C BAND SATELLITE INSTALLATION GUIDE

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Step 1: Preliminary and Background

1.1 : Why install a C Band Dish?

Welcome to the world of TVRO (TV Receive Only)!

A C band dish or BUD (Big Ugly Dish) or large dish is simply an antenna for receiving satellite signals in the frequency range of 3.4GHz to 4.2GHz known as the C band of the electromagnetic spectrum.

The installation of such an antenna opens up a window to television viewing that few people even know actually exists. Most people receive television signals using a terrestrial antenna, a cable subscription or DTH (small dish) subscription. What few people realize is that practically all this content is up linked by broadcasters to C band satellites before being down linked to cable/DTH providers for redistribution. Broadcasters use over 50 such satellites in North America to distribute their content and with a motorized C band antenna you can easily intercept and view any content that is being transmitted ITC (in-the-clear).

In addition to receiving C band signals, a TVRO antenna can also receive Ku band signals such as those broadcast by DTH (Direct-To-Home) providers or master signals transmitted directly by broadcasters.

1.2 : Size Matters

If you plan to install a TVRO dish make sure you choose the right size. In order to understand why size matters; let us use a baseball analogy. The size of a catcher's glove is slightly larger than the ball it was designed to catch. Although such a glove does an excellent job of catching a baseball, it would have a hard time catching a soccer or beach ball. The same logic applies to a satellite dish. Small DTH or Ku band antennas are designed to capture small wave length signals (2-3cm) but can't capture larger wave length signals(7-8cm) such as C band signals. A much larger dish is required to receive such signals.

Don't be fooled into purchasing a 4 ft or 6 ft diameter dish and thinking you will receive reliable C band reception. The minimum dish size for reliable C band reception in North America is an 8 ft diameter dish. Even an 8 ft dish will only receive approximately 90% of broadcasts over North

America. If you are outside of the main footprint of the satellite or the broadcaster is using a complex encoding scheme (DVB-S2 FEC=5/6 or higher) to transmit the signal, you will need a 10 ft diameter dish. If you want to receive programming from Central or South America, you will also need a 10 ft diameter dish.

If you are considering purchasing a C band dish, we suggest you keep the following in mind when making your selection:

Note: Rainier subscription signals will work ok with a well-tuned 7.5 ft dish using a PLL LNB..

8 ft diameter Dish
-recommended for budget and space conscious users
-recommended for residential use only
-works very well in the continental USA and along the USA-Canada border(especially North Eastern USA) where North American satellite beams are strongest
-will receive 90% of North American broadcasts and about 50% of broadcasts intended for Latin America

Rainier 9 ft or 10 ft diameter Dish
-recommended if you are north of 50 degrees latitude
-will receive 100% of North American broadcasts and about 90% of broadcasts from Latin America.
-recommended for residential or commercial usage (bars, hotels, etc.)
-recommended for off-axis multiple feeds

12 ft diameter Dish
-recommended for Alaska, Hawaii, Yukon, Northwest Territories, Caribbean and other areas outside of the main satellite beam
-recommended for fringe reception of Latin American broadcasts that can’t be received with a smaller antenna
-recommended for commercial usage (bars, hotels, cable uplinks/downlinks, etc.)
-recommended for off-axis multiple feeds

14-16 ft diameter Dish
-recommended for Alaska
-recommended for commercial uplinks/downlinks
-recommended for off-axis multiple feeds

1.3 : Geostationary Satellites

Geostationary satellites are those satellites that orbit 22,300 miles above the Earth's equator with an orbital period the same as the Earth's rotation period. These satellites appear stationary to an observer on Earth and are used to broadcast C and Ku band television signals.

A TVRO antenna is said to track the satellite arc when it is aligned to track this geostationary orbit over the Earth's equator. If you live near the equator, your dish will point mostly straight up when tracking the arc. If you live north of 60 degrees latitude, your dish will be pointed mostly down at the horizon when it tracks the arc.

1.4 : Understanding Radio Wave propagation and footprints

Radio waves are generated by accelerating electric charges such as electrons. When free electrons are caused to oscillate in a metal it is found that free electrons in a nearby metal will oscillate in exactly the same way. In other words, an oscillating electric current in one metal will cause an identical electric current to appear in a nearby metal but it will not happen instantaneously and the generated current in the 2nd metal will be much smaller.

The primary cause of this phenomenon is unknown but exploiting it for signalling purposes is clearly obvious. The connection between the two metals described is modeled by a radio wave that travels at the speed of light from the first metal (transmitter) to the second (receiver). It is found that the power contained by the radio wave is proportional to the inverse of the square of the distance travelled. Since the surface area of a sphere is also known to be directly proportional to the square of the radius, a radio wave can be thought of as an expanding sphere (at the speed of light) with its origin at the source. The total power contained by such a radio wave will always be spread over the surface of such a sphere. As the sphere grows larger, there will be less power available per unit area on the surface of the sphere since the total transmitted power is constant, but the surface area of the sphere keeps growing. This model suggests that the power contained in a travelling radio wave is directly proportional to the surface area in space that contains the radio wave. This has been confirmed by experiments and will perhaps help you understand why a 10 ft diameter dish will receive 56% more power than an 8 ft diameter dish (10^2 / 8^2). A 12 ft diameter dish will receive 225% (12^2 / 8^2) more power than an 8 ft diameter dish.

If the origin of the radio wave is an infinitesimal point source, the power of the radio wave will be spread uniformly over the sphere in all directions. In real life point sources do not exist, but any source, regardless of geometry can always be modeled with a bunch of point sources with different phases and added up. The result is a power density that is not uniform over the surface of a sphere. This is how directional radio waves with more energy in one particular direction or region are created (e.g. satellite footprints over a particular country or satellite spot beams).

Although this may all sound quite complicated, it really isn't and gives us a powerful way to visualize radio waves and easily understand how a satellite signal is transmitted and received over long distances.

To summarize, a radio wave can be visualized as an expanding sphere with the radius increasing at the speed of light and with a varying power density over the surface of that sphere. A receiving antenna that comes into contact with that sphere will extract an amount of power that is exactly proportional to the surface area or aperture of the antenna and the intensity of the radio wave in that direction.

A typical communications satellite transponder may transmit 10 Watts of power (less power than a small fluorescent desk lamp). If that beam is aimed over the continental USA (8,000,000 km^2), the fraction of power that a 10 ft diameter dish would collect is:

10W*(Pi*((0.003/2)^2)/8,000,000) = 9pW

That is very little power indeed!

It can be shown that the noise floor power for signals between 3.7GHz to 4.2GHz is about 2pW. As long as the power captured by our parabolic antenna is greater than the noise floor, we can amplify it and recover the encoded information.

Notice that if in the above example the 10W beam was spread evenly over North America and South America, the portion our parabolic antenna would capture would be much smaller and perhaps closer to the noise floor. In that case, we could not recover the encoded information and would have to use a larger dish.

1.5 : Antennas and Reflectors

Before proceeding any further, we need to differentiate between antennas and reflectors. An antenna is usually understood to mean the driven element where the tiny oscillating current is created and amplified by electronic circuits. The reflector is any structure that directs incoming radio waves towards the driven element or antenna.

In our case, the parabolic surface of the dish would be the reflector and the driven element is the ¼ wavelength dipole needle inside the LNB.

The reason we need the reflector is quite simple. If we only used the dipole antenna without the reflector, the dimensions of the dipole are so small that we would only capture a small fraction of the radio waves in our vicinity. You might ask: why not make a bigger dipole? This is not possible because the dipole length is constrained by the fact that is has to be ¼ of a wavelength long in order to work efficiently. For C band signals this works out to about 2 cm in length. What we could do is use an array of dipoles to capture more radiation but this would be getting too complicated. It is much easier to use a parabolic reflector to capture more radiation and reflect it to the focus where we place a single dipole antenna.

1.6 : Angles and Power

The last thing you need to understand before beginning your TVRO installation is the relationship between antenna angle and the power received. We have already established a simple model of visualizing radio waves, namely an expanding sphere with the source at the origin. When this sphere becomes very large, the curvature at any particular point becomes very small and looks flat. An analogy would by the Earth: we know that the Earth is a giant sphere, but the area beneath our feet looks pretty flat!

By the time radio waves from geostationary satellites reach us here on Earth, the sphere has grown so large that if we focus on just a small area of that sphere, it will appear like the radio waves are simply propagating as uniform plane waves in a single direction. The power we receive will still be proportional to the surface area captured by our reflector, but we must point it in the incoming direction of the radio waves for maximum power reception.

If the angle of our antenna is off a bit, we will receive less power than is theoretically possible. The relationship between power reception and antenna angle is a simple one:

% of Available Power Received = 100*(cos^2(¸))

where ¸ is the mismatch in angle.

If ¸=0 degrees, then our antenna element is perfectly aligned and will receive 100% of available power. If ¸=90 degrees, then we will receive 0% of available power. (Incidentally, this is the reason why Horizontal and Vertical polarization radio waves are transmitted 90 degrees apart.)

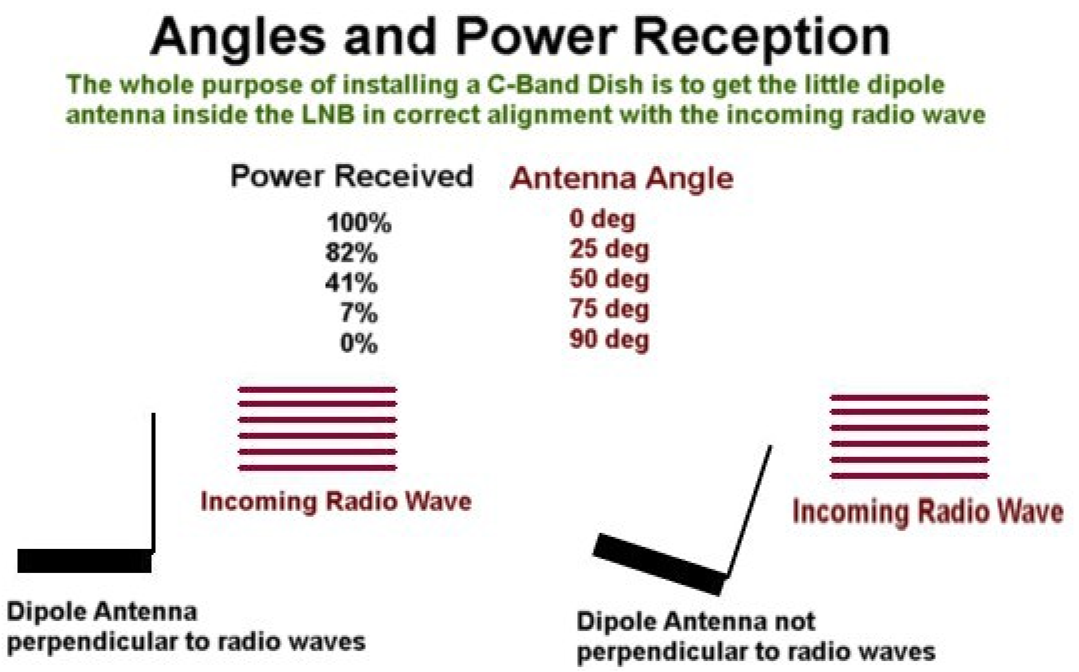
You need to keep this in mind when setting your pole angle, dish elevation angle, declination offset angle, azimuth angle and LNB skew angle. Each small error in angles will compound and become additive. For example, if your pole is not perfectly plumb and is off by 3 degrees and your elevation is off by 4 degrees and your declination is off by 2 degrees and you are pointed 5 degrees away from true south and your LNB skew is off by 7 degrees, then the worse case scenario becomes:

Maximum Angle Error = 3 + 4 + 2 + 5 + 7 = 21 degrees

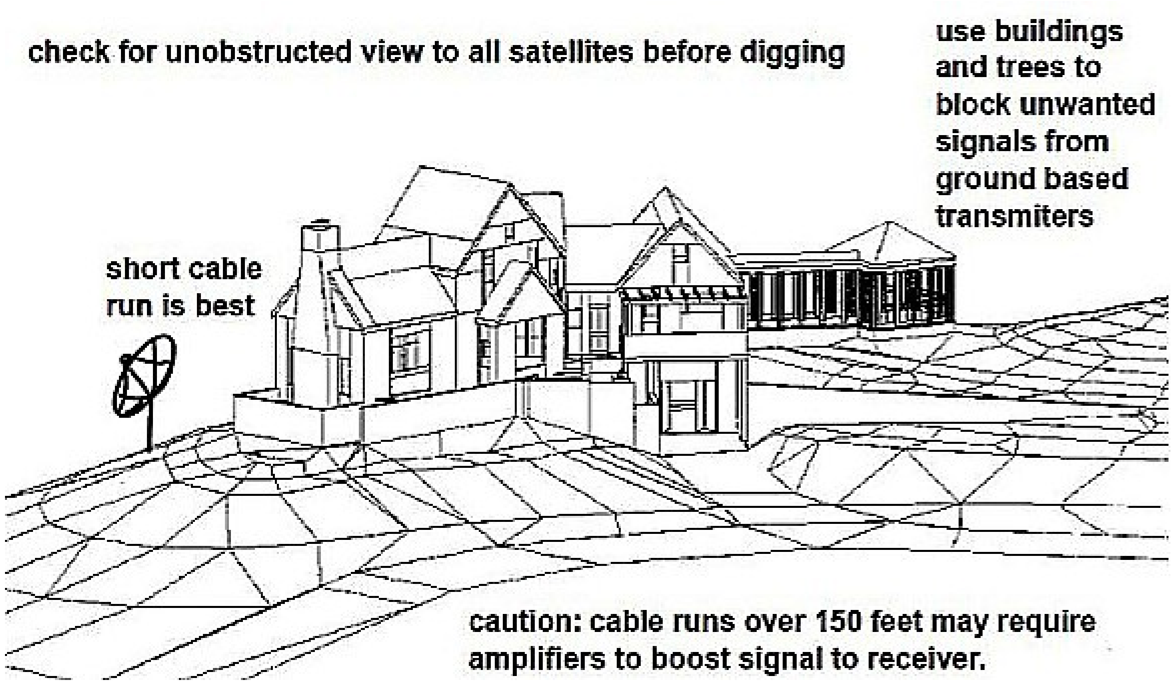
% of Available Power Received = 100* cos^2(21) = 87%

In this example, 13% of available power was lost. The result would be a misaligned dish operating below its peak performance. Some inexperienced TVRO installers do such a poor job setting angles that their dish only receives signals over a small portion of the arc, say between 90W – 121W and they can’t figure out why! If you take care to reduce all possible angle errors mentioned, you will have a properly aligned dish that can track the satellite arc from 30W to 139W!

