Section 4

Shielding, Harmonizers and Consumer EMF Products: Protection Claims Without a Test Standard, and the Shielding Paradox

Author: J. Joaquín Machado, EMR Researcher and EFEIA Founder & Director. **EFEIA Institute**, Miami, Florida, USA. info@efeia.org. **Evidence grades:** (a) peer-reviewed, standards body, court or regulatory record, or accredited laboratory report; (b) institutional report, agency guidance or press release, preprint, thesis or recognized seal; (c) manufacturer, advocacy or media source. **Disclosure:** the author is also NOXTAK's founder and CTO, and EFEIA operates within the NOXTAK ecosystem, which develops SPIRO (Section 5).

Scope: products and measures used to reduce exposure: shielding materials, canopies and phone cases, plug-in filters, grounding products, "harmonizers" and wearables, and how such products should be evaluated. **RFI questions answered:** 5(n), 5(o), 6, 8, 9 (consumers), 13(a), 13(c), 13(d), 15(d), 16, 17 and 18, each tagged in brackets where answered.

OUR PROPOSAL

EFEIA proposes that HHS lead, with NIST, the FTC and the FCC, a National Framework for the Evaluation and Regulation of Electromagnetic Protection Technologies: every product sold as protection is classed by the function it claims, tested for physical performance, for effects on its surroundings and on communications and, where health is claimed, for that benefit, and recognized only for what was verified (Exhibit 4A).

For shielding, the test should measure what a person receives before and after installation, including the person's own phone, which transmits harder when its link to the network weakens.

An independent survey of marketed products in accredited laboratories, with published data, should inform consumer guidance that starts with distance and source control.

1 SUMMARY OF THE ISSUE

1. Shielding and the shielding paradox. Shielding materials are rated on flat samples in laboratory fixtures, for example under ASTM D4935, from 30 MHz to 1.5 GHz under plane-wave conditions [1], not in occupied rooms with seams, windows and transmitters inside. Power-frequency magnetic fields pass through most materials [2]; indoors, NIEHS names improper grounding and wiring as the "chief causes" of residential exposure [3]. Under 3GPP power control a phone raises its uplink power as path loss grows, up to 23 dBm (200 mW, conversion) for LTE and 5G NR phones of Power Class 3 [4,5]. The FCC warns that shielded cases "may actually increase RF absorption in the head" by forcing the phone to increase power [6], and the FTC that "phony shields may cause it to draw even more power" [7]; the German and Swiss agencies agree [8,9]. Trimming a weak distant signal can raise the strongest exposure a person receives, from the phone at the head or on the pillow. EFEIA's LEDNA principle (Low Emission Design – Near Field Awareness) therefore puts design and distance before blocking, treating sources as design choices from building site and wiring to room layout and wired communication [10].

2. Consumer products. Stickers, pendants, plug-in "harmonizers", filters and grounding sheets are sold as protection. "Electromagnetic protection" covers different functions that no single test or generic seal can establish: attenuating, absorbing or redistributing a field, altering signal characteristics, or producing a physiological response [11]. No U.S. statute, regulation or consensus standard defines "EMF protection", "harmonizer" or "neutralizer" or says how such claims must be tested; the FTC Act's ban on deceptive advertising and its reasonable-basis requirement apply, but set no test method [12]. The FCC says such devices "generally do not work as advertised" [6]. Some "negative ion" wearables emit ionizing radiation [13,14].

Compliance is not protection. Phones are tested at maximum power ("In general, maximum time-averaged power levels must be used for evaluation" [15]), which the FCC calls "an additional margin of safety" [6]; but under weak reception, exposure from 2G phones on four U.S. networks was up to four orders of magnitude higher than under strong reception [16], and energy-efficient buildings attenuate 24.86-31.98 dB against 5.16 dB for an old building [17]. Without a test standard, buyers cannot tell tested products from untested ones.

2 WHY IT MATTERS [Q9]

People buy protection that is not tested. ANSES found no data that objectively demonstrate the effectiveness of white zones or "whitened" buildings, and asked that any created be rigorously evaluated [18]; in a review of nine controlled treatment trials, the efficacy of shielding, like every treatment other than cognitive behavioral therapy, was not "adequately demonstrated" [19]. In 2002 the FTC alleged that earpiece patches were advertised as blocking "up to 97% or 99%" of radiation without a reasonable basis [20]; the cases ended in a $726,874.06 default judgment [21] and stipulated orders, without admission, including $342,665 in consumer redress [22].

