

Create Healthy Homes

Environmental Design and Inspection Services

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Wiring Error Information For Electricians

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Introduction

We recommend that clients have their electric breaker panel and circuits evaluated for wiring errors. Wiring errors are a potential source of magnetic field exposure. They are caused by incorrect wiring practices that are inadvertent but common during the installation of electrical wiring, however long ago that occurred in the past. They also occur when new wiring is added, particularly by homeowners, electricians and handymen over the years who don't follow proper electrical code.

Wiring errors cause parallel paths for neutral return current to flow, which causes unbalanced loads and therefore, magnetic field exposure along the route of the branch circuit(s) when electric loads are turned on. These fields extend out into occupied rooms from walls, ceilings and floors.

Magnetic fields, whether caused by wiring errors, power lines, current on grounding paths or point sources, create the most serious and detrimental effects on occupant health, in our opinion. These errors need to be traced and fixed to provide a healthy environment for clients, especially if you are EMF-sensitive.

Wiring errors can be tested for at the breaker panel and if discovered, the source can be traced and repaired in the branch circuitry. We work in conjunction with electricians to guide them in implementing a protocol developed by our faculty, who are electrical engineers, to find and fix these errors.

Resources on Tracing and Repairing Wiring Errors

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To learn more about the detection and repair of wiring errors, I refer you to the following resources. These handouts refer to material that we teach in the Building Biology Advanced EMR 312 seminar (<https://hbelc.org/seminars/advelectro>) on the testing and mitigation procedures for wiring errors in house branch circuitry. These cause magnetic field EMFs. Here are the handouts:

1. A three-page handout summarizing our procedure for screening for wiring errors during an EMF evaluation, available at http://www.createhealthyhomes.com/Wiring_Error_Docs/Wiring_Error_Screening_Test_OM_2_11_19_v.1.pdf.
2. A two-page handout with instructions on how to make a continuity tester for wiring errors on neutrals in branch circuitry, available at http://www.createhealthyhomes.com/Wiring_Error_Docs/Blue_box_9_18.pdf. We refer to it as the "blue box" because it is housed in a blue plastic box used by electricians as a junction box for a switch or outlet when non-metallic, or NM, Romex plastic circuits are used in walls.
3. A video in which Oram explains how wiring errors are created and how they cause magnetic fields, available at <https://hbelc.org/free-videos-and-free-fact-sheets/common-wiring-errors-that-imperil-health-in-homes>. The video is part of an eight-part series of lectures on EMFs presented by Oram and his colleagues at the Institute for Building Biology and Ecology (<https://hbelc.org/index.php>). To see the other videos, go to http://www.createhealthyhomes.com/EMF_lecture_slides.php#1.
4. A one-page summary as well as a six-page full version of our wiring error mitigation procedures for electricians to follow to repair wiring errors. For the one page summary, go to http://www.createhealthyhomes.com/Wiring_Error_Docs/Wiring_Error_Protocol_one_page_312_OM_10_30_16_v.3.1.pdf.
5. For the full version, go to http://www.createhealthyhomes.com/Wiring_Error_Docs/Wiring_Error_Protocol_full_version_312_OM_2_11_19_v.1.pdf.
6. An excellent book written by Karl Riley, entitled, "Tracing EMFs in Building Wiring and Grounding." Karl has also produced a 23-minute DVD for Southern California Edison showing how wiring errors are created and how to repair them. Both the book and DVD are available from LessEMF by going to www.aitsafe.com/go.htm?go=www.lessemf.com/book8.html&afid=51307&tm=90&im=#530.

Karl Riley is a retired science teacher in North Carolina who joined a group of electricians who were hired to evaluate and mitigate elevated magnetic fields in schools in Northern California some decades ago. They found wiring errors in branch circuits as well as electric current on grounding paths as the causes of the magnetic fields. These were violations of the National Electric Code. Tracing and repairing the wiring errors and current on grounding paths removed the magnetic fields.

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Karl wrote about his experiences in his book, *Tracing EMFs in Building Wiring and Grounding*. The book is now in its third edition. Karl was subsequently asked to join the National Electric Code (NEC) review committee. The NEC, as you know, comes out with an updated version of their code book every three years, and Karl assists in that process.

You can also view a video on identification and repair of wiring errors that Oram Miller recorded at the headquarters of the International Association of Certified Home Inspectors (InterNACHI) (<https://www.nachi.org/>). To view the video, entitled, "Common Wiring Errors That Imperil Health in Homes", go to <https://hbelc.org/free-videos-and-free-fact-sheets/common-wiring-errors-that-imperil-health-in-homes>. The video is part of an eight-part series of lectures on EMFs presented by Oram and his colleagues at the Institute for Building Biology and Ecology, at <https://hbelc.org/index.php>. To see the other videos, go to www.createhealthyhomes.com/EMF_lecture_slides.php#1.

Wiring errors and electric current traveling on grounding paths that we find in single family homes, apartment buildings and condo buildings are all violations of the NEC.

You can read two articles by Karl summarizing the information in his book. The first article by Karl is entitled, *What Electricians Should Know About EMF*, available at www.windheimemfsolutions.com/wp-content/uploads/2015/09/NEC-Code-Violation_Riley.pdf. The second article by Karl is entitled, *Should an Electrician Have a Gaussmeter?*, available at www.mikeholt.com/mojonewsarchive/PQ-HTML/HTML/ShouldElectricianHaveGaussmeter~20020326.htm.