The moral of the story is this: take your time to install a perfectly plumb pole, set your elevation and declination angles as accurately as possible using a digital inclinometer, make sure you are pointed due south and adjust the skew of your LNB for peak performance.



Step 1: Site Survey



1.1 : Unobstructed view of southern sky

A thorough site survey is the first step in a successful TVRO installation. We suggest you take a few days to think about the installation location and don't rush to begin the installation. Here are some guidelines you can follow:

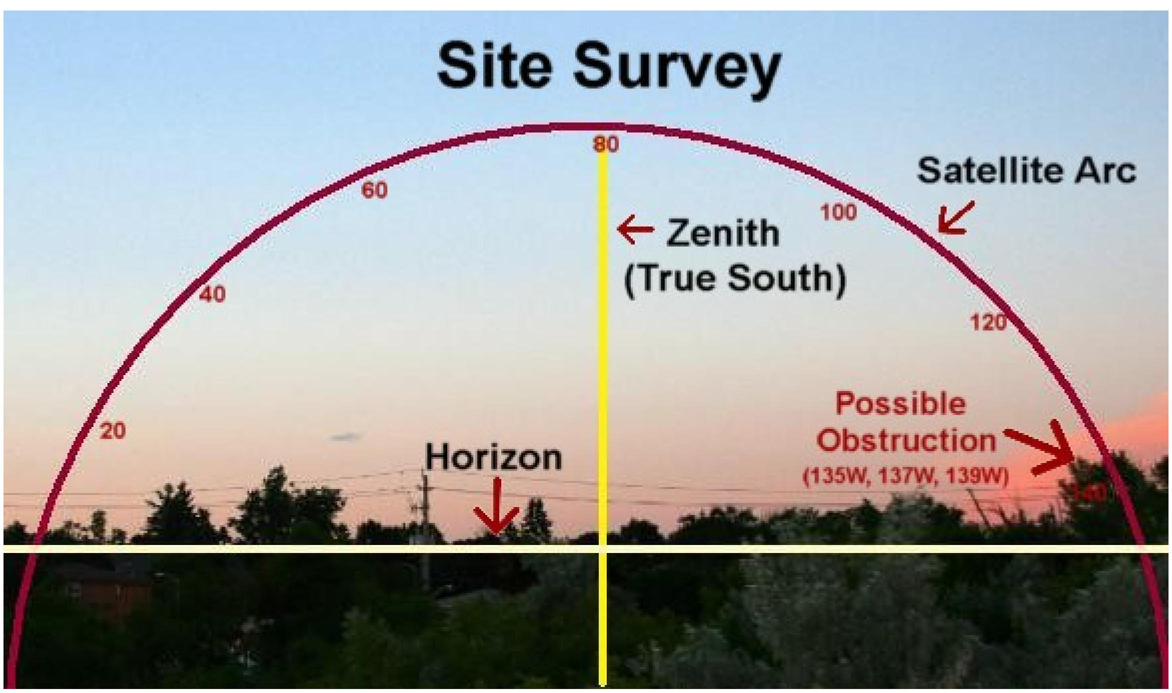
1. Choose a location that has an unobstructed view (or least obstructed view) of the satellite arc in the southern sky from horizon to horizon. This is the most important consideration in your survey. In general, the further south your latitude, the less likely it is for you to encounter any obstructions since your dish will be pointing almost straight up in the sky. The further north you are, the greater the probability for obstructions since your dish will be pointing downwards towards the horizon. In general, trees, houses, buildings, transmission towers and other obstructions that are more than 300 ft away from your location will not be a problem as they will be too low on the horizon to interfere with your reception. On the other hand, an adjacent house, your garage or a tall tree on your property will most likely cause interference. If your view is obstructed, try moving to a different location. Even moving the location 50 ft can make a dramatic difference.

2. Choose a location that is as close as possible to your house to minimize cable runs and reduce signal degradation (satellite signal and motor control). Short cable runs will save you money and provide the best performance possible.

3. Choose a location that will give you easy access to align the dish and change feeds, actuators, etc. Remember, if you install the dish very high it will be harder to maintain and make adjustments. During the winter season, you may also have to remove any snow accumulation.

4. Choose a location that is a "quiet" zone and doesn't experience terrestrial interference of any kind. The best such location is usually in your backyard next to your house. Your house will act as a natural insulator of terrestrial radiation and block it from reaching your dish. Test the quiet zone with an LNB by sweeping the target area along the satellite arc and watching for signal spikes.

5. Choose a location that is aesthetically acceptable to you and your neighbours.



1.2 : Dealing with potential obstructions

If your installation options are limited and you encounter obstructions, you may want to consider installing your dish on a very tall pole mast or anchor it against your house and above your roof. You should only consider such an option as a last resort because the installation will be a lot more difficult and easy access for aligning the dish and maintaining it will not be available.

Before deciding on such a course of action, consult satellite charts and determine which satellites you will be missing. For example, between 61W and 78W there are no active C band satellites in operation and any obstructions wouldn't matter anyway. If on the other hand you are only interested in English language American programming, you only need a clear line-of-site between 87W-105W and 121W-137W and obstructions between 30W – 87W and 107W-121W would be of no concern since they carry mostly Latin American programming, Mexican Programming, Canadian programming or no programming at all.

Finally, keep in mind that broadcasters transmit their signals on several different satellites. For example, CNN and CNN feeds are broadcast on no fewer than 5 satellites across the satellite arc. Even if one or two satellites are blocked by obstructions, you will still likely find these signals elsewhere.

Step 2: Pole Installation

2.1 : Pole Mast Dimensions

Before starting your installation you must ensure that your pole dimensions are compatible with the dish that will be installed. You must ensure that your pole outer diameter will fit comfortably on the dish saddle mount. You must also ensure a minimum ground clearance so your dish can track the satellite arc without encountering any obstacles (e.g. snow accumulation during the winter season).

Dish and pole mast sizes vary by manufacturer and the recommended sizes given below are for C band Satellite mesh antennas.

Pole Outer Diameter

8 ft Dish: 3.5 inches
10 ft Dish: 4.25 to 4.5 inches
12 ft Dish: 4.5 inches

Minimum Pole Ground Clearance

8 ft Dish: Minimum 4 ft
10 ft Dish: Minimum 5 ft
12 ft Dish: Minimum 6 ft

Do not use a pole with an outer diameter that is smaller than the recommended size given above or the weight of your dish (especially a large dish) will cause it to droop a bit to one side when you are trying to align it. This will make alignment more difficult because the dish will change position slightly when you tighten the cap bolts and bring it out of alignment. You want a snug fit between pole and dish saddle that will prevent any drooping and at the same time will allow you to easily rotate the dish on the pole for proper alignment. When you tighten the cap bolts, they should lock the saddle in place without pushing or pulling the dish in any direction.

If you experience a lot of snow accumulation in your area during the winter season, you might consider adding an extra foot or two to the minimum ground clearances suggested above.

If you can't find a pole with the right dimensions, consider purchasing one that has been manufactured specifically for your dish by the manufacturer. It will save you a lot of trouble and ensure a proper installation.

Finally, regardless of the pole installation technique you choose below, make sure your pole is absolutely plumb. This is critical if you want to track the satellite arc with a great degree of Accuracy. We strongly suggest you use a digital inclinometer and measure the pole angle on all sides. A satisfactory pole mount will be within 1 degree of perpendicular. An excellent pole mount will be within 0.5 degrees of perpendicular.

2.2 : Ground poles in concrete

Use this method of installation on grass or soft soil where hard rock does not prohibit you from digging out a hole of 4 – 6 ft in depth. As a rule of thumb, use the <u>1/3 below ground</u> and <u>2/3</u> <u>above ground</u> pole rule and follow the recommended dimensions below:

8 ft Dish

Pole above Ground: Minimum 4ft Pole below Ground: Minimum 2ft Total Pole Length: Minimum 6ft Hole Diameter: Minimum 12 inches

10 ft Dish

Pole above Ground: Minimum 5ft Pole below Ground: Minimum 2.5ft Total Pole Length: Minimum 7.5ft Hole Diameter: Minimum 16 inches

12 ft Dish

Pole above Ground: Minimum 6ft Pole below Ground: Minimum 3ft Total Pole Length: Minimum 9ft Hole Diameter: Minimum 18 inches

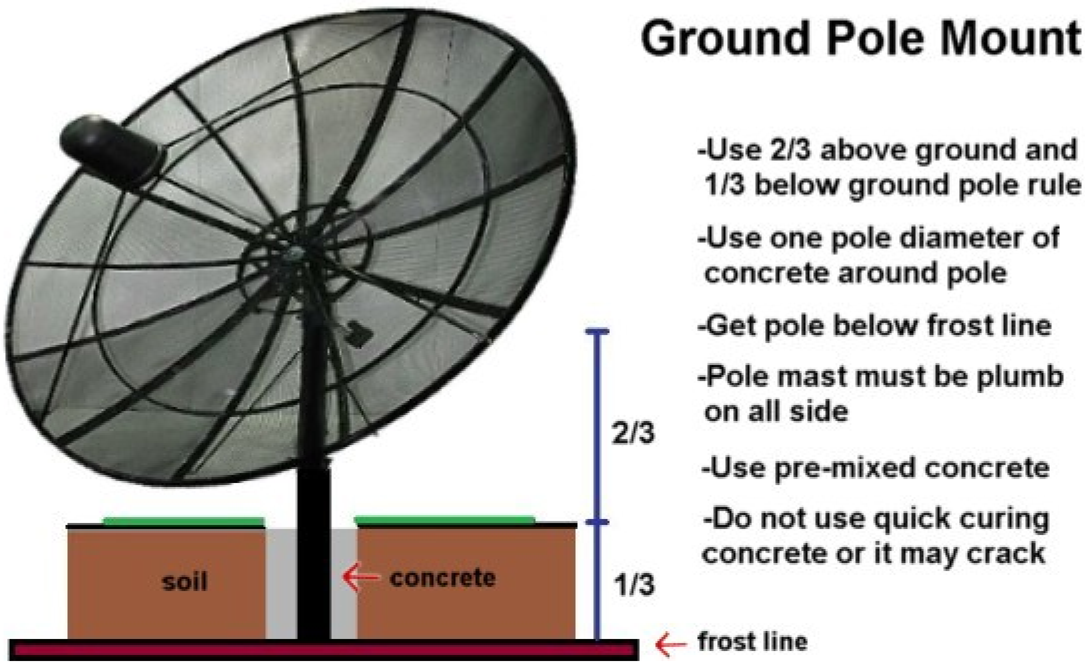
The above recommendations are the minimum acceptable dimensions for a mesh antenna that will experience average wind loads. If you are installing a solid dish or will experience above average wind loads in your area, increase the dimensions by at least 25-50%. We also strongly recommend that you use braces that are welded or drilled through the bottom of the pole to prevent the pole from turning in the concrete under load conditions. You can do this by bolting a few 10 inch bolts through the pole section that will be embedded in the concrete. The bolts will prevent the pole from turning once the concrete cures.

Use pre-mixed concrete (available at your local hardware store) to fill the hole and follow the manufacturer's directions. Pre-mixed concrete bags usually weigh 80 lbs and you will need a minimum of five or more bags depending on your dish size. Place a layer of gravel at the bottom of the hole to seat the pole. Have someone hold the pole and constantly check for plumbness while you add the concrete mix. Do not mix and pour all the concrete at once. Mix one or two bags at a time and shovel small amounts of concrete equally around the pole. Use a rod to gently stir the mix around the pole and ensure no air gets trapped in the mix. Continue to check for pole plumbness and proceed with the next batch of concrete mix. You should add slightly more water for each subsequent mix because the additional moisture will cure the concrete to have more strength.

For added stability with larger dishes or when using long poles, fill the pole with pre mixed concrete to the top. This will add rigidness to prevent flex from wind load.

Add as much concrete mix as necessary to fill the hole. If you wish to landscape around your pole, leave a few inches of space at the top and add top soil, grass, rocks, etc. If you do this, make sure you dig a few extra inches into the ground when you make your hole to make up for the lost space at the top.

If your pole came with "tripod" ground rods, you need to create three small concrete pads to anchor them. Dig each hole about 4x4x4 inches and fill with left-over concrete mix. You will use anchor bolts to anchor the rods in place once the concrete has cured. The purpose of the ground support rods is to prevent the pole from bending or vibrating under high wind loads. Although your pole is embedded in concrete, it may sway by as much as 0.25 - 0.5 cm under severe wind loads, especially if it is a rather long pole. Ordinarily this isn't a problem for C band signals because the wavelength of those signals is quite large, but it could cause temporary outage of Ku signals. The support rods will keep the top of your pole steady and should be bolted as close as possible beneath the dish saddle.



2.3 : Pole mounts on concrete pads

Use this method of installation if you purchased the antenna manufacturer's pole mast with heavy base constructed specifically for anchoring the pole on a concrete pad.

