DXC 18m eXtreme User Guide Version 1.0 November 2020

Congratulations on the purchase of your DX Commander 18m ABV multi-band antenna KIT

SAFETY NOTE

DX Commander antenna components are designed for hobby radio amateurs by Callum McCormick, M0MCX. Radio Amateurs pass exams where health and safety is included in the syllabus. Please be careful in your handling, erection and general usage of any DX Commander parts so that yourself, property or a third party in the vicinity of your antenna experiments remain safe. Note also that engineered parts can have some sharp edges so be careful before handling roughly with bare hands.

Overview: The antenna runs multiple vertical quarter-waves with a single feed-point and is a similar concept to a fan-dipole, but turning the "fan" 90 degrees on it's X-axis and placing one side of the fan on the ground. The antenna should give you less than 1.5:1 SWR on all your chosen bands. In testing, using 10m of quality coax, my readings were better than 1.2:1 SWR at the tune point with extremely wide bandwidth.

Parts list

1. DX Commander 18m Pole
2. Ground Plate 3mm aluminium
3. Radiating Plate 3mm aluminium
4. 5 x UHMWPE Spreader Plates
5. SO239 Assembly with flying lead
6. Appropriate number stainless bolts
7. Appropriate number stainless wing Nuts
8. Plenty of Fork Connectors (earth)
9. Plenty of Fork Connectors (elements)
10. Hose Clamps
11. Rubber tubing
12. Length 4mm marine shock cord
13. 100m Mastrant Guy Cord
14. Plastic Carabiners that snap together
15. Glue lined shrinkwrap
16. 400m DX10 Mil-Spec antenna wire

Please make yourself familiar with all the parts and satisfy yourself that all is present and correct. We take great care when we pack these boxes so if something is missing, but we do make mistakes!

In DETAIL

The DX Commander Nebula Antenna comprises of 6 vertical elements tuned for 80m, 60m, 40m, 30m, 20m and 17m. It is similar in concept to a fan dipole but turned through 90 degrees. Some ¼ wave elements will have harmonics that also fit inside other amateur bands. For instance, 40m will resonate again at around 21.35MHz and again at 50MHz. 80m will resonate somewhere between 18.4 and 18.6Mhz and again at around 29MHz (and the 30m will also want to resonate again at around 31MHz).

Sometimes this is good enough for us to operate at 100W with ATU engaged but high-power users often require resonance and very low SWR.

For this reason, there are work-arounds to achieve resonance on the harmonics, specifically the 15m band and the 10m band.

15m is a harmonic of the 40m band and to achieve resonance on both bands, we need to linear-load the top of the 40m element, discussed later in the document.

10m band is conveniently 1 and ¾ wave element for 80m band (great gain at low angles). Again, we can achieve resonance on 10m by linear loading in a very particular way – discussed later in this document.

If you want the FAST version of this guide, skip to page 7.

The system is shipped in 2 x boxes.

TELESCOPIC POLE

This telescopic pole is like no other I have had the opportunity to use. It appears to be extremely strong and built to very high manufacturing tolerances. There is a screw cap on the base and a plastic protective cap on the top.

The 18m pole actually extends to between 17.3m and 18m in length depending on pole temperature and strength of the user. It can go longer but obviously, be sensible in how sympathetic your engineering tendencies are. I recommend that you extend one section at a time, using two strong and motivated individuals. Make sure you have completely clear ground to attempt the first extension by teasing all the sections from the smallest (thinnest top section) and work your way towards the heaviest (fattest) section. Make sure not to accidentally trap the very end (thinnest diameter) in the ground as you do this.