Some products add exposure. Germany's radiation protection office warns that a sticker with metal wires placed over the antenna can degrade the connection so that the device increases its transmission power [8]. Health Canada found that each of two Stetzer filters draws 0.9 A of reactive current, which the authors conclude increases the current supplied to the home and the ambient magnetic field (not measured), and that the filter "does not clean up line voltage harmonics" [23]. The Dutch nuclear regulator found ten wearables, among them an "anti-5G" pendant and a sleep mask, emitting ionizing radiation that, worn 24 hours a day for a year, could exceed the strict Dutch skin limit [13]; the NRC reports uranium and thorium above licensing levels in wristbands and pendants, none licensed [14]; modeled doses reached 1.57 mSv a year for a garment worn 24 hours a day and 1.22 mSv for a necklace worn 16 hours, above the 1 mSv public limit [24,25].

The FCC record is open. The D.C. Circuit required a reasoned explanation for retaining the testing procedures for portable devices [26]; comments are due 22 October 2026 [27].

3 CURRENT LIMITATION OR GAP [Q5(o)]

G1. Net exposure unmeasured. EFEIA found no peer-reviewed study of personal exposure, downlink plus the person's own uplink, before and after residential shielding.

G2. Ratings are not installed performance. The IEEE enclosure methods have been Inactive-Reserved since 2023 and 2024 and no U.S. method tests an installed home [1]; one coat of 17 shielding paints gave 1 to 43 dB at 1 GHz, and two paint additives 0 dB [28]; one fabric fell from 7.20 to 1.61 dB at 0.9 GHz after ten washes with powder detergent [29]; ANSES judged in-situ efficacy "plus qu'aléatoire" without good installation practice [18].

[Q13(c)] G3. Sources inside the shield, and natural fields. Cordless phones and wireless LAN or Bluetooth contributed about 82% of bedroom RF exposure in 1,348 German households [30]; a fully enclosed metal space raised SAR from a phone inside [31], and in ANSES-commissioned tests a Wi-Fi-type emitter in a "shielded" room raised the local maximum field by 20% [18]. A narrative review adds that metal shielding also blocks natural fields, and favors avoiding exposure, with shielding kept to intermittent use [32].

[Q5(n)] G4. No claim-based standard. Standards cover pieces: shielding of materials and enclosures, SAR, harmonics, 2-150 kHz emissions and conducted disturbance [1,33]; as far as their catalog descriptions show, none sets pass criteria for a protection claim. Accreditation shows that a laboratory is competent for a test [34], not that a product is effective or that its claims hold beyond the conditions tested [11].

G5. Add-ons sit outside certification. FCC guidance requires body-worn accessories supplied with the phone, and metal-containing accessories its maker offers, to be SAR-tested with it, and asks third-party suppliers of accessories without transmitters only to consult the phone maker on approval options; in EFEIA's reading, aftermarket passive products are not required to be SAR-tested with the phone [35]. A report that three ordinary cases raised SAR by 20-70% rests on a case maker's filing, not an FCC test [36].

G6. Product tests and outcome measures are few. One peer-reviewed SAR test of stick-on products [37], one government test of two filters [23], one review of filter studies [38]. HRV has a 1996 measurement standard [39]; GDV/Bio-Well is under active validation, and a 2024 study reported large measurement variability [40]; the FTC regards randomized controlled trials as the most reliable health evidence [12].

[Q9] G7. No current public health guidance, episodic enforcement. EFEIA found no HHS guidance on shielding or weak-signal phone use; federal statements are an FCC FAQ [6], FTC tips of 2011 [7] and a 1996 NIOSH, NIEHS and DOE booklet [2]. The FDA page on accessory claims was removed [41], and the latest federal action EFEIA found is a 2020 FTC warning letter [42].

[Q5(o), Q9] G8. One rating hides divergent outcomes. A shield can reduce a field in one place, redistribute it nearby and degrade a link; a physiological change does not show lower exposure, and preserved connectivity does not show biological protection. A single score or seal hides these differences, and buyers read seals as guarantees beyond the conditions evaluated [11].