You can construct either a large concrete floating pad or a smaller concrete pad that is anchored into the ground. If hard rock prohibits you from digging into the ground down to the frost line, you should pour a floating pad instead. Your floating pad should be more than twice as large as an anchored pad. In this article we will only discuss the construction of an anchored pad, but the same method (without the anchor) can be used to make a floating pad.

Anchored Pad Dimensions 8ft
Dish

3ftx3ft pad (3 inches thick)
Ground Anchor Hole: 2ft deep by 12 inches wide

10ft Dish

4ftx4ft pad (3 inches thick)
Ground Anchor Hole: 2.5ft deep by 14 inches wide

12ft Dish

5ftx5ft pad (3 inches thick)
Ground Anchor Hole: 3ft deep by 16 inches wide

Floating Pad Dimensions (must be heavier and uses more concrete) 8ft Dish

5ftx5ft pad (3-4 inches thick)

10ft Dish

7ftx7ft pad (3-4 inches thick)

12ft Dish

9ftx9ft pad (3-4 inches thick)

The first thing you need to do is dig out the anchor hole to the dimensions mentioned above. Use 2x4 wood to frame the pad to the desired dimensions. If you want the pad to be flush with ground level, you will have to dig out an additional 3-4 inches of dirt where you place your wooden frame. Make sure your frame is level by measuring across the top of the frame with a carpenter's level. If your frame is not level, neither will be your pad.

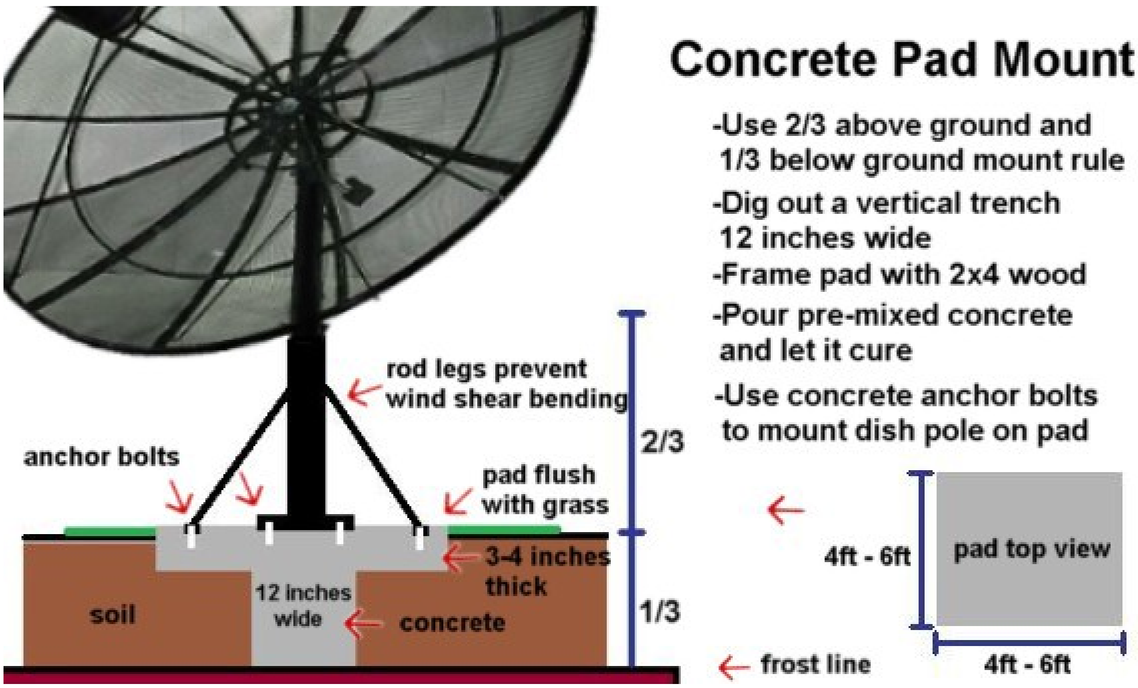
Use pre-mixed concrete (available at your local hardware store) to fill the anchor hole and follow the manufacturer's directions. Pre-mixed concrete bags usually weigh 30-40 kgs and you will need a minimum of seven or more bags depending on your dish size. Do not mix and pour all the concrete at once. Mix one or two bags at a time and shovel small amounts of concrete into the anchor hole. Use a rod to gently stir the concrete and ensure no air gets trapped in the mix. You should add slightly more water for each subsequent mix as the additional moisture will cure the concrete to have more strength.

Add as much concrete mix as necessary to fill the anchor hole and then the wooden frame. Use a 2x4 piece of wood to smooth out the surface of the pad by pushing it across the top of the frame and squeezing excess concrete mix away. Use a float to smooth out the top of the pad and make it flush with the top of the wooden frame.

Allow your pad to cure and then remove the frame. Mount your pole on the pad and measure for plumbness. If the pole is not plumb on all sides, you will have to shim the base of the pole until it is plumb on all sides. Drill ½ or ¾ inch holes for the anchor bolts and bolt the base of the pole to the concrete pad.

If your pole came with “tripod” ground support rods, you need to anchor these into the pad using 3/8 inch anchor bolts. The purpose of the ground support rods is to prevent the pole from bending or vibrating under high wind loads. Although your pole is anchored to the concrete pad, it may sway by as much as 0.25 - 0.50 cm under severe wind loads, especially if you are using a very tall pole. Ordinarily this isn’t a problem for C band signals because the wavelength of those signals is quite large, but it could cause temporary outage of Ku band signals.

The support rods will keep the top of your pole steady and should be bolted as close as possible beneath the dish saddle.



2.4 : Non-penetration roof-top installation

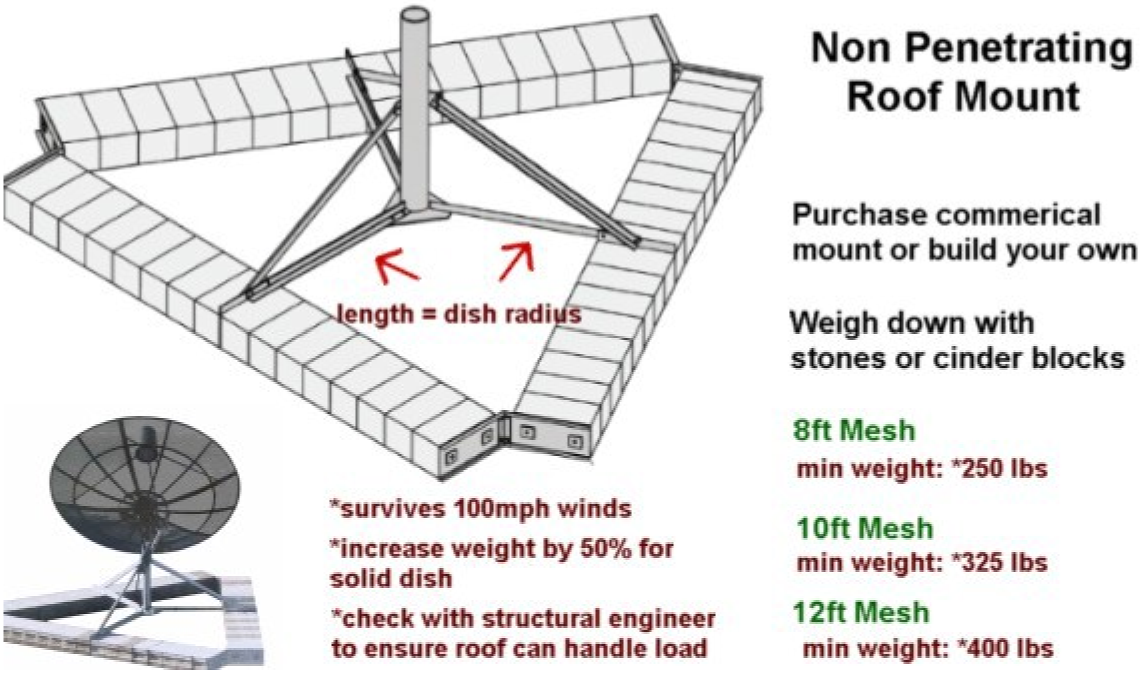
If you are planning to install your dish on a flat roof (e.g. industrial building, office building, etc.) and don’t want to penetrate the surface of the roof to weld the pole to a joist or beam, you will have to build or purchase a commercial non-penetrating roof mount.

We DO NOT recommend you pour a concrete pad on the roof unless a structural engineer is consulted first. A concrete pad could easily weigh 800 – 1000 lbs and might deform the structure of the roof or cause it to collapse.

The idea behind a roof mount is to take advantage of leverage by weighing the dish down 8–10 ft away from the pole and using a lot less weight. For example, weighing down the mount with 200-300lbs of stones that are 10ft away from the pole, will be equivalent to a concrete pad weighing 2000-3000lbs.

You will have to use steel bars and either weld or bolt them together to build a non-penetrating roof mount. Check your local hardware store for steel building supplies.

Finally, be sure to place your roof mount over a building joist or truss or beam to prevent damage to the roof. It is also advisable to consult with a certified structural engineer about safe wind and weight loads for your roof.



Step 3: Wiring and Grounding

You will need to run two different types of cables to your satellite dish: a coaxial cable for the signal and a 4-wire cable for controlling the actuator that moves the dish.

3.1 : Actuator Wiring

A minimum of 4 wires are required to control most satellite actuators. Two wires are used to provide 36V DC power to the actuator motor and two more wires are needed for receiving data from the actuator sensor about the dish movements.

The two power lines should be capable of driving between 1 – 2 amps of current to the actuator depending on the size of the dish. An 8ft mesh dish usually requires about 750mA of current to drive with an 18 inch actuator, whereas a 12ft mesh dish requires about 1.5A of current to drive with a 36 inch actuator. If your actuator is moving a solid dish or has to move the dish under heavy wind loads, it will use even more current. You must ensure that the actuator wire you select is rated for the voltage and amperage needed.

The two data lines transmit a differential analog voltage signal from a sensor that is generated by a magnetic wheel inside the actuator that turns in synchronization with your dish and provides information about dish movements. The voltages generated in this pair of wires are very small and can be attenuated significantly over long cable runs.

In general, you need to select a bundled 4-wire cable that will meet your specific TVRO setup. At the very minimum, you need to choose a wire size that can handle the power requirements needed. The longer your cable run, the thicker your wires need to be. We suggest that at the very minimum you use an 18 AWG 4-wire cable with stranded wire and shielding.

Recommended Actuator Wire (stranded and shielded with ground line)
(AWG = American Wire Gauge – the lower the AWG the larger the wire diameter)

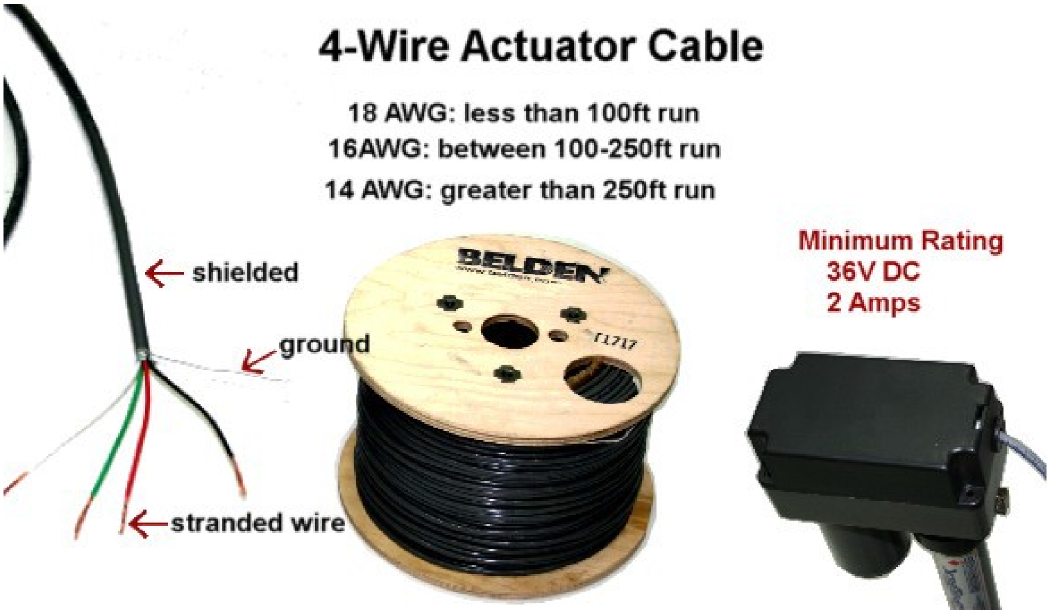
8ft Dish
18 AWG: less than 100ft run
16 AWG: between 100ft – 250ft run 14
AWG: greater than 250ft run

10ft Dish
18 AWG: less than 75ft run
16 AWG: between 75ft – 200ft run 14
AWG: greater than 200ft run

12ft Dish
16 AWG: less than 75ft run
14 AWG: between 75ft – 200ft run 12
AWG: greater than 200ft run

If you plan to use a servo motor to control the skew of your LNB, you will need to run a 6-wire cable bundle as the servo motor requires two wires for power. Ortho feeds with two LNB’s don’t require this as they use two separate probes for detecting polarized signals. Single LNB and servo use a single probe that needs to be rotated 90 degrees depending on the signal polarity. If you plan to use an LNB with analog skew control, make sure you run a 6-wire cable with ground. Rainier Recommends our Havard Scientific Tuned ortho feedhorn with 2 PLL LNB’s. This simplifies the install and give you maximum signal when set up properly.

Cable can be expensive especially 14-AWG and 12-AWG cable longer than 150ft, but you may encounter problems if you don’t use the right size. For example, long cable runs with the wrong wire can result in synchronization problems where your controller misses pulse counts from the actuator sensor and doesn’t land in the correct pre-programmed position along the satellite arc.



