pipe used for our towers, these materials are not provided by Southwest Windpower. These materials are readily available through most fence suppliers or plumbing companies and will cost much less when purchased locally than if we were to try to ship them from our factory.

The “AIR” wind turbine is designed to be mounted on a 1.875 in. outside diameter pole. This is the same outside diameter as 1 ½ in. steel water pipe where the “1 ½” is a nominal size indicating an outside diameter that is actually 1.875 in.. Whether the pipe is “schedule 20”, or “schedule 40”, the outside diameter will be the same and the schedule number will determine the wall thickness of the pipe. If the pipe is lighter than “schedule 20”, it is referred to as “tubing”, and the actual outside diameter and wall thickness are usually specified. ***Use only structural steel tubing for this tower!***

The design of this tower kit allows steel pipe (or tubing) of various different wall thickness to be used depending on its availability and on the severity of the wind at your site location.

Use the following table to determine the acceptable pipe size(s) for your tower and wind severity. In most locations structural steel tubing with a wall thickness of .065 inches is sufficient for the conditions and preferable in terms of cost and ease of assembly. Electrical conduit should be avoided for use in your tower assembly, since it is generally not designed for strength.

Use the following table for Pipe / Tubing wall thickness guidelines:

<u>Maximum Wind Speed</u>	<u>Recommended Wall Thickness</u>	<u>Pipe Schedule</u>
84 mph.	.065 inch (1.65 mm)	Tubing
96 mph.	.090 inch ( 2.3 mm)	Schedule 20
120 mph.	.140 inch ( 3.6 mm)	Schedule 40

Although the design of this tower kit will allow different wall thicknesses of pipe to be used in the same tower, we recommend that the same thickness pipe be used for both the upper and lower sections.

Pieces of Tubing Needed:

- (1) **24 foot** (7.3 M) length of pipe for tower (wall thickness selected for local conditions)
- (1) **21 foot** (6.4 M) length of pipe for tower (wall thickness selected for local conditions)
- (1) **6 foot** (1.8 M) length of tubing for tower base (.065 in. wall thickness)
- (1) **21 foot** (6.4 M) length of tubing for gin pole (.065 in. wall thickness)

*\*\*\*\*In some areas there are subsidies and grants available for installing renewable energy systems. If you live in one of these areas and need an engineering analysis for this tower assembly to satisfy your local authorities please contact us. We have an engineering analysis available for this tower kit.*

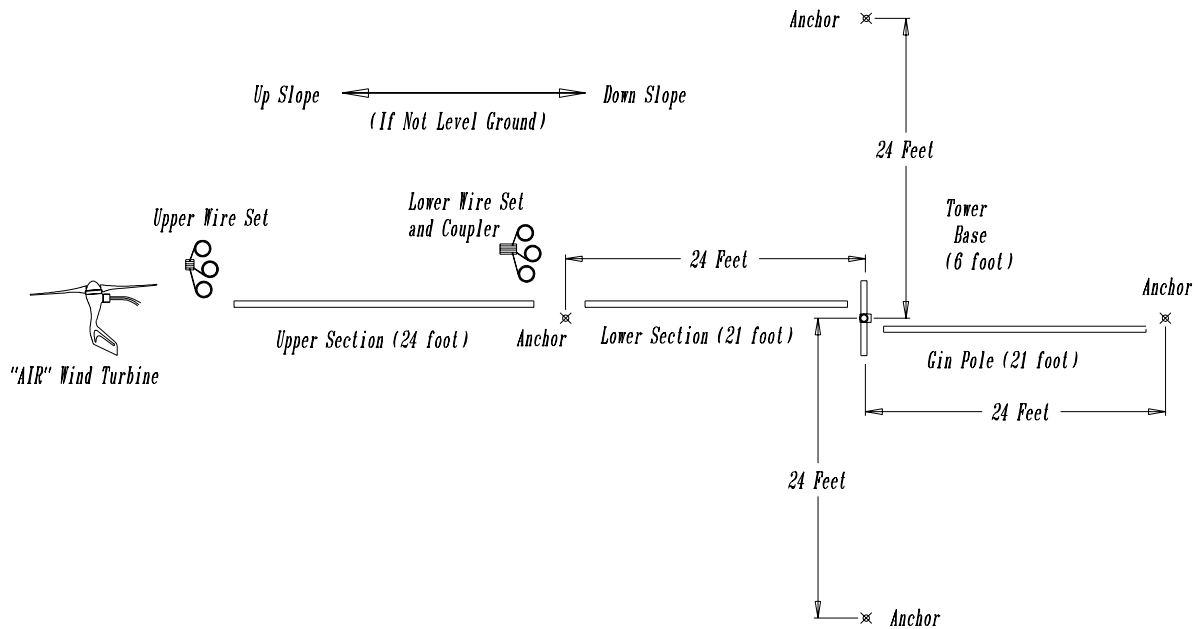
### **Step 3: Tower, Base and Anchor Layout**

This tower kit should be assembled on a calm a day (no wind). The tower base and anchors should be laid out as described in the drawing below. As a time saver the 24 foot length of tower pipe can be used as a measuring stick between the tower base and anchor locations

The Tower will be assembled laying on the ground and then tilted up into position.

If the tower is being erected on the side of a hill it will be much easier to raise the tower if it is assembled to the uphill side of the base as it will already be part way up once it is assembled. In this case the two “side” anchors should be at the same height or elevation on the hill. The two remaining anchors should be directly uphill and downhill from the tower base.





If the tower is to be erected on flat ground and there is a breeze blowing the tower should be assembled towards the wind if possible, so that the wind may help slightly as the tower is raised rather than working against you. If your tower is on the side of a hill *and* there is a breeze blowing ignore the breeze and assemble the tower on the uphill side.

Be sure that the anchor points and base position are in a line when sighted from anchor to anchor. This will insure that the forces on the guy wires are balanced properly, make final guy wire adjustments simpler and will help a great deal during the actual raising of the tower. The side anchors and tower base should also be at the same elevation. If either of these requirements is not met, the guy wires will either tighten excessively or go slack as the tower is raised. If the guy wires tighten excessively the tower may buckle and collapse, causing possible injury or even death and at the very least, damage to both the tower and the turbine. Carefully read the section on raising the tower for further instructions on making the proper adjustments in these situations.

## Step 4: Guy Wire Anchor Installation

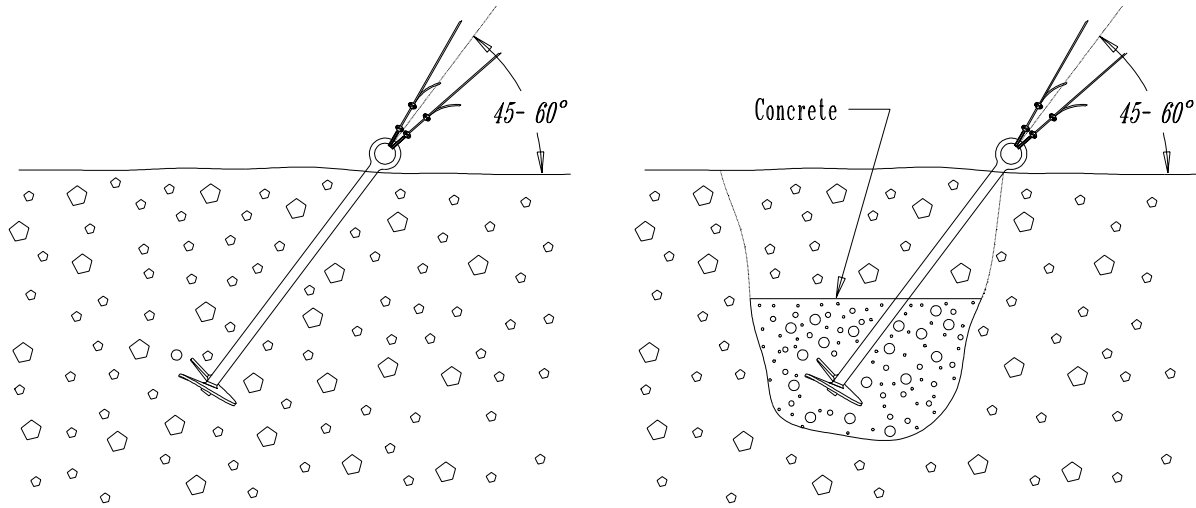
There are four types of anchors that are most commonly used with our towers; screw in “Auger” type anchors, hammer driven “duckbill” anchors, cast concrete anchors and expansion bolts (for use only in solid rock). **What anchor should be used depends on the soil type that the anchors will be placed in.** See the following table for our suggestions:

<u>Soil Type</u>	<u>Recommended Anchor</u>	<u>Alternatives</u>
Sand	Buried Concrete	None
Loose Gravel	Buried Concrete	None
Loam	Auger	Duckbill, Buried
Clay	Duckbill	Concrete
Rocky Soil	Duckbill	Auger, Buried Concrete
Gravelly Soil	Auger or Duckbill	Buried Concrete
Solid (Soft) Rock	Large, Long Expansion Bolt	Buried Concrete
Solid (Hard) Rock	Smaller Expansion Bolt	Large Eye Bolt + Cement
		None

The loads on a single anchor can exceed 500 lb. in a 100-mph gale. Make sure that the anchors chosen can withstand at least this much force or the tower will have to be lowered during storms. Augers and Duckbill anchors are frequently available at mobile home supply stores. Augers are also available the dealer where your turbine was purchased or from our factory, however when shipping costs are added they may be more expensive than if they are purchased locally. Expansion bolts for anchoring in solid rock can be purchased at most hardware stores.

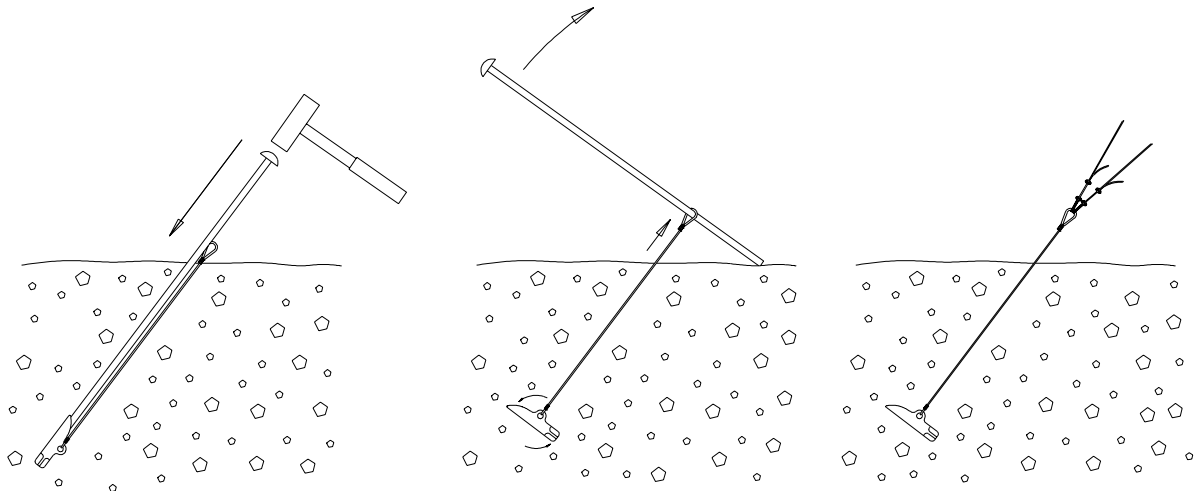
**Augers:** If the soil conditions make their use feasible, augers are the simplest anchors to install. Augers screw into the ground using either a piece of wood, pipe or rod as a “cheater bar”. If a mistake is made or if the tower must be removed an auger can be “unscrewed” out of the ground and reused. They depend on the soil holding together for their strength are not suitable for sand or loose gravel. If the soil is rocky or clay-like you may have difficulty screwing them in.

An auger is usually installed by screwing it straight into the ground to get it started and then tilting it to the desired angle once it is into the ground a few inches. A substantial downward pressure is usually necessary to get an auger started. Screw the augers in as far as possible for the greatest strength.



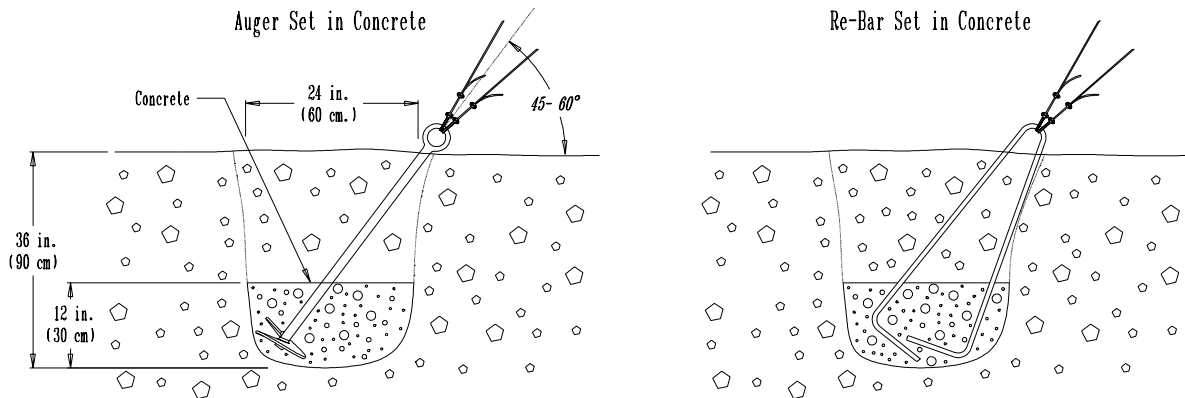
Augers depend on the ability of the soil to hold together for their strength. If augers can not be screwed in, simply digging a hole and burying them will not work. We recommend buying augers, and if they can not be screwed in properly, a hole can be dug and the auger cast in concrete. This will provide a good loop for guy wire attachment and make an excellent anchor in the concrete.

**Duckbill Anchors:** Duckbill anchors consist of an anchor attached to a cable with a loop on the end. They are driven into the ground using an anchor driver, which is a steel rod with either an enlarged striking surface (for a large hammer) or an attachment for a jackhammer or impact driver. The rod fits into the anchor and holds it straight while it is being driven into the ground. Once the anchor is sufficiently deep in the ground, the driver is withdrawn and the anchor cable is pulled a short distance to “set” the anchor. As the anchor is being set it will rotate perpendicular to the hole made as it was driven in, making it very difficult to move any further.



*Please note that once a duckbill anchor is set in place it can not be removed without digging it out.*

**Buried Concrete:** A buried concrete anchor may be the only solution if the ground is loose gravel or sand or if it is too rocky for an auger or duckbill to be driven in,. Buried concrete anchors work well in any situation other than solid rock. A hole must be dug in the ground at the desired anchor point. One good tactic is to purchase either augers or duckbills and if they can not be used as intended, then dig holes and cast them in concrete. Otherwise some other means of attachment must be created for the guy wires, such as a loop of steel reinforcing bar (re-bar) or chain.