These two articles provide a summary of the justification for how wiring errors are created and how they cause magnetic fields. All electricians and EMF consultants should know this information, as it is essential in detecting and mitigating some of the most common causes of unhealthy magnetic field exposure in homes and offices. Karl not only discusses the health implications of wiring errors, he discusses how they can also impact electronic appliances and possibly overheat conductors (wires in circuits), a potential fire hazard.

You can also see an excellent five-page summary of this topic in an article written by Karl, entitled, "Suggested Protocol for School Electricians for Correcting Wiring Errors Causing Net Current Magnetic Fields," previously published by the California Electric and Magnetic Fields Program (the funding for which unfortunately ended in the mid-2000s), available at www.createhealthyhomes.com/WiringProtocol_Calif_Schools_K_Riley.pdf.

Wiring Errors as Violations of National Electric Code (NEC)

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In these articles Karl discusses how magnetic fields are created due to uncanceled magnetic fields from wiring errors and current flowing on grounding paths, such as water service supply pipes and cable TV cables, all of which are violations of the National Electric Code.

Neutral-to-Neutral Wiring Errors

In particular, neutral-to-neutral wiring errors are, according to Karl, a violation of two specific NEC Code provisions. The first is Section 301-3(b), which states, "all conductors of the same circuit -- including the neutral and all equipment grounding conductors -- must be run in the same raceway, cable tray, trench, cable, or cord," referenced at www.mhprofessional.com/downloads/products/0071546529/NECch3.pdf .

The second is NEC Code Section 310-4, which, "prohibits connecting a neutral to another neutral such that a parallel return path to the panel is set up, unless the conductors are 1/0 or larger and meet exacting conditions," referenced at ehib.org/cehtp/cehtp.org/emf/WiringProtocol.pdf . Circuits in most residential settings are not larger than gauge 1/0, and therefore this provision applies.

Neutral-to-Ground Wiring Errors

Likewise, current flowing on grounding paths are also National Electric Code violations, specifically Sections 250-24(a)(5) -- 1999 and 250-61(b). Grounding paths include ground wires within metal-clad or plastic, non-metallic NM (Romex) wiring, or the metallic sheathing surrounding metal-clad circuits. They also include metallic grounding paths such as water pipes, natural gas lines, cable TV sheathing and the like.

In particular, Provision 250-24(a), according to Karl, "prohibits connecting of neutrals to any grounding connection on the load side of the service entrance main disconnect. Formerly this was 250-61(b)". This is referenced at ehib.org/cehtp/cehtp.org/emf/WiringProtocol.pdf as well as www.createhealthyhomes.com/WiringProtocol_Calif_Schools_K_Riley.pdf from the article, "Suggested Protocol for School Electricians for Correcting Wiring Errors Causing Net Current Magnetic Fields", by Karl Riley. Karl says sections 250-23(a) and 250-61(b) both, "prohibit connecting neutrals to ground on the load side of the service entrance".

Mike Holt, an electrician who writes a blog for other electricians, has written a comprehensive article on wiring errors, entitled, "NEC Article 250 — Sections 250.6 through 250.12". This includes NEC section 250.6, which involves what is referred to as "Objectionable Current Flowing Through The Grounding Path". The article is available at <https://www.mikeholt.com/mojonewsarchive/GB-HTML/HTML/NECArticle250Sections250.6-250.12~20020125.htm> .

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Unfortunately, many electricians do not follow these provisions because they are not taught that the magnetic fields that wiring errors create are important. Some electricians have created these errors unknowingly out of expediency as a short cut, not knowing they are also creating conditions that could cause adverse health risks for occupants, let alone potentially leading to conditions that in rare circumstances may cause a fire.

I have even been told by electricians that they have never heard of these provisions in the NEC when they went through training. I have asked why these provisions are even in the code book in the first place. I was told they prevent one of the potential causes of fire, albeit, a very obscure cause, way down the list of fire sources that electricians would be concerned about.

Secondly, the magnetic fields caused by wiring errors are known to interfere with the functioning of sensitive electronic equipment, such as computer monitors and servers. To us, it is odd that code inspectors, or whoever wrote these particular provisions in the NEC, would be concerned about the "health" of computer equipment but not the health of human occupants of buildings. However, for reasons discussed elsewhere in my article, Magnetic Field EMFs, at http://www.createhealthyhomes.com/articles_magnetic_fields.php , it seems there is a tendency by some to not regard magnetic fields as a health risk.

We certainly disagree and feel magnetic fields do pose a significant health risk, even at levels about 1-2 mG. Several of us in the building biology profession have clients (and their pets) who have or have had cancer who live in homes with high magnetic fields from wiring errors and current on grounding paths. While this is not a scientifically valid survey or sample size, it is nevertheless a correlation we have made in our practices that bears acting upon.

Likewise, electrical and home inspectors do not find these errors because, as Karl points out, junction boxes are not inspected and the consequences of wiring errors, mainly magnetic fields, are not considered important. Wiring errors must be looked for and corrected, if present.