3.2 : Coaxial Cable

The purpose of the coaxial cable is to conduct the down converted and amplified satellite signal from the LNB to the receiver. This signal ranges in frequency between 950 MHz – 1450 MHz and will be attenuated by the coaxial cable in direct proportion to the cable run and frequency. In other words, the longer the cable run and the higher the frequency, the greater the signal attenuation. If the signal gets attenuated too much and falls below the receiver threshold of detection (or below the noise floor), it cannot be processed and displayed.

For most TVRO applications a standard RG6 coaxial cable with 75 Ohms of characteristic impedance is typically used. This is the same type of coaxial cable used for DTH and terrestrial antenna applications. We strongly suggest that you DO NOT use RG59 coaxial cable which experiences more loss and is intended for indoor short cable runs only.

If your cable run is longer than 150 ft we recommend you use Rainier's 4.5 GHZ PURE HD video coax and actuator cables.

Dual Solid Copper Center RG-6 Coax

- **Ultra Low Loss - 4K Ready - Belden Brand**
- **4.5 GHZ Swept Tested. The Ultimate!**
- **Actuator 2 motor and 2 shielded sensor wires.**

Get the Signal with maximum picture resolution with Rainiers Premium Quality Dual RG-6/U Type Precision Low Loss Serial Digital Video Coax by Belden. **SOLID COPPER CENTER CORE (not steel clad center, copper coated like bargain brands) for maximum signal transfer.** Better overall reception with lower BER. 4K Ready. Cables Made in USA.

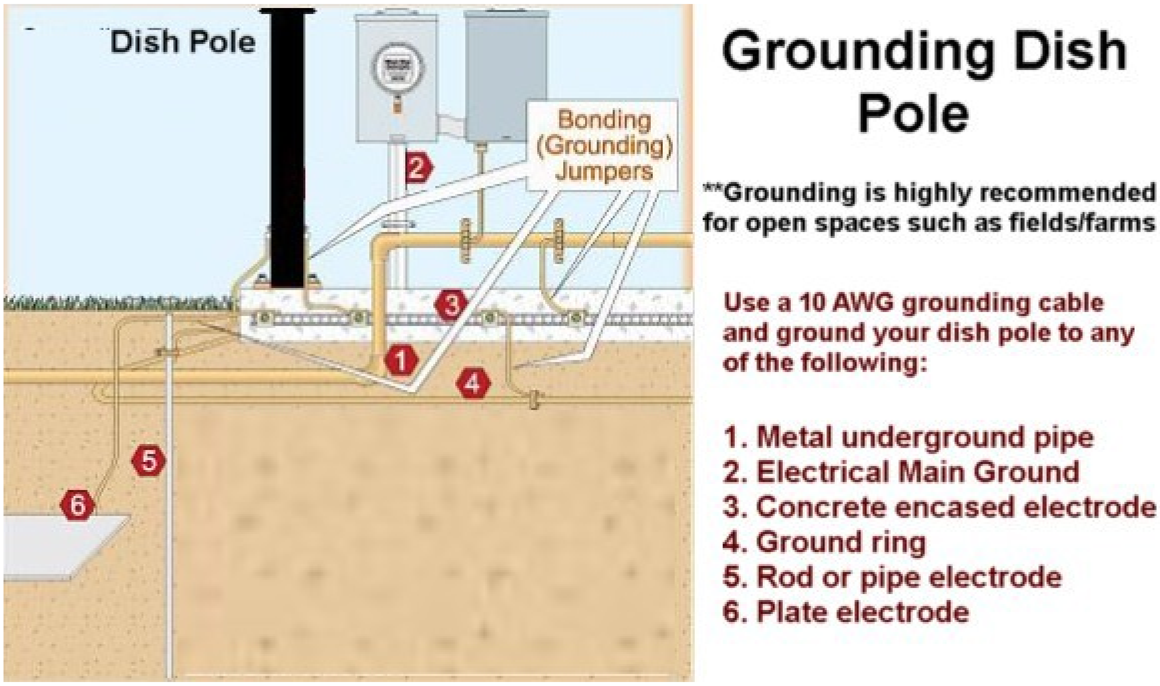
It can be purchased directly from Rainier Satellite.

3.3 : Grounding

To avoid lightning damage to your home and property we strongly suggest you ground your TVRO satellite system. Use a No. 10 AWG or larger solid copper ground cable and run it from the pole supporting your dish to the main A.C. electrical ground for your home. You may also connect the ground cable directly to the main ground rod/ring on your property or if this is not easily accessible, connect to the main water copper pipe servicing your home. Be sure to sand down the surface of the pole where you connect the ground wire so that it makes good electrical contact.

Should your TVRO satellite take a direct lighting strike and it is properly grounded, the electrical surge will follow the path of least resistance and be discharged harmlessly into the ground cable and will not enter your home through the actuator/coaxial cables. If on the other hand your dish is not grounded, any direct hit will attempt to discharge through the pole and into the Earth, but if it can’t be discharged quickly enough, it will also conduct along the actuator/coaxial cables and into your home where it may cause serious damage and/or start a fire.

We strongly recommend you ground all your antennas on your property and check your local electrical code for compliance. We also strongly recommend that you use a quality AC surge protector for your TVRO electronics inside your home to prevent against damage from power utility company transformer problems and line surges.



Step 4: Assembly of Dish Frame

Pictures of dish shown are generalized. Please consult your owner's manual for specifics pertaining to your dish.

As the saying goes, a picture is worth a thousand words and we recommend that you carefully study the pictures below to assemble your TVRO dish.

4.1 : Saddle Mount and True South

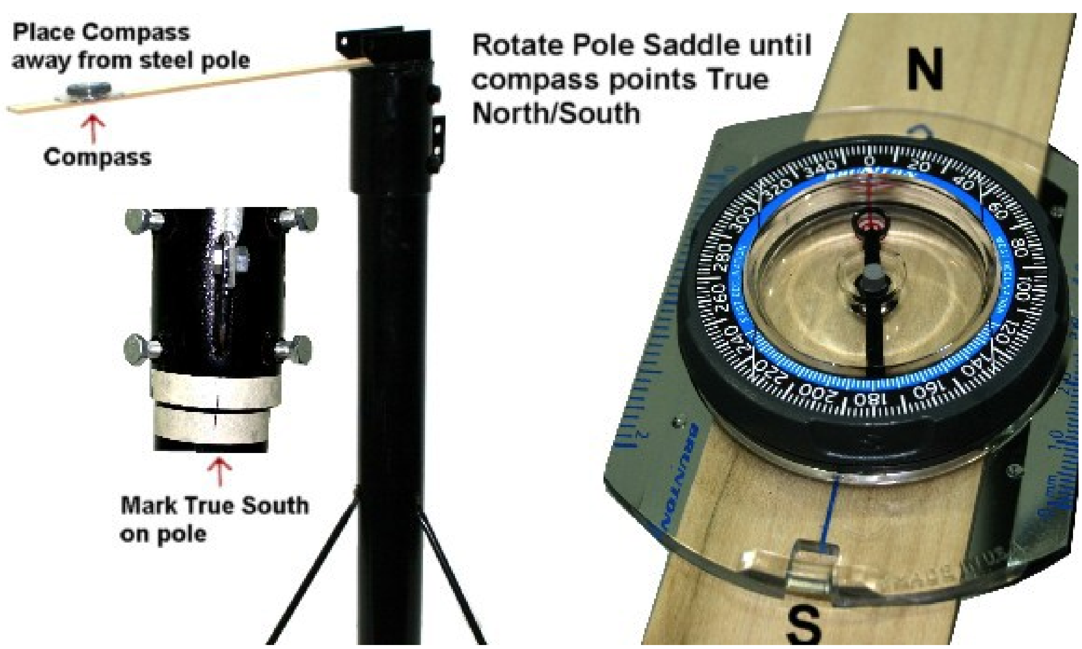
The first thing you need to do is to roughly determine true geographic south (not magnetic south) for your location. Your dish MUST be pointed exactly due south in order to track the satellite arc properly. At this time you only need to be pointed roughly due south and you will fine tune the direction later when aligning the dish.

You can do this by using a simple magnetic compass. Before using the compass however, you must adjust the magnetic declination so that it points true south and not magnetic south. Follow the instructions that came with your compass or use the link below to find your magnetic declination:

http://www.magnetic-declination.com/

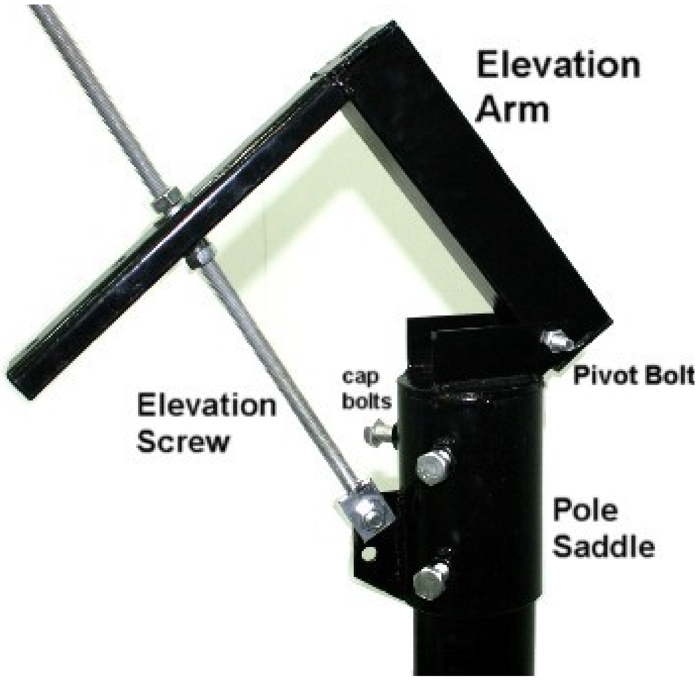
Place the dish saddle on the pole and tape a long, flat stick to the saddle and put the compass on the end of the stick. (If you place the compass directly on the steel saddle, it will distort the magnetic field and your compass will not give you a reliable reading). Make sure the stick is level and gently start rotating the saddle until your compass points due south. Mark this position on both the saddle and pole.

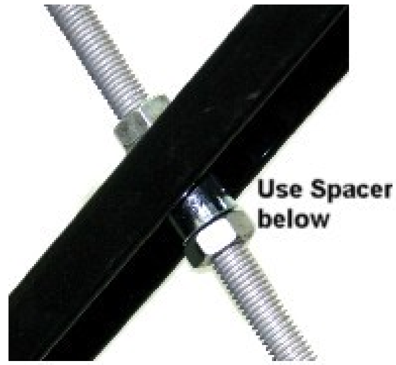
We strongly recommend that you either chalk the pole or use masking tape to mark the position. When you fine tune the alignment later on, you will need to move the dish a few degrees to the left or right of this point to peak the signal. If you don't mark it, you will found yourself guessing and becoming very frustrated indeed!

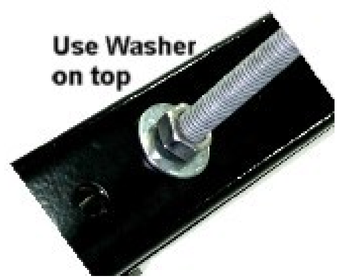


4.2 : Assembly of Elevation Arm and Screw

Assemble the elevation arm and elevation screw as shown in the picture below. Use a spacer below the arm to make elevation screw adjustments easier. Tighten the pivot bolt just enough so that the elevation arm doesn't wiggle back and forth on the saddle.







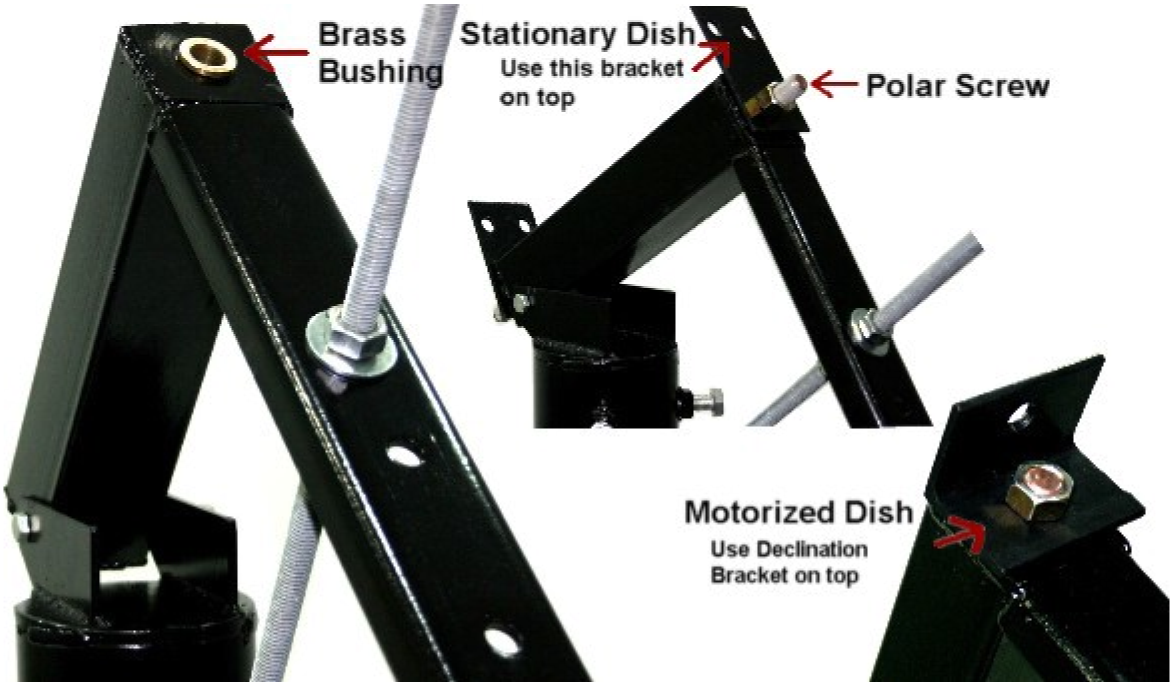
4.3 : Assembly of Polar Mount Pivot Screw

Assemble the polar mount pivot screw as shown in the picture below. Be sure to add the brass bushings on the top and bottom of the elevation arm. The purpose of the brass bushings is to ensure a snug fit with the pivot screw and at the same time allow the dish to pivot about this axis. If the bushings are the wrong size or you do not use them at all, the pivot axis will move around (due to the weight of the dish) as you move the dish and signal reception along the satellite arc will become erratic. Even a little play between the bushings and the pivot screw will cause slight misalignment problems when you swing the dish from horizon to horizon.