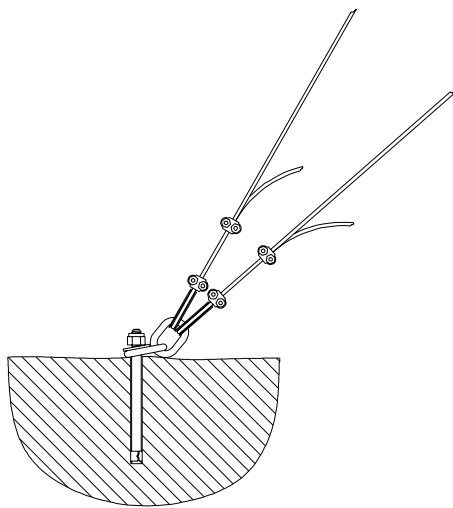


Holes for concrete anchors should be at least 2 feet in diameter and at least 3 feet deep. The attachment should be placed in the hole and concrete or cement poured around it to a depth of at least 1 foot. Once the concrete has set it should be buried before use.

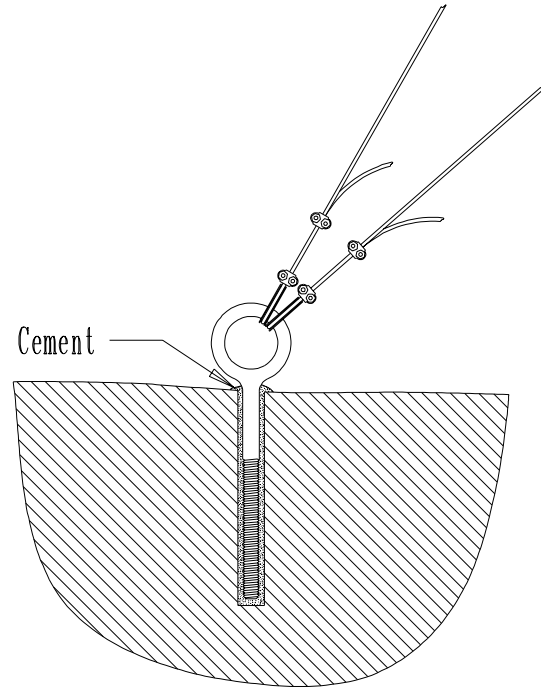
**Anchoring in Rock:** If your tower site has large rocks around it or is located on solid rock, expansion bolts in the rock may be the best means of anchoring your guy wires and base tube. A hole is drilled into the rock and the bolt is placed in the hole with an attachment hanger, a piece of chain or other loop to connect to the guy wires.

For expansion bolts to work properly the rock must be of good quality and not fracture easily. If the rock quality is poor a larger deeper hole must be drilled and a large eye-bolt cemented into it. For very hard rock such as granite and basalt, a 1/4 inch diameter bolt 1 1/2 inch deep can be used. For slightly softer rock such as dacite, welded tufts and some denser varieties of sandstone, a 3/8 inch diameter bolt 3 to 4 inches deep should be used.

For softer types of rock, such as sandstone or limestone, a hole 1 inch diameter and 8 inches deep can be drilled and an eye-bolt 5/8 inch in diameter cemented into it. If cement is to be used, it should be mixed just thin enough to pour and poured into the hole before the bolt is installed (a straw inserted to the bottom of the hole before pouring will help prevent a bubble from forming). This will help to insure that the cement goes to the bottom of the hole and help prevent bubbles that may compromise the strength of the attachment. If expansion bolts are to be used, follow the instructions supplied with the bolts. There are several different types of expansion bolts that are installed using different methods.



Anchor For Hard Rock

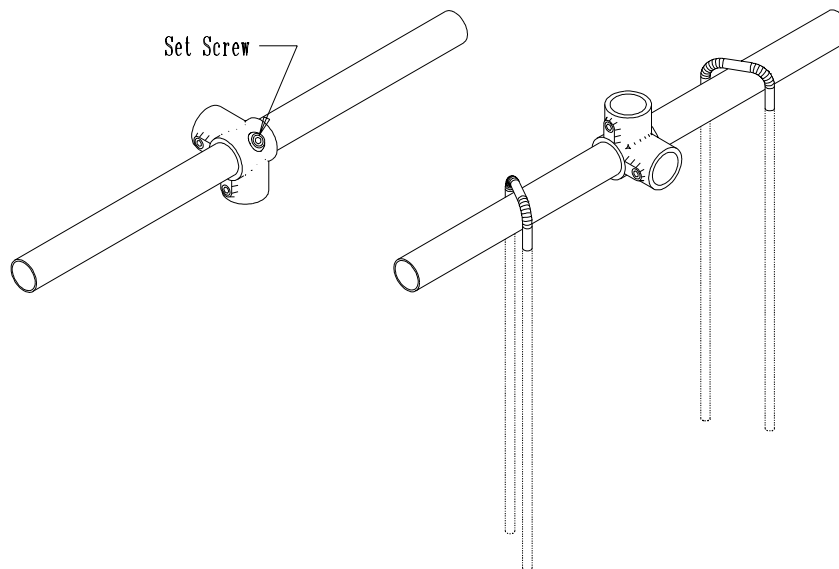


Anchor For Soft Rock

### Step 5: Tower Base Assembly

To assemble the base, a 6 foot long piece of tower tubing is positioned half way through the base tee as shown in the drawing below and the set screw tightened to hold it in position (use the 5/16 inch allen wrench included with your turbine).

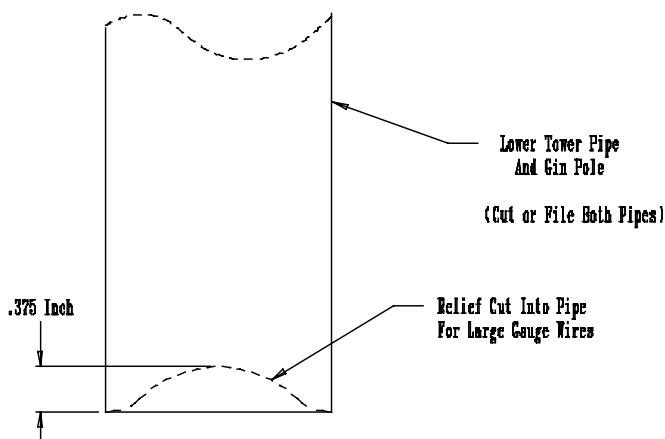
The base “T” should now be placed in the position chosen for the base of the tower, perpendicular to the direction that the tower will be raised. Once assembled, the tower will pivot on the base tube as it is raised into position.



Depending on the nature of the soil at the site, the ground staples should be driven or cemented into the ground so that the base tube is captured. If cement pads are to be used, the base tube can be supported at its ends and used to hold the staples while the cement is setting. If the base is to be on solid hard rock, expansion bolts and chain should be used. For softer rock the staples can be cut shorter and cemented into holes drilled in the rock. **If you know that you will be using Method III (under “Erecting the Gin Pole”) take note of these procedures, but wait until the gin pole is up to perform them.**

### Step 6: Assembly of Tower and Turbine

*Note: If larger than 6 gauge electrical wire is to be used, it may be necessary to cut or file reliefs in the bottom of the lower tower pipe section and in the gin pole for increased wire clearance. This should be done before proceeding. Make sure that interior edges of the tower pipe and the bottom of the gin pole are smooth and free of burrs that could damage the electrical wires. (see drwg. on p.18)*



The basic method you will be using to raise the tower will involve assembling the tower on the ground, erecting a gin pole, and then raising the tower by pulling from the top of the gin pole. There are actually three different methods that can be used to erect the gin pole. Which method should be chosen will depend on the size of electrical wire being used, the manpower available and personal preference. For all three methods assembly of the tower begins as follows:

- 1) The electrical wires for the turbine should be straightened and cut 2 to 3 feet (1 m) longer than the tower height.
- 2) Trim and strip the ends of the turbine wires so that the wires are staggered about 2 inches (red wire 12 inches, black wire 10 inches, green wire 8 inches).
- 3) Connect the electrical wires to the turbine wires using copper split bolts or by soldering the connections. Wrap each connection with a generous amount of electrical tape.