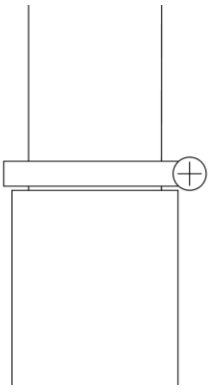
To achieve maximum extension, you will need two strong persons. One grasps the top of one of the larger tube and the other grasping the bottom of a smaller mating tube and both pull apart and twist in unison. Assuming you are both facing each other, then you would both twist and pull in YOUR clockwise fashion (opposite to your partner). Some tubes will extend some more than others and the thinnest sections extend easily. You may measure the extended length of each section to make sure most are approximately extended the same. In the main, I measured between 1.43m (nearer the base) and 1.52m (nearer the top) which is around 4.9 feet (for our US friends).

You can achieve a longer pole if you want to - although I don't believe there is much benefit in this. Experience has shown that heating the outside mating tube section with hot water will allow the inside section to pull out a little bit more. If one of the sections seems shorter than the others, try this method with a kettle of water. Don't heat both sections, just the outside section.

In the bag of accessories, there are two (2) plastic loops. One of these will need to be superglued to the top of the pole. Keep one safe as a spare. See pictures at the end of this document from page 9 onwards for detail.

THE KIT

HOSE CLAMPS



We have supplied a large selection of stainless hose clamps of appropriate size from largest through to smallest.

The telescopic pole needs to be braced between each section to ensure that in the event one upper section wants to break free, it doesn't fall down and collapse. These clamps are fitted to the base of each section as per the drawing.

Each hose clamp needs to be clad in rubber tubing to increase friction and to protect the pole at the same time.

You will find a 2m (about 6 feet) section of very high-quality flexible rubber tubing in the kit. You will only need around 1.6m, so you have enough if you make a mistake and need to discard some.

Measure out each piece of rubber tubing by wrapping it around the section you need it for and cut the full circumference with a sharp knife or scissors.

Undo all the hose clamps and sleeve each clamp with the appropriate size of rubber tubing. I found after fitting, I cut a "slot" in the tubing allowing the screw assembly to poke though. A sharp hobby knife will slice this tubing very nicely.

ALUMINIUM PLATES

There are two plates. The one with the bent-up tab is called the Ground plate and the plain circular one is called the Radiating plate. They are pre-drilled and tapped with a 6mm thread.

You will need to fit the 6mm bolts to both the Ground plate and SOME holes in the Radiating plate. Let us cover the Ground plate first. It is up to you whether you fit the bolts facing upwards or downwards. On the one hand, it is easier to fit your radial wires when the bolts are facing upwards in the field, however if you want to use washers, it can sometimes be easier if the bolts are facing downwards. This is only from a practical point of view.

For the radiating plate, I have designed the hole pattern for either 3, 4 or 6 elements. Although it is tempting to use all 6 element slots, be assured that with only 4 elements, you can achieve 80m, 60m, 40m, 20m, 15m, 10m and 6m without ATU. With ATU engaged, it will be an all-band antenna. However adding 2-more elements makes this 6-element antenna adding 30m and 17m. (or 12m and 17m) with perfect tune.

Personally, I recommend you initially make your antenna with only 3-elements (missing every other hole on the hex-shape) with 80m, 40m and 20m elements only, leaving space for another 3-elements another day. This pattern will still give you 80m, 40m, 20m, top of 15m and top of 10m (and 6m). I say this so that if you have anomalies in your SWR curves, you can easily track down which element is giving you an issue. For instance, if you tune your 80m very low in the band, you will find it might resonate near 17m band too as a ¾ wave antenna. Once satisfied with your three elements, move to six.

Which ever way you proceed, fit the bolts in the radiating plate according to the drawing shown later in the document. This hole pattern is replicated through all the UHMWPE plates as well, but also with larger holes to fit your guy ropes.

UHMWPE PLATES

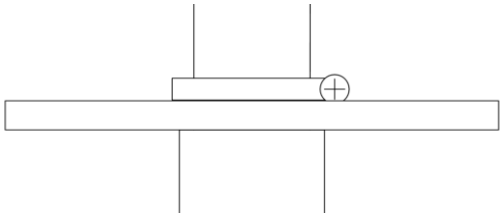
UHMWPE stands for Ultra-high-molecular-weight polyethylene and I have been using this in a plain, natural colour (color) for many years, shipping over 1,000 kits all over the world. It appears very stable, tolerates high RF fields and doesn't break down quickly in strong sunlight. We did try black plates for a while however these actually absorb RF and can catch fire.

