IGNIR

International Guidelines on Non-Ionising Radiation

INTERNATIONAL GUIDELINES ON NON-IONISING RADIATION

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IGNIR

INTERNATIONAL GUIDELINES ON NON-IONISING RADIATION

IGNIR is a set of Guidelines for electromagnetic exposure based on EUROPAEM EMF Guidelines 2016.

IGNIR
MISSION STATEMENT

To facilitate healthier environments through compliance with low levels of electrosmog

IGNIR
GUIDELINE AIMS

- ◇ *Comprehensive, for long-term and short-term effects*
- ◇ *Inclusive, for all people including people with EM sensitivity*
- ◇ *International, for all locations and countries*
- ◇ *Practical, for easy use in assessing compliance*
- ◇ *Responsive, incorporating feedback from users*
- ◇ *Rigorous, based on mainstream scientific evidence*

GENERAL PRINCIPLES

IGNIR offers science-based guidelines and assessment advice for the health and environmental effects of man-made non-ionising radiation, including non-thermal or low-level effects. Its aim is to protect people and the environment from detrimental exposure to man-made EMF pollution, and comprises three functions:

- To provide advice about appropriate safety levels for man-made electromagnetic exposure
- To assess published guidelines on man-made electromagnetic exposure and make its own recommendations as to which are appropriate
- Provide practical and reliable assessment guidelines for surveyors and building biologists.

The IGNIR guidelines for electromagnetic exposure are based on the peer-reviewed EUROPAEM EMF Guideline 2016, except for the VLF range.

IGNIR's guidelines are also aimed to help protect sensitive groups such as children, the elderly, fetuses, pregnant women, those with co-morbidity, body metal work and people with Electromagnetic Hypersensitivity (EHS).

IGNIR guidelines are for **long-term exposures** and based on **known biological effects**. They are therefore much more protective than outdated short-term guidelines, such as those issued by the ICNIRP and FCC, which are based only on heating and acute effects. Thermal short-term safety guidelines for high or radio frequency (HF, RF) are averaged over 6 or 30 minutes and based on a temperature rise of one degree; for low or extremely low frequency (LF, ELF), they are based on induced internal electric fields, acute nerve stimulation, perceptible electric charges on the skin surface and the induction of retinal phosphenes. These ICNIRP and FCC HF and LF guidelines are not designed to protect against long-term and non-thermal effects.

Long-term and non-thermal effects are now accepted by the majority of scientists as proven beyond reasonable doubt from the evidence of thousands of scientific studies.

High Frequency (wireless, approximate ranges):

• *Background levels:*	0.00002 V/m	0.000001 µW/m^2
• *Full safety level (Zero Emissions):*	0.00002 V/m	0.000001 µW/m^2
• *Long-term international biological guidelines:*	0.006 – 0.2 V/m	0.1 – 100 µW/m^2
• *Short-term heating guidelines (e.g ICNIRP, FCC):*	61 V/m	40,000,000 µW/m^2

[1 µW/m^2 = 0.0000001 mW/cm^2]

Low Frequency (power lines, approximate ranges):

• *Background levels:*	0.0001 V/m	0.0002 nT
• *Full safety level (Zero Emissions):*	0.0001 V/m	0.0002 nT
• *Long-term international biological guidelines:*	0.3 – 10 V/m	10 – 1,000 nT
• *Short-term acute guidelines (e.g ICNIRP, FCC):*	5,000 – 10,000 V/m	360,000 – 1,000,000 nT

[100 nT = 1 mG]

The IGNIR guidelines have been drawn up by an independent multi-disciplinary team. The steering committee comprises of medical doctors, scientists, EM surveyors and engineers, and representatives of vulnerable groups. See the website *www.ignir.org* for current membership.

GUIDELINES

IGNIR has three levels of guidelines, Day (D), Night (N) and Sensitive (S), covering three frequency ranges.

Electromagnetic (EM) hygiene and safety involves minimising exposure levels to an environmental toxin. This guidance is based mainly on the international EUROPAEM EMF Guidelines 2016. Although at present there are no assured safe levels of man-made EM exposure, and studies continue to show harm to living systems at very small exposure values, this guidance aims to help achieve substantial reduction in EM exposure.

Frequency range	***Metric***	***Type of reading***	***D Day***	***N Night***	***S * Sensitive ****
Radio Frequency *30 MHz – 300 GHz*	V/m	Average †	0.06	0.02	0.006 to <0.001
	$\mu W/m^2$		10	1	0.1
	V/m	Maximum	0.2	0.06	0.02 to <0.002
	$\mu W/m^2$		100	10	1

[1 $\mu W/m^2$ = 0.0000001 mW/cm^2]

Frequency range	***Metric***	***Type of reading***	***D Day***	***N Night***	***S* Sensitive****
VLF *3 kHz – 100 kHz §*	G-S Units §§	Average †	120	70	30

Frequency range	***Metric***	***Type of reading***	***D Day***	***N Night***	***S* Sensitive****
ELF *15 Hz – 3000 Hz*	V/m	Average †	10	3	1
	nT	Average †	300	100	30
	nT	Maximum	1000	300	100

[100 nT = 1 mG]

** Sensitive:* *(a) Sensitive groups include children, the elderly, fetuses, pregnant women, the ill and people with EHS. (b) Electromagnetic hypersensitive (EHS) people can have mild, moderate or severe sensitivity. (c) People with body metal work.*

† Average: *See Appendix 1: B.2(i): an average of 6 readings in 1 minute.*

§ VLF 100-300 kHz is not included at present. *§§ G-S Units = Graham-Stetzer Units. Greenwave Filters recommend <25 mV and state that >50 mV should be reduced. There is no consistent correlation between G-S Units and mV. This depends on the frequencies of Dirty Electricity or High Frequency Voltage Transients measured.*

RF: Radio Frequency: 30 MHz – 300 GHz

includes Wifi, digital radio and TV, DAB+, cordless (DECT) and mobile phones, TETRA, FM radio, microwave ovens. wireless smart appliances, and 5G.

