The Building Biology Survey according to the

STANDARD OF BUILDING BIOLOGY TESTING METHODS

SBM-2008

The Standard gives an overview of the physical, chemical and biological risks encountered in sleeping areas, living spaces, workplaces and properties. It offers guidelines on how to perform specific measurements and assess possible health risks. All testing results, testing instruments and procedures are documented in a final written report. In case potential problems are identified, an effective remediation strategy is developed.

The individual subcategories of the Standard describe critical indoor environmental influences. With its professional approach, it helps identify, minimize and avoid such factors within an individual's framework of achievability. It is the Standard's goal to create indoor living environments that are as exposure-free and natural as practicable, this holistic approach is accomplished by taking all subcategories into account and implementing all available diagnostic possibilities. Testing, assessment and remediation strategies focus mainly on the building biology experience, precaution and achievability. Any risk reduction is worth striving for.

Between 1987 and 1992, *BAUBIOLOGIE MAES* developed the *Standard of Building Biology Testing Methods*, the accompanying *Building Biology Evaluation Guidelines for Sleeping Areas* and additional testing details on behalf and with the support of the *Institut für Baubiologie und Ökologie Neubeuern IBN*. Scientists, medical doctors and colleagues also offered their support. The *Standard* was issued for the first time in May 1992. The most current *Standard* SBM-2008 is the seventh edition and was published at the beginning of 2008. Since 1999 a 10-member expert commission assists in maintaining and updating the *Standard,* including the *Guidelines* and specific testing protocols. The current members of the commission are as follows: Dr. Dipl. Chem. Thomas Haumann, Dipl.Ing. Norbert Honisch, Wolfgang Maes, Dipl.Ing. Helmut Merkel, Dr. Dipl. Biol. Manfred Mierau, Uwe Münzenberg, Rupert Schneider, Peter Sierck, Dipl. Chem. Jörg Thumulla, Dr. Ing. Martin H. Virnich.

A FIELDS, WAVES, RADIATION

1 AC ELECTRIC FIELDS (Low Frequency, ELF/VLF)

Sources: AC voltage in electrical installations, cables, appliances, outlets, walls, floors, beds, high-tension and other power lines...

Measurement of low frequency electric **field strength** (V/m) and human **body voltage** (mV) as well as identification of dominant **frequency** (Hz) and prominent **harmonics**

2 AC MAGNETIC FIELDS (Low Frequency, ELF/VLF)

Sources: AC current in electrical installations, cables, appliances, transformers, motors, overhead and ground cables, power lines, railways...

Measurement and data logging of low frequency magnetic **flux density** (nT) from power grid or railway system as well as identification of dominant **frequency** (Hz) and prominent **harmonics**

3 RADIOFREQUENCY RADIATION (High Frequency, Electromagnetic Waves)

Sources: cell phone technology, RF transmitters, broadcast, trunked radio systems, line-of-sight systems, radar, military, cordless phones...

Measurement of high frequency electromagnetic **power density** (µW/m²) as well as identification of dominant RF **sources** and low frequency **signals** (pulse, periodicity, modulation…)

4 DC ELECTRIC FIELDS (Electrostatics)

Sources: synthetic carpeting, drapes and textiles, vinyl wallpaper, varnishes, laminates, stuffed toy animals, TV or computer screens...

Measurement of electrostatic **surface potential** (V) as well as **discharge time** (s)

5 DC MAGNETIC FIELDS (Magnetostatics)

Sources: steel components in beds, mattresses, furniture, appliances, building materials; DC current in street cars, photovoltaic systems...

Measurement of **geomagnetic field distortion** as **spatial deviation** of magnetic flux density (µT, metal/ steel) or **temporal fluctuation** of magnetic flux density (µT, current) as well as **compass deviation** (°)

6 **RADIOACTIVITY** (Gamma Radiation, Radon)

Sources: building materials, stones, tiles, slags, waste products, devices, antiques, ventilation, terrestrial radiation, location, environment…

Measurement of **equivalent dose rate** (nSv/h, %) as well as **radon concentration** (Bq/m_3)

7 **GEOLOGICAL DISTURBANCES** (Geomagnetic Field, Terrestrial Radiation)

Sources: currents and radioactivity in the earth; local disturbances caused by faults, fractures, underground water courses...

Measurement of earth's **magnetism** (nT) and earth's **radiation** (ips) and its prominent **disturbances** (%)

8 **SOUND** and **VIBRATION** (Airborne and Solid Sound)

Sources: traffic noise, air traffic, train traffic, industry, buildings, devices, machines, motors, transformers, sound bridges...

