MOBILE NOISE ABATEMENT

Appreciating the increased popularity of Mobile HF operation, enhanced recently with the latest generation of transceivers like Yaesu's FT817, 897 and FT100, it is appropriate we share this excellent article from the US, aimed at making your mobile as quiet as your home station.

There are two aspects to noise abatement; the reduction of existing noise, and keeping what noise there is remaining out of our circuitry. I'll do my best to keep these as separate subjects, however the reader should keep in mind they are intertwined and nearly inseparable.

Radio frequency noise (RFI) is generated by just about every mechanical and electrical device in the modern automobile, truck, RV, or motorcycle. Ignition systems, fuel injectors, DC motors, alternators, relays, fuel pumps, engine computers, airbag control circuitry, defroster grid wires, you name it, it generates RFI. From time-to-time, each and every one of these devices, and a few I haven't mentioned, all require some type of noise abatement. And make no mistake about it; there is not a universal cure, not even the world's best noise blanker. Fact is if you have to use your noise blanker to "fix" a noise emanating from your vehicle, you need to do more suppression work.

If there is a cure all, it is the ubiquitous ferrite core. Since they have come into general use, literally billions have been used to control RFI in every form of consumer electronics you can think of, and even in automobiles. We amateurs use them in a variety of ways such as baluns and chokes. Ferrites come in a large range of sizes and shapes. One commonly sees toroids, round bars, flat bars, and tubular shapes cut along their axis, better know as split-beads. And they come in a large range of mixes too. Depending on the application, permeability requirements, frequency range, and temperature needs, one can choose from near 600 different mixes from dozens of manufacturers. With this many to choose from, it is important we know what we're going to use them for. Before we go any further remember this; it is the frequency of the RFI we need to control not the frequency we operate on which determines the best.

There are three popular mixes, which we need to be concerned with. They are: Mix 43 which has an operating range of .01 to 1 MHz (best for all around use); Mix 77 which has an operating range of .001 to 2 MHz (marginally better for 80 and 160); and Mix 61 which has a range of .2 to 10 MHz (marginally better for VHF). Ferrites work because they get very lossy at frequencies outside of their frequency range. For example, at 10 MHz Mix 43 has a loss of about 80 ohms and if installed on a low impedance circuit, it will act like 80 ohms in series with the offending RFI. They are simple to install, they literally snap on, and the best part is you don't have to open the circuit to install them. I digress.

Opening circuits to install capacitors and/or chokes can be the proverbial sticky-wicket. Aside from the warranty issues, it has been my experience that beads work just as well, cause less problems, and the best part is they are easily removed to be reinstalled on a newer vehicle.

Split beads commonly come in 1/4", 3/8" (8mm), and 1/2" inside diameters, and have a plastic outer case, which holds the two parts and firmly snaps together. As long as they fit over the wire and will snap close, it is unimportant that they be a snug fit, with the possible exception of plug wires (more on this in a moment). They should be placed as close to the offending device as possible to minimize RFI leakage. So let's look at a few real-world applications.

Fuel pumps (especially on 2001 and earlier Fords and Toyotas) are particular troublesome because they are not rhythmic and therefore hard to pin down. And they are so noisy it sometimes takes two or three beads to quiet them down. You'll need 1/4" beads for this application.

Electronic fuel injectors are controlled by the engine management system, and although they are well shielded, some RFI does leak out. The RFI is generated on both the rise and fall of the control voltage creating a rhythmic double tick that is easily detected. You'll need 1/2" beads for this application.

A few years ago, if someone told me I could use split beads over my plug wires to control RFI, I would have argued with them. But I tried it, and I was amazed at the effectiveness. You'll need 3/8" (8mm) ID beads for this application. They need to be installed as close to the coil pack (or distributor) as possible. These will be a snug fit and they need to be to keep them in place.

Those critics, who say placing beads on spark plug wires is not a good practice, haven't done their homework. The distributor has disappeared in favor of computer control, coil packs, and plug wires, to the latest iteration, coil-over-plug (COP) technology where there isn't any plug wires at all. But in most cases, inside of that COP assembly is a toroid

core. Nonetheless these units can leak RFI over their control wires and split beads work well in this application. Personally I would try split-beads on any circuit I thought was causing RFI. It is doesn't work, it can be easily removed. Again, the beads should be placed as close to the offending device as possible to minimize RFI leakage.
Low impedance circuits are a must for mobile installations whether or not you use split beads to control RFI. Even a few tenths of an ohm is enough to allow stray RFI to invade equipment. This is why I recommend at least size 8 AWG. Both + and - leads are beaded close to where they pass though the firewall, and again at the fuse block.