VLF: Very Low Frequency: 3 kHz -100 kHz

includes "dirty power/electricity" on mains power supply cables, powerline communication, compact fluorescent lamps (CFL), induction hobs and VLF radio.

ELF: Extremely Low Frequency: 1 Hz – 3 kHz

includes mains electricity, power cables, and some home power appliances.

(These guidelines are not inclusive of all EMF devices and exposures, such as DC fields, metal detectors, body scanners, MRI scanners, pacemakers, and lasers. As with ionising radiation, for medical investigations the benefits may outweigh possible harm.)

ELECTROSMOG QUIET ZONES (EQZ)
('WHITE' ZONES)

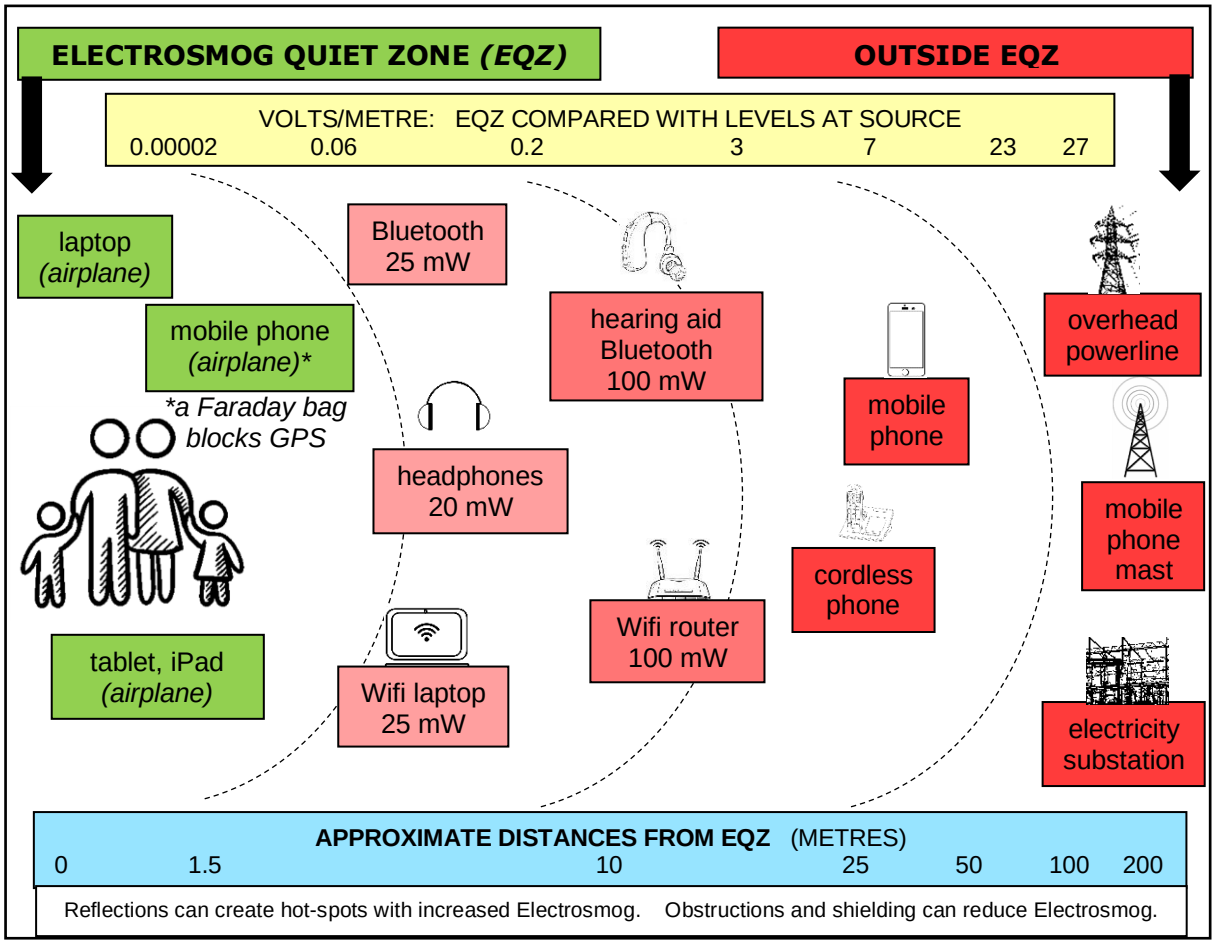
Definition: An Electrosmog Quiet Zone (EQZ) is an area where many people can live or work without conscious ill health or injury, but not everyone sensitised to electrosmog.

EQZ Guidelines: As for IGNIR Night-time (N) levels: 0.06 V/m, 10 μW/m^2, 300 nT. This covers some of the ~1.2% of the population severely affected by electrosmog. Up to 0.65% of the population is extremely sensitive and may need additional protection.

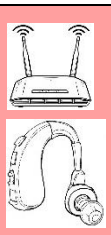
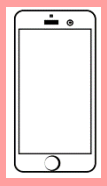
Labels: Electrosmog Quiet Zones (EQZs) for invisible radiation air pollution should be clearly labelled, like Low Emission Zones for invisible particulate air pollution.