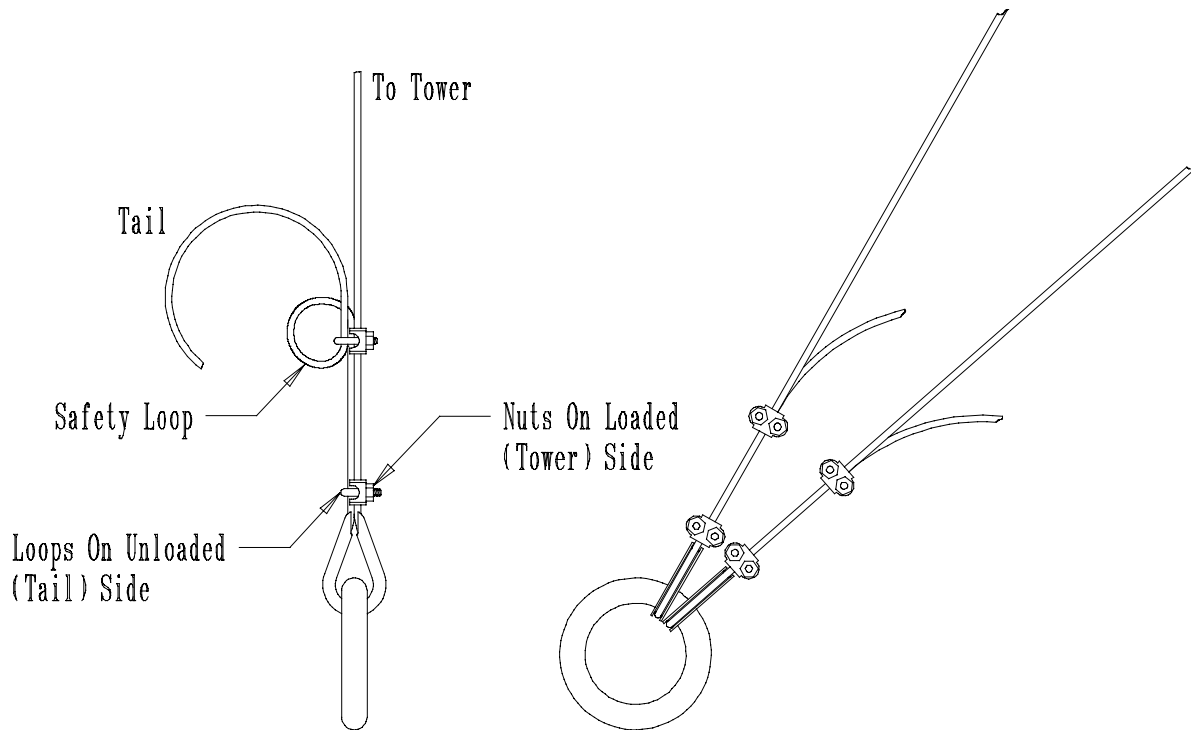
- 4) Extend the wires straight from the turbine and tape them together every 3 feet. They will be much easier to push through the pipe as a group than one at a time.
- 5) If pipe insulation is to be used on the wires, a short piece (6 inches) should be taped securely onto the wires every 3 feet or so. This will keep the wires from contacting the pipe and transmitting turbine noise to the tower.
- 6) Slip the lower guy wire hanger (coupler) onto the lower tower pipe near its top (guy wires toward the bottom).
- 7) Push the wires down through the lower pipe section. If it is too difficult to push the wires, then slide a guy wire up through the pipe and tape the wires to it. Pull the wires through the pipe using the guy wire.
- 8) Mount the turbine to the upper tower section as described in the turbine's owners manual.
- 9) Position the upper and lower tower sections together and slide the lower guy wire hanger / coupler over the joint. At this time tighten the upper (non guy wire) bolt to 18-20 ft.-lb. This should hold the two sections together (the other bolt will be installed later).

### **Step 7: Attaching Guy Wires to Anchors**

With the assembled tower laying on the ground the guy wires at the sides and rear of the tower should now be attached. Make sure that the bottom of the tower is at the tower base so that the distances from the anchors to the guy wire attachment points on the tower will be the same as when the tower is vertical. Leave about 6 inches of slack in the wires to allow for any misalignment or unnoted elevation differences (the wires will be adjusted more precisely later). The side wires can be pulled to their anchors and attached using the wire rope thimbles provided with your tower kit.

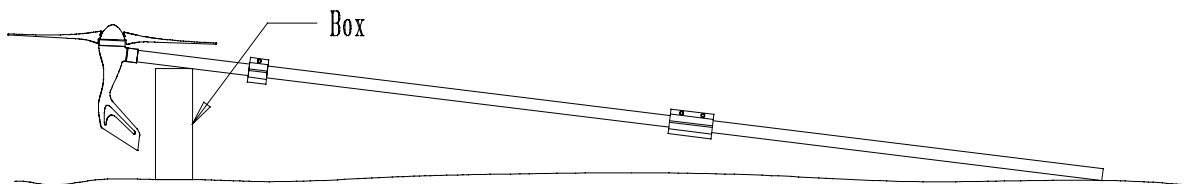
Note: The thimbles may need to be spread open to install them on your anchors. This can be done with a pair of pliers and the end of one of the tower tubes. Be sure to press the open end of the thimbles back together (with pliers) before attaching the guy wires.

The rear wires length can be estimated by pulling them to a side anchor and placing a piece of tape on the wire at the distance of the side anchor. The rear wires will then be attached to their respective anchor at the point marked by the tape. This should make their length approximately correct when the tower is up (again these will be readjusted, so don't worry about a few inches one way or the other). Make sure that none of the guy wires are crossed and that the side wires are straight with no rear wires on top of them. Run the tail of each guy wire through the second clamp twice, forming a safety loop. Attach all of the side and rear wires securely as shown in the drawing with two clamps on each wire. Use 6-8 ft.-lb. of torque on each nut. It is important (for good strength) that the saddle part of each clamp is on the loaded (tower) side of the guy wire.



**MAKE SURE THAT ALL GUY WIRES ARE SECURE BEFORE PROCEEDING !**

At this point the turbine should be propped up on a box, chair, stool or milk crate so that the blades are not damaged when they are installed. Mount the blades onto the turbine at this time.



**Step 8: Erecting the Gin Pole**

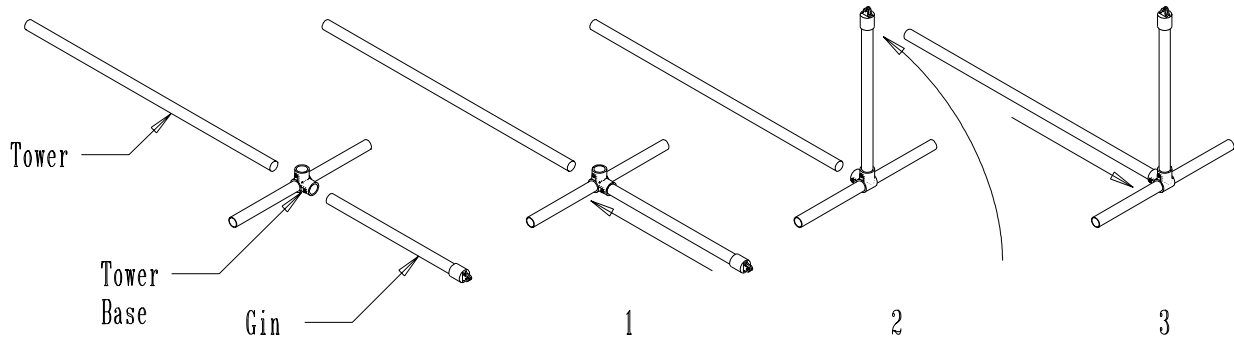
**MAKE SURE THAT ALL GUY WIRES ARE SECURE BEFORE PROCEEDING !**

There are three methods for erecting the gin pole and preparing to raise the tower. All three methods all arrive at the same point and are simply different ways of getting the gin pole and tower assembled together.