4 EXISTING EVIDENCE [Q6, Q13(a), Q15(d), Q18]

Table 1. Shielding, power control and consumer products. Values as printed in each source, except the SPIRO reduction,

calculated from printed values.

Topic	Source (grade)	Result as reported
Phone power	Joshi 2017, 2020 (a)† [5,43]	LTE, Sweden: maximum power in about 40-60% of raw 200 ms samples in rural, suburban and urban cells; 6-min time-averaged power below 1% of the maximum, on average. 5G NR mid-band, mostly dense-urban: about 64% and 40% of instantaneous samples at maximum (upper bounds); 15-min average at most 42.5% and 39.5% of the maximum time-averaged power under TDD
Weak signal	Wall 2019 (a) [16]	Up to four orders of magnitude higher at 1-2 bars than at 4-5 bars (2G, four U.S. operators); weak-signal exposure at 48 cm similar to or greater than strong-signal exposure at 4 cm
Enclosures, indoor cells	Tang 2008, Aerts 2015 (a) [31,44]	Peak SAR rose significantly in a fully enclosed elevator, mainly a resonance effect; an in-train small cell could cut brain exposure 35-fold and whole-body exposure 11-fold
50/60 Hz	Adams 2004 (a) [45]	Where code violations create net current loops, wiring exposure is likely more important than external lines; wiring an important source in 4 of 6 developments
Stick-on shields	Oliver 2003 (a)† [37]	Nine products (five shields advertised as up to 99% effective; four claimed to emit counteracting oscillations), 914 and 1880 MHz: 1 g SAR did not change by any statistically significant amount
Plug-in filters	Health Canada 2006 (b) [23]; de Vocht 2016 (a) [38]	0.9 A reactive current per filter; line-voltage harmonics unchanged; 4-100 kHz components below the noise floor with and without the filter; meter readings fell. 25 publications: no evidence for the 50-unit safety threshold "being anything more than arbitrary"
Grounding	Brown 2016 (a) [46]	n = 50, no sham: AC body voltage "reduced by an average of 58-fold" when grounded; health claims not tested
Non-attenuating technology	Morlab 2015, Verkotan 2017 (a) [47,48]; Korotkov 2022 (a) [49]	Independent, accredited laboratories: SPIRO card, up to 91% reduction in 10 g-averaged SAR across seven configurations, antenna performance unchanged within uncertainty on the same handset and on two further handsets. University-led, open, randomized, placebo-controlled 30-day trial, n = 50 (Section 5)

† Ericsson, Telia or Motorola authors (stated); not downgraded.

F1. Well established: phones raise uplink power when the link weakens, and weak coverage raised exposure by up to four orders of magnitude [4,16]. **F2. Well established for materials, unknown in homes:** laboratory ratings vary widely and degrade [28,29]; installed, net performance is unmeasured (G1). **F3. Consumer products:** a manufacturer laboratory's test of nine stick-on products found no statistically significant change in 1 g SAR [37]; filters change meter readings but not line harmonics [23]; some wearables carry a radiological risk [13,14,24]. **F4.** One non-attenuating technology has paired SAR and antenna-performance reports from accredited laboratories [47,48].

5 WHAT EFEIA CAN CONTRIBUTE [Q18]

Table 2. EFEIA datasets and actions.

Dataset or action	Gap	Contribution	Status
Installed shielding and field maps	G1-G3	Before-and-after insertion loss of canopies, paints and films, 0.7-6 GHz, seams and grounding recorded; 10 cm grids in V/m behind partial shields, with and without an active phone	Planned
Uplink inside and outside shielded spaces	G1	Transmit power at matched signal strength on three or more models, LTE and NR: median, 95th percentile, time at maximum [5,43]	Protocol proposed
50/60 Hz wiring audits	G3	Net current and μT before and after electrical-code correction [45]	Planned
National evaluation framework and unified protocol	G4-G6, G8	Products classed by the function claimed, any mechanism described so that it can be tested. Three dimensions: physical performance (named standards, device identification, stated uncertainty, SAR with antenna performance on one handset so that a SAR drop from a degraded antenna is caught [47]); effects on surroundings and communications (redistributed fields, phone power, interference, noise floor, link performance); and, where health is claimed, pre-registered, sham-controlled trials matched to the claim. Radiological screen; laboratory and installed-system tests with interlaboratory comparison	Submitted with this comment as Exhibit 4A