In total, there are five of these plates. Four larger ones and one smaller one which we fit near the top.

I call these plates Spreaders. They slide over the top of the pole and accomplish three things; they guide our elements, allow us to tension our elements and they are used for guying the mast too. They all have a different inside diameter.

PLATE FITMENT

In practice, it probably doesn't matter if you fit your spreader plate above or below the hose-clamp assembly. It will depend on how much tolerance the plate has to the pole fit. If it is slightly loose once in position, you can fit the hose clamp ABOVE the plate, squishing the rubber close to the plate so that it doesn't rotate (as the drawing shows).



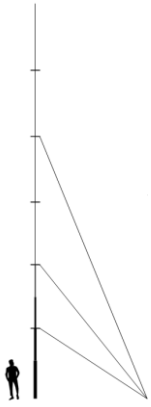
I know the 4th spreader plate is a tight squeeze and you will see on the video that I had to smack it with with my hand as if I was emptying a tomato-sauce bottle against it. Warming in hot water for 30-seconds would assist this process.

GUYING

In the kit, you will find some 2mm Mastrant guy cord which is low-stretch, high performance guy line. It is also very economical, available for under £10 ($15). In testing, I used the 3mm variant.

I also used a radius of 5m for each of the three guying stakes (not supplied – but any angle-iron would do for this depending on the ground).

I have done a number of videos for guying this mast and for light wind. For ease of assembly, I used Guy #1 and guy #3 for testing. In the field, I would still keep guy #1 but I suggest installing the main tension guys at #2 and #4. In the diagram shown, there are guys at #1, #2



and #4 (#1 being the lowest plate and shortest guy wire/cord).

I recommend you do a test erection of your pole in the field without any elements just to get the feel of the system and the weight. You can walk the pole up by hand easily. You just want to make sure the base of the pole doesn't walk away.

I made a simple home-brew hinge for mine however there is a work-around to a hinge by using some guy lines tied on the plastic sleeved end-cap between the 2-aluminium plates. Use some extra guy stakes to create dual "stops" around 18 inches from the base (50cms) away, in the direction of the lowered mast at 90 degrees to each other. These will act as your "second man" so as you walk the pole up, the base will remain in one place. I discussed this in one of the videos.

I strongly recommend you watch the video series I made for this pole, specifically about guying. One-person can do all this on his own. I know, I did it. This is the video: https://youtu.be/3hIBENc1UWg

One Man Erects 18m Antenna Mast - eXtreme N...
Watch me put up a fully-loaded 18m DX Commander eXtreme. I demonstrate this with the 18m eXtreme...

SO239

The SO239 assembly comes with a flying lead. These are soldered to the SO239 and sealed with glue-lined heat-shrink to ensure a weather proof seal and a fork-connector is fitted with same process.

BUT you will need to seal between the PTFE insulation and SO239 body. Use the self-amalgamating tape to achieve this (supplied).

Peel off the white backing and tightly make a seal by stretching the tape around the bottom of the flying lead.

PLASTIC CARABINERS AND SHOCK CORD

The clips are for making up the elastic extensions between elements and the Spreaders to keep the elements under tension. The shock-cord is genuine marine 4mm Marlow shock-cord. It stretches just over 200% and is very high quality.

To fit the shock-cord to the carabiners, thread your Marlow Shock-Cord inside the back of the body and use a simple over-hand knot. Snip the remainder off the shock-cord and fit the clip. You can re-use the clips but they need some careful management to extract. You have enough to build a 6-element system with a few to spare. TIP: Frayed ends will have difficulty in going through the small hole, so cut 6mm (¼ inch) off before pushing through the hole.