Masts and fixed wireless antennas					
Likely to be EQZ compliant			*Unlikely to be EQZ compliant*		
	V/m	*μW/m^2*		*V/m*	*μW/m^2*
mast > 500 m, outdoors	0.06	10	mast < 500 m	0.2-6.6	100–103,000
mast > 200 m, indoors	0.06	10	smart meter (US)	14-22	500,000-1,400,000
satellite wireless	0.007	0.12	Wifi routers, 1m	1.7	8,000
Movable and hand-held devices					
Likely to be EQZ compliant			*Unlikely to be EQZ compliant*		
	V/m	*μW/m^2*		*V/m*	*μW/m^2*
laptop *(airplane)*	0	0	Bluetooth hearing aid	3.01	23,000
mobile phone *(airplane)*	0	0	Wifi, laptop, 50 cm	3.0	22,000
tablet, iPad *(airplane)*	0	0	*Fitbits, wireless trackers*	*cannot be turned off*	

Below:
Examples of likely distances for different devices to comply with an EQZ without the use of shielding.



Approximate distances from EQZ, depending on transmitter power, traffic and location.
Portable devices: the more powerful the transmitter, the further away from the EQZ the device needs to be.
Phone masts: the distance from the EQZ depends on the number of transmitters and the amount of traffic.

									
V/m	*Back-ground level, *airplane mode*	IGNIR **EQZ**	mast: ~150m, or less traffic	Wifi laptop 25 mW	WiFi router 100mW Bluetooth hear. aid	mast, ≤100m, or more traffic	DECT cordless phone 1.8 GHz	smart meter *(2.4 V/m at 0.5m)*	mobile phone
.87-27									
0.87-23									
12.33									
2.0-6.23									
2.0-7.0									
3.0									
0.275									
0.06									
0.00002									
µW/m^2	0.000001	10	200	23,000	10,000-130,000	10,000-103,000	403,000	2,000-1,400,000	2,000-1,800,000
Distance	**-**	**-**	**>180m**	**1.5m**	**10-100m**	**>100-500m**	**5-20m**	**3-40m**	**3-40m**

**Natural EM radiation does not have the harmful polarisation and pulses of most man-made Electrosmog.*

APPENDIX 1 - TESTING FOR COMPLIANCE

GENERAL PRINCIPLES FOR MEASUREMENTS

A. The Utilisation and Exclusion Zones

First: Partition the building or area into UZ and EZ.
Measurements for compliance with IGNIR apply to UZ only.

A.1 Utilisation Zone (UZ)

Measurements are taken in Utilisation Zones, areas where people typically move, work and rest. They are locations where people could remain over 4 hours in total per day.

Typical UZs: workstations, classroom desks, home settees, kitchen chairs or work surfaces, seating in transport (car, coach, train), cinema or theatre seats, library chairs, hospital wards and health centres, hairdressers and beauty salons, gyms, supermarkets, shopping centres, etc.

(i) Measure over 150 mm (6 inches) from the walls of a room.
(ii) Measure from 2 metres (6 feet 6 inches) high to down to the floor level.

A.2 Exclusion Zone (EZ)

Exclusion Zones, which do not require measurement, include inaccessible areas of rooms or at heights above head height (standardised at 2 metres, or 6 feet 6 inches).

Exclusion zones can include limited areas around hotspots such as pendant lamps, cable runs or steel beams, so long as there is no seating close by.

(i) EZs include under 150 mm (6 inches) from the walls.
(ii) EZs include above 2 metres (6 feet 6 inches) in height.
(iii) Additional EZs should be specified on the IGNIR Compliance Form.

B. Measurements

B.1 Metrics

For a room to be certified as meeting the D, N or S guidelines, it must meet all relevant metrics (V/m, $\mu W/m^2$ and nT) for all 8 values, according to whether it is for Day or Night or Sensitive use.

B.2 Measurement Techniques

Measuring electromagnetic energy is a skill acquired through practice and careful observation. The whole property needs to be considered.

(i) **Average readings:** an average from 6 readings within 1 minute.
(ii) Usually a meter kept **stationary for up to a minute** will indicate whether the reading is steady or varying significantly.
(iii) Where the **reading varies, a longer period is required** and often readings at further locations.
(iv) Readings should record **date and time**. Readings vary according to the time.
(v) Surveying for microwave radiation should be performed with the **minimum practical number of people present**. The number of

people within the space is to be recorded. This applies especially in classrooms and offices.

(vi) The meter should be held **0.5 metres from the body** of the surveyor.

(vii) **All others present** in the room should be **at least 2 metres away**.

(viii) Readings can depend on **hidden features**, such as power distribution boxes or smart meters on the other side of a wall, or lighting units in a room below, or the location of electric storage heaters, or Wifi from a neighbour.

(ix) There should be a check for **hotspots**. These can be caused by reflection from metal radiators, filing cabinets and similar fixtures. Measurers should **walk around the whole area.**

(x) Measurers should note if there is an **obstruction** in the line of sight between a radiation source and the meter.

(xi) In apartments, flats or terrace houses with party walls, radiation and fields from nearby **devices on the other side of the wall** or **from flats below or above** should be included.

(xii) **Nearby phone masts, powerlines**, including some buried cables, and **substations** can produce significant fields and these should be included as measured within the room.

(xiii) Wireless **smart meter** radiation is included, along with any **neighbour's home Internet of Things** with wireless communication using wireless smart appliances.

(xiv) **Incidental or occasional radiation** from aircraft ground-seeking radar, passing buses with Wifi or car online phone-based satnavs need not be included unless frequent enough to cause problems for a sensitive person and the meter is able to measure these high frequency exposures.

(xv) **Special situations:** e.g. some radars operate on an 8-minute cycle

(xvi) **Transport: cars:** cruise control radar (often from the bumper or driver's mirror), magnetic fields from pumps and wheels (often near the feet), telematics ('black') boxes;
buses, trains and aircraft: Wifi, mobiles, magnetic fields.

(xvii) **Public places:** airports, hotels, shops, theatres etc.: Wifi of mobile phones and wireless devices, magnetic fields.

