

Homebrew AS-2259/GR NVIS Antenna By N3OC

The AS-2259/GR is an NVIS (near vertical incident skywave) military antenna for short to medium range communications on the lower HF bands. It has been made over the years by several manufacturers, and when available, they are usually somewhat expensive. This is pretty much the same antenna as the Collins 637K-1, the Telex Model 1990, and the Harris RF-1936.



The ionosphere generally supports NVIS communications at 10 MHz and below. At frequencies above the critical frequency (CF), the signal never returns to earth. During sunspot low periods, the CF rarely goes above 6 MHz, and during sunspot high periods, the CF occasionally approaches 10 MHz. This is probably why many military HF packsets such as the PRC-74 only operate from 2-12 MHz.

I became interested in a deployable antenna that did not need any additional support, and was drawn to this design. Most of what I have done here was inspired by W9WIS and his excellent web page on making a homebrew version of this antenna, with a few of my own improvements. So giving him full credit, I have blatantly stolen some of his ideas for this article, and adapted it specifically for the ham bands.

Antenna Components

The AS-2259/GR consists of two crossed horizontal dipoles (or inverted vees) supported on a 15 foot support structure. The dipole elements slope back towards the ground and transition to a rope support as they approach the ground, and are terminated in something resembling a tent stake, 42½ feet away from the support mast.

On a genuine AS-2259/GR, the support tubes are also filled with foam and a center conductor and form the feedline to the top of the antenna, similar to hard

line. For homebrew versions, the coax will be run inside insulated support masts either made from PVC pipe or fiberglass poles.

The PVC is faster to obtain, but in the end I prefer the fiberglass poles, OD carrying bag, and bases that are available from Poles & Things, W3ARS, the guy you see at Dayton selling tons of fiberglass military poles every year. Get a carrying bag, a base, four fiberglass poles, and three ground stakes from him. His web site is a little dated but he comes to Dayton and most major Mid-Atlantic hamfests:

http://www.w3ars.com/pole_info.htm

Various bases are available for the AS-2259/GR, depending on the intended use of the antenna. The PRC-104 base has a 4:1 transformer inside to step up the impedance to something the tuner can better handle. Other bases contain no transformer, and some bases consist of adapters to connect to vehicle antenna mounts. For the homebrew antenna, the base will just support the mast, and the coax will run inside the mast and terminate in a UHF barrel connector.

Dipole Length Considerations

When I constructed my first version of this antenna using the original military wire lengths (38' and 25'), I found the antenna to be resonant at around 5 MHz and 8 MHz. This makes sense, as those with experience using these radios in the field reported they were usually used around 5 MHz.

Working our normal formula of $234/f$ to determine the length of a quarter-wave antenna backwards, I came up with a new constant of around 220 to use when calculating the wire length of such a wire in close proximity to the ground. So use $220/f$ to determine the approximate length of the wire if you want your version of the antenna to be resonant at a particular frequency.

Of course these antennas were designed to be used with a tuner, but armed with the above knowledge that two resonant frequencies with good SWR were available and predictable, I ran the numbers for 7250 and 5403 so that my homebrew version would have perfect SWR on 40 and 60 meters, and could then be used with a tuner on other bands if needed. This yielded lengths of **40' 8"** and **30' 10"** (over average ground) for a 60 and 40 meter version of the antenna.

Antenna Height Considerations

The AS-2259/GR is a compromise antenna. It is meant to be light and easily deployable with no other support structures needed.

Any horizontally polarized HF antenna mounted below $\frac{1}{4}$ wavelength becomes an NVIS antenna. If you don't believe me, model it. So most of us have NVIS antennas anyway on the low HF bands. Additionally, any antennas mounted below .15 wavelengths lose gain as their ground losses increase.

On 40 meters, the AS-2259/GR, with its 15' mounting height, is .12 wavelengths high. OK, not so bad, so I will say it is probably OK on 40 meters. At 60 meters, with its 15' mounting height, the AS-2259/GR is .09 wavelengths high, so there will definitely be a reduction in gain on that band. The lower you go in frequency (without increasing the height), the worse it gets.

This proves this is a compromise antenna, but again the design considerations were portability and deployability, so we can tolerate some loss. It will no doubt work better on 40 meters than it will on lower frequencies. Some have included a wire length to support 80 meters more efficiently on their version of this antenna, but I have elected not to do so on mine, for the above reasons.

Homebrew Construction

You can either use 3 X 5' pieces of 1 $\frac{1}{2}$ " PVC pipe, or 4 X 4' sections of commonly available military OD fiberglass supports for the center support of the antenna.

For the PVC version, cut three 5' sections of 1 $\frac{1}{2}$ " PVC pipe. Glue a coupler (union) on one end of two of the sections. On the bottom section, drill a hole near the bottom large enough through the side to accommodate a PL-259 connector passing through. This is where the feedline will exit the center mast. Drill this hole just above where the ground spike's washer fits inside the pipe (see below). NOTE – if using the fiberglass masts, don't drill the hole. The folding paddle base has a hole in the center and the feedline will simply exit the bottom of the mast.