GLUE LINED HEAT-SHRINK

Find some lengths of this in your kit. You only need a small amount per element to make loops at the top of each element so that the carabiner can clip to it. Only fit once elements are correct (start with electrical tape) because once fitted, they are difficult to remove, further, remember to only fit the lower carabiner to your shock-cord once your element lengths are confirmed. Until then, tie a loop and use some electrical tape. By the way, alternatives to a genuine hot-air gun are: plumbers blow torch, low gas flame on kitchen hob, steam from a kettle or a lighter (watch for carbon deposits).

RADIALS

Supplied in the kit is 400m of DX10 wire in 100m factory reels of wire. I suggest keeping one-reel spare for the time being for additional radials or changes to the system and only using this for extra radials once you are happy with your element lengths and your system is working well.

Ground radials: You can fit between 4 and 6 radials per connector (I fitted 4). If you have fork connectors with the plastic insulated sleeves, I recommend you take these off (hot air gun or snips will remove). Tin four radials and then solder / crimp (or both) in place. Use approximately 25mm (1-inch) of the glue lined heat shrink to completely cover the soldering and the exposed metal. 10m radial lengths are ideal. You can easily make up 30 radials from the kit (optimum being apparently around 60 radials at 10m lengths for 80m – according to UN4UN Low Band DX Book). Of course for 40m, you will have effectively "double" that number due to lengths.

ELEMENTS

Normally the fork connectors are slightly smaller (might not be!) than the fork connectors for the ground radials. There are LOTS of fork connectors in the kit, plenty to make mistakes and corrections.

Here is the cut chart (add the loop to the main dimension) and READ NOTE below for 80m and 60m:

- 80m - up 17.2m - back 4.83m and then a little loop of 10cm (22.23m in total) *
- 60m - 12.86m plus a loop for the carabiner of 6cm (13.02m in total)*
- 40m - 9.81m plus a loop for the carabiner of 6cm
- 30m - 6.82m plus a loop for the carabiner of 6cm
- 20m - 4.86m plus a loop for the carabiner of 11cm (I think 4.88 + 6cm [like Classic] would also work)
- 17m - 3.81m plus a loop for the carabiner of 5cm

I have added 100mm (4-inches) to the lengths of the 80m and 60m elements because later, in the field, you will add some more small loops later for tensioning requirements – so the 80m element is 22.23m (not 22.13) and the 60m element will be cut to 13.02m (not 12.92, if you add up my numbers).

For the record, here is the adjustment chart if you wanted to drop down to CW or move the frequency up a bit depending on your country frequency allocation.

Changing Frequency by 50kHz (cut for higher freq / extend for lower frequency):

- 80m - changing the frequency of the linear loaded return is not same as changing the overall length. So a 50cm change on the return leg of the 80m element will move frequency up or down 50kHz.
- 60m - 12cms will move resonance by 50 kHz
- 40m - 6.87cms changes the resonant frequency by 50kHz
- 20m - 1.75cms required for change of 50kHz
- 17m – You should only need to change the length by 1cm to achieve change of 50kHz

80m <u>WITH</u> 11m and 10m band:

Element placement is discussed next but in testing, instead of a wide separation between the linear loading element, I used close spacing linear loading and achieved the 80m as well as 11m and 10m. If you wanted this, here is the cut chart:

- Up 17.5m and back 7.2m - CLOSE SPACE the return wire, do not separate out as discussed next

ELEMENT PLACEMENT

You may build either a 3, 4 or 6-element system. The drawing here shows the hole pattern which on first-glance can be confusing until you realise why I have designed it as such. The 4-hole and 6-hole system share some holes.