B.3 Day Time (D)

(a) Applicability:

(i) Everyone (except Sensitive people who have their own S guideline values) in places where they typically can spend four hours or more as residents, workers or visitors (night and sleeping areas have separate guidelines).

(b) Measurement techniques:

(i) Day-time places should include chairs, desks and tables where

people spend time, such as in kitchens, sitting rooms, work places, classrooms, lecture halls, etc.

(ii) Usually four spot measurements per chair/workplace are sufficient (at the head, abdomen, hands and feet).

B.4 Night Time (N)

(a) Applicability:

(i) Everyone (except Sensitive people who have their own S guideline values) in places where they sleep.

(b) Measurement techniques:

(i) The only location necessary to measure is at the top surface of the mattress.

(ii) Measurement points should be 150mm (6 inches) from the edge on each side and in the centre, at each end of the bed and across the middle, giving a matrix of nine locations. Single beds may have a matrix of six points instead of nine.

(iii) Meters for ELF Electric Fields should be held by a person lying on the bed, and not earthed.

B.5 Sensitives (S)

(a) Applicability:

(i) Sensitive groups, including children, fetuses, the elderly, pregnant women, the ill and people with EHS.
People with body metal work need appropriate protection, as may people with active implants like pacemakers.

(ii) People with Electromagnetic hypersensitivity (EHS) can have mild, moderate or severe sensitivity.
Those with moderate or severe sensitivity will probably need lower exposures than other sensitive groups.
Individual sensitive people need to have a level below which they have no symptoms.

(b) Measurement techniques:

(i) As above in B.3 and B.4, for measurements including both D and N locations, but they are referenced to S guideline values.

(c) Cumulative exposures:

(i) For each individual person, exposure to electromagnetic (EM) energy is cumulative, so it is important for that person to know how much EM energy is present over a few hours in one location (UZ), since combined with other locations this could result in that person exceeding the guidelines.

(ii) UZs are unlikely to include rooms or areas which are used rarely or only for a short time, except for a few people with severe Electromagnetic hypersensitivity.

APPENDIX 2 - FURTHER DETAILS

A. GUIDELINES: (i) BIOLOGICAL OR (ii) THERMAL

There are two types of Guidelines for man-made electromagnetic energy:

- Biological and/or non-thermal, for long-term and short-term effects, e.g. IGNIR
- Thermal, for short-term (6 minutes) heating effects, e.g. ICNIRP

(i) Biological and/or non-thermal guidelines, both long-term and short-term effects

- IGNIR (International Guidelines on Non-Ionising Radiation)
- EUROPAEM EMF Guideline 2016 (European Academy for Environmental Medicine)
  - EUROPAEM EMF Guideline 2016
  - Article (pdf)
  - Supplementary material
- Building Biology: Guidelines for Sleeping Areas (2015); Instructions (2015)
- Bioinitiative Report (2012)
- Barnes F et al.: "Setting Guidelines for Electromagnetic Exposures and Research Needs" (*Bioelectromagnetics,* 2020): suggests a 'practical' level of 0.1 V/m.

Non-thermal guidelines can now be based on biological effects such as DNA damage, cell hydration, miRNA effects, oogenesis, VGCC effects and nitric oxide.

(ii) Thermal guidelines: only short-term (6/30 minutes) heating effects

- FCC: RF Safety (2019)
- ICNIRP (2020) (International Commission on Non-Ionizing Radiation Protection)

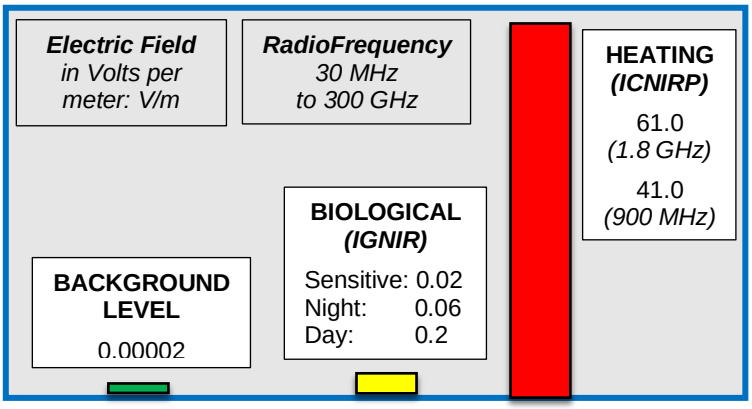
"The guidelines of ICNIRP are irrelevant to the present situation when the majority of the population over the world is chronically exposed to non-thermal RF from mobile communication."
(The Russian National Committee on Non-Ionizing Radiation Protection, 2017)

The chair of ICNIRP has accepted that people can chose whether to adopt biological (non-thermal) or thermal guidelines. The ICNIRP in 2002 stated that sensitive people need biological guidelines and not the ICNIRP thermal ones. Since the 1950s many countries, such as Russia, have adopted non-thermal guidelines. ('Non-thermal' is where a temperature rise cannot be measured easily.) Any biological action is a health effect. Some governments, including the UK and USA, still follow thermal guidelines based on Schwan's hypothesis of 1953 that the only adverse EM effect is heating the body one degree within six minutes. People can raise body temperature this amount by exercise, but without the risk of cancers, neurological and cardiovascular harm and fertility effects.

A chart to represent the differences between:
- Background environmental level;
- Biological Guidelines *(IGNIR)* maximum long-term;
- Heating Guidelines *(ICNIRP,FCC)* maximum short-term (6/30 min.)

RF Power Density in microWatts per meter squared: μW/m²

Background:	*0.000001*
Biological:	*1-100*
Heating:	*40,000,000*



Time-varying or information-carrying signals are more biologically active than continuous waves. For RF Power Density, background environmental levels are roughly a million times lower than Biological Guidelines, which are roughly a million times lower than Heating Guidelines.