Measurement of **noise level**, **sound**, **infrasound**, **ultrasound**, **oscillations** and **vibrations** (dB, m/s^2)

Supplement to the Standard of Building Biology Testing Methods SBM-2008

BUILDING BIOLOGY EVALUATION GUIDELINES

FOR SLEEPING AREAS

The Building Biology Evaluation Guidelines are based on the precautionary principle. They are specifically designed for sleeping areas associated with long-term risks and a most sensitive window of opportunity for regeneration. They are based on the building biology experience and knowledge and focus on achievability. In addition, scientific studies and other recommendations are also consulted. With its professional approach, building biology testing methods help identify, minimize and avoid environmental risk factors within an individual's framework of possibility. It is the Standard's goal to identify, locate and assess potential sources of risk by considering all subcategories in a holistic manner and implementing the best possible diagnostic tools available with analytic expertise in order to create indoor living environments that are as exposure-free and natural as practicable.

No Concern This category provides the highest degree of precaution. It reflects the unexposed natural conditions or the common and nearly inevitable background level of our modern living environment.

Slight Concern As a precaution and especially with regard to sensitive and ill people, remediation should be carried out whenever it is possible.

Severe Concern Values in this category are not acceptable from a building biology point of view, they call for action. Remediation should be carried out soon. In addition to numerous case histories, scientific studies indicate biological effects and health problems within this reference range.

Extreme Concern These values call for immediate and rigorous action. In this category international guidelines and recommendations for public and occupational exposures may be reached or even exceeded.

If several sources of risk are identified within a single subcategory or for different subcategories, one should be more critical in the final assessment.

Guiding Principle:

Any risk reduction is worth achieving. Reference values are meant as a guide. Nature is the ultimate standard.

The small print at the end of each subcategory of the Building Biology Standard is meant as a comparative guide - e.g. legally binding exposure limits or other guidelines, recommendations and research results or natural background levels.

A FIELDS, WAVES, RADIATION

1 AC ELECTRIC FIELDS (Low Frequency, ELF/VLF)

		No Concern	Slight Concern	Severe Concern	Extreme Concern
Field strength with ground potential in volt per meter	**V/m**	**< 1**	**1-5**	**5 - 50**	**> 50**
Body voltage with ground potential in millivolt	**mV**	**< 10**	**10 - 100**	**100 - 1000**	**> 1000**
Field strength potential-free in volt per meter	**V/m**	**< 0.3**	**0.3-1.5**	**1.5 - 10**	**> 10**

Values apply up to and around 50 (60) Hz, higher frequencies and predominant harmonics should be assessed more critically.

ACGIH occupational TLV: 25000 V/m; DIN/VDE: occupational 20000 V/m, general 7000 V/m; ICNIRP: 5000 V/m; TCO: 10 V/m; US-Congress/ EPA: 10 V/m; BUND: 0.5 V/m; studies on oxidative stress, free radicals, melatonin, childhood leukaemia: 10-20 V/m; nature: < 0.0001 V/m

2 AC MAGNETIC FIELDS (Low Frequency, ELF/VLF)

		No Concern	Slight Concern	Severe Concern	Extreme Concern
Flux density in nanotesla	**nT**	**< 20**	**20-100**	**100 - 500**	**> 500**
in milligauss	**mG**	**< 0.2**	**0.2-1**	**1 - 5**	**> 5**

Values apply to frequencies up to and around 50 (60) Hz, higher frequencies and predominant harmonics should be assessed more critically. Line current (50-60 Hz) and traction current (16.7 Hz) are recorded separately.

In the case of intense and frequent temporal fluctuations of the magnetic field, data logging needs to be carried out - especially during nighttime - and for the assessment, the 95^{th} percentile is used.

DIN/VDE: occupational 5000000 nT, general 400000 nT; ACGIH occupational TLV: 200000 nT; ICNIRP: 100000 nT; Switzerland 1000 nT; WHO: 300-400 nT "possibly carcinogenic"; TCO: 200 nT; US-Congress/EPA: 200 nT; BioInitiative: 100 nT; BUND: 10 nT; nature: < 0.0002 nT

Building Biology Evaluation Guidelines for Sleeping Areas SBM-2008, Page 2	**No** Concern	**Slight** Concern	**Severe** Concern	**Extreme** Concern

3 RADIOFREQUENCY RADIATION (High Frequency, Electromagnetic Waves)

Power density in microwatt per square meter	**µW/m²**	**< 0.1**	**0.1-10**	**10 - 1000**	**> 1000**

Values apply to single RF sources, e