The next phase in noise abatement is bonding, or strapping if you please. Not only does it help reduce RFI, it also aids in lowering the ground losses, which directly affects antenna efficiency. I make up several different lengths of RG58 shield (you can buy copper braid at some hardware stores if you don't have any old RG58 laying around), and attach solder lugs to each end. I use lugs, which have built in star washers to make sure they make good contact. Where there is a chance they will be abraded, I use the discarded coax vinyl cover to protect the braid.
I use self-tapping sheet metal screws to secure them to the frame and/or body parts. Care must be taken drilling into doors, etc. because you do not want to interfere with any existing hardware or electrical circuitry. I use stainless steel hose clamps to attached straps to the exhaust and tail pipes. Doors, hoods, trunk lids, pickup beds, and inner bumper supports are all targets for bonding.
Here's a caution: If your car has a steel gas tank (mine is plastic and they don't need bonding) use great caution in bonding the tank to the frame. While it is possible to safely drill outside the roll welded area, I don't recommend it. Your safest bet is to use the clip-on ground lugs available at most hardware stores. They are typically located in the TV accessory area. These can be safely attached to the peripheral of the tank. And, when attaching the lugs to the body or frame, make sure you know what's behind that screw. Safety first always!

The last item I want to cover is static discharge. You hear static discharge during rainstorms, and sometimes when it snows. It slowly builds up to a crescendo until the static is discharged by a lightning strike. -- One hopefully not to your antenna. You can't control nature, but you can cure static discharge from your vehicle and antenna to a point. The corona ball at the tip of most vertical antennas is there for two reasons. During transmit; it minimizes the high-voltage that would otherwise "leak" from the pointed end of the whip. This is, after all, the highest voltage point on the antenna. During receive it theoretically limits static build up on the antenna, but in reality, it doesn't do a very good a job of it. Adding insult, revolving tires, and axle parts add their part to the static build up on your vehicle and antenna. Fortunately, there are a couple of things you can do to lesson the impact.
First, if your antenna is not matched with a balun, auto-transformer, or inductance matching coil, it behoves you to DC ground your antenna. This is easily done with a small RF choke designed for the purpose. Even a 10 K ohm resistor across the antenna terminals will do the trick.
You also need to get the static off the surface or your vehicle. In the old days, amateurs used to put graphite in the tires and use special bronze contact springs inside the wheel bearing cups to minimize the problem. Nowadays, tires already have a graphite coating, and the bronze contacts have been replace by preloaded, high-metallic content disc brakes. There is an additional way to minimize the static. Enter the static discharger, or drain if you please. Airplanes have used these devices for ages. They're attached to the edges of the wing and consist of graphite-impregnated fibreglass enclosed in a protective vinyl sheaf, with a hint of the material out in the air slip. They effectively drain the static from the surface of the plane, a necessity given the vital nature of the electronics therein. And you can make one for your car a lot cheaper than the $50 to $100 they cost at the airplane parts companies. Here's how I did it...
I used an 8 " length of 1/8" stainless steel, vinyl covered aircraft cable. On one end I stripped 1/2" of the cover off and crimped and soldered a wire lug to it. The other end I stripped back one inch and flayed out the individual strands purposely to make the ends stand out. I screwed the lug onto the frame extension at the rear of the vehicle so about 3 inches stick out past the bumper. It's been on the vehicle for two years and no one has asked what it is for. Does it work? Yes it does! 10-meters has always been a problem for me, because as soon as I got over 10 or 15 miles per hour, the static built up to S4 or S5. That ceased when I installed the drain. Trust me folks, this isn't an April Fool thingy, it actually works!

The old adage "an ounce of prevention is worth a pound of cure" fits mobile operation very well. I must have spent a pound of prevention, as I have virtually no noise from my vehicle, save for 18 MHz (17 meters), which is a natural noise peak frequency. And then, less than an S-unit. Now…if I could only get all those other cars, trucks, and power lines quieted down, I'd be in hog heaven (if you get the pun).

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