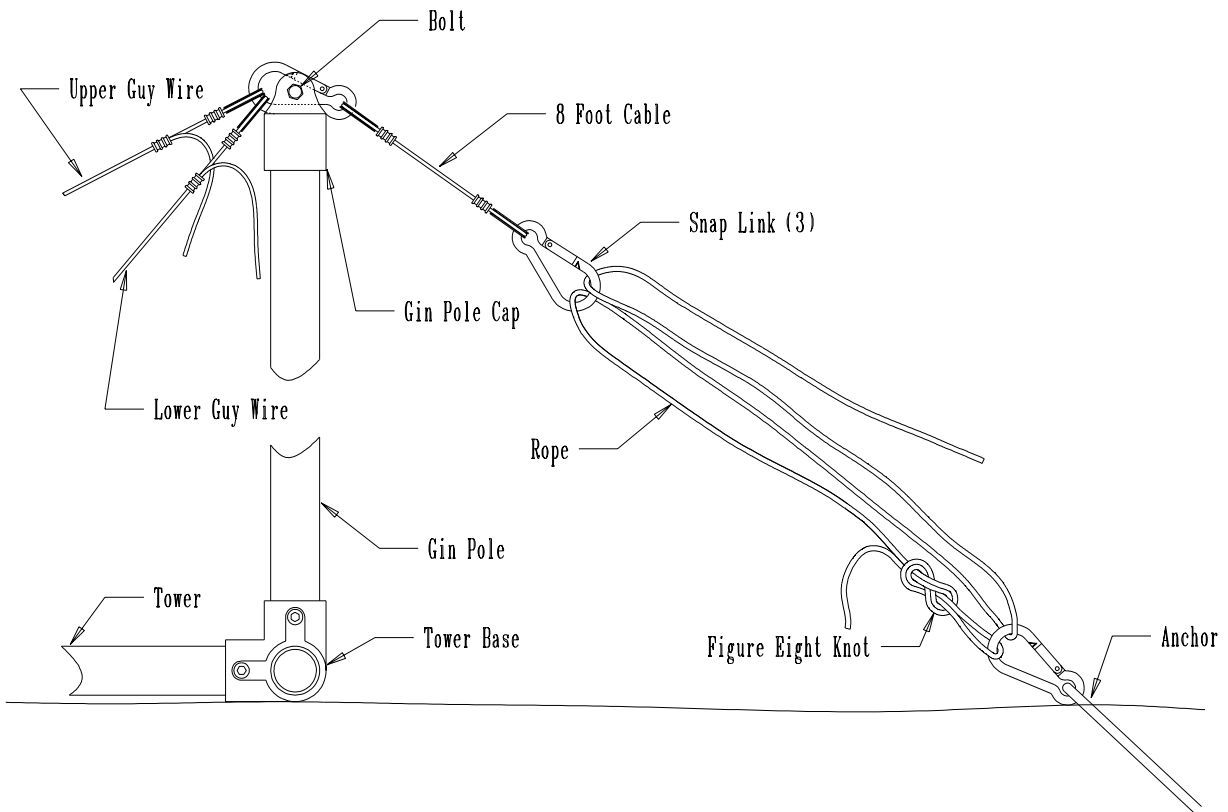


## Method I (Gin Pole to Base, then Tower to Base)

This is the simplest method, but can be difficult if large wires (4 gauge or larger) are used.

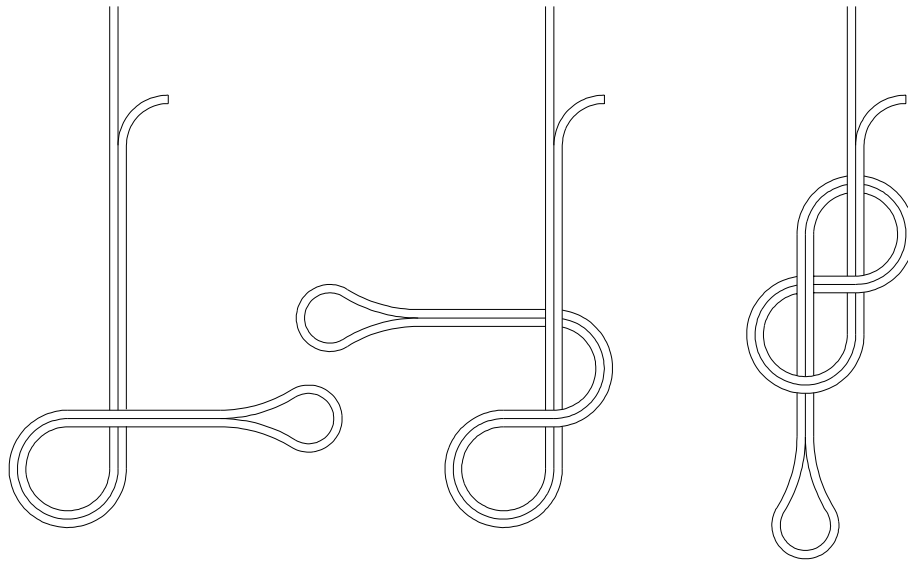


- 1) Mount one end of the gin pole in the tower base and tighten the set-screw to hold it.
- 2) Mount the gin pole cap and install the bolt through its tabs. Snug the nut onto the bolt.
- 3) Attach the snap links and 8 foot cable as shown in the drawing.



- 4) Tie the rope to the anchor on the gin pole side and loop it through the snap links as shown. Leave enough slack in the loops so that the gin pole can be raised to vertical. A “figure eight” knot is recommended. This can be tied as shown and then clipped into the snap link on the anchor.

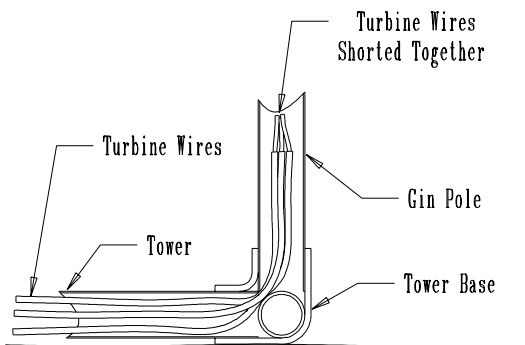
“Figure Eight” Knot



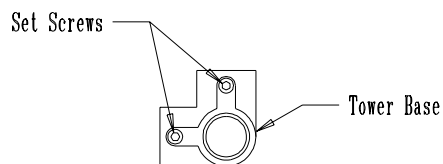
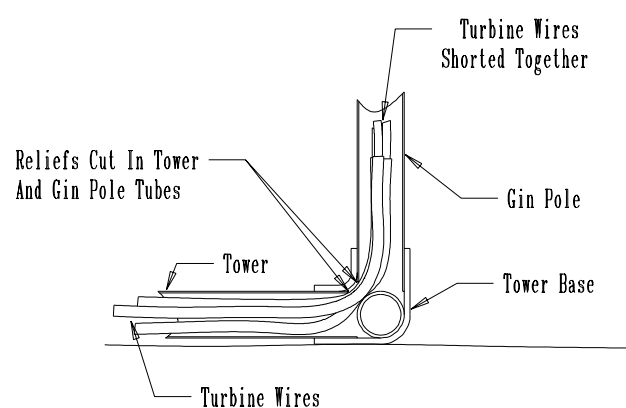
Loop Through As Shown,  
Then Pull Tight

- 5) Attach the “gin side” guy wires to the gin pole Snap Link as shown.
- 6) The black and red turbine wires should be shorted together at the tower base end. This will prevent the turbine from spinning as the tower is being raised and will prevent sparking of the bare wires.