B. DEFINITION OF 'SENSITIVE'

IGNIR: *(a) Sensitive groups include children, fetuses, the elderly, pregnant women, the ill and people with EHS.*
(b) Electromagnetic hypersensitive (EHS) people can have mild, moderate or severe sensitivity.
(c) People with body metal work. (2018)

EUROPAEM: *EHS, immune compromised, fetus, developing children, elderly and people on medications.* (2016, EMF Guideline)

Bioinitiative: *Sensitive populations include the developing fetus, the infant, children, the elderly, those with pre-existing chronic diseases, and those with developed electrical sensitivity (EHS).* (2012, Report)

Seletun: *Sensitive populations (for example, the elderly, the ill, the genetically and/or immunologically challenged) and children and fetuses.* (2010, pdf)

ICNIRP: *Different groups in a population may have differences in their ability to tolerate a particular NIR exposure. For example, children, the elderly, and some chronically ill people might have a lower tolerance for one or more forms of NIR exposure than the rest of the population. Under such circumstances, it may be useful or necessary to develop separate guideline levels* [from the ICNIRP short-term heating levels] *for different groups within the general population, but it may be more effective to adjust the* [ICNIRP short-term heating] *guidelines for the general population to include such groups. Some guidelines* [e.g. ICNIRP short-term heating] *may still not provide adequate protection for certain sensitive individuals.* (2002, General Approach to PNIR)
It should be noted, however, that the [ICNIRP short-term heating] *exposure guidelines are not meant to be protective for people with certain clinically substantiated diseases or conditions that may make them more susceptible to harm from non-ionizing radiation.* (2020, Principles NIRP)

EPA on FCC: *The FCC's current exposure guidelines, as well as those of the IEEE and the ICNIRP, are thermally based, and do not apply to chronic, nonthermal exposure situations…. The FCC's exposure guideline is considered protective of effects arising from a thermal mechanism but not from all possible mechanisms. … Federal health and safety agencies have not yet developed policies concerning possible risk from long-term, nonthermal exposures. When developing exposure standards for other physical agents such as toxic substances, health risk uncertainties, with emphasis given to sensitive populations, are often considered. Incorporating information on exposure scenarios involving repeated short duration/nonthermal exposures that may continue over very long periods of time (years), with an exposed population that includes children, the elderly, and people with various debilitating physical and medical conditions, could be beneficial in delineating appropriate protective exposure guidelines.*
(N Hankin, EPA, to J Newton, July 16 2002, letter)

C. TYPES OF EXPOSURE AND FREQUENCIES

Average and maximum:

- Average measurements (6 readings in one minute) give an indication of the general hygienic level of a location.
- Maximum is important because of the damage caused by a short blast of high intensity radiation. This intensity is masked when averaged over the 6 or 30 minutes used by the ICNIRP and FCC.

RF: Radio Frequency: 30 MHz – 300 GHz

The IGNIR Guidelines have a single set of average and maximum values for radio frequency. Particularly significant are the pulse characteristics, modulation and amplitude. The EUROPAEM EMF Guidelines 2016 divide Radio Frequency into four groups based on the different characteristics. The IGNIR Guidelines, based on Groups A and B for average and maximum readings, include the wireless exposures most commonly causing health problems, such as Wifi, mobile phones, and 5G.

Group A:	Wifi (2.4/5.6 GHz, 10 Hz pulsing) DAB+ (10.4 Hz pulsing) GRPS (2.5 GHz) with PTCCH (8.33 Hz pulsing)
Group B:	LTE (4G) (800, 900, 1800, 2500-2700 MHz), UMTS (3G) (2100 MHz) DECT cordless phone (1900) GSM (2G) (900 and 1800 MHz)
Group C:	DVBT (Digital Video Broadcasting: Terrestrial) TV TETRA (400 MHz)
Group D:	radio broadcast (FM)

VLF: Very Low Frequency: 3 kHz -30 MHz

For example: "dirty power/electricity", powerline communication (PLC), radio-frequency identification transmitters (RFID), compact fluorescent lamps (CFL).

ELF: Extremely Low Frequency: 1 Hz – 2 kHz

For example: mains electricity 50/60 Hz, 17 Hz railways and 400 Hz airplanes.
For V/m: without ground reference (potential free).

D. BIOLOGICAL EFFECTS

- *Biological effects include both long-term or chronic effects, and also short-term or acute effects.*
- *Biological effects cause subconscious, and sometimes conscious, health effects.*
- *Biological effects can lead to one or more of a variety of common symptoms and symptom complexes, depending on the biological homeostasis and genetic profile of the individual concerned.*

Common symptoms:

Common symptoms from exposure to low-level anthropogenic EM energy, including some occasionally caused by geomagnetic disturbances, include:

- Anxiety
- Blood pressure effects
- Concentration problems
- Depression
- Dizziness
- Earaches
- Fatigue
- Headaches
- Lethargy
- Memory loss
- Muscle pains
- Neurological changes
- Skin lesions
- Skin tingling
- Sleep disruption
- Tinnitus

Symptom complexes:

Illnesses linked to continued exposure to low-level anthropogenic EM energy include:

- Cancers
- Cardiovascular effects
- Electromagnetic hypersensitivity
- Infertility and miscarriages
- Neurological conditions
- Suicide

E. FURTHER INFORMATION ON BIOLOGICAL EFFECTS

The following lists feature just a few of the many mainstream organisations and websites across the world concerned with low-level EM biological effects and their consequences. There are thousands of peer-reviewed studies relevant to this topic.

