Building a DIY Faraday Cage

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"Sleeping in a Faraday Cage is the best way to find out if your body is sensitive to Electrosmog, and the best way to help your body recover."

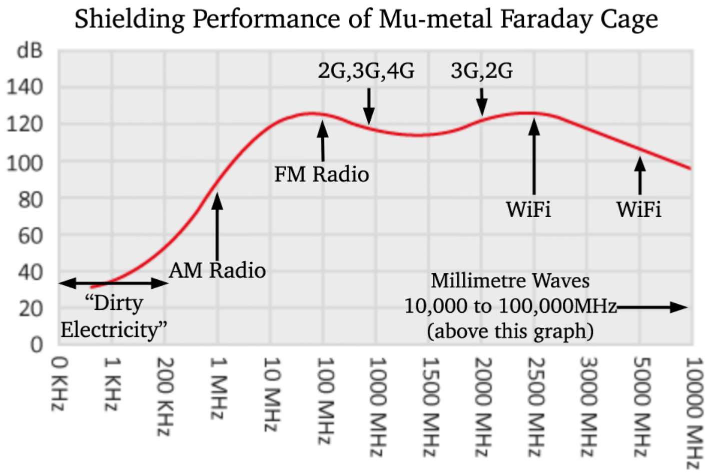
1. What is a Faraday Cage?

Faraday Cages are designed to shield objects within them, and keep electromagnetic fields outside their walls. When I was teaching (in the 1970's) I had access to a professional Faraday Cage. I used it for testing the radio receivers and transmitters I was designing. It was an expensive structure, shared by several Universities. The cage was a large rectangular room with walls, ceiling and floor made from mild-steel sheets, about 1mm thick, welded together at the seams. There were actually two layers of mild-steel sheeting! The door was so heavy it would break your hand if you were not careful when closing it... Inside the cage was absolutely quiet, both for sound and electromagnetic radiation. There were holes in the wall through which we could bolt power distribution boxes, if necessary. I do remember being warned not to stay inside the cage too long, as it "was very claustrophobic, and it makes some people go crazy (more on this later)." So we used the Faraday Cage very sparingly.

2. What do we want the Faraday cage to do in Electromagnetic Hyper-Sensitivity (EHS)?

Since EHS is driven by the presence of electromagnetic fields, then the Faraday Cage must remove these fields from a person's immediate environment. This is actually extremely difficult to do, because so many forms of EM radiation exist. The light we see with our eyes is very high frequency EM radiation, yet it is easy to block light from an environment. At frequencies below visible light we find infra-red, microwaves, radio waves and even the Alternating Current (AC) powering our electrical appliances, but these are much harder to block than light waves. The best introduction to this Electromagnetic Spectrum was produced by NASA. Their 5 minute video can be found on YouTube (click here). As you build your DIY Faraday Cage you will need to understand the concepts introduced in this video, please check it out.

Which of all these types of EM waves can affect the human body? Which does our Faraday Cage have to remove? Filtering light waves is simple, infra-red heat is a little harder, and Radio Waves even harder than that. Here is the shielding-efficiency-graph of a professional enclosure made by Holland Shielding Systems out of MuMetal (which shields even better than steel) and copper.



On the graph's bottom axis is listed the frequency of the EM waves outside the Faraday Cage (FC) in kiloHertz (KHz) and megaHertz (MHz), and on the vertical scale is plotted the amount (in dB, Decibels) by which those waves are reduced in strength (power level) (attenuated) inside the Faraday Cage (Wikipedia has a good explanation of Decibels).

Why does the attenuation of the professional cage fall towards the bottom and top of its frequency range? Why are some waves harder to attenuate than others? How can we make sure our DIY Faraday Cage stops all the fields of biological importance?

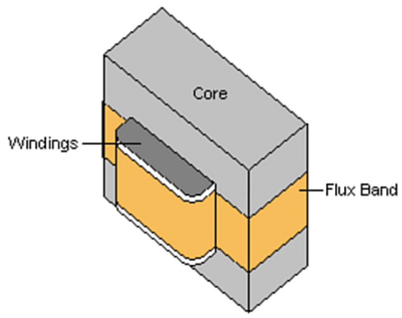
Well, higher frequencies have shorter wavelengths (remember the NASA video?) and can easily get through holes and defects in the 'skin' of the FC structure. For example, at WiFi frequencies, a slit just 2.4 inches (6cm) long will allow waves to pass through it unhindered. At even higher (millimetre) microwave frequencies, a 4mm hole is enough to allow signals to pass through. The 77GHz radar which is part of an automobile's "Driver Assist" technology will easily pass through a 4mm hole (is your bedroom facing a street or garage?). So it becomes much harder to build a Faraday Cage which provides protection (attenuation) as the incoming frequency increases. But provided we make the cage out of a material which short-circuits the electric field, it is not difficult to shield against the frequencies above 500MHz (which contains the 4G, 3G and 2G cellphone and WiFi fields). Silver threads in clothing can be made to do a good job at these higher frequencies, as can virtually any solid metal.