Dataset or action	Gap	Contribution	Status
		[34]; conformity statements limited to the verified function [11]	
LEDNA design measures	G1, G3, G7	Design before shielding: site, panel and wiring layout, bed and desk placement, wired communication, night-time shutdown; sleep spaces first [10,50]	Published by EFEIA
BEMCP	G4	Certifies spaces; tier thresholds published; measurement protocols, assessor qualifications and a conflict-of-interest policy to be published [51]	To publish

Each EFEIA dataset will carry instrument and serial number, calibration certificate, protocol, averaging, location and uncertainty when filed.

6 ADDITIONAL RESEARCH NEEDED [Q5(o), Q8, Q16, Q17]

R1. Residential before-and-after study. Shielded and matched unshielded homes, logging downlink per band, Wi-Fi and cordless phones, the occupant's own phone power and 50/60 Hz fields through days and nights of normal use, with field maps behind partial shields [16,30,31]. **[Q17] R2. Installed-performance test.** A NIST room-level method covering seams, openings, grounding and interior sources, with round-robin tests of marketed products and durability after washing, UV and abrasion [1,29]. **[Q6, Q13(d)] R3. U.S. phone power under weak signal** by coverage, building type and shielding, including direct-to-device satellite links (Section 2), as instantaneous and time-averaged distributions, entered in ET Docket 13-84 [16,27,43]. **[Q5(n), Q17] R4. Claim-based test standard** from NIST with IEEE, ASTM, IEC, the FTC and the FCC: categories by claimed function, methods for each dimension of the unified protocol, pass criteria with stated uncertainty, SAR to IEC/IEEE 62209-1528 with antenna performance on the same handset, reference materials and interlaboratory comparisons, and labeling [1,11,12,33,34]. **R5. Independent market survey** of 30-50 products in ISO/IEC 17025 laboratories, with raw data published [34]. **R6. Filters with modern loads,** measuring the magnetic field directly [23]. **R7. Biological claims:** pre-registered, double-blind, sham-controlled crossover trials with HRV to the 1996 standard and GDV/Bio-Well paired with an independent physiological reference [12,39]. **[Q9] R8. Radiological screening** of "negative-ion", "quantum" and "scalar" wearables sold in the United States [13,14,24,25]. **R9. EHS outcomes:** blinded, sham-controlled shielding trials with exposure measured before and after [18,19]. **R10. Shielding and natural fields:** whether whole-house shielding, which also attenuates natural fields such as the Schumann resonances, affects sleep and circadian rhythms, a hypothesis EFEIA raises [32,50]. **[Q8] R11. Communications noise as a measured quantity.** Signal strength, interference and noise floor are not interchangeable: tests should state bands, measurement bandwidth, traffic, location and instrument settings, and read signal-to-noise or signal-to-interference-plus-noise ratios with link performance [11], building on NIST's coexistence metrics [52].

7 PROPOSAL AND NEXT STEPS [Q5(n), Q9, Q16, Q17]

[Q5(n), Q17] P1. National framework. HHS, through OASH, convenes NIST, the FTC, the FCC and the CPSC to establish the National Framework for the Evaluation and Regulation of Electromagnetic Protection Technologies and its unified protocol, and to develop the claim-based test standard (R4), with EFEIA contributing Exhibit 4A. Each certification or declaration of conformity states the verified function, the frequencies and configurations tested, installation conditions, the size of the result, limitations, adverse effects found, what was not evaluated and which changes require retesting; a product is recognized only for the function verified, with the same scope in labeling and advertising. A multidisciplinary body runs it under independence, disclosure of conflicts of interest and review of favorable and unfavorable results [11]. **P2.** HHS funds the residential before-and-after study (R1) and the market survey (R5). **[Q9] P3.** HHS consumer guidance starts with distance and source control, as the Swiss health office advises: a low-SAR phone, a hands-free kit kept away from the body, a corded or Bluetooth headset, and no shielding products, which "may increase the phone's radiation levels" [9], and the LEDNA measures in Table 2. **[Q9, Q17] P4.** NRC and CPSC follow up the radiological screening (R8) and warn consumers. **P5.** The FCC addresses aftermarket accessories sold as reducing exposure in ET Docket 13-84, testing them with the phone for SAR and antenna performance [27,35]. **[Q5(n), Q9] P6. Post-market surveillance.** The FTC, the CPSC and the FCC, each within its authority, record performance deterioration, interference and adverse outcomes reported for recognized products; design changes trigger review, installation conditions that manage a limitation become part of the recognition, and a recognition is reviewed when an effect contradicts an essential claim [11].