(i) A few organisations and websites:

Americans Resp.Tech	Elettro Sensibili	Internat. EMF Sci.App.	Robin des Toits
Associazione AMICA	Elöverkänsligas Riksförbund	Kompetenzinitiative	Sähköherkät ry
Austrian Medical Assoc.	EMFSA	Microwave News	Stop UMTS
AVAATE	EM RRT	Norad4U	Swedish Rad.Prot.Foun
Bioinitiative Report	EMR Safety	ORSAA	Take Back Your Power
C4ST	EM Sense Ireland	Pandora	Teslabel
Diagnose-funk	EUROPAEM	PHIRE	The Baby Safe Project
Dr Magda Havas Phd	Health-Safe Telecom.	Phone Gate Alert	The 5G Appeal
EHT	IEMFA	Physic. for Safe Techn.	The EMF Call
Electromagnetic Health	Internat.Appeal Stop 5G on Earth & Space	Powerwatch	Towards Better Health
Electrosensitive Society		Priartem	We Are The Evidence
Electrosensitivity UK		Radiation Dangers	Wiser Wireless Wales

(ii) A few studies:

- Barnes F et al.: "Setting Guidelines for Electromagnetic Exposures and Research Needs" (*Bioelectromagnetics,* 2020)
- Belpomme D et al.: "Thermal and non-thermal health effects of low intensity non-ionizing radiation: An international perspective" (*Environ Pollut.*, 2018)
- Belyaev I et al.: "EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses" (*Rev Environ Health*, 2016)
- BioInitiative Report: "A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Fields (ELF and RF)" (2012)
- Fragopoulou A et al.: "Scientific panel on electromagnetic field health risks: consensus points, recommendations, and rationales" (*Rev Environ Health.* 2010)
- Havas M: "Electrohypersensitivity (EHS) is an Environmentally-Induced Disability that Requires Immediated Attention" (*J Sci Discov.,* 2019)
- Kaszuba-Zwolińska J et al.: "Electromagnetic field induced biological effects in humans" (*Przegl Lek.*, 2015)
- Pall ML: "How to Approach the Challenge of Minimizing Non-Thermal Health Effects of Microwave Radiation from Electrical Devices" (*Int J Innovat Res Engin Management (IJIREM)*, 2015)

(iii) Databases:

- EMF-Portal, www.emf-portal.org
  The Research Center for Bioelectromagnetic Interaction (femu), part of the Institute of Occupational Medicine, RWTH Aachen University, Germany.
- National Center for Biotechnology Information, National Library of Medicine (U.S.)
  https://pubmed.ncbi.nlm.nih.gov/
- ORSAA (The Oceania Radiofrequency Scientific Advisory Association Inc.) www.orsaa.org/
  A not-for-profit organisation of scientists and professionals.

(iv) Lists, reviews etc.:

- Bioinitiative Report 2012, https://bioinitiative.org/
- Electromagnetic Radiation Safety, www.saferemr.com/2016/06/index.html
- Electrosensitivity UK: "Selected Studies on Electrosensitivity (ES) and Electromagnetic Hypersensitivity (EHS)"
- Environmental Health Trust: science: https://ehtrust.org/science/

SUPPLEMENT 1

REASONABLE ADJUSTMENTS

AND

REMEDIATION

to help make a location comply with IGNIR guidelines

REASONABLE ADJUSTMENTS

Hard-wired internet access, in place of wireless radiation

An obvious 'reasonable adjustment' is the use of hard-wired internet access and the removal of wireless radiation. This solution is already used exclusively in high tech institutions such as the military.

Hard-wired internet access:
(a) allows access to those disabled by EHS,
(b) proactively and responsibly protects the health of especially vulnerable sub-populations, such as children,
(c) proactively and responsibly protects the health of everyone,
(d) prepares for when Wifi and mobile phone radiation is reclassified as certain cancer agent.
NOTES:

(a) The presence of a child known to have EHS or another condition linked with EMF exposure requires immediate conversion to such hardwired alternatives in order not to further damage health and accommodate the child in keeping with the Equalities Act 2010.
(b) This adjustment has already been made in a number of schools in the UK and abroad so the 'reasonable' nature of the accommodation is well proven. Indeed the largescale ban on Wifi in some schools, such as in France, shows that this step can be considered 'reasonable' on a broad scale.
(c) The result of failing to make the reasonable adjustments may lead to a widespread negative health impact where significantly damaging outcomes may justify considerable changes and expenditure.
(d) Such adjustments may also be considered damage-limiting or 'future-proofing' in light of the expectations by many scientific experts that RF will be reclassified as a minimum of a Group 2A probable, and likely a Group 1 known, human carcinogen by IARC in 2022-24.

REMEDIATION

Remediation covers two aspects, (a) location (the room etc) and (b) personal (your own devices and protection). Although the IGNIR guidelines relate to locations, compliance there can be compromised by the use or presence of personal devices like mobile phones.

(a) Location

(i) Daytime (and night)

A room at home, classroom, lecture hall, hospital ward, shop, theatre etc can all be made more likely to comply with the IGNIR guidelines for Day (D), by the following.