The performance drop at lower frequencies (at the left of the graph) is less well understood, yet it is key to obtaining the shielding a human body needs. We call the waves "ElectroMagnetic" because they possess both an electric voltage and a magnetic flux component as they travel through space. At the lowest frequencies we usually measure the magnetic field strength in Gauss or Tesla, and at higher frequencies we measure the electric field in Volts per Metre. Remember that NASA told us the wavelength gets longer as the frequency falls? At 900MHz (4G frequencies) the wavelength is about 13 inches, 33cm. We adjust the length of the whip antenna on a measuring instrument to one quarter of this length, 3.2inches, to obtain an optimal reference measurement of the electric-field component. An FM Radio, at a frequency 10 times lower (100MHz) uses a whip antenna about 30" long. But at lower AM Radio frequencies (1MHz) the wavelength has increased to 300 metres (328ft) and it is impossible to use a 82ft collapsible whip antenna to make sure we intercept all the electric signal! The magnetic component of these lower frequencies dominates the signal being intercepted by 6ft bodies, such as a human being. AM Radio sets are consequently fitted with a ferrite rod to receive the magnetic component of the radio waves (if the radio set covers short-waves then a whip antenna is often provided to use on its short-wave frequency bands).

A magnetic material (such as steel or MuMetal) is used in the walls of a professional Faraday Cage as it attenuates the magnetic component of waves at the lower frequencies. Yet the manufacturer of the cage (above) still had considerable difficulty in maintaining shielding performance at AM Radio and lower frequencies. This is why the professional Faraday Cage I used in the 1970's had two layers of mild-steel around it, rather than the single relatively-thin layer of MuMetal used in the Holland implementation.

3. Our DIY breakthrough allows Aluminum or Copper instead of Steel walls

The average handyman cannot easily weld sheets of mild-steel into walls and floors, and even soldering the MuMetal sheets from Holland Shielding Systems is difficult. To design a Faraday Cage using Aluminum foil or Copper mesh, we reached back to some electrical transformer designs I did in the 1970's. In transformers the problem is reversed, there is a magnetic flux in the structure, and we don't want that flux to leak into the environment, so I used to wrap a copper "flux-band" around my transformers. This worked well, as long as the resistance of the flux-band was kept very low. Thanks to Hendrik Lorentz, who defined Reciprocity in 1896, the flux-band principle also applies in reverse, so that external magnetic fields are reduced inside the band. What we do in



our DIY Faraday Cage design is to put a continuous sheet of highly conductive material around the entire body of the DIY Faraday Cage, so that AM radio signals, and other lower frequency EM sources (such as ‘Dirty Power’) are attenuated or eliminated by the current flowing in that ‘Flux Band.’

4. By how much does the Electrosmog radiation have to be reduced?

This really involves answering two questions – what is the level of waves we need to achieve so that a human body can function properly, and what are the strengths and frequencies of the incoming radiation we need to attenuate from our homes, our workplaces, and our bedrooms?

That question introduces three more elements of complexity – the importance of time, human activity, and the lack of definition by the medical community as to what defines “function properly” or “Health.” The first two factors were clarified when our research found that if a person is to recover from EHS, sleep is the most important time to be shielded. Indeed, most of my colleagues only use their Faraday Cage for sleep and relaxation, when our bodies need maximum protection.

Bioinitiative 2012 noted the level of –37dBm as that where studies have demonstrated measurable response in humans, and suggested –47dBm as a precautionary maximum level. But we have been able to devise experiments which have proven far more sensitive than those used by most other research groups. If you watch my presentation at the Autoimmunity Congress in Lisbon, I explain that our own research has shown that humans who are EM-sensitive can identify the presence of Radio Signals to below -90dBm (Wikipedia has a good explanation of the term ‘dBm’).

The amplitude of waves in a typical 2018 home environment ranges from -50dBm to -30dBm. Thus a Faraday cage needs to attenuate the waves in a home by at least 40dB to 60dB (10,000 to one million times in amplitude) in order to ensure that a wave will remain undetectable.

