**Ham 41 – Antenna Path & 3 Grounds -How?**

Dr. Marc & Rosemary © 220530

1. A ham antenna system contains three sub-systems: (1) RF path, (2) mast, and (3) lightning protection. Each of these has its individual grounding requirements. Then the three grounding systems must be bonded together per *NEC (NFPA 78)* and *Lightning Protection (NFPA 780)* specifications and ARRL *Grounding and Bonding for the Radio Amateur*.
2. Use equipment listed for the purposes and rated for the applications. By appropriate bonding and installation, lightning, transients, and noise splits along the three sub-system paths to earth, reducing the deleterious effects entering the structure and impacting the radio.
3. *RF Path*: (a) antenna conductor, (b) counterpoise, (c) coax connector, (d) seal, (e) coax top, (f) ferrite beads type 31, (g) lightning protector, (h) coax main, (i) enclosure, (j) single-point ground bar, (k) lightning protector 2, (l) grounding electrode conductor terminal, (m) grounding electrode conductor, (n) electrode clamp (o) electrode, (p) individual bond to all other electrodes. Connect (q) coax from single-point protector to radio, and ground if radio has a connection.
4. The National Electrical Code (NEC) and NFPA 780 specify zone of protection. NEC 810.15 states: *Masts and metal structures supporting antennas shall be grounded in accordance with 810.21, unless the antenna and its related supporting mast or structure are within a zone of protection defined by a 46 M (150ft) radius rolling sphere.*
5. *Mast*: (a) metal support, (b) metal offset from mast, (c) clamp for antenna, (d) mast clamp to grounding electrode conductor, (e) grounding electrode conductor, (f) electrode clamp, (g) electrode, bond to other electrodes. Bond across any joints or couplings on the mast or tower.
6. Masts within a structure or under a roof line, are less likely to be exposed to lightning, and are under the structure zone of protection. Consequently, the mast is often non-metallic. Even if under cover, still use the beads, lightning arrestors and grounds.
7. *Lightning protection*: (a) lightning rod above antenna high enough to shield, (b) rod clamp to mast, (c) rod clamp to downcomer, (d) downcomer, (e) if height > 60', bond downcomer to mast at half way point, (f) electrode clamp, (g) electrode, bond to other electrodes. The purpose is to provide a low impedance path to ground.
8. The RF Path routes the radio signal. The antenna is preferably dc-grounded to provide a low resistance path for transients. PL-259 is used for connectors on VHF and lower. Seal connectors to stop moisture. For runs less than 25', RG-8X may be used. RG-213U works for 50'. Long runs should consider LMR400.
9. Four or five, mix-31 ferrite beads around the coax mitigates transients including lightning. If the coax run from the common-ground to the antenna exceeds 25', a lightning protector should be added near the antenna. Bond to the metal mast.
10. A single-point ground is required near the entrance to the building. The coax should depart from the mast, near the base, to equalize impedance between the 3 sub-system ground paths. A grounding electrode should be less than 20' from single point bus. Use #10 AWG or larger.
11. Separate the ground rods by >17', if practical. To improve conductivity, drill 12" hole for each ground, insert rod, backfill with cement. Bond all electrodes together with >#6 conductor.
12. To increase ground contact, run a ground radial from each rod. Place ground rods 17' along radial.
13. Lightning rod should extend at least 2' above antenna, and far enough to create a zone of protection. Typically, 8'copper clad rod is adequate. Electrically and mechanically bond to mast to provide one downcomer path. Bond #1/0 basket-weave downcomer to lightning rod for second downcomer.
14. Bond mast at bottom to ground rod. Use #1/0.
15. Dissimilar metals corrode, making poor connections. Use only copper, bronze, or stainless steel.