- Wifi:
  - Remove Wifi and use ethernet cables for each computer or laptop.
  - Ensure Wifi is fully disabled on each device.
  - Use a wired USB adaptor for a notebook without an ethernet port.
  - If ethernet cables are not available, you can access the internet with wired powerline adapters. Although these are preferable to Wifi, they send radio frequencies over power cables and should be switched off at night.
- Appliances with wireless:
  - Switch off home networks for appliances (Internet of Things) and smart meter transmitters for home appliance.
  - Check that any transmitter on appliances can be switched off before buying the appliance, or ask the supplier to disable the transmitter.
  - Replace any wireless keyboard, mouse, game console etc with wired versions. Infrared controls do not cause most wireless health effects.
- Cordless phones:
  - Replace cordless phones with wired telephones.
  - For conference calls, wired hands free receivers are useful.
- Wireless baby alarms:
  - Use wired baby alarms, or keep the cot in the parent's room.
  - Do not use wireless baby alarms or wireless video monitors.
- Burglar, movement and smoke detectors and alarms:
  - Replace active wireless systems with passive wired units
- Smart meters:
  - Refuse a wireless smart meter.
  - Apply shielding if a neighbour's smart meter is close to your property
- CFLs (compact fluorescent lights):
  - Replace with incandescent bulbs where possible, or with halogens if incandescent bulbs are unavailable.
  - Remove all CFLs (compact fluorescent lights).
- Electric battery chargers:
  - Keep switched off when not in use.
  - Avoid wireless electric chargers.
- Mobile phones, iPads, etc:
  - All mobile phones and wireless devices should be switched to airplane mode.
  - Alternatively, all mobile phones should be stored in a Faraday box.

- It is advisable to check that mobile phones are not emitting radiation. Some switch back onto wireless the following morning or act as relay stations.

(ii) Night

The IGNIR guidelines for Night (N), are focused on the sleeping area in the bedroom. The general remediation advice given for (i) Day should also be applied in the bedroom.

- Beds:
  - Use wooden frames.
  - Use mattresses without metal springs.
- Bedrooms, alarm clocks:
  - Use a battery alarm clock, not a plugged in alarm unless it is kept well away from the bed.
- Bedrooms, mobile phones:
  - Do not leave mobile phones switched on in a bedroom; keep them in flight mode.
  - Do not place mobile phones under the pillow.
  - Do not charge mobile phones in a bedroom.
- Bedrooms, other electrical equipment:
  - Keep as much switched off as possible.
  - Fitting a demand switch for the bedroom is good practice and may be necessary to achieve low fields in the bed space.
  - Switching off the lighting circuit for the floor below may also be necessary.
  - Switching off the ring main to the bedroom and other circuits may help hypersensitive persons. Keep a torch near the bed if the breaker is off.

(iii) Shielding:

For both Day (D) and Night (N) locations, some people use shielding, in addition to the general remediation advice given for (i) Day (D) and (ii) Night (N).

For wireless from masts or neighbours' Wifi some shielding systems may help but:

- it can be difficult to make effective;
- it can make the situation worse by reflecting radiation;
- shielding paint can be difficult to remove.

Shielding usually needs earthing, but check your home wiring Earth to see if it carries stray currents, or use a separate earth.

Common shielding solutions include:

- metallic fabrics or netting;
- carbon-based paints;
- window screening.

It is very difficult and expensive, or impossible, to shield effectively against power frequencies, such as being near to substations, overhead power cables, main power cables in blocks of flats, etc.

- To reduce 'dirty electricity' some people use filters on the wiring circuit.
- Shielded cabling is advisable for a new building or renovations.

(b) Personal

Even if a location is compliant with the IGNIR guidelines, it is also essential not to compromise that compliance by introducing wireless devices into the location.

- Always keep your mobile phone as far from your body as you can if it is not on flight mode.
- Do not carry an active mobile phone in your pocket, bra or on your person
- Keep your mobile phone in airplane mode as much as you can, but note that some smart phones revert to active mode each night.
- Although texting rather than speaking reduces exposure to your head, is not advised since it exposes other parts of your body to high levels of radiation.
- If you have to speak, use an airtube headpiece or loudspeaker mode, and keep the phone as far away as you can, ideally at least 1 metre (3 feet) from you or anyone else. This distance is still far too close for hypersensitive people who may be consciously affected at up to 15 metres or 45 feet depending on conditions.
- Avoid wireless fitbits, wireless watches, glasses with transmitters, and any other wireless device next to or near your body.
- Keep away from wired electric battery chargers.
- Keep away from wireless electric chargers.
- Some appliances with high fields in their immediate vicinity:
    - mobile phones
    - iPads and notebooks
    - cordless phones
    - Wifi laptops
    - Wifi routers
    - Bluetooth devices
    - smart meters
    - solar panel inverters
    - electrical fuse boxes and meters
    - electric storage heaters
    - electric chargers
    - mains adaptors
    - electric blankets: do not have them switched on when in bed
    - hair dryers
    - microwave ovens
    - induction hobs
    - electric shavers
    - electric fans
    - some LED lights
    - dimmer switches
    - electric cars
    - radial tyres reinforced with steel wires
    - cars with inbuilt Bluetooth or Wifi
    - appliances with inbuilt Wifi such as some printers, TVs, fridges, boilers
    - wireless radio hearing aids
    - wireless radio controls for games, toys, drones etc.
    - radar trackers to measure ball speeds in games practice
    - virtual helpers (e.g. Alexa, Echo, Home).

- Protection:
    - Some EHS people wear protective clothing, but unless this entirely inclusive of the whole body, it does not provide full protection.
    - Wireless devices can be kept in 'Faraday' bags. However, since this simply impairs their function, it is better to switch them to airplane mode and off.

- Avoidance:
    - Maximise your distance from wireless and electrical appliances.
    - Mobile phones have their heating absorption (SAR) inside the small print of the manual. Often these state that a phone should be kept about 2 cm (¾ inch) away from all parts of the body. This means that the mobile cannot be held in the hand. This distance prevents heating but not the other established harm from wireless radiation at below heating levels.
    - Keep at least 2 metres (6 feet 6 inches) from your microwave oven if possible. Household microwave ovens are allowed to leak up to 50,000,000 $\mu W/m^2$ (microWatts per metre squared) at 5 cm (2 inches) (or 100,000 $\mu W/m^2$ in Russia). At 1 metre (3 feet) they typically give out 36,400 $\mu W/m^2$. Although these 2.4 GHz microwaves are not pulsed like Wifi, Bluetooth or cordles phones, they can still be harmful, especially for sensitive persons. Older ovens can leak more than new ovens. They also emit low frequency fields.
    - Keep as far a possible from electric induction hobs. These use 20-100 kHz. Some have exceeded heating limits at 0.3 metre (1 foot). Sensitive people, especially pregnant women and children, should try to keep out of the kitchen while an induction hob is in use. It is best to replace this type of cooker with another.