Related: Sections 1 (instrumentation), 2 (urban monitoring) and 5 (a passive nanocomposite presented as a candidate solution, with the relationship disclosed).

KEY REFERENCES

1. Shielding and SAR test standards. ASTM D4935-18(2026), planar materials, 30 MHz to 1.5 GHz, far-field plane-wave conditions, doi:10.1520/D4935-18R26. IEEE Std 299-2006, shielding enclosures of 2.0 m or more, Inactive-Reserved since 30 March 2023, and IEEE Std 299.1-2013, enclosures of 0.1-2 m, Inactive-Reserved since 21 March 2024. IEC/IEEE 62209-1528:2020 with Amendment 1 of 2 September 2026, SAR of hand-held and body-mounted devices, 4 MHz to 10 GHz. (a, standards)

2. NIOSH, NIEHS, U.S. Department of Energy. Questions and answers: EMF in the workplace. Electric and magnetic fields associated with the use of electric power. DOE/GO-10095-218. September 1996. https://stacks.cdc.gov/view/cdc/180957. (b, federal agency report)

3. NIEHS. NIEHS report on health effects from exposure to power-line frequency electric and magnetic fields. NIH Publication No. 99-4493. 4 May 1999. p. 38. (b, federal agency report)

4. 3GPP/ETSI. ETSI TS 136 213, clause 5.1.1.1 (LTE uplink power control); ETSI TS 138 213, clause 7.1.1 (NR); ETSI TS 136 101 V19.6.0 (2026-08), Table 6.2.2-1; ETSI TS 138 101-1 V19.6.0, Table 6.2.1-1 (Power Class 3, 23 dBm, tolerance 2 dB with band-specific relaxations). (a, standards)

5. Joshi P, Colombi D, Thors B, Larsson L-E, Törnevik C. Output power levels of 4G user equipment and implications on realistic RF EMF exposure assessments. IEEE Access. 2017;5:4545-4550. doi:10.1109/ACCESS.2017.2682422. (a; Ericsson and Telia authors (stated), not downgraded)

6. Federal Communications Commission, Office of Engineering and Technology. RF safety FAQ. Undated; read 24 September 2026. https://www.fcc.gov/engineering-technology/electromagnetic-compatibility-division/radio-frequency-safety/faq/rf-safety. (b, federal agency guidance)

7. Federal Trade Commission. FTC offers tips to help consumers avoid cell phone radiation scams. Press release, 16 June 2011. https://www.ftc.gov/news-events/news/press-releases/2011/06/ftc-offers-tips-help-consumers-avoid-cell-phone-radiation-scams. (b, federal agency guidance)

8. Bundesamt für Strahlenschutz. So-called "protective products against electrosmog" are unnecessary. 30 July 2025. https://www.bfs.de/EN/topics/emf/competence-centre-emf/reports/reports-emf/anti-emf-products.html. (b, national agency statement)

9. Federal Office of Public Health FOPH (Switzerland). Mobile phone. Factsheet. 1 June 2026. https://www.bag.admin.ch/dam/en/sd-web/xQX5eZkpxLaW/faktenblatt-smartphone.pdf. (b, national agency factsheet)

10. EFEIA Institute. Beyond shielding: why EFEIA is moving from ALARA to LEDNA. efeia.org; 21 November 2025. https://efeia.org/beyond-shielding-why-efeia-is-moving-from-alara-to-ledna/. (c, EFEIA's own position statement)