#6 Or Smaller Wires



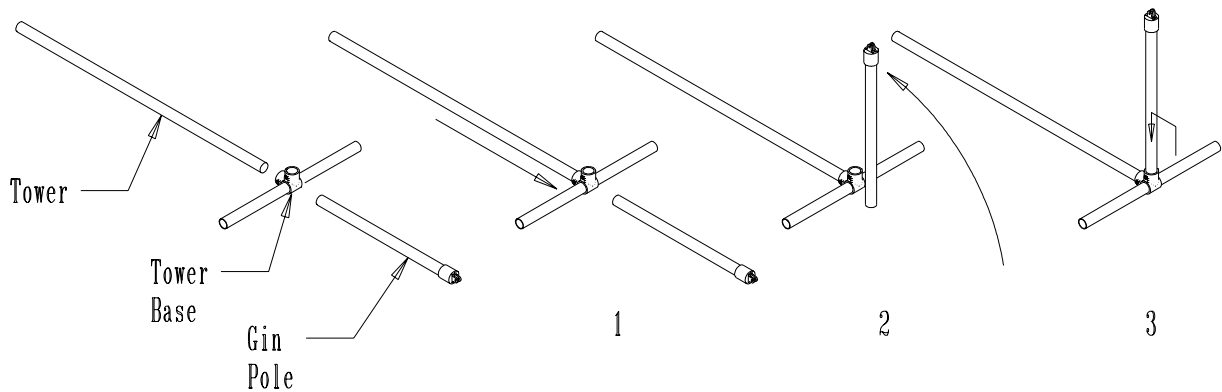
#2 or #4 Gauge Wires



- 7) Raise the gin pole to vertical.
- 8) Have one person hold the gin pole while the electrical wires are pushed up into it (can be difficult with large wires). Slide the assembled tower into the tower base then tighten the set-screw (use hex key from turbine kit).
- 9) Attach the “gin side” guy wires to the bolts on the coupler and upper guy wire hanger. Tighten the coupler over the joint between the upper and lower tower sections and tighten the upper guy wire hanger about three feet from the turbine.

#### Method II (Tower to Base then Gin Pole to Base)

This method requires lifting the gin pole into the tower base, which can be strenuous. Up to 2 gauge wires are no problem when using this method.



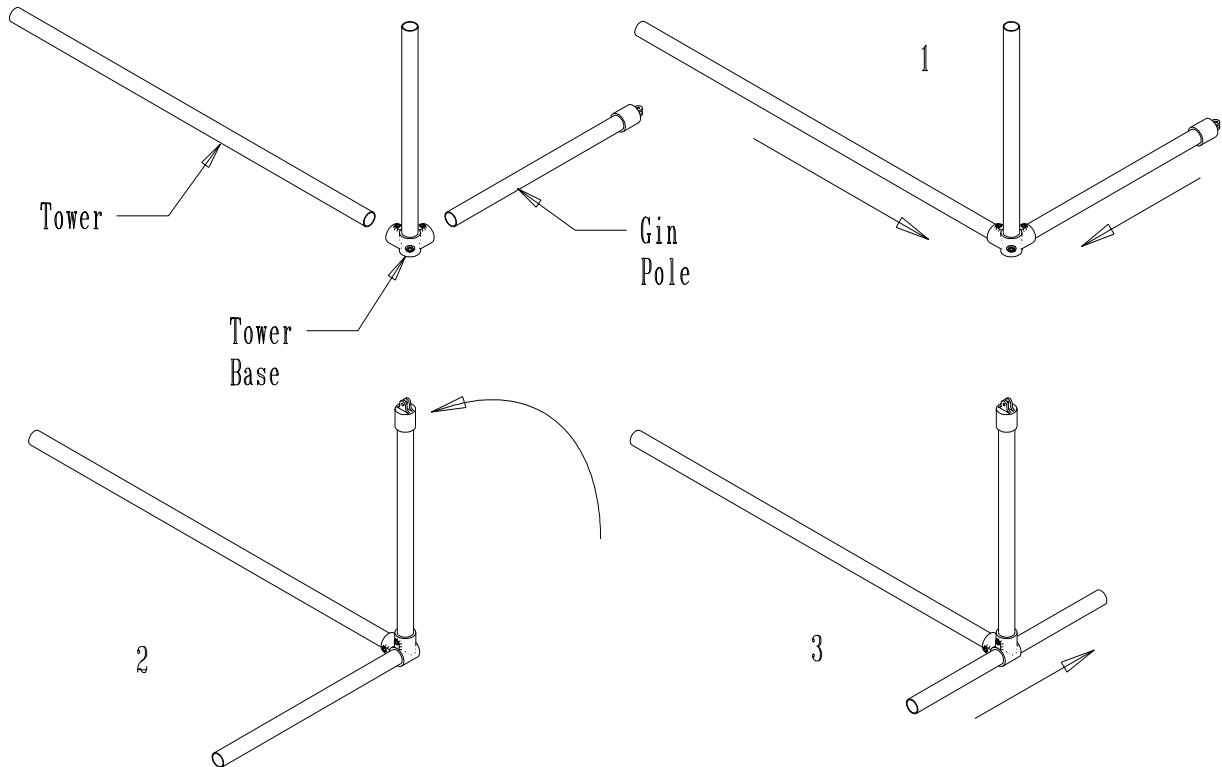
*Note: For 4 gauge or larger wires a relief will need to be ground at the base of the lower tower pipe and at the base of the gin pole pipe. (See drawings on pages 16 and 18)*

- 1) The relief in the lower tower pipe should be positioned toward the top. Push the electrical wires into the tower base and attach the tower to the tower base.
- 2) Mount the gin pole cap to the top of the gin pole and install the bolt through its tabs.
- 3) Attach the snap links and 8 foot cable as shown in the drawing from method I.
- 4) Tie the rope to the gin pole side anchor and loop it through the snap links as shown.
- 5) Attach the “gin side” guy wires to the gin pole Snap Link as shown.
- 6) Attach the loose ends of the “gin side” guy wires to the bolts on the coupler and upper guy wire hanger. Tighten the coupler over the joint between the upper and lower tower sections and tighten the upper guy wire hanger about three feet from the turbine.
- 7) Raise the gin pole to vertical.

- 8) Lift the gin pole and set it over the electrical wires and into the tower base so that the relief in the pipe is positioned over the wires. Tighten the set-screw in the tower base.

Method III (Gin and Tower to Base on Side, Rotate, then Slide in Base Tube)

This method can be fairly easy although the tower base tube must be slid into position and the base anchoring staples installed while the gin pole is being held vertical.