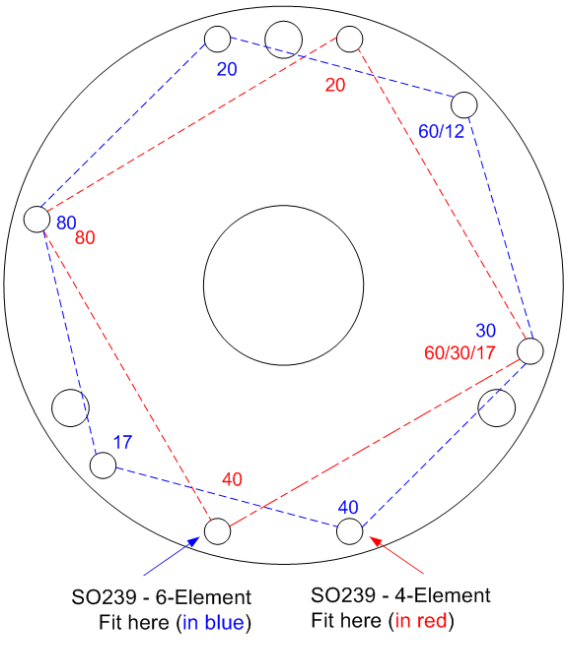
You will find that it is important to lay your 2-longest elements down each side of the pole when it is lying on the ground. The pole will have a natural curve and fitting your longest elements along the curve, will eliminate the possibility of having loose elements or very tight elements once erected.

I have not experimented with other placement scenarios. This one worked – so I suggest you follow my lead.

Further, please fit all your plates in the same hole-pattern layout so that one guy-point is at the top, just like the drawing. If you fit them incorrectly, you can have a scenario where one of your guy points is in the wrong place.

For confidence, I fitted mine so that I could always see three holes at the top and that all the plates were the right way around (if you look at the “back” of the plate, they would not be symmetrical).

EXAMPLE 18m Nebula HOLE PATTERN
Square (4-element) or Hex (6 element)
(For 3-elements, use every-other Hex hole)



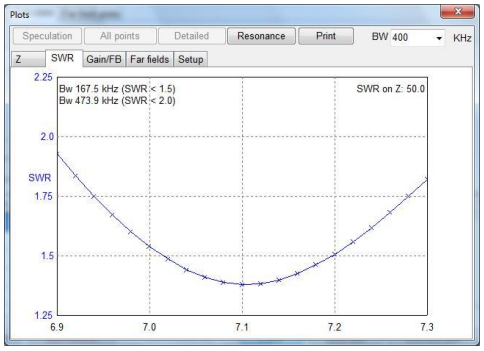
(Larger holes on UHMWPE plates are Guy Points)

TIP: Use a Sharpie or perhaps a label printer to mark all the positions on the Driven Plate, Spreaders and elements. I have previously pulling the wrong element up through the Guy Plate and even connecting to the wrong place on the Upper Spreaders. Eventually, you will have a random set of wires and it won't work. Perhaps colour coding might be cool so that 40m holes and elements are red, all 20m are yellow etc..

ONLY Fit your heat-shrink and final carabiners to the shock-cord ***after*** you have sorted all the element lengths out. This way, once your antenna works to your liking, you can heat shrink the elements and do a final fit of your carabiners to the cord.

40m and 15m

If you absolutely need 15m cut your element length slightly too long for 40m (actually 11.06m). Go "up" 9.2m and come back down close-spaced for the remainder. Connect the shock-cord to the natural loop that will form when you fold-back the element.



This should tune perfectly on 40m and also give you a tune at about 21.10MHz. You can cut the fold-over shorter and move the 15m up in frequency. It now starts behaving similar to a 5/8th wave (although not perfectly).

80m and 11m/10m

As discussed earlier, to achieve perfect resonance on 11m and 10m, cut a longer element and close-fold-back the remainder and treat this as a single long element. Ignore the fact that it's linear loaded. You will not need to worry about the detailed instructions about coming back down the pole. It becomes just one element.

To clarify, you will need to cut a piece of DX10 wire of 24.70m and fold the element back on itself at the 17.5m point. The return / foldback will be 7.2m long. For tensioning this element, add a small section of glue-lined heatshrink about 30cms / 1-foot down from the 3rd and 5th plate and attach your carabiners between the elements directly onto the heatshrink. This will save you creating loops.

