Welcome to AntennaSelect™ Volume 15 – October 2014

Welcome to Volume 15 of our newsletter, AntennaSelect™. Each month we will be giving you an "under the radome" look at antenna and RF technology. If there are subjects you would like to see covered, please let us know what you would like to see by emailing us at: info@micronetixx.com

In this issue:

- **Radomes – part 2**
- **Moding in Coaxial Transmission Line**
- **Passive Intermodulation (PIM) – part 5**

Radomes – part 2

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Last month we looked at slot covers and some of the drawbacks the design has. This month we will look at partial unpressurized radomes. At Micronetixx, all of our side and top mount slot antennas us a partial or full 360 degree radome system. Our radome material of choice is UV stabilized polyethylene. There are several reasons why this material is our go to choice. First, it has an excellent service life, and is stable over a wide range of temperatures.

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UV stabilized Polyethylene is also an excellent material to form into arcs to wrap around a antenna pylon. It has excellent dimensional stability in all operating environments. For operation in icy and snowy areas, the material is slick enough to minimize ice build up. Most of our side mounted directional slot antennas, use arced radomes over the front two-thirds of the antenna. The arced shape of the radome also helps to lessen ice build up.

Most radomes we deliver are white. At 500 feet up a tower it becomes very hard to see the antenna as it blends into the sky. If a customer needs a radome like international orange, the pigments are imbedded into the material and do not fade over time. The down of Polyethylene is paint does not adhere to it. Darker colored Polyethylene also can have a higher dielectric constant depending on how metallic the pigmenting components are

Last month we discussed how the slot covers can change tuning of the antenna under certain weather conditions. UV stabilized Polyethylene material has a very small relative permittivity (Єr) or dielectric constant, even at UHF (Band IV) frequencies. With our design the radome is 3 to 8 inches out from the antenna slots. Instead of the RF energy going through a small area of slot cover material, the partial radome system has a surface area of 20 to 100 times higher than a slot cover. RF density per square inch is greatly reduced – hence no heating of the radome material.

As the radome system is moved farther from the slot, the dielectric property of the radome material has a smaller effect in antenna detuning. And if there is ice or snow accumulation on the radome, the changes in the overall dielectric content of the radome and moisture are greatly reduced, as compared to a slot cover.

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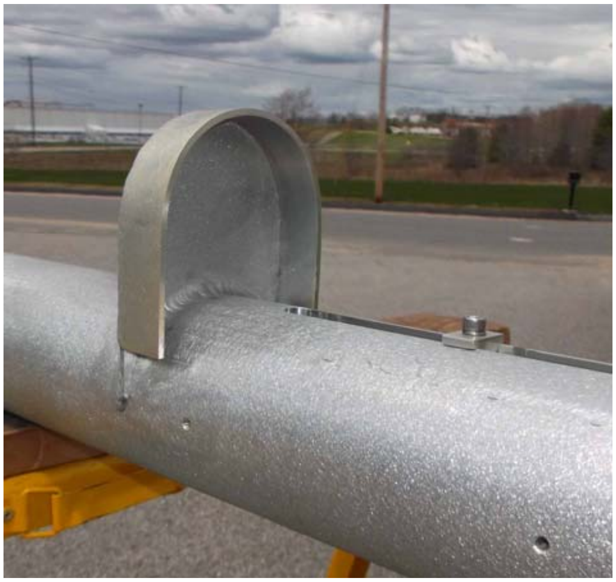
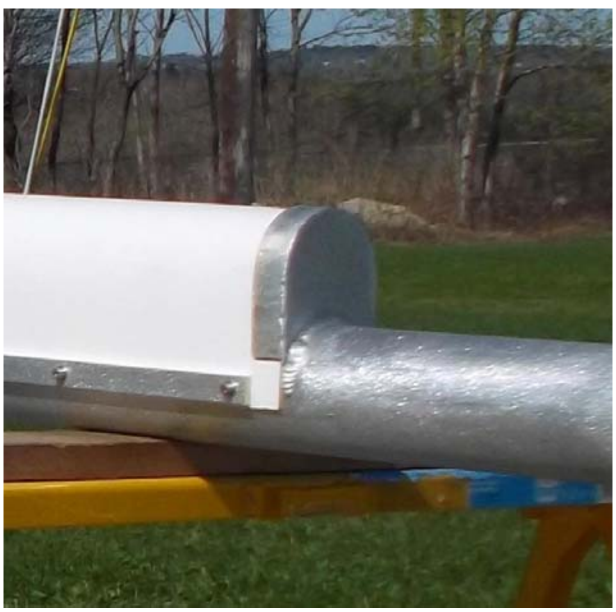
While we are talking about materials for radomes, what about using Teflon ? Teflon has a slightly lower dielectric constant as compared to Polyethylene, but it is far less rigid mechanically. Plus if a color other than white is needed, the pigmentation is much more irregular than Polyethylene.





To form the radome on this Omnioid UHF slot antenna, we use a radome stop that is on the top end of the antenna. For this design the radome material is bent into a U shape and slipped under the edge of the radome stop. It is held in place by a pair of Aluminum strips that run the length of the pylon. This provides a slot clearance of 3-1/2 inches. The U shape design of the radome reduces the tendency that ice will form and stay adhered to the antenna.