11. Machado, J. J. (2026). *National Framework for the Evaluation and Regulation of Electromagnetic Protection Technologies: Problem analysis and proposed unified evaluation protocol* [Proposal]. Zenodo. https://doi.org/10.5281/zenodo.23513472 (b; Exhibit 4A; EFEIA's own proposal; the author is also NOXTAK's founder and CTO, and NOXTAK develops a non-blocking technology of the kind the framework would evaluate)

12. Federal Trade Commission. Health products compliance guidance. December 2022. https://www.ftc.gov/business-guidance/resources/health-products-compliance-guidance. (b, federal agency guidance)

13. Autoriteit Nucleaire Veiligheid en Stralingsbescherming (ANVS). Do you have a "Quantum Pendant" anti-5G pendant or a "negative ion" jewellery item or sleep mask? If so, store it away safely. 16 December 2021. https://english.autoriteitnvs.nl/latest/news/2021/12/16/do-you-have-a-quantum-pendant-anti-5g-pendant-or-a-negative-ion-jewellery-item-or-sleep-mask-if-so-store-it-away-safely. (b, national regulator)

14. U.S. Nuclear Regulatory Commission. Negative ion products containing radioactive material. Fact sheet, October 2024. https://www.nrc.gov/regulations-legislation/fact-sheets-brochures/negative-ion-products-containing-radioactive-material. (b, federal regulator)

15. 47 CFR 2.1093(d)(1). Radiofrequency radiation exposure evaluation: portable devices. (a, regulatory record)

16. Wall S, Wang ZM, Kendig T, Dobraca D, Lipsett M. Real-world cell phone radiofrequency electromagnetic field exposures. Environmental Research. 2019;171:581-592. doi:10.1016/j.envres.2018.09.015. (a; California Department of Public Health authors)

17. Rodriguez I, Nguyen HC, Jørgensen NTK, Sørensen TB, Mogensen P. Radio propagation into modern buildings: attenuation measurements in the range from 800 MHz to 18 GHz. IEEE 80th Vehicular Technology Conference (VTC2014-Fall). 2014:1-5. doi:10.1109/VTCFall.2014.6966147. (a)

18. ANSES. Hypersensibilité électromagnétique ou intolérance environnementale idiopathique attribuée aux champs électromagnétiques. Avis et rapport d'expertise collective, auto-saisine 2011-SA-0150. Avis of 13 March 2018, p. 9; report pp. 266-269. https://www.anses.fr/fr/system/files/AP2011SA0150Ra.pdf. (b, institutional report)

19. Rubin GJ, Das Munshi J, Wessely S. A systematic review of treatments for electromagnetic hypersensitivity. Psychotherapy and Psychosomatics. 2006;75(1):12-18. doi:10.1159/000089222. (a)

20. Federal Trade Commission. FTC charges sellers of cell phone radiation protection patches with making false claims. Press release, 20 February 2002. https://www.ftc.gov/news-events/news/press-releases/2002/02/ftc-charges-sellers-cell-phone-radiation-protection-patches-making-false-claims. (b)

21. Federal Trade Commission. Announced actions for April 4, 2003. Press release, 4 April 2003; default judgment against Stock Value 1, Inc. and Meristar International, Inc., Civ. No. 02-80131-CIV-HURLEY/LYNCH. https://www.ftc.gov/news-events/news/press-releases/2003/04/announced-actions-april-4-2003. (b)

22. Federal Trade Commission. Radiation protection patch marketers cell consumers short. Press release, 6 August 2003; Rhino International and Safety Cell, E.D.N.Y., CV 03-3850 and CV 03-3851. https://www.ftc.gov/news-events/news/press-releases/2003/08/radiation-protection-patch-marketers-cell-consumers-short. (b)

23. Gajda G, Thansandote A, Lemay E, Lecuyer D, Gorman W, McNamee J. Report on evaluation of Stetzer filters. Consumer and Clinical Radiation Protection Bureau, Health Canada. 11 May 2006. Third-party-hosted copy: https://www.electronicsilentspring.com/wp-content/uploads/2015/05/Evaluation-of-Stetzer-Filters.pdf. (b)

24. Hassan HJ, Hashim S, Abu Hanifah NZH, et al. The enhanced naturally occurring radioactivity of negative ion clothing and attendant risk. Applied Sciences. 2021;11(12):5412. doi:10.3390/app11125412. (a)