FAST USER GUIDE:

- Prepare all your elements as per the cut chart and solder / crimp the fork connector and apply heat-shrink
- Fit bolts, washers and wing-nuts according to you requirement
- Make up your radials and elements according to cut-chart
- Prepare your hose-clamps and rubber tubing as discussed earlier
- Hammer three guy stakes into the ground, 120 degrees apart from where the centre of the mast will end up with radius of about 5m (20 feet).
- Extend the pole in your working area and twist-lock each section very firmly by pulling, twisting and extending at the same time.
- Unscrew the bottom of the pole and fit the ground Plate to the thread and re-tighten the base.
- Slide the circular Radiating Plate over the pole so that it fits snugly at the bottom of the mast, on top of the plastic moulding. Use one of the larger hose clamps to stop it from slipping around. Do not over-tighten.
- Fit remainder of plates and hose-clamp assemblies taking care that each plate is a copy of the next
- Fit lower set of guy-lines and conduct a test-erection (ideally have a second person to help you)
- Start to fit elements and shock-cord. Use the diagram shown earlier and thread the elements through each hole. I fitting mine one-at-a-time and checked approximate SWR as I built it, starting with 80m.
- Use insulation tape between shock-cord, and elements and also on the element fold-backs in case you need to make an adjustment during the build.
- For the longer elements (60m and 80m for instance), make a small loop for an intermediate tensioning at 3rd guy-plate as pictures shown from page 9.
- The 80m element has a small journey to make. The kit has two (2) hard plastic loops. Please super-glue ONE of these to the very top of the pole (one is a spare). Continue your element up to this loop, going through all the correct holes on all spreaders and come back down 180 degrees, again through the top spreader. Use some shock-cord to connect this element to the 4th spreader plate.
- Further, on the 80m element create some “slack” at the 5th spreader plate with two sets of shock cord and carabiners to let the top to remain tight. Again, as picture. This allows some movement for the element to remain tight everywhere else
- Assuming you now have all the elements connected to the Radiating Plate and that they have temporary loops held in place with electrical tape to shock-cord and carabiners permanently clipped to the plastic Spreaders… Connect the SO239 flying lead on the Ground Plate to the Radiating Plate.
- Raise the whole pole vertically and check you have moderate tension to both the elements and the guys.
- Check SWR and adjust elements (if necessary). Once satisfied with tuning, permanently finish off with glue-lined heat-shrink and carabiners and remove electrical tape.

TIP: Joining DX10 wire. I often join two pieces of wire in the field. Strip back 25mm (1-inch) of wire on each piece of wire and twist them together tightly. Then slip over a longer section of the glue-lined heat shrink and seal. You will find that you have made a perfect, maintenance-free connection that stops moisture and oxygen corroding the wire.

This nifty SWR adjustment calculator may also assist:

https://www.m0mcx.co.uk/quick-swr-calculator-for-vertical-and-dipole-ham-radio-antennas/

IMPORTANT NOTES:

Do not rush this build

A tiny mistake can take lots more time to correct. Take your time, enjoy the build. I suggest giving yourself two or three days to think about what you are achieving.

I know you will want to get this in the air as soon as possible but I don't want you to have an accident or worse.. If you get stuck, go and make a coffee and have a think about it. Ideally sleep on it.

Stop before you do anything which means you cannot revert back to Plan A.

If you don't understand something, drop me a Whatsapp message. My number is on the email confirmation. Or book a phone call with me and I can talk it through with you. Remember, if I'm not about, the discord server is always open and folks there are willing to assist. See the "antenna support" channel and drop in a photo of what you think the issue is. Server location is discord.io/dxcommander

You will have a real sense of achievement when it comes together, particularly when you start working DX stations you have never heard before. But please DO NOT RUSH.

PLEASE check out my YouTube channel. Although I make films on many aspects of the hobby, there are some gems when it comes to this particular design.

FINAL THOUGHTS

I designed this for antenna permanent use (although with a small team you could use for an expedition too) and I know it can be improved by throwing some more money at it, however I am very price conscious and I enjoy coming up with economic and novel solutions to engineering problems. In turn, this delivers fabulous results at a small cost. This kit I believe satisfies that desire, at a great price – with superb results.