4.4 : Assembly of Declination Bracket and Screw

Assemble the declination bracket and screw for your dish. The declination design varies by dish model and may be located at the top (like in the illustration) or at the bottom of the elevation arm. The declination screw allows you to move the dish frame a few degrees (0 – 10 degrees) away from the elevation arm. This setting is extremely important for tracking the satellite arc and will be discussed in more detail later.

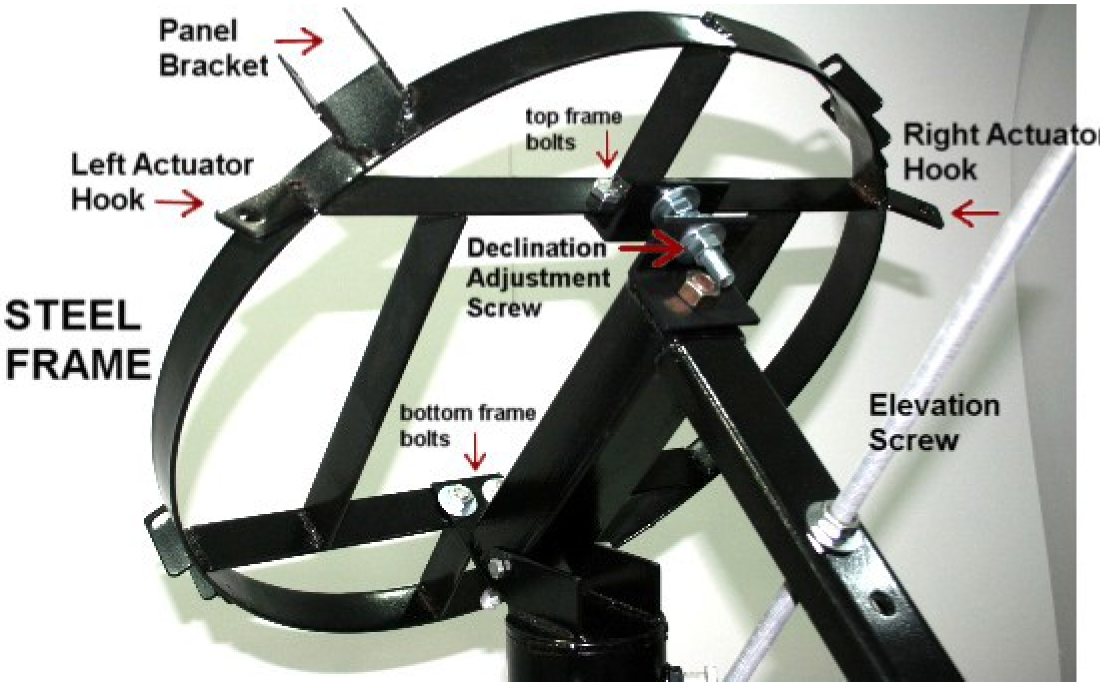
If you are installing a stationary TVRO satellite, you do not need the declination bracket and screw (for most models).



4.5 : Assembly of Dish Frame

Bolt the frame on to the elevation arm and declination bracket. Tighten the pivot screw bolts (top and bottom) enough so that a force of 15 – 20 lbs is required to swivel the frame about the pivot screw. DO NOT over tighten these bolts because your actuator will struggle to push and pull the frame. If your actuator can't move the dish, loosen the bolts.

The reason for tightening so that a 15 – 20 lbs force is required to move the frame is to prevent high winds from rocking your dish back and forth. Even though your dish will have the actuator attached, even the best actuators will have a little play (1-2mm) and the wind will move it back and forth. Although 1-2mm doesn't sound like much, it could cause the signal quality to fluctuate by 10-15%, especially with Ku band signals.



4.6 : Set Elevation Angle

Consult the chart below to set your elevation angle. Your elevation angle is approximately equal to your geographical latitude. It is slightly modified from your precise latitude in order to better track the satellite arc at the ends. It turns out that the satellite arc cannot be tracked perfectly with one degree of freedom of motion. It can be tracked perfectly at the top of the arc (zenith) but will be off by 1-2 degrees at the horizon ends. We can get around this problem by using a modified elevation angle and modified declination offset angle to improve tracking at the arc ends.

Find your modified elevation angle from the chart below and place your inclinometer on the pivot screw axis as shown in the picture below. Avoid measuring the elevation angle against the steel elevation arm because imprecise machining of the arm may have resulted in a surface that is not exactly parallel to the pivot screw axis. Adjust the elevation screw settings until you get the desired modified elevation angle.

For our setup, we used Buffalo, NY as the geographical location with a latitude of 43 degrees North. According to the chart below, our modified elevation angle should be **43.65 degrees.** With a digital inclinometer we were able to set the modified elevation angle to 43.60 degrees!

Once you set your modified elevation angle, we strongly recommend that you mark the elevation screw with a black felt tip pen so you know this setting. In theory, you should never have to change this setting unless you want to fine tune your dish alignment (described later).

4.7 : Set Declination Offset Angle

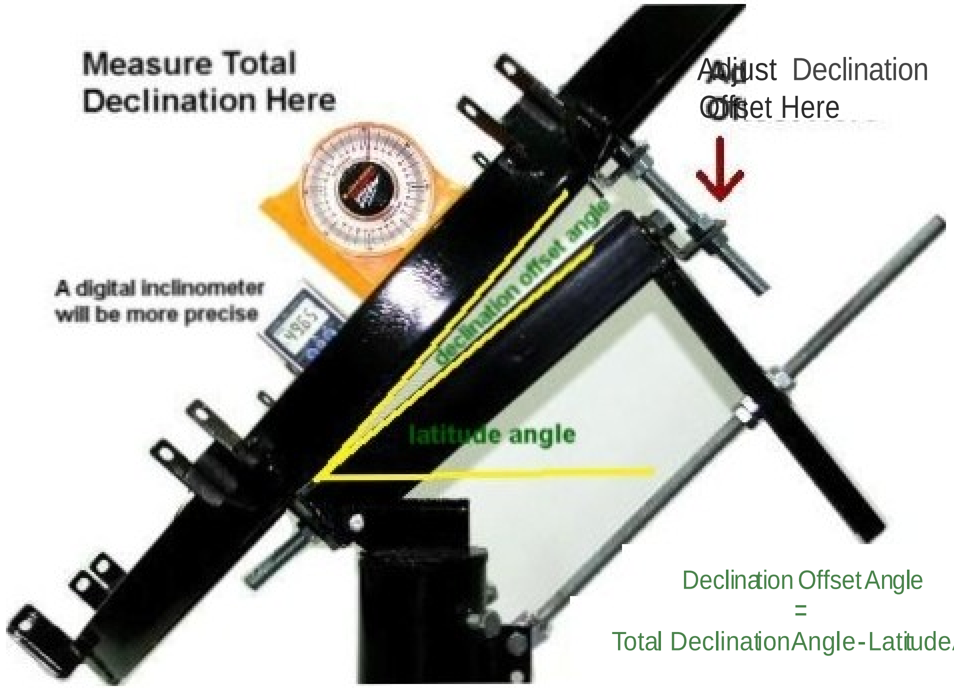
Consult the chart below to set your modified declination offset angle. This adjustment will 'tilt' your dish frame slightly forward by a few degrees.

It is easier to measure your total declination angle which equals your modified elevation angle plus your modified declination offset angle. To do this, place your inclinometer on the front or back surface of the dish frame as shown. If you have the panels already assembled, you will have to either take the measurement on the back of the frame if possible or across the panel rims from the front. You MUST make this adjustment while the dish frame points true south (zenith).
Adjust the declination screw until you are satisfied with your setting. At this point it is not critical that this adjustment be perfectly accurate as we will fine-tune it later on.

For our Buffalo, NY example, the modified declination offset from the chart below was 5.96 degrees so:

Total Declination = 43.65 + 5.96 = 49.61 degrees

In the picture below were able to set it to 49.65 degrees!



Declination Offset Angle
=
Total Declination Angle - Latitude Angle

Latitude (Degrees)	Elevation Angle (Degrees)	Declination Angle (Degrees)	Latitude (Degrees)	Elevation Angle (Degrees)	Declination Angle (Degrees)
1.0°	1.02°	0.15°	32.0°	32.60°	4.66°
2.0°	2.05°	0.30°	33.0°	33.60°	4.79°
3.0°	3.07°	0.46°	34.0°	34.61°	4.91°
4.0°	4.10°	0.61°	35.0°	35.62°	5.04°
5.0°	5.12°	0.77°	36.0°	36.63°	5.16°
6.0°	6.15°	0.91°	37.0°	37.63°	5.28°
7.0°	7.17°	1.06°	38.0°	38.64°	5.40°
8.0°	8.20°	1.21°	39.0°	39.64°	5.51°
9.0°	9.22°	1.36°	40.0°	40.65°	5.63°
10.0°	10.23°	1.54°	41.0°	41.65°	5.74°
11.0°	11.27°	1.66°	42.0°	42.65°	5.85°
12.0°	12.29°	1.81°	43.0°	43.65°	5.96°
13.0°	13.31°	1.96°	44.0°	44.66°	6.07°
14.0°	14.33°	2.11°	45.0°	45.66°	6.18°
15.0°	15.33°	2.29°	46.0°	46.65°	6.28°
16.0°	16.38°	2.40°	47.0°	47.65°	6.38°
17.0°	17.40°	2.55°	48.0°	48.65°	6.48°
18.0°	18.42°	2.69°	49.0°	49.65°	6.58°
19.0°	19.44°	2.84°	50.0°	50.64°	6.67°
20.0°	20.43°	3.02°	51.0°	51.67°	6.70°
21.0°	21.47°	3.12°	52.0°	52.66°	6.79°
22.0°	22.49°	3.26°	53.0°	53.65°	6.88°
23.0°	23.51°	3.40°	54.0°	54.65°	6.97°
24.0°	24.52°	3.54°	55.0°	55.61°	7.11°
25.0°	25.51°	3.73°	60.0°	60.56°	7.51°
26.0°	26.56°	3.81°	65.0°	65.49°	7.84°
27.0°	27.57°	3.95°	70.0°	70.41°	8.11°
28.0°	28.58°	4.08°	75.0°	75.32°	8.33°
29.0°	29.60°	4.21°	80.0°	80.22°	8.48°
30.0°	30.57°	4.40°	85.0°	85.11°	8.57°
31.0°	31.59°	4.53°			

Step 5: Adding a Dish Actuator

Actuator and motor drive controller images are generic. Please consult your specific unit's manual for proper connections.

A linear actuator (or jack) is simply a motorized arm that telescopes in and out of a fixed tube and moves your dish across the satellite arc. If you want to track multiple satellites and receive many more channels than a typically stationary dish is capable of receiving, then you need to install an actuator.

5.1 : Determining Actuator Mount Side

Before mounting the actuator you need to determine which side to mount it on. Knowing the satellite arc at your geographical location will help you make this determination. The general rule of thumb is this:

Left Side Mount

Mount the actuator on the left side if your location is west of 80 degrees longitude.
Use this if your location is west of the Mississippi.

Right Side Mount

Mount the actuator on the right side if your location is east of 80 degrees longitude.
Use this if your location is east of the Mississippi

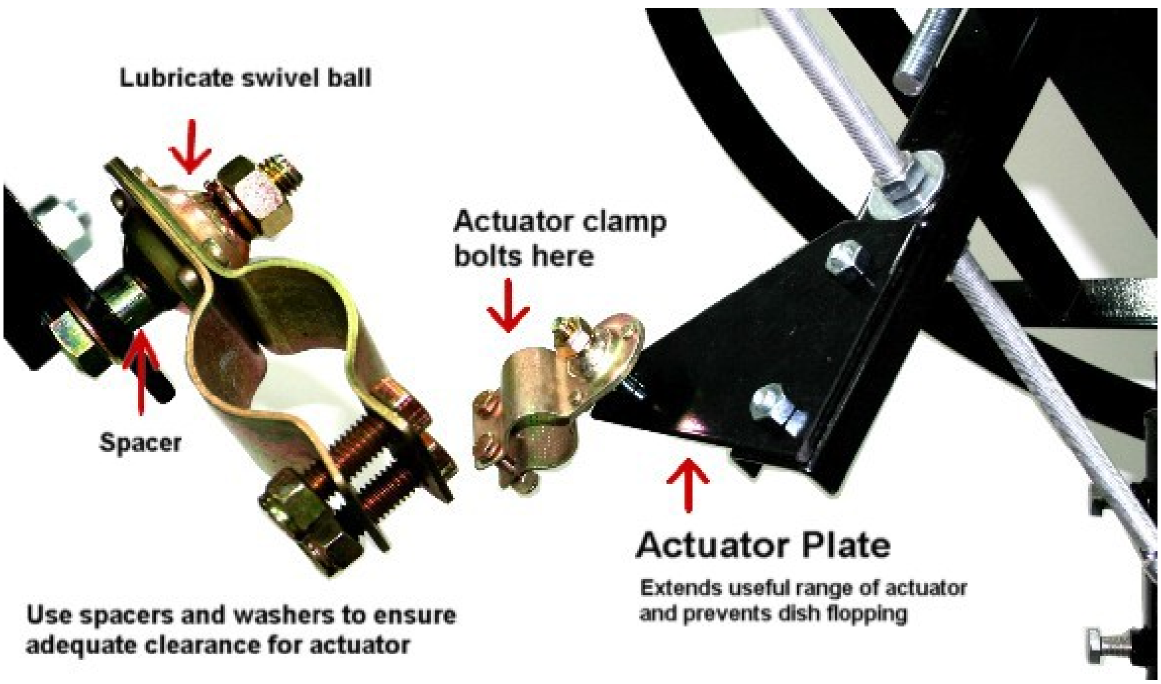
The reasoning behind this 'actuator mount rule' is simply that the average 24 inch actuator can track about 100 degrees of the arc altogether (a 36 inch actuator can track about 120 degrees). In North America, geostationary satellites are positioned from 11W to 139W along the arc and the idea is to track as much of this arc as possible by mounting the actuator intelligently. For example, if you are located at 120W, there are only a few satellites west of your zenith but many more east of your location and near the horizon. In this case, you would mount the actuator on the left side and adjust it so it starts 'pushing' the dish away from 45W because this satellite is the lowest on the arc that is NOT below the horizon and is visible from 120W. By mounting the actuator on the left side, you would be able to track the arc from 45W to 139W. If you mounted it on the right side, the actuator arm would extend quite a bit already before encountering the first satellite at 139W and would not be able to make it all the way to 45W. Instead, you would only be able to track from 139W to 70W.