5. What if the Faraday Cage makes me ‘sick’, what do I do then?

As I hinted above, some EHS sufferers experience a temporary increase in their symptoms when starting to use shielding, including a Faraday Cage. In actuality, fluctuations of the fields around them in their daily lives also modulate their symptoms but it is really hard to pin down any cause-effect relationship when there is a delay of hours from exposure-change to a complete immune system response, and a recovery period often spanning days. For more insight into this phenomenon, immunopathology, please read my paper “Electrosmog and Autoimmune Disease”

From a practical point of view, it is best to only sleep in the Faraday cage for periods which are relatively comfortable. For some that will be an hour or two, for some it will be a full night’s sleep. As the months go by, and the body begins to recover, we have found even the most sensitive folk will start to get a good night’s sleep, and, eventually, will regain an EMF tolerance when out of the fully shielded environment.

6. The most important decision to make when planning a DIY Faraday Cage.

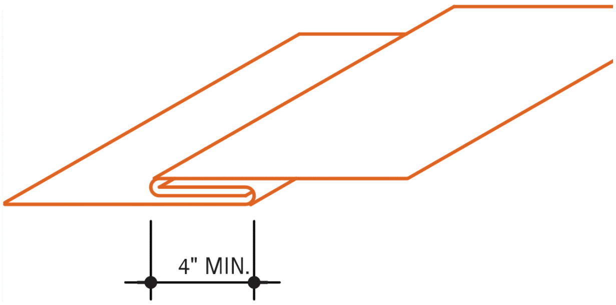
The most important decision an EHS patient can make is not to cut corners when implementing electromagnetic shielding. When I say that “we have tested the following materials and they work well” I also imply that we have tested many times that number of materials which have ***not*** worked well.

We have found that the Attic Foil aluminum product from Texas has worked well for several of our members. It is made from two very, very, thin aluminum surfaces applied to each side of a strong, yet flexible, polymer sheeting. The resistance of the layers is quite low, at least until they have been flexed repeatedly, such as occurs in a door flap. It is best to assume the door flap will need to be replaced every few months. This product is unique by comparison with the mylar film and evaporated-metal products which look the same, but which do not have a low resistance when you measure their surfaces. There are tiny holes punched into the foil for ventilation, these do not measurably affect the shielding performance. The product is available in a variety of widths. The cage at the top-left of this document uses this foil, and it achieves an attenuation greater than 60dB not only at all the microwave frequencies, but also in the AM broadcast band.

As you can see from the photo at the right-top, a very fine semi-transparent copper mesh is also available. The two sizes which we have tested are the 145mesh by 0.0022 copper and the 100mesh by 0.0045 copper. The second is nearly 3 times the weight of the first, and even though it is less expensive, you should remember that the a 4ftx100ft roll of the 100mesh weighs about 55 pounds when UPS delivers it to you. Attenuation of both at 40GHz is above 40dB, at 4GHz (4000MHz) its attenuation risen beyond 55dB and remains above that throughout the 2G, 3G and 4G bands.

Under no circumstances should copper 'insect screening' be used. Microwaves travel straight through its large holes, and its shielding effectiveness at 2G, 3G, 4G and WiFi frequencies is well below 40dB.

The Flux Strap should be one continuous length of foil or mesh, with only one seam.



I prefer to place the seam underneath the floor boards, so it is under constant pressure. Use a folded seam as shown at right. A little copper tape along each edge of the seam will keep dirt out of the contact region. Although the minimum overlap is shown as 4" I personally prefer a foot or more of overlap.

The copper mesh loop can be cut if absolutely necessary, with a seam like this held under pressure between two timber or metal spars. This construction was used in the whole-bedroom Faraday Cage shown above.

7. The door flap

A glance at the selection of doors typically used for commercial Faraday Cages shows that they are out of reach for DIY construction. Their metal construction makes them much to heavy to be supported by a DIY structure, either piping or wood.

We have found the best door construction is formed by a flap which is pulled to a U-Shaped frame around which the outer surface of one end of the flux band is wrapped. You can see the U-shaped frame here, with metal strips attached to the inside surface. Three pieces of 1" x 1" aluminum angle (which are fairly rigid) each have two powerful neodymium magnets bolted to them. The magnetic force from the magnets pulls through the aluminum angle (about 1/16"), the flap, the outer shell of the flux band to the u-shaped metal strips fastened to the door frame, holding them all firmly together without any slits or gaps which would destroy high-frequency performance, while maintaining low contact resistance necessary for low frequency (magnetic) performance. In this way we produce another low-resistance path at the ends of the structure, creating additional 'flux bands' to shield magnetic fields coming into the ends of the Faraday Cage.