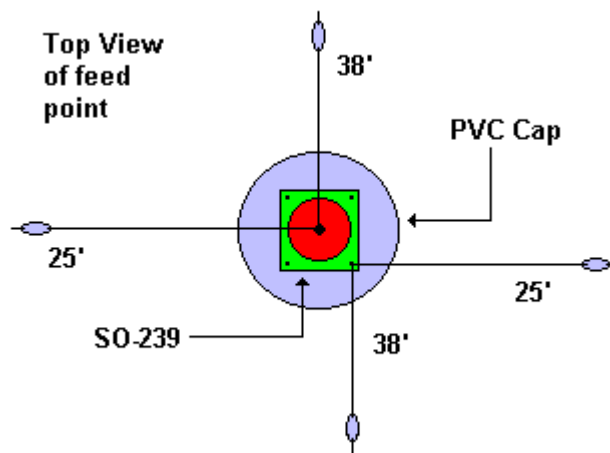


Feedline Detail Photo from W9WIS web page

Fabricate two terminals for the dipole into a 1½" PVC end cap using #6 brass screws, nuts, and knurl nuts. Inside the PVC end cap, connect an SO-239 dangling on two short pieces of wire connected to the brass screws that protrude through the top. This end cap will pop on the top section of pipe, and allow the feedline's PL-259 to attach inside.



Top Cap Detail – PVC Version



Dipole Layout Photo from W9WIS web page

Construct a base spike out of another 1½" PVC end cap, and a short (8") section of 5/8" threaded rod. With a grinder, grind one end down to a blunt point to make it easier to pound the base into the ground. Mount the threaded rod through a hole in the center of the end cap with two nuts, two fender washers and one lock washer, and allow the rod to protrude inside the end cap a couple of inches.



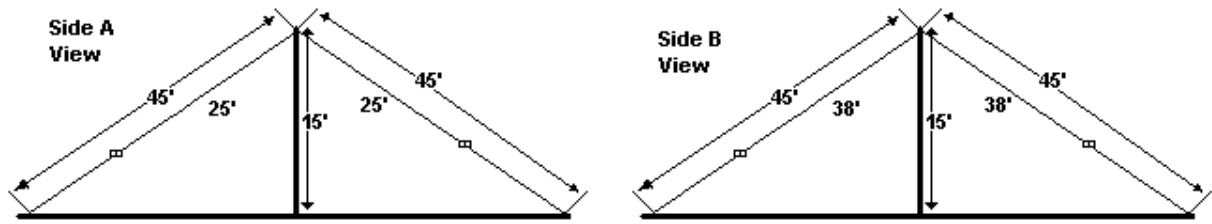
Base Spike Detail, PVC Version

On the short section that protrudes inside the end cap, mount a single fender washer near the end with two nuts and a lock washer. Then turn down this fender washer on a grinder until it's diameter just fits inside the 1½" PVC pipe section. This will provide additional support to the pipe and likely allow it to stand up by itself when attached to the base spike long enough to get the dipole wires tensioned as guy wires.

Paint all PVC parts with OD Camo paint if desired. Do not paint where the pipes fit inside the couplers to attach to each other. The PVC will take paint OK, but it does scratch up easily to don't expect it to look pristine at all times. If you use the fiberglass poles, don't worry about paint as they are already OD color.

Cut the dipole wires to desired length. Make them a little long at first, to assist with final tuning. No need to use steel cable like the real AS-2259/GR, that is simply ridiculous overkill. Use insulated earth color (brown) #16 or #14 wire. Also there is no real need for an egg insulator unless you want to. Just tie the end of the wire in a knot and attach the ropes with a knot.

Cut rope lengths of an appropriate size, again a little long. Remember the ground stakes are 42½" feet away, and the height of the support is 15'. You can now use the Pythagorean Theorem ($a^2 + b^2 = c^2$) to determine the amount of rope needed to add to your wire. If a is 15, and b is 42.5, then c is 45'. So your total length of the dipole wire plus rope needs to be 45', plus a little extra for guy tensioning.



Side View Photos from W9WIS web page

Fabricate guy tensioners from short pieces of plastic or wood with three holes drilled in it. Depending on your rope size, it may tighten with just two holes, or you may need a third if your rope is very small. See the pictures for my tensioners.



Guy Tensioner Photo from W9WIS web page

Make a piece of mini RG8X or RG58 coax of an appropriate length (around 15') to connect to the SO-239 at the top of the antenna, feed through the support masts, and exit through the hole you drilled at the bottom. Put PL-259 connectors on each end of this piece of cable, and a UHF barrel at the bottom so you can attach your feedline near the base.



Complete Antenna, PVC Pipe Version
(Note that PVC couplers are only on two sections of the pipe, not all three.)



Complete Antenna, Fiberglass Pole Version

Additional Reading

Much of the homebrew construction principles in this article were inspired by W9WIS's web site at:

<http://home.century.net/w9wis/NVIS.html>

More detailed information about the various versions and uses of the AS-2259/GR and its close cousins is on Brooke Clark's web site at:

<http://www.prc68.com/l/AS2259.shtml>

A lot of information about the height and gain of NVIS antennas is on W8JI's web site at:

http://www.w8ji.com/nvis_n_v_i_s_antenna.htm