25. Hassan HJ, Hashim S, Abu Hanifah NZH, et al. Naturally occurring radioactive materials in bracelets and necklaces: radiological risk evaluation. International Journal of Environmental Research and Public Health. 2021;18(21):11170. doi:10.3390/ijerph182111170. (a)

26. Environmental Health Trust v. Federal Communications Commission, 9 F.4th 893 (D.C. Cir. 2021). Nos. 20-1025 and 20-1138, decided 13 August 2021. (a, court record)

27. FCC, Office of Engineering and Technology. FCC seeks comment on RF exposure issues subject to D.C. Circuit remand in Environmental Health Trust v. FCC. Public Notice DA 26-997, ET Docket No. 13-84, released 17 September 2026. Federal Register. 2026;91(182):60128-60131. (a, regulatory record)

28. Moldan D. Reducing radio frequency radiation in the built environment: building and shielding materials. 1st update 2022: shielding paints. VDB EMC Guides, vol. 5. Jesteburg: German Association of Building Biology Professionals VDB e.V.; May 2022. ISBN 978-3-948407-16-2. (b, professional-association report; the author's testing firm co-distributes it)

29. Pušić T, Šaravanja B, Malarić K, Luburić M, Kaurin T. Electromagnetic shielding effectiveness of woven fabric with integrated conductive threads after washing with liquid and powder detergents. Polymers. 2022;14(12):2445. doi:10.3390/polym14122445. (a)

30. Breckenkamp J, Blettner M, Schüz J, et al. Residential characteristics and radiofrequency electromagnetic field exposures from bedroom measurements in Germany. Radiation and Environmental Biophysics. 2012;51(1):85-92. doi:10.1007/s00411-011-0389-2. (a)

31. Tang CK, Chan KH, Fung LC, Leung SW. Effect on radio frequency human exposure of mobile phone inside an enclosed metallic elevator. Microwave and Optical Technology Letters. 2008;50(8):2207-2210. doi:10.1002/mop.23612. (a)

32. Panagopoulos DJ, Chrousos GP. Shielding methods and products against man-made electromagnetic fields: protection versus risk. Science of the Total Environment. 2019;667:255-262. doi:10.1016/j.scitotenv.2019.02.344. (a, narrative review)

33. Power-quality test standards. IEC 61000-4-7:2002+AMD1:2008, harmonics and interharmonics up to 9 kHz. IEC 61000-4-30:2025 (Edition 4.0), power-quality methods, 2-150 kHz emissions in Annexes C and D. CISPR 16-2-1:2014+AMD1:2017, conducted disturbance 9 kHz to 30 MHz. (a, standards)

34. International Organization for Standardization, International Electrotechnical Commission. General requirements for the competence of testing and calibration laboratories. ISO/IEC 17025:2017. (a, standard)

35. Federal Communications Commission, Office of Engineering and Technology. KDB 447498 D01 General RF Exposure Guidance v06, sections 4.2.2 and 6.4. 23 October 2015. https://apps.fcc.gov/oetcf/kdb/forms/FTSSearchResultPage.cfm?id=20676&switch=P. (b)

36. Environmental Working Group. Does your cell phone case raise your radiation exposure? 3 March 2015. https://www.ewg.org/research/does-your-cell-phone-case-raise-your-radiation-exposure. Data from a Pong Research Corp. filing to the FCC, 31 May 2012. (c, advocacy; data from a case manufacturer)

37. Oliver JP, Chou CK, Balzano Q. Testing the effectiveness of small radiation shields for mobile phones. Bioelectromagnetics. 2003;24(1):66-69. doi:10.1002/bem.10076. (a; Motorola authors (stated), not downgraded)

38. de Vocht F, Olsen RG. Systematic review of the exposure assessment and epidemiology of high-frequency voltage transients. Frontiers in Public Health. 2016;4:52. doi:10.3389/fpubh.2016.00052. (a)

39. Task Force of the European Society of Cardiology and the North American Society of Pacing and Electrophysiology. Heart rate variability: standards of measurement, physiological interpretation, and clinical use. Circulation. 1996;93(5):1043-1065. doi:10.1161/01.CIR.93.5.1043. (a)