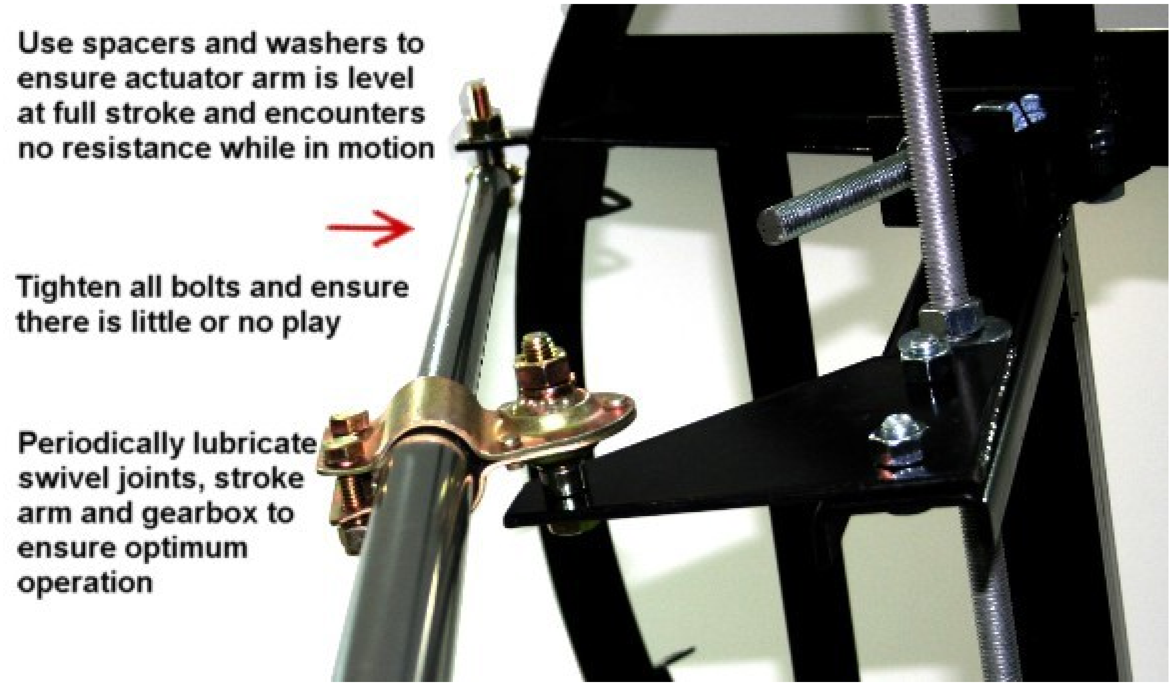
5.2 : Actuator Plate

The purpose of the actuator plate is to optimize the clamp position of the actuator in order to maximize the useful range of the satellite arc that can be tracked. Bolt it on the left or right side depending on where you plan to mount the actuator.

5.3 : Actuator Clamp Assembly

Attach the actuator clamp to the actuator plate as shown in the picture below and use spacers and washers as needed to ensure the clamp clears the plate when it swivels around. Mount the actuator through the clamp but DO NOT tighten the clamp yet because you will need to move the actuator back and forth to find the right place to clamp it. Bolt the end of the actuator arm to the frame hook as shown below and add spacers and washers to ensure proper clearance. Ensure that the actuator arm moves freely and doesn't encounter any resistance or friction when being extended or retracted in the actuator tube. If it does encounter resistance, you must add washers and spaces at the clamp and frame hook until the actuator arm telescopes in and out smoothly.
You should test for smooth operation by wiring the actuator to the controller and moving it across the arc.





5.4 : Optimum Actuator Clamp Location

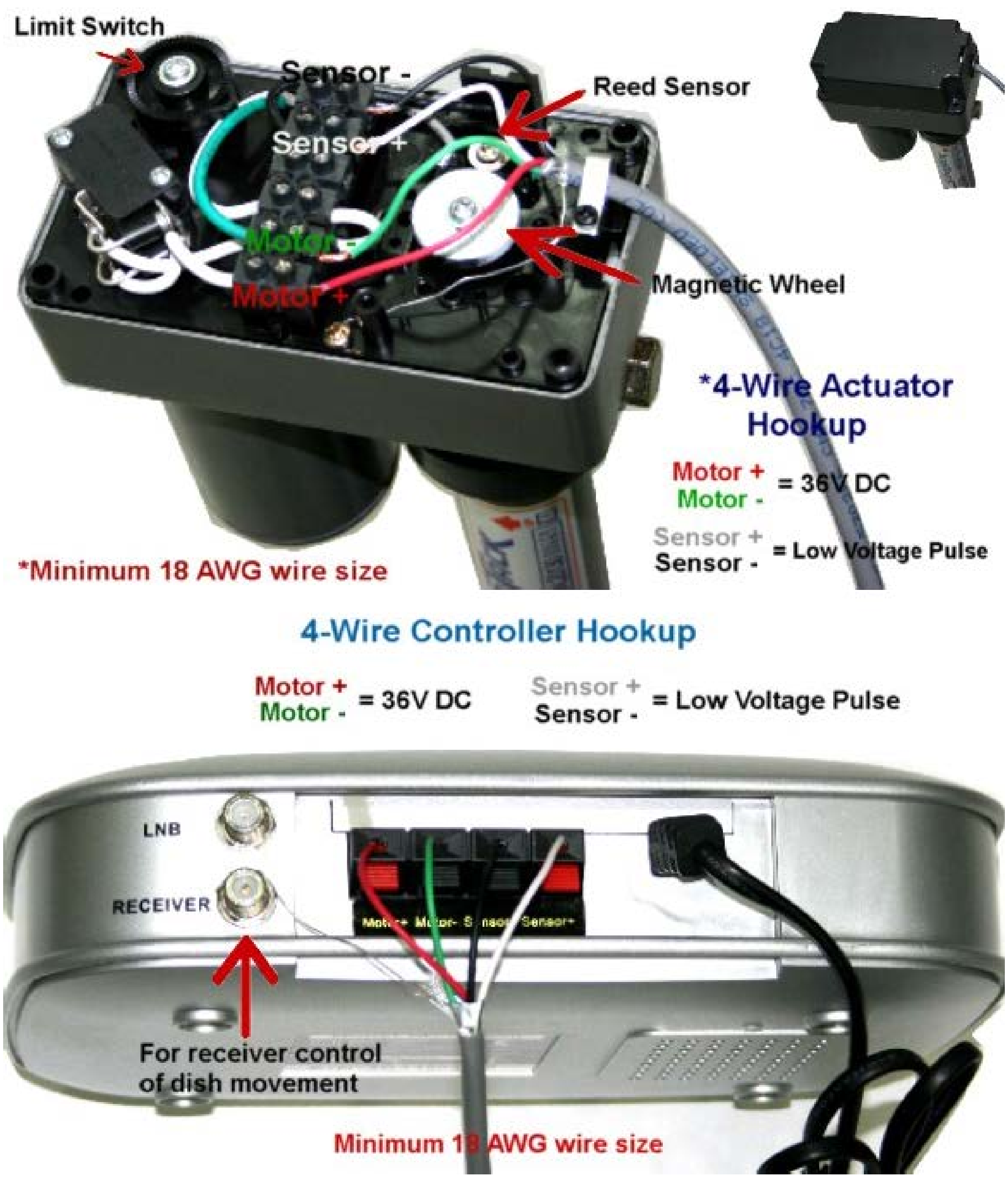
In order to optimize the useful range of the actuator over the satellite arc, you need to retract the actuator arm completely and clamp the actuator in place when the dish is aimed at the lowest satellite above the horizon that is visible from your location or the lowest satellite above the horizon that you wish to track. When you have found this satellite, tighten the clamp and ensure the actuator tube doesn't slip when moving the dish.

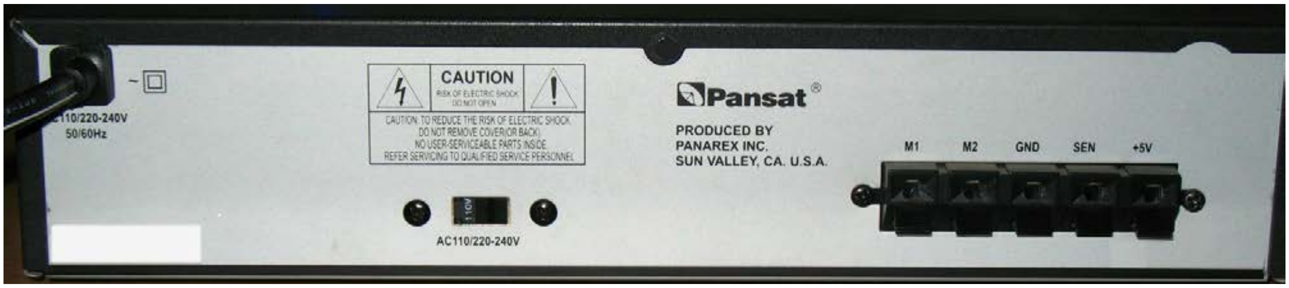
5.5 : Wiring the Actuator and Controller

Wire the actuator and controller as shown in the pictures below. The red and green wires provide 36 DC power to the motor and the black and white wires relay sensor information. DO NOT mix up the power wires with the sensor wire or you may damage the sensor.

If you reverse the red and green wires on the controller, your dish will simply move in the opposite direction in response to the polarity change. Reversing the black and white wires will have no effect because the sensor signal is differential and not referenced to ground.

It is worth repeating once more: DO NOT mix up the red/green power wires with the black/white sensor wires or your actuator sensor may be damaged.





Rainier's recommended AP-600 rear view.

5.6 : Setting Actuator Mechanical Limits

It is strongly recommended that you set the mechanical limits inside the actuator motor housing in case your receiver or controller malfunctions and overdrives the dish possibly causing it to flop or hit an obstacle.

The mechanical limit switch consists of a plastic cam that trips a microswitch that cuts power to the actuator motor. Set the cam to trip the switch just past the point of the last satellite on the arc that you want to receive or just before the dish encounters any kind of physical obstacle.

5.7 : Lock-down Bar for Stationary Installation

If you don't plan to use your dish to track multiple satellites across the arc, then use the lock- down bar to park the dish in the zenith position. You only need to adjust the elevation angle and azimuth angle to align your dish for a stationary installation (leave the declination angle at zero degrees). Note that the elevation angle in a stationary installation is completely different from the elevation angle in a tracking installation. The elevation angle in a stationary installation is the actual elevation angle to the satellite and will vary depending on the satellite you are aiming at.

Use the lock-down bar for stationary dish installations where an actuator is not required

Step 6: Assembly of Dish Panels

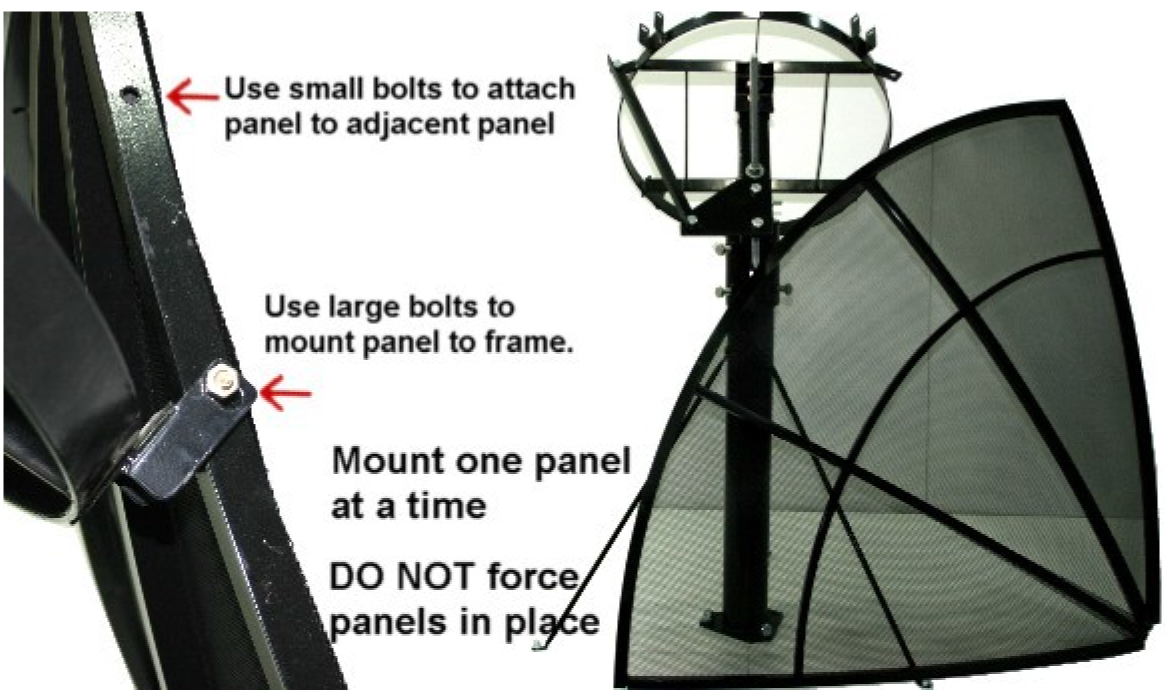
Assembly of the dish panels is fairly straight forward and probably the easiest part of a TVRO satellite installation. Some people prefer to assemble the panels on the ground and then mount the whole thing on the frame. We strongly recommend against such an approach, especially for larger antennas where the panels bolted together could weigh more than 50 lbs and make it difficult to maneuver in place on the frame. Instead, we suggest you mount one panel at a time.