Plastic ties are used to hold the u-shaped frame wood to the piping of this structure. Similarly, the ties are used to hold the floor boards, 3-ply sheets 2ft x 4ft, in place between the bottom pipes of the frame. Gaffer tape is used to 'join' the floor panels and prevent gaps between them. Gaffer tape should also be used to cover the metal strips on the U-frame, and to cover any sharp corners on pipe-fittings which might rub on the flux-strap.

8. Airflow – Carbon Dioxide clearance

As a human being breathes, oxygen is sucked into the lungs, and carbon dioxide is blown out. If the concentration of carbon dioxide becomes too high the individual will become ill, and unless moved to fresh air, may even die. Consequently you will see a 5" computer fan on all our DIY aluminum Faraday Cages, fed from a transformer power supply (not a switchmode power brick). The components I favor are this fan, and this transformer. If the fan is too strong the walls of the cage will be sucked inwards too much when the door is closed, so don't buy a more powerful fan unless you really need it.

Since there can be no wiring entering or leaving the Faraday Cage there has to be something to cover the hole in the wall of the cage through which the fan can suck air. There are two options, either an aluminum honeycomb, or one of the copper meshes linked above (preferably the 145 mesh). Either must overlap the edges of the hole in the aluminum foil by several inches, and some form of clamp, for example using small magnets, is needed to make sure there are no gaps through which high microwaves could sneak. The same care needs to be taken with the output vent, which should be near the floor, where the carbon dioxide collects (it is heavier than air). I actually used 1" thick honeycomb with 1/8" cells

9. The copper conductive tape.

You will note that the edges of the honeycomb structure are covered by lots of copper tape. This is a special conductive tape. It must have a very low resistance adhesive, such as the tapes from 'Tapes Master.' This tape is also used to join the various flaps which make up the cage structure. But note that at all junctions there is considerable surface area overlap on aluminum sheet panels to ensure aluminum to aluminum conductivity. The tape basically just holds the overlap in place. No butt joints are used. If you need multiple flux band loops, for example, make sure they are overlapped at least 6" so that good contact is made between the aluminum sheets.

10. Photographic montages of Aluminum foil and Copper mesh structures

a. Aluminum foil and PVC pipe construction: https://photos.app.goo.gl/D1ahnqY8LuZPs7Lz5

b. Copper mesh (100 x 0.0045) and wood: Click here for the link to Google Photos

>>> Explanations of these photographs are attached as Addendum A and Addendum B.

11. No Electronic devices within the Faraday Cage

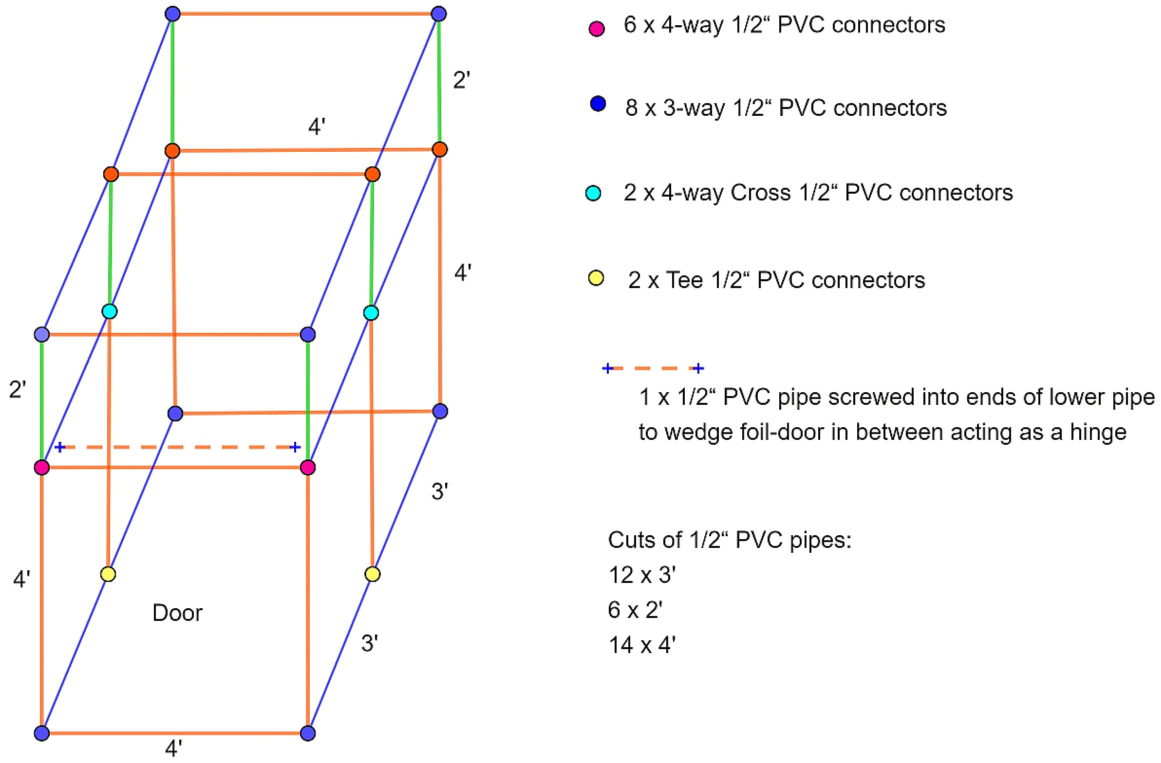
In this YouTube video I show how even a tiny MP3 player, using just one AAA battery, can radiate sufficient digital noise into the cage to ruin its shielding ability (note that we have improved the mounting of the door flap since this video was taken, the flap is now kept as taut as possible to minimize the wrinkling you see in the video).

