REP *Design* LLC

Dick Post (N7EMW) * www.repdesign.us * 1- (860) 426.1894 * n7emw@cox.net

Use of Ferrite Bead Filters for Amateur Radio Mobile HF Installations, by Dick Post, N7EMW

The purpose of this document is to present guidelines that have been used successfully by the author to help improve the tuning (e.g. reduce SWR) of motorized/screwdriver HF antennas, reduce interference to vehicle electronics and instruments, and sometimes solve erratic behavior with motorized/screwdriver antenna control devices. To understand the theory behind ferrite beads, and for more details, the reader is directed to various American Radio Relay League (ARRL) publications and to manufacturer web sites (see Table 1 below).

The author, Dick Post (N7EMW), is the owner of REP Design LLC (www.repdesign.us) which designs and manufactures heavy-duty mounts for motorized / screwdriver antennas and other antenna accessories.

Prior to installing ferrite beads, the following must be done in order to have a safe and effective mobile HF antenna installation. (1) Mount the antenna safely and securely to the vehicle. (2) Establish an effective ground between the antenna and vehicle, and between transceiver case and vehicle ground. (3) Install a heavy gauge power supply cable using 8 to 12 gauge wire, depending on run length, from the vehicle battery to transceiver, and install fuses on both the positive and negative wires at the battery. (4) Run good quality coaxial cable from the antenna to the transceiver. The author uses LMR-200MA, 100% shielded "RG58 size" coax. For most mobile installations, especially if running under 500 watts, a good quality and at least 97% shielded RG58 is more than adequate. RG8X and RG8, while having less loss and higher power capability, are harder to run as they have a larger diameter and generally are stiffer than RG58. (5) For antennas to tune 160 and 80 meters with a low SWR, a load inductor, impedance matching device or capacitive device is required.

The following are ferrite bead installation considerations used by the author. For mobile installations, I use Mix 31 ferrites listed in **Table 2** (includes cable size and the maximum number of turns that will fit each ferrite).

1. Do NOT use ferrites that are of unknown type as they may not filter HF frequencies. Various "mixes" of ferrites are made from ceramic/metal blends and determine the range of frequencies filtered (see **Table 1**).
2. The size of the ferrite is proportional to its filtering ability - larger ferrites work better than smaller ones.
3. Ferrites come in split and non-split configurations. Split ferrites clamp around cables and non-split ferrites require you to push the wire through the ferrite. Both types essentially filter the same. (see **Figure 1**).
4. Install ferrites on all cables as close (e.g. 12 inches or less) as possible to the antenna to decouple RF from coax shield and motor control wires. Install them on the coax at the transceiver, power supply cable at the transceiver, power supply cable at the antenna control device, and on control cables between antenna control device and the transceiver. The number of ferrites listed below is the ***minimum*** number recommended but more may be needed. Install them until the problem is solved or proven to be another issue.
    a. Install at least three (3) EACH on coax and motor control cable. On at least one per cable, wrap the coax/cable two to three times around the ferrite to improve the filtering at lower frequencies.
    b. Install at least one (1) EACH: (i) on the coax at the transceiver; (ii) on the power supply wire going into the transceiver and antenna controller; and, (iii) on the control cables between the controller and transceiver if erratic operation occurs.
    c. The more turns around the ferrite the more RFI is filtered BUT the frequency range is reduced significantly for each turn (**Table 1** shows freq. for straight through wires).
    d. Mark ferrite beads with a silver permanent "Sharpie" to remember what type they are (e.g. **Table 2**).

REP *Design* LLC

Dick Post (N7EMW) ∗ www.repdesign.us ∗ 1- (860) 426.1894 ∗ n7emw@cox.net

The tables below are color coded by Mix type. I use Mix 31 for mobile installations.

Table 1: Common Mix Type vs. Frequencies Attenuated (filtered):

REP Design Ferrite #	Mix Type	Freq.Filtered (mHz) [1]	Application Notes
1,2	73	1 - 25	Best for low HF (80m band +/-)
3 & 5-11	31	1-300	My favorite for overall HF+ to VHF
	43	20 - 300	VHF
	44	20 - 300	VHF
4	61	200+	UHF

[1]: frequencies filtered assumes wire straight through ferrite bead; frequency significantly LOWERED, and filtering action INCREASED, for each turn wound around the ferrite (e.g. better filtering on 160-80m bands). As you add turns, the top end of the frequency range that is filtered is reduced. This information is provided by Fair Rite on their web site (http://www.fair-rite.com). Fair Rite manufactures a wide range of ferrites; there are also other manufacturers of ferrites.

Table 2: Suggested Ferrite Bead Application by Cable Type:

REP Design Ferrite #	Mix Type	Fair Rite Part # [1]	Configuration [2]	Application Notes [3]
1	73	26-73-012401	NS	Wire < 22gauge ("g"); 2 Turns ("T")
2	73	26-73-002402	NS	Wire 22g 2T
3	31	26-31-540202	NS	Wire 18g 2T
4	61	26-61-540002	NS	Wire 14g 2T
5	31	26-31-625102	NS	Round cables such as CAT5 type
6	31	26-31-665702	NS	Wire 12g 2T
7	31	04-31-164181	S	RG8 coax 1T; RG8X 2-3T; Wire 10g 3T
8	31	04-31-164951	S	RG58 coax 1T(tight); Wire 18g 2T
9	31	04-31-164281	S	RG58 coax 1T(loose); RG8X 1T; Wire 14g 2T
10	31	04-31-167281	S	RG58 2-3T; RG8X 1T(loose);Wire 10g 2T; AC cords
11	31	26-31-250202	NS	Wire 16g 1T(tight)

[1]: Fair Rite mfgr. part #: [xx – **mix #** - xxxxxx] (http://www.fair-rite.com)
[2]: **S**=Split; **NS**=not split
[3]: Application Notes include largest cable that will fit inside the ferrite & maximum number of turns around ferrite:
"**1T**"=cable is straight through ferrite; "**2T**"=two turns around ferrite, etc.
"**T**"=number of turns of cable/coax around ferrite; "**tight**" =fits tight inside ferrite; "**loose**"=loose inside ferrite.

Suppliers (partial list):

Elna Magnetics (www.elnamagnetics.com); Amidon (www.amidoncorp.com);
DX Engineering (http://www.dxengineering.com/Products.asp?ID=182&SecID=89&DeptID=25)

Figure 1: Example of split and non split ferrite bead filters.