6.1 : 4-panel / 6-panel / 8-panel Antennas

The smallest C band antennas (8 ft) usually consist of 4 panels, whereas mid-size antennas (10 ft and 12 ft) are constructed with 6 or 8 panels. Even 16 panel antennas are not unheard of for 16 ft diameter dishes.

Large antennas consist of many panels in order to facilitate shipping of the antenna but if the assembly of these panels is not done properly during installation, the surface of the parabolic dish might be distorted leading to less than optimum performance.

When bolting together adjacent panels, you MUST ensure that there is a seamless fit between panel edges and that the panel rims line up perfectly. Even a surface mismatch of 5mm between two adjacent panels could result in enough C band distortion to lower your signal quality by more than 15%. In the case of Ku band signals, the distortion would be even more severe.



6.2 : Bolting panels together

TIP: FOR THE BEST PARABOLIC SHAPE PANELS SHOULD BE ASSEMBLED ON THE GROUND USING A FLAT SURFACE. Snug up each section so the shape is true. When you're done attach the ring on the ground or attach to the reflector to the ring on the pole. *Safety First* Lift whole assembly on pole with the help of manpower needed to perform this.

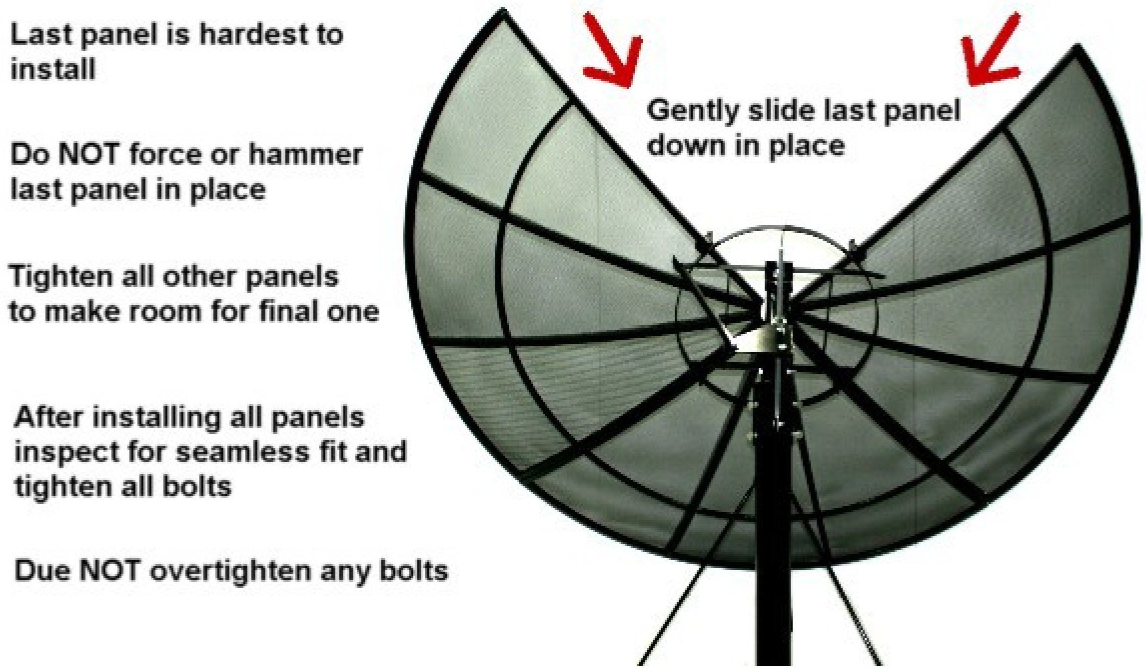
Bolt the panels to the frame using the large bolts and bolt them to each other using the smaller bolts. NEVER force or hammer any panels in place. If one panel is really tight or won't fit, try using another one. If you can't get a seamless fit with two adjacent panels, try opening up the pre-drilled holes by drilling them a little bit larger.

As you add more panels, you may find it easier to rotate the frame about the pole and adjust the elevation in order to allow some panels to lean against the ground for support.

6.3 : Adding final panel

The last panel is always the hardest to add in place. Before attaching the last panel, make sure all other panels have been installed properly and make a seamless fit. Tighten down all the panels before installing the last one.

Slide the last panel into place from the rim towards the center of the dish. Do NOT hammer the last panel in place. If you encounter too much friction pushing it into place, have someone push/pull on the lips of the assembled panels in order to make some extra room to slide the lastpanel in place. If you can't get the bolts through this last panel, you might consider opening up the pre-drilled holes on the last panel by drilling them 15% - 20% larger in order to facilitate the installation of this final panel.
Once the last panel is in place, tighten them all down but DO NOT over tighten and damage the aluminium panel frames. Inspect the parabolic surface of the finished dish and ensure there are no distortions caused by a misaligned panel.



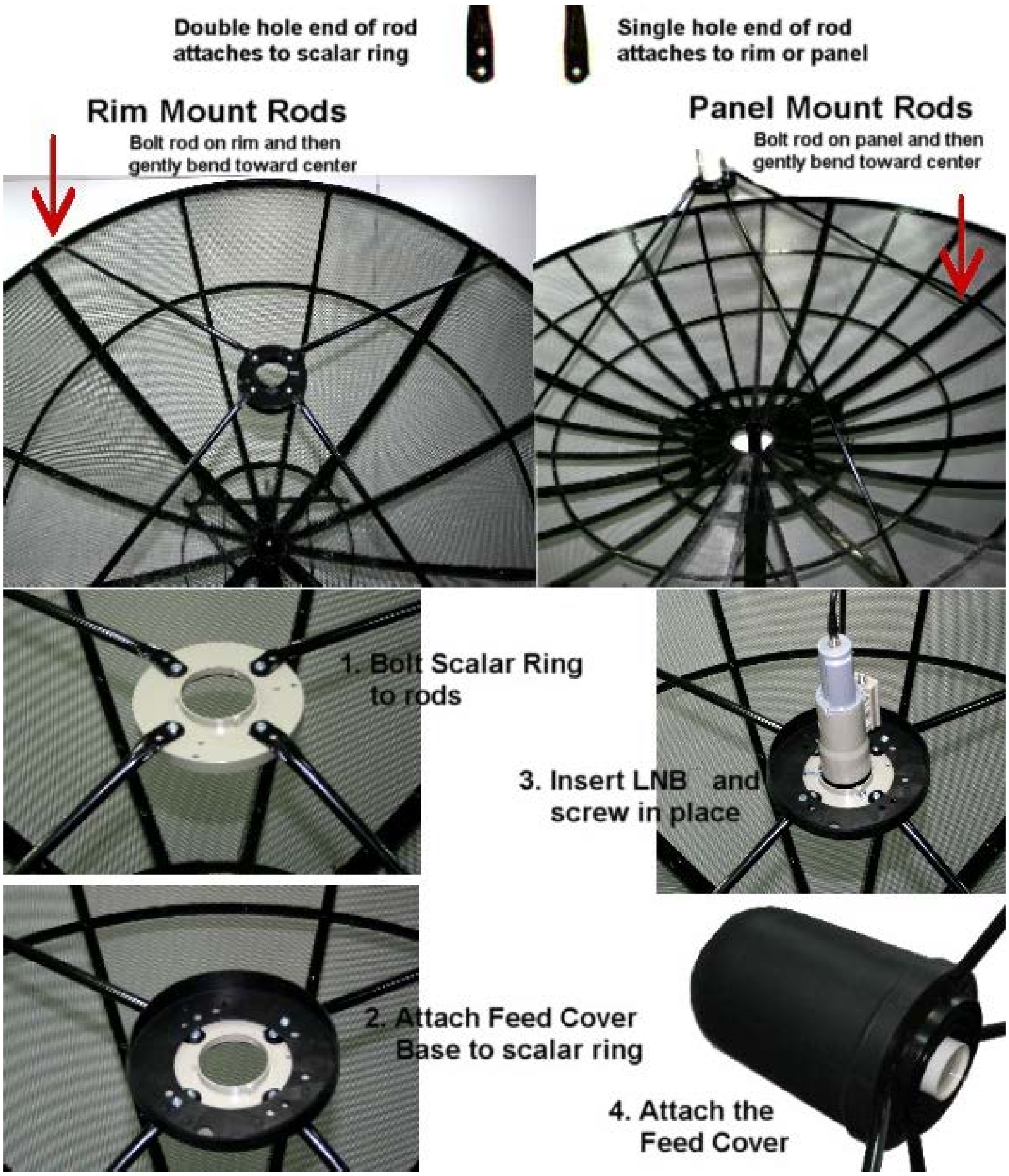
Step 7: Assembly of Rods and Scalar Ring

The purpose of the dish rods is to hold the scalar ring which in turn holds the LNBF at the focal point of the parabolic dish. The vast majority of C band antennas use 3 or 4 dish rods.

7.1 : Rim or Panel Mount Rods

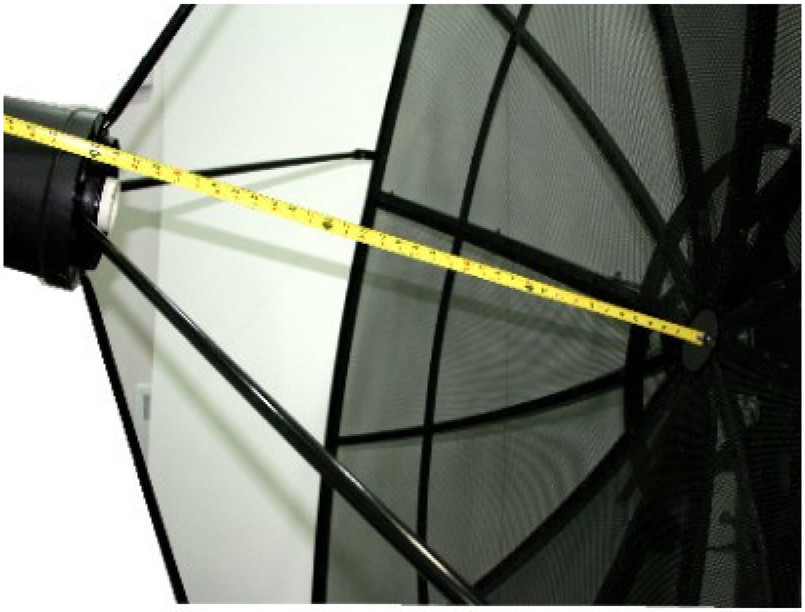
Some rods mount on the rim of the panels while others are designed to mount on the surface of the panels. Usually there are pre-drilled holes on the panels where the rods are supposed to mount. If there are pre-drilled holes on both the rim and surface of the panels, you will have to determine if your dish rods are rim mount or panel mount. You can ask your dish supplier or if you know the focal length of the dish, try and rim mount and if that falls too short, do a panel mount.

When mounting the rods, the end with the two holes bolts to the scalar ring while the single hole end bolts to the panel. You will need to gently bend the ends of the rods in order to bring them to the focal point of the dish so they can be bolted to the scalar ring.



7.2 : Measuring Focal length

Once you have the scalar ring in place, you will need to measure the focal length of the dish and ensure it closely matches that given by the manufacturer. You need to measure from the absolute center of the dish to the inner surface of the scalar ring. If your dish has a center piece, you will have to add about ½ an inch to your measurement. Make sure that the focal distance is within 1 inch of the manufacturer's specifications. Remember, you will be able to fine-tune the focal length later when you position the LNB in and out of the scalar ring.



Wrong focal length = No Signal Reception

Measure Focal Length and ensure it matches dish specs

Adjust Scalar Ring so it is equidistant to dish center on all sides

8ft Dish
Focal Length = 36 inches
F/D = 0.40

10ft Dish
Focal Length = 48 inches
F/D = 0.40

12ft Dish
Focal Length = 51 inches
F/D = 0.48

7.3 : Scalar Ring Adjustment

Finally, make sure the scalar ring is equidistant (and parallel) to the dish face on all sides. Measure to be sure and if necessary, gently bent the scalar ring to ensure it is equidistant on all sides. If the scalar ring is not equidistant but rather inclined at an angle, the radio waves will also enter the LNB at an angle and optimum reception will not be achieved.

You could compromise as much as 1-2 dB in signal strength if you don't properly adjust the scalar ring. This means that a 10ft dish (with misaligned scalar ring) will only function like an 8ft dish (with properly aligned scalar ring). And an 8ft dish (with misaligned scalar ring) will function like a 6ft dish(with properly aligned scalar ring)!