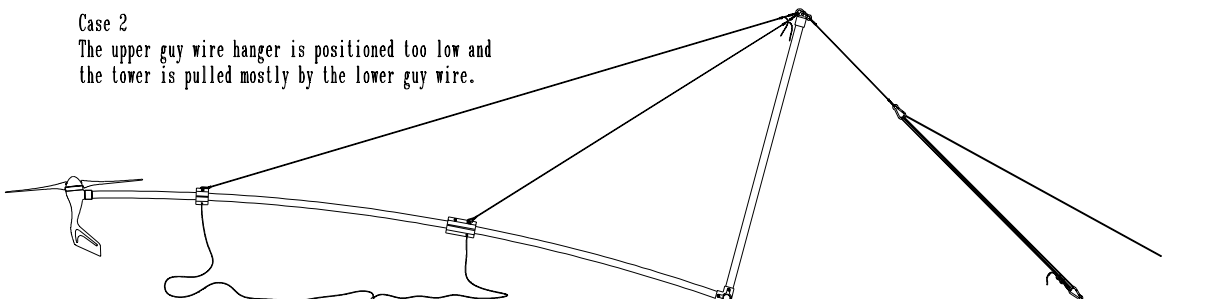
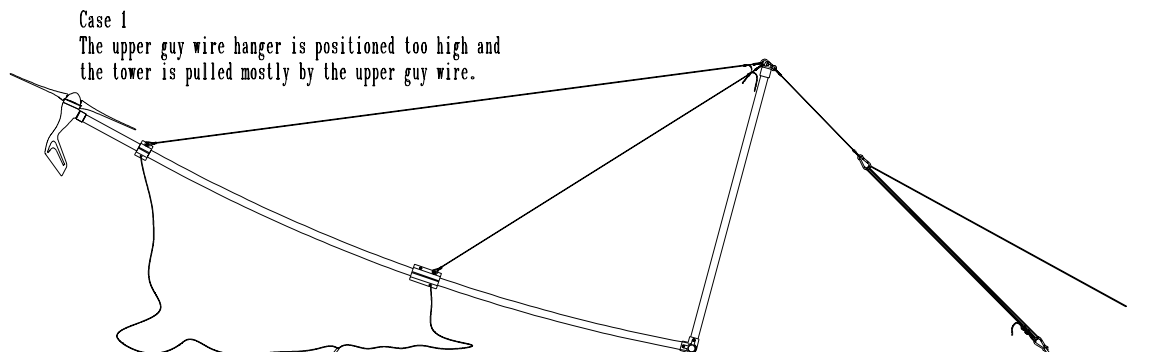
- 1) Loosen the set-screw and slide the tower base tube so that one end is flush with the tower base fitting.
- 2) Push the electrical wires into the tower base and attach the tower to the tower base. Tighten the set-screw.
- 3) Attach the loop ends of the “gin side” guy wires to the bolts on the coupler and upper guy wire hanger. Tighten the coupler over the joint between the upper and lower tower sections and tighten the upper guy wire hanger about three feet from the turbine.
- 4) Rotate the tower so that the base tube is sticking straight up.
- 5) Position the gin pole over the electrical wires and into the tower base. Tighten the set screw
- 6) Mount the gin pole top piece and install the bolt through its tabs.
- 7) Attach the snap links and 8 foot cable as shown in the drawing.

- 8) Tie the rope to the anchor on the gin pole side and loop it through the snap links as shown.
- 9) Attach the “gin side” guy wires to the gin pole Snap Link as shown.
- 10) Raise the gin pole to vertical (rotating the tower).
- 11) With the gin pole being held vertical, slide the tower base tube into the tower base fitting until it is centered. Tighten the set-screw (if you can get to it....not critical).
- 12) Install the tower base anchoring staples or chains at this time.

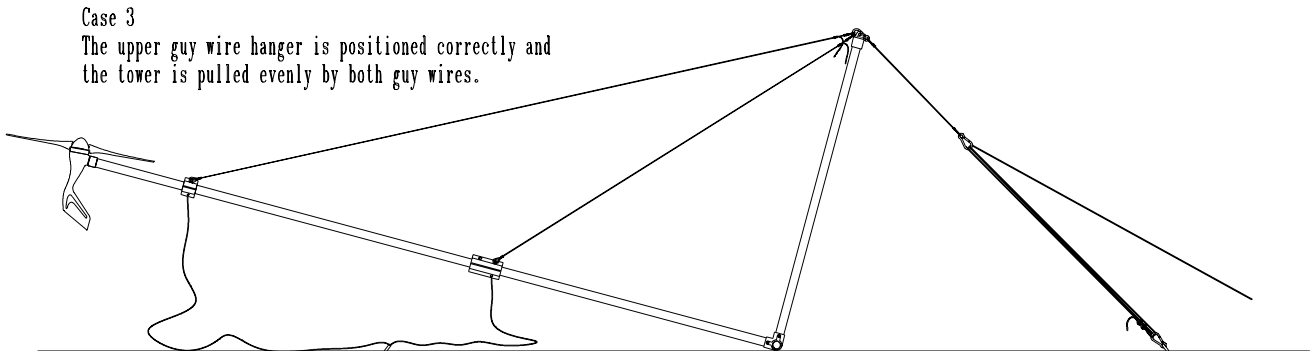
## Step 9: Raising the Tower

**Before attempting to raise the tower make sure that all side and rear guy wires are attached and that all cable clamps are tight. Also be sure that the two bolts on the coupler are tight and that the bolt on the upper guy wire hanger is tight.**

Pull the loose end of the rope towards the gin pole side anchor until it is taut. Check to see that the rope is not twisted and no wires are tangled. Pull (hard?) on the rope until the tower comes up a few feet. With the tower off the ground a few feet, make sure that all the wires are coming up cleanly, none are tangled and that the loops at the attachment points on the tower are straight. At this point note if the tower is bending as it is being lifted. The tower should remain straight as it is being raised.



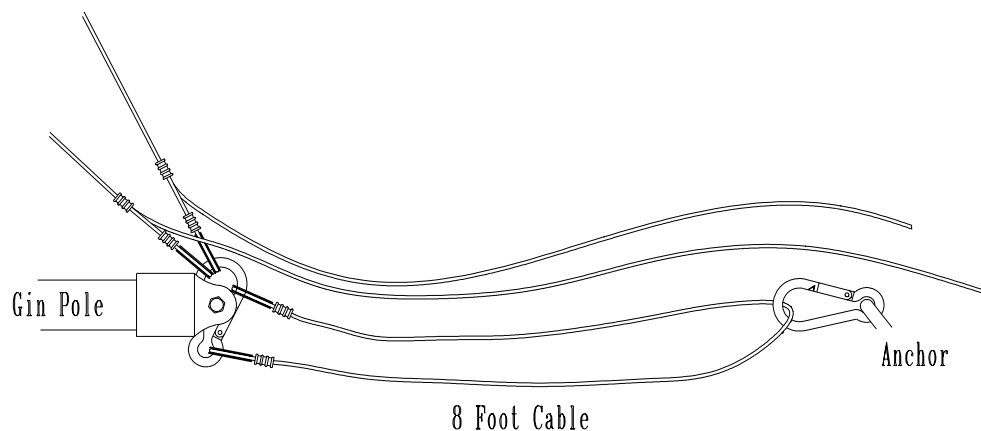
If the top of the tower is coming up more than the middle, lower the tower back to the ground and move the upper guy wire hanger down the tower a few inches. If the middle of the tower is being pulled up more than the top, lower the tower back to the ground and move the upper guy wire hanger up the tower a few inches. Raise the tower a few feet and check again. Repeat this step until the tower remains straight as it is being raised.



Continue pulling and watch to see if the side guy wires are getting too tight. If they are too tight the tower will begin to bow. This is usually caused by the ground at the base being slightly higher than the ground at the side guy wire anchors, or if the anchors and the base are not in a straight line. If this happens, immediately lower the tower back to the ground and adjust the side guy wires a few inches looser.