There can be no MP3 players, no Kindle readers, no power wiring, and even LED lights put out EM noise. We have tested these LED lamps to be quiet, with a soft ambient lighting when reflected off the roof. Additionally, this spotlight is OK for those who need more light for reading books, etc.

If you choose a cassette player for audio, make sure not to get one with a digital display. Earlier models, such as the Walkman WM-D6C which I bought around 1983, work well. Some earlier boom boxes may work, but from the 1990s onwards they started using switching-mode (noisy) audio power amplifiers in them. If you want music in your Faraday Cage it will prove expensive, easily doubling the cost of the structure.

12. If you have room for it, 8ft length is preferable

All that is needed to make an 8ft long Faraday Cage (instead of 6ft) is to use the 60” attic-foil and cut the 12x3ft pipe lengths to 4ft instead. The attic-foil should be placed around the frame so that the seam is underneath the floor boards, and 12” to 18” overhang at the door end, 3” to 6” are wrapped around the rear and conductive-taped to a 6ft length serving as the rear wall of the cage. The door-end-attic foil is wrapped around the door framework, as shown in the photographs, and a 6ft piece serves as the door-flap assembly. Make sure that there is a 6” overlap on all attic-foil joins, as the aluminum to aluminum contact is better than through the conductive tape. If you plan the lengths as 7ft9” or 5ft9” then you will have more foil available to overlap at the ends of the structure.



<u>Typical parts list for an Attic Foil Faraday cage:</u>

For a 6ft length cage, a total of 104ft of piping is needed.
It comes in 10ft lengths from (for example) Home Depot. Twelve lengths
 (sometimes Home Depot will cut it to the shorter lengths you need)
Six by 4-way PVC connectors (in tens from Amazon)
Eight 3-way PVC connectors (in tens from Amazon)
Two 4-way cross PVC connectors (from Amazon)
Two 2-way tee PVC connectors (in tens from Amazon)
Three hardwood floor-slabs (eg Home Depot)
Conductive tape (Tapes Master)
Fan & Fan transformer
Gaffer tape (I will assume that any DIY already has a roll of this)(Amazon)
Aluminum Honeycomb (this is 1/4", I would prefer 1/8” mesh)(Amazon)
Attic-foil, 250sqft 48” width for a 6ft length Faraday cage (60” for an 8ft cage)
Door assembly: 3 pieces of flat iron to attract magnets (Home Depot)
 3 pieces of 1”x 4”x 48” pine (Home Depot)
 Three magnet-holding aluminum strips (eg Home Depot)

13. Honeycomb to cover air inlet and outlet holes

The 1/4" honeycomb I suggested from Amazon (above) will work as high as 24GHz, but I personally prefer 1/8" holes, which work to 50GHz. It needs to be 1" thick, although you can make it so by cascading two 1/2" thick honeycomb slabs if necessary. An alternate 1/8" honeycomb from Ebay can be cascaded to 3/4" thickness and will work well.

Remember to place venting near the floor, where the carbon dioxide collects (because it is heavier than air).

14. Support.

Questions may be asked at our MarshallProtocol.com (for cohort members only) and SchwannSongs.org (anybody can join) message boards, https://www.schwannsongs.org/

--------------21 August 2018----------------