Step 8: Adding a Feed System

The purpose of the satellite feed system is to amplify and down convert the C and Ku band satellite signals at the reflector focus to a much lower frequency (950 – 1450 MHz) that can be propagated down a coaxial cable with minimal energy loss. The feed system usually consists of a feedhorn and waveguide that guide the signals to the LNB (low-noise block downconverter).

Rainier’s Harvard Scientific Ortho C band tuned feedhorn.

C band PLL LNB. 2 lnb’s are used with our ortho feed above. One for vertical, one for horizontal polarity.

Assemble lnb’s to waveguide flanges using nuts and bolts tightly. Do not forget to use the rubber gasket when assembling.

Step 9: Dish Alignment : Tracking the Satellite Arc

If you have made it this far it is now time to get your TVRO antenna to track the satellite arc! This step tends to be the most difficult and frustrating for most people, especially for novices, but it doesn't have to be if you follow the instructions below.

Before you align your dish you will need either a working satellite meter or Cisco D9865 receiver with our transponder information pre-programmed for the satellites you intend to track. You should consult our quick tips startup guide if you need the parameters for our services and didn't order our data preload service.

9.1 : Strategy for TVRO Satellite Alignment

If you haven't already done so, point your dish true south and set the Elevation angle, Declination Offset angle and LNB skew angle as outlined in sections 4.1, 4.6 and 4.7 respectively.

You should NOT have to change the elevation angle beyond this point. It is the easiest angle to set accurately (especially with a digital inclinometer) and remains fixed. The declination offset angle is the next easiest angle to set accurately and the hardest adjustment is the true north/south alignment of the dish (azimuth angle = 0 degrees).

With that being said, our strategy for alignment and tracking the satellite arc will be as follows:

1. Adjust the Azimuth (true north/south) alignment first by rotating the dish about the pole until the first satellite signal is received.
2. Adjust the LNB skew and focus to peak the first signal received.
3. Adjust the Declination Offset angle to peak signals from satellites low in the arc.
4. Finally, fine-tune the Elevation, Declination Offset, Azimuth and LNB skew for maximum efficiency.

Make sure you follow the strategy above or you will mess up the alignment. The biggest mistake people make is thinking azimuth doesn't play a large role or that the dish is pointed true south and they begin fiddling with elevation and declination adjustments instead. Remember, the average magnetic compass isn't that accurate and its unlikely that you have a more sophisticated method of pointing the dish true south. So you have to work with the assumption that the azimuth is off to begin with.

It is worth saying one more time: DO NOT adjust the elevation angle and declination offset angle until you are absolutely positive that the azimuth angle is correct. You will know that the azimuth angle is correct when you can track the arc symmetrically on both sides of the arc. If one side tracks better than the other, then the azimuth angle is incorrect.

9.2 : Tracking the Top of the Arc: Azimuth Adjustments Only

The first satellite you need to track is the one closest to the zenith or top of the arc. For example, if you were in Buffalo, NY with longitude 78.8 west, you would try to track Simon Bolivar at 78W or AMC 9 at 83W. You should only worry about C band signals for now because due to their longer wavelength, they are easier to find. After finding the arc, you can track Ku band signals to fine-tune your dish alignment.

Start moving the dish with the actuator around the top of the arc until you receive your first signal. If you can't lock any signals, barely loosen the cap bolts and rotate the dish slightly about the pole and try again. Be sure to mark the starting point on your pole for your reference. If you still don't register any signals, try rotating the dish some more. If still nothing, rotate the dish in the opposite direction and repeat the procedure.

Once you register the first signal, immediately adjust the LNB skew and focus settings in order to peak the signal. After this point, you can assume your LNB has been adjusted correctly and will only require fine-tuning (if any) later on.

Now that you have the top of the satellite arc in view, drive the dish east and west and program each satellite you find into your controller or receiver. Fine tune the mount rotation of the dish until you can track as many satellites as possible on both sides of the arc. As a general rule of thumb if you can track more satellites further west than east, you should slightly rotate the mount east and vice-versa.

To fine tune the Azimuth (north/south alignment), do the following:

1. Point your dish at the most extreme western satellite you can track and gently raise/lower the bottom lip of the dish. If raising the lip improves the signal, slightly rotate the mount to the west. If lowering the lip improves the signals, slightly rotate the mount to the east.

2. Point your dish at the most extreme eastern satellite you can track and gently raise/lower the bottom lip of the dish. If raising the lip improves the signal, slightly rotate the mount to the east. If lowering the lip improves the signals, slightly rotate the mount to the west.

When you are satisfied with the true north/south alignment of the dish and you can track the arc symmetrically on both sides, you should lock the cap bolts in place. You should not have to rotate the dish about the pole again except for fine-tuning if necessary.

9.3 : Tracking the Bottom of the Arc: Declination Offset Adjustments Only

To properly track the satellites located at the bottom of the arc, you will have to adjust and fine tune the declination offset angle which has the greatest effect on signal reception for these satellites.

To fine tune the Declination Offset angle, do the following:

1. Point your dish at the most extreme eastern/western satellite you can track and gently raise/lower the bottom lip of the dish. If raising the lip improves the signal, subtract declination offset. If lowering the lip improves the signal, add declination offset.

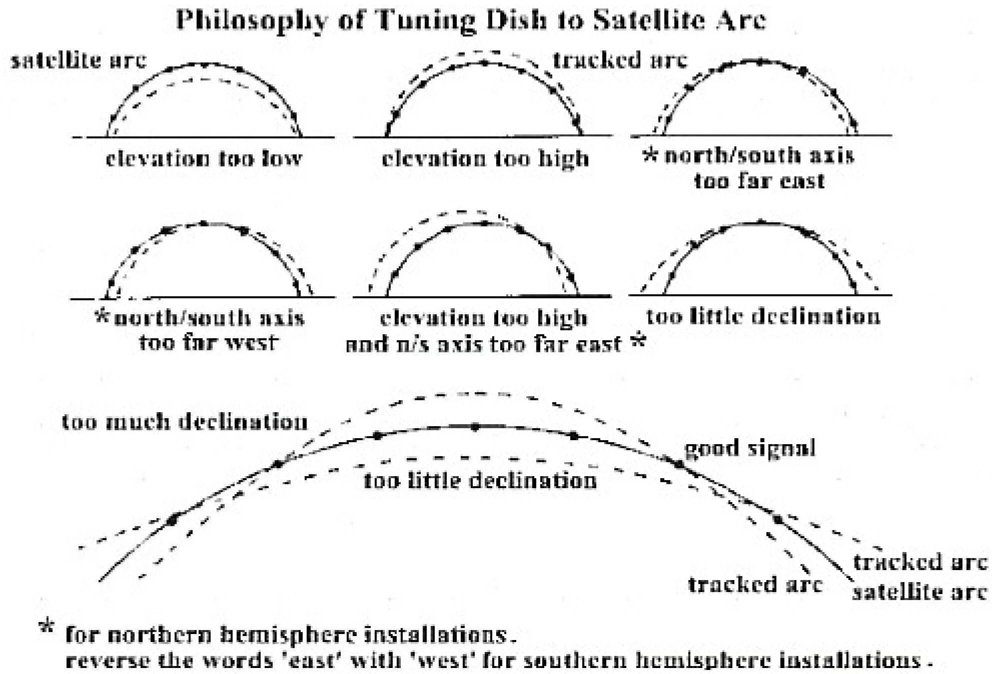
2. Track the next most extreme eastern/western satellite and repeat the above procedure.

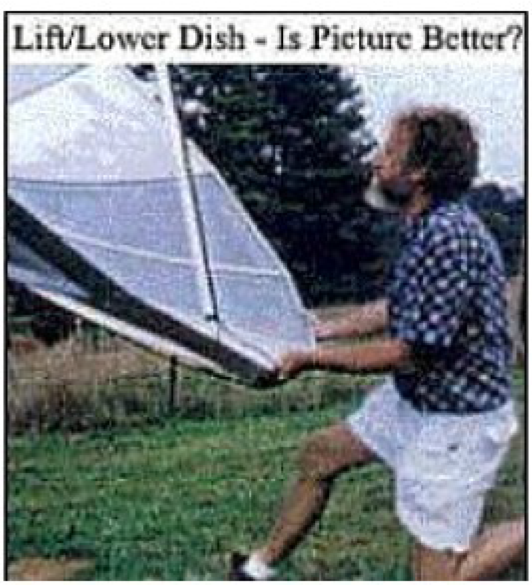
When you are satisfied with the signal reception of the horizon satellites, lock the declination screw in place.

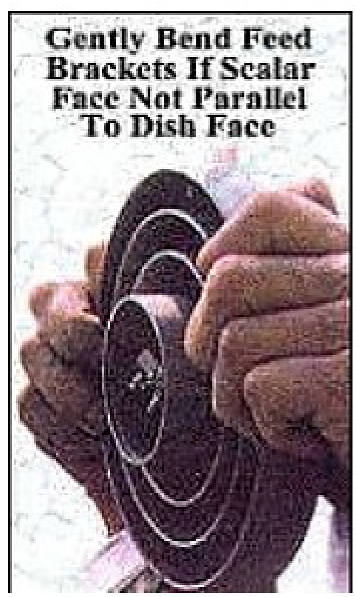
9.4 : Tracking the Top of the Arc Again: Elevation Adjustments Only

After making true north/south and declination offset adjustments, you need to drive the dish back to the top of the arc and observe signal reception again. If the small adjustments you made reduced the signal strength at the top of the arc, fine-tune the elevation setting until you achieve maximum signal strength again.

Do not be tempted to make declination or azimuth adjustments at the top of the arc because they will have little or no effect.







9.5 : Fine Tuning Azimuth, Elevation, Declination Offset and Skew Angles

Now that you can track the arc successfully, you will probably want to fine-tune each angle in order to maximize the efficiency of your TVRO dish.

The best way to do this is to make a list of all the satellites along the entire arc and pick one transponder frequency from each satellite. Drive the dish to each satellite and record the best signal quality for this frequency.

Now fine-tune each angle one at a time and drive the dish over the entire arc recording the new signal qualities. If you notice some improvement, you can keep the new angle, otherwise revert to the previous angle.

Keep the following in mind when fine-tuning the alignment:

1. Fine-tuning the Elevation angle has the most effect at the TOP of the arc.
2. Fine-tuning the Declination Offset angle has the most effect at the bottom of the satellite arc.
3. Fine-tuning the LNB skew and focus adjustment has equal effect throughout the satellite arc.
4. Fine-tuning the Azimuth (true north/south) ensures symmetrical tracking east/west of the top of the arc.

9.6 : Tracking Ku Band Satellite Signals

The procedure for tracking Ku band satellite signals is the same as C band satellite signals. Since the wavelength of Ku band signals is much smaller, even the slightest adjustments will have a large effect on Ku band reception – that's why C band signals are tracked first because they are much easier to find in the first place! In general, if you can track C band signals along the arc, you will also receive the majority of Ku band signals, but you may have to fine-tune the alignment a bit.

9.7 : Alignment Summary

To summarize:

1. Set the Elevation angle, Declination Offset angle, Azimuth (true north/south) alignment and LNBF skew angle as accurately as possible before starting.
2. Track C band signals first and start at the top of the satellite arc.
3. Adjust the Azimuth (true north/south) alignment until you lock the fist signal.
4. Adjust the Declination Offset angle to receive horizon satellites on both sides of the arc.
5. Check the top of the arc again and only adjust the Elevation angle to peak the signal.
6. Fine-tune all settings for maximum efficiency.
7. Check the reception of Ku band signals and perform additional fine-tuning if required.
8. Lock everything down and enjoy your new TVRO dish!

Step 10: Dish Maintenance

10.1 : Replacing deformed or damaged panels

If you live in an area that occasionally experiences hurricane force winds (> 125mph), you will have to inspect the dish for panel damage after each storm. Although rare, even a single distorted panel will seriously compromise the efficiency of the dish. The more likely damage caused by high winds tends to be loose or missing mesh from the panel. In such a case, you only need to repair the mesh.

10.2 : Repairing loose mesh with rivets or screws

You should thoroughly check the mesh on your dish after every winter season. If you notice any mesh strips separating from the aluminum panels, you will need to reinforce them. When ice builds up between the mesh and the panel frame, it tends to exert a small force (because water expands when it freezes) that over time will pull the mesh seams away from the frame, thereby slightly distorting the reflector surface and lowering the efficiency of the dish.

If you own a rivet gun, simply add some new rivets wherever the mesh appears loose. If you don't own a rivet gun, you can also use 8x9/16 wafer framing screws to screw down the mesh. By inspecting the entire reflector surface and repairing any loose mesh in the manner described your dish will continue to deliver peak performance for years to come.

10.3 : Lubricating the Actuator

Driving the dish across the satellite arc using a good quality actuator under normal load conditions should result in little or no noise. In order to maintain such quiet operation, you should periodically lubricate the arm of the actuator that extends out of the tube. You should also lubricate the top and bottom brass bushings housing the polar screw. If the actuator gear box is accessible, inspect the gears and add grease or lubricant by following the manufacturer's recommendations.

If you notice a lot of play with the actuator arm resulting in constantly missing satellite positions even after resynchronization, it is probably time to replace the actuator. A good actuator will work well for about 5 years before it starts to suffer from serious wear and tear problems and need replacement.

10.4 : Corrosion Prevention

Although the aluminum panels will not rust or corrode, the same cannot be said for the dish frame and pole. The frame and pole are made of steel and if the paint starts to chip away and become exposed to the elements, it will eventually begin to rust. You should periodically check for rust and corrosion and use some low gloss black rust paint to cover it up. It only takes a minute and it will prevent further corrosion and at the same time keep your TVRO antenna looking new!

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