If the antenna is either Circular or Elliptically polarized and the antenna is going to be installed in a area where there is ice or snow build up, the radome can be extended outward and be shaped more like a tear drop.

Since antennas are operated in such diverse environments, we design and manufacture the radome system to ensure the best operation for the location it is installed in. The antenna pictured above has a 125 M.P.H. basic wind speed rating. Need an antenna ? Our radome designs will have you covered.

Moding in Coaxial Transmission Line

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For digital television transmission, high power signals from the transmitter are usually transported from the transmitter up the tower or other supporting structure through coaxial transmission line. (The phase-dispersive characteristics of waveguide make that transmission line approach disadvantageous for digital television. This is not the case for old analog television applications.) Whenever electromagnetic signals are transmitted through any transmission line, the electric and magnetic fields within that line organize themselves in such a manner that they support the transport of energy down the length of the line from the source, (the transmitter), to the load, (the antenna).

The specific configurations or map of the electric and magnetic fields in a transmission line depend on many factors, including frequency of the electromagnetic wave as well as the physical size of the transmission line carrying the signals. These specific electric and magnetic field configurations are commonly referred to as "modes". Coaxial lines are usually operated with their energy transmitted in the principal mode, called transverse-electromagnetic, or the TEM Mode. (This means that both the electric and magnetic fields in the coaxial line are transverse, relative to the direction of the energy traveling down the line.)

Theoretically, the TEM Mode can carry energy down the line at any frequency. However, as the frequency of the electromagnetic RF or microwave energy is increased for a given size of coaxial transmission line, as the physical dimensions of the coaxial line become larger and larger percentages of a wavelength, high order Modes, (called waveguide modes), can also exist in the coaxial line.

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The electromagnetic field configurations in these higher-order waveguide modes can disrupt the fields in the Principal TEM-Mode, and actually cut off the flow of energy down the coaxial line in the TEM-Mode.

Lines designed to operate at a given frequency are usually restricted in size so that none of these higher-order waveguide modes can exist in the coaxial line being used for transmission. An approximate mathematical formula for specifying the critical wavelength of a signal that can support higher-order modes is:

$$\lambda=\pi*(b+a)$$

Where: "b" is the inside radius of the coaxial outer-conductor
"a" is outside radius of the coaxial inner conductor.
(All dimensions are in inches.)

Or, the coaxial moding frequency in MHz is approximately equal to:

$$fMHz =(11803)/(\pi*(b+a))$$

Again, "a" and "b" are defined above.

(ie., the limiting operating wavelength is approximately equal to the circumference at the arithmetic mean coaxial line diameter.)

When determining the specific size of the coaxial transmission line that will be used in a particular installation, it is always important to be sure that the appropriate line size is selected such that the transmission line is large enough to be able to safely carry the power from the transmitter to the antenna in an efficient manner, but that the line is not so large that higher-order waveguide modes are possible.

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For convenience, a quick reference of many types of popular coaxial transmission lines is available on our website. This is accessed by going to, or clicking on the link: http://www.micronetixxantennas.com

On the third pane down on the left, click:

Coax Transmission Line DATA.

Passive Intermodulation (PIM) – part 5

Connectors and coax cables themselves can become PIM generators. Corrosion or imperfections on either can easily raise PIM levels 50 dB or more. Small amounts of corrosion on connector surfaces can be likened to speed bumps or even small potholes on the road. If all the surface area of the connector is not able to conduct the same amount of energy, it is a non linear junction and loses the constant V to I ratio transfer needed to keep PIM from being generated. If a connector is damaged and is transferring enough power, damaged sharp surfaces can cause electrons to collect on these edges. When driven hard enough, corona can form. If the connector materials are constructed out of paramagnetic materials, they become excited by the current saturation taking place, which becomes another PIM generator. If you are running your transmission lines or cables at close to 100% capacity, going to a larger size line will lessen the chances of PIM generation.

Cables, especially braided cables can be problematic in multi user sites. A cable that is flexed will see the slight repositioning of the braids. At multi user sites with a lot of RF present, braid of a cable may be carrying a lot of RF energy from two or more signals.

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When braid cables are being vibrated, the eddy currents can change, which means a possible PIM source. There are specially designed multi braid and braid/foil cables that exhibit less change with vibration. Depending on the eddy currents flowing, a better quality cable may exhibit 40 to 50 dB less PIM generation when vibrations are present.

Connector quality is another factor in how much PIM is generated. New out of the box connectors have very little or no surface oxidation. Over time as the connectors are being used, thin layers of oxide can form. A high quality connector will have a combination of materials that break down the oxide layer with effective wiping operations.

Tight fitting connectors also help to eliminate PIM generation by providing better overall mating of the surfaces. Since oxides are on top the surface of the connector, a tighter fit flattens out oxides and provides more uniform contact area.

One trick to help eliminate PIM and provide better contact when making connections with connectors such as BNC or N connectors, is insert and remove the connector several times. The extra insertions help to wipe away any surface oxidation that may be on the connector or the jack it is plugging into. If you work with equipment that has RF connectors, consider buying connector caps. They limit the chance for moisture and other contaminates from forming oxides on connector surfaces.

Be on the lookout for the next volume of AntennaSelect^{TM} coming out in November

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