40. Miraglia FE. Unreliability of the gas discharge visualization (GDV) device and the Bio-Well for biofield science: Kirlian photography revisited and investigated. Parts I and II. Journal of Anomalistics. 2024;24(1):80-119 and 120-150. doi:10.23793/zfa.2024.080; doi:10.23793/zfa.2024.120. (a)

41. U.S. Food and Drug Administration. Reducing radio frequency exposure from cell phones. Content current as of 10 February 2020; page since removed. Archived capture: https://web.archive.org/web/20251214154638/https://www.fda.gov/radiation-emitting-products/cell-phones/reducing-radio-frequency-exposure-cell-phones. (b, federal agency guidance)

42. Federal Trade Commission. Warning letter to BioElectric Shield, Co. 27 April 2020. https://www.ftc.gov/system/files/warning-letters/covid-19-letter_to_dap_bioelectric_shield.pdf. (b)

43. Joshi P, Ghasemifard F, Colombi D, Törnevik C. Actual output power levels of user equipment in 5G commercial networks and implications on realistic RF EMF exposure assessment. IEEE Access. 2020;8:204068-204075. doi:10.1109/ACCESS.2020.3036977. (a; Ericsson authors (stated), not downgraded)

44. Aerts S, Plets D, Thielens A, Martens L, Joseph W. Impact of a small cell on the RF-EMF exposure in a train. International Journal of Environmental Research and Public Health. 2015;12(3):2639-2652. doi:10.3390/ijerph120302639. (a)

45. Adams J, Bitler JS, Riley K. Importance of addressing National Electrical Code violations that result in unusual exposure to 60 Hz magnetic fields. Bioelectromagnetics. 2004;25(2):102-106. doi:10.1002/bem.10155. (a)

46. Brown R. Effects of grounding on body voltage and current in the presence of electromagnetic fields. Journal of Alternative and Complementary Medicine. 2016;22(9):757-759. doi:10.1089/acm.2015.0340. (a)

47. Shenzhen Morlab Communications Technology Co., Ltd. SAR test reports SZ15100123S01 (handset, EN 62209-1:2006 and EN 62209-2:2010) and SZ15100123S02 (802.11b router, EN 62209-2:2010), issued 17 November 2015; antenna performance test report SZ15100123E01, YD/T 1484-2011 and YD/T 1978-2009, issued 20 November 2015. Applicant and manufacturer NOXTAK TECHNOLOGIES VBA. Morlab is an FCC-recognized test firm, listed under 47 CFR 2.948 at the time of the tests and now accredited by A2LA with FCC designation US1192; the reports print no accreditation statement. (a, accredited laboratory report)

48. Verkotan Oy, Oulu, Finland. OTA summation test reports, LG G6 and ZTE AXON, 3GPP 34.114, free space; date of report 17 October 2017; client Noxtak Group. FINAS-accredited laboratory (T287, EN ISO/IEC 17025, printed on each page). (a, accredited laboratory report)

49. Korotkov KG, Gavrilova EA, Churganov OA, Machado JJ. Influence of electromagnetic protection technology on human psychophysiological condition. Journal of Applied Biotechnology and Bioengineering. 2022;9(1):12-16. doi:10.15406/jabb.2022.09.00279. Ethics approval by the Saint-Petersburg Scientific-Research Institute for Physical Culture; co-author J.J. Machado (NOXTAK relationship disclosed in Section 5); the first author's team developed the Bio-Well GDV device. (a)

50. EFEIA Institute. The double-edged sword of EMF shielding: when protection becomes a health risk. efeia.org; 23 May 2025. https://efeia.org/the-double-edged-sword-of-emf-shielding-when-protection-becomes-a-health-risk/. (c, EFEIA's own position statement)

51. EFEIA Institute. BEMCP, Bio-compatible Electromagnetic Compliance Program. Retrieved 1 October 2026. https://efeia.org/bemcp/. (c, interested party)

52. National Institute of Standards and Technology, Communications Technology Laboratory, RF Technology Division. Wireless coexistence impacts and test methods. Web page created 2 June 2016, updated 27 May 2026, marked as no longer updated. https://www.nist.gov/ctl/rf/wireless-coexistence-impacts-and-test-methods. (b, federal agency web page)