Additional information

Some governments specifically list ES/EHS as a disability and provide recommendations on suitable remediation.

Since 2012 tribunals and courts in Europe and Australia have awarded compensation where an employer has failed to provide a workplace with levels of EMF safe for people with ES or EHS, or required the removal of Wifi for sensitive pupils in schools.

Many EMF surveyors, including those qualified under the Building Biology Institute, have a wealth of experience in measuring EMF exposures and remediation.

- Adjustments for EHS: "USA Job Accommodation Network" (JAN, 2015)
- Clegg FM et al.: "Building science and radiofrequency radiation: What makes smart and healthy buildings" (Building & Environment, 2019)
- Healthy Home Standard (Draft 2012 v1.1) International Institute for Building-Biology® & Ecology, Inc. (IBE)
- Johansson O: "Electrohypersensitivity: a functional impairment due to an inaccessible environment" (*Rev Environ Health*, 2015)
- Michael Kagelidis: "How to shield your house from electromagnetic radiation" (Home Biology)
- Schirmung elektromagnetischer Wellen im persönlichen Umfeld [Shielding electromagnetic waves in the personal environment] (2008)
- Sears ME: "The Medical Perspective on Environmental Sensitivities" (Canadian Human Rights Commission, 2007)
- Vizi GN et al.: "Building materials and electromagnetic radiation: The role of material and shape" (J Build Eng., 2016)

SUPPLEMENT 2

EXAMPLES OF METERS

1. This Supplement aims to give an indication of the wide range of meters available.[1]
2. This list is not prescriptive and does not recommend or apply approval of any meter.
3. Meters can measure electric fields, magnetic fields and power flux density.
4. A digital display is very helpful.
5. If the meter has only lights, the table below helps correlation with the Guidelines.
6. Meters sufficient for IGNIR compliance typically cost 100-400 USD or 100-300 GBP.
7. Industrial, laboratory and specialist meters and spectrum analyzers cost more, from 1,500 USD upwards, and usually require greater expertise in operation.

Some manufacturers and suppliers of RF and ELF meters:

Aaronia
Cornet Microsystem
EMFields Solutions
Gigahertz Solutions
Greenwave
RS Components
Stetzer Electric

Approximate colour light correlations between some meters and IGNIR Guidelines

Radio Frequency:
electric field (V/m) and power density (μW/m²)

Example Meter	***Colour of lights***	***Reading***		***Nearest IGNIR Guideline***		
		V/m	μW/m²		V/m	μW/m²
Acousticom 2 (lights, sounds)	Green	0.01 V/m	0.3 μW/m²	Night - Average. Sensitive -Maximum	0.02 V/m	1 μW/m²
	Yellow	0.05 V/m	7 μW/m²	Day-Av; Night - Max	0.06 V/m	10 μW/m²
				Day - Maximum	0.2 V/m	100 μW/m²
	Amber	0.3 V/m	240 μW/m²			
	Red	3.0 V/m	24,000 μW/m²			
Acoustimeter AM-10 (lights, digital readout, sounds)	Green	0.02 V/m	1 μW/m²	Night - Average. Sensitive -Maximum	0.02 V/m	1 μW/m²
	Yellow	0.07 V/m	14 μW/m²	Day - Average. Night - Maximum	0.06 V/m	10 μW/m²
	Red	0.5 V/m	700 μW/m²			
Cornet ED78S (lights, digital readout)	Green	0.014 V/m	0.5 μW/m²	Night - Average. Sensitive -Maximum	0.02 V/m	1 μW/m²
	Yellow	0.21 V/m	105 μW/m²	Day - Maximum	0.2 V/m	100 μW/m²
	Red	1.2 V/m	3,800 μW/m²			

Links to manuals for meters listed above		
Acousticom 2	Acoustimeter AM-10	Cornet ED78S

[1] *Record of Conflict of Interest:* One member of the original IGNIR committee, Alasdair Phillips, has a commercial interest in the production of meters.

IGNIR COMPLIANCE FORM *[DRAFT]*

Supplement 3

Address:	Room:	Name of surveyor:	Signature:	Sheet no.:
RF Meter Make:	ELF Meter Make:	Comments:		

			DAY				***NIGHT***				***SENSITIVE***				***IGNIR COMPLIANCE*** ***Day / Night / Sensitive***			
			IGNIR	**Reading**	**Date**	**Time**	**IGNIR**	**Reading**	**Date**	**Time**	**IGNIR**	**Reading**	**Date**	**Time**				
RF	*V/m*	Av.	0.06				0.02				≤0.006				**D/N/S**	Av.	*V/m*	**RF**
		Max	**0.2**				**0.06**				**≤ 0.02**				**D/N/S**	**Max**		
	µW/m²	Av.	10				1				0.1				**D/N/S**	Av.	*µW/m²*	
		Max	**100**				**10**				**1**				**D/N/S**	**Max**		
VLF	*G-S Units*	**Max**	**120**				**70**				**30**				**D/N/S**	**Max**	*G-S Units*	**VLF**
ELF	*V/m*	Av.	10				3				1				**D/N/S**	Av.	*V/m*	**ELF**
	nT	Av.	300				100				30				**D/N/S**	Av.	*nT*	
		Max	**1000**				**300**				**100**				**D/N/S**	**Max**		

Notes:

[Please send any suggestions for improvement to IGNIR.]