WARNING. With my other kits, the pole is not the expensive component but with the Nebula antenna, the pole is half the price of the kit. It is a very expensive part for me to buy and in turn supply you. Please take care. Although it appears to be VERY strong (I was surprised at its strength), anything can fail used incorrectly. Think about what you are doing on the one hand – but be brave on the other. More than anything, really think about what you are doing and understand the risks and anticipate what might go wrong.

If you can't tie knots, find someone who can. I most often use Bowline knots to connect the guy lines to the guy plates and Alpine Butterfly knots to create a pulley near the base, about 1m / 3-feet up from the guy stake, where I tie off the guys (with half hitches). I know how to tie these knots and I am comfortable with them. I also know I can get them undone. Either learn how to tie these knots – or source an appropriate mechanical device that can do this for you.

If you are using this near salt-water, you may observe ANYTHING can start corroding. Salt water is VERY corrosive. To help in this regard, connectors and other metal parts may be squirted, brushed or have applied a variety of product: WD40, Vaseline, silicon grease, WaxOil etc. This will stop oxygen getting to connectors. Actually, I often use Vaseline on SO239 threads. It works for me.

For the fork-connectors, it should be pointed out that using the right amount of marine glue-lined heat shrink will also keep out moisture from these connectors (which is why we chop off the plastic insulated parts of the fork-connectors).

The complete Nebula Playlist on YouTube is here:

https://www.youtube.com/playlist?list=PLAjpQM3cGOdPfWn7HVfv4rLNuieRcsbBC

PICTURE GALLERY

The arrangement to tension the top and bottom of the 5th plate for 80m (looking down the pole from top. 80m coming up on the right and re-tensioned again at 12 o'clock – top of picture. 80m element goes back down the pole 180 degrees opposite entry. Just above at 10 o'clock is the termination of the 60m element.

Arrangement of how to form a small loop to keep the 80m and 60m elements tensioned at the 3rd and 5th guy plates. The element continues to the left of picture, through the same hole the carabiner is connected to, continuing up the pole. You may also do this on the 2nd guy plate for the 40m element.

If made correctly, you will find these will still fit through the small element holes in the UHMWPE plates in the event you want to disassemble the antenna. You can always soften them slightly with a hot air gun to help.

Showing the 80m element coming through the 3rd guy point and continuing to left of picture with carabiner holding tension on the plate.

Looking up the pole from base. Note how fork connectors are sealed from the weather with small sections of heat-shrink. Ignore the white tape on the radials – these were indicators for me that these radials were shorter. 80m and 60m elements are on the left and right of driven plate so that they match the curve of the pole during construction..

When assembling your plates on the pole, ensure they are all perfect copies and not accidentally “flipped” or “Mirrored”. This ensures all your guy points and hole patterns are identical going up the pole.

Showing guy-line attached to the large hole, reserved for guying and not elements.

Showing 80m element coming up the pole on lower-right, passing through the 5th plate and continuing with more shock-cord which is attached to the next hole, just higher in this photo. This allows some movement of the 80m element whilst keeping it stable.

Find two small loops in the kit for top of pole. Glue one of these to the top unless you need the hollow tip for a different experiment. I used superglue.

General arrangement of the base with three elements fitted. The radials are in place and hose clamp tightened to keep the Driven plate from moving up the pole.

Metal guy stakes about 45cm long (18 inches) should be suffice. You can use plain angle-iron for this and drill some holes. You don’t need to spend a lot on this.

Walking the pole up.

Test your mechanical arrangement before fitting your elements to ensure you are comfortable with putting the antenna up and down.

And take your time. Remember, this is not a race.

Completed Nebula in the air, ready for operation

With 6-elements fitted.

Good luck!

Remember to view the playlist here:

https://www.youtube.com/playlist?list=PLAjpQM3cGOdPfWn7HVfv4rLNuieRcsbBC

Callum, M0MCX, December 2020.