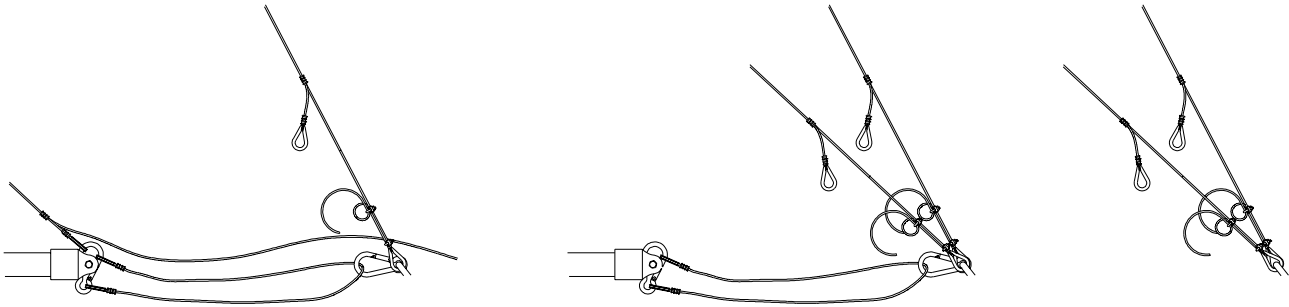
**Failure to adjust the guy wires properly before raising the tower may cause the tower to buckle and seriously damage the turbine and tower and could cause serious personal injury or death!**

If the side guy wires are not over tightened, continue to pull the rope until the tower is nearly vertical and the top of the gin pole is within reach. Pull the gin pole top to the ground and loop the 8 foot cable through the anchor snap link and clip it back to the top of the gin pole. This will act as a safety leash and will temporarily anchor the gin pole side of the tower while the gin side guy wires are being attached to their anchor.



At this point the tower should be checked for guy wires that are slightly too tight or too loose. Guy wires that are too tight will cause the tower to bow. If they are too loose the tower will usually sway back and forth a bit. The proper tension is where there is no tension and no slack. This is easily achieved by hand without turnbuckles. Correct any mis-adjusted wires by loosening their cable clamps one at a time, adjusting the wire and re-tightening the clamps.

With the gin pole secure, the rope should be removed from the snap links, coiled and set aside. Thread the slack end of the upper gin side wire through the two clamps, the anchor (with thimble) and back through the clamps. Unclip the wire from the gin pole snap link, and without letting go of it, adjust the wire and tighten the clamps at the anchor. Repeat these steps with the lower gin-pole side wire. Once all the guy wires are attached to their anchors the gin pole can be removed from the tower base.



### **Step 10: Final Adjustment of Guy Wires**

First look to see if any of the guy wires are too tight and are causing the tower to bow. A tower with slightly loose wires is safer than a tower with wires that are too tight. If there are, determine which wire(s) are too tight (the wires act in pairs) and release the tension on one of the wires. To relieve tension on a wire, loosen the two cable clamps until the cable can be slid through them.

The tension on the wires should be very light and can be set by pulling the wire by hand. It is easy to over tighten the guy wires, even by hand. Be sure to re-tighten the cable clamp nuts. Repeat this for the upper and lower tower sections until the tower is no longer bowed.

Now walk a short distance from the tower and look to evaluate whether the tower is straight or leaning to one side.

At this point focus on the lower section of the tower and adjust the lower cables to get the bottom section straight (a carpenter's level held against the tower can be helpful for this). You will probably need to relax one wire and tighten the wire opposite to it, then check the tower straightness and repeat the process until the lower tower section is straight.

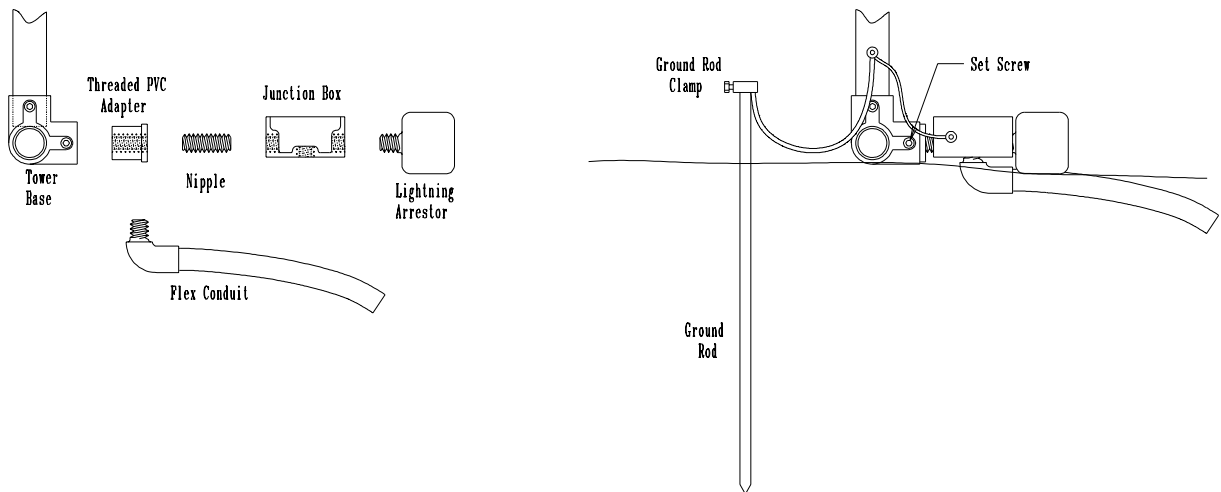
Once the lower section is straight look to the upper section from the base of the tower to see which way to adjust the upper cables. Keep in mind that no tension is necessary, except to reduce the

slack in the cables. Just barely taut is ideal. The same procedure of slackening and tightening should be used on the upper tower section until the tower is straight.

When you are done make sure that all the cable clamps are tight. If the tower is to be lowered, only unclamp the cables on the gin pole side so that when the tower is re-erected only those cables will need to be readjusted.

### Step 11: Junction Box and Lightning Arrestor Installation

Once the tower is completed a junction box for the wire connections at the base can be attached to the base. If it is desired a lightning arrestor can be installed in this box as well. For the wire connections we recommend #8 split bolts available from your local electrical supply store. The best box to use is a 4x4 in. junction box with 3 holes with  $\frac{3}{4}$  in pipe threads. One hole should hold a short  $\frac{3}{4}$  in. nipple with a  $\frac{3}{4}$  in female thread to 1  $\frac{1}{2}$  in. (nominal) CPVC pipe adapter. This adapter will fit into the base of the tower where the gin pole was. The other two holes should hold the lightning arrestor and a flexible conduit connector to route the wires into the ground. Generally direct burial wires are used from the batteries to the tower base. These wires should be buried from the batteries (or shed / house) out to the tower base then routed into the junction box. The wires coming out of the junction box should all be trimmed to about 5 in. The turbine wires and the lightning arrestor should all have about an inch of insulation stripped from their ends and be connected together with the split bolts. Once connected, they should be thoroughly wrapped with electrical tape and the lid to the junction box secured.



### Grounding

To properly ground the tower to the earth a ground rod (usually copper plated steel) should be installed as close to the tower base as possible. A #10 AWG or larger wire should be attached to the tower pipe near the bottom of the tower with its other end clamped to the ground rod.



## **Maintenance**

Periodically check to see that the guy wire tension is set properly. Typically there is no other maintenance required for this tower. Keep your setup kit in a safe place in case the tower needs to be moved or the turbine requires service.

## **Lowering the Tower**

If it is necessary to lower your tower for any reason, follow these steps:

- 1) Disconnect your turbine wires at the batteries.
- 2) Disconnect the turbine wires at the base of the tower and remove the junction box and lightning arrestor if applicable. Connect the turbine wires together to short the turbine and cause it to stop rotating.
- 3) Install the gin pole in the tower base.
- 4) Assemble the snap links, rope and 8 foot cable as they were when the tower was raised.
- 5) Disconnect the guy wires on the gin pole side only.
- 6) Position a box where the tower is expected to come to the ground to protect the turbine blades from damage.
- 7) With the tower raising / lowering rope in one hand, push at the base of the tower until the tower starts to tip and the rope/gin pole is holding the tower.
- 8) Gently feed rope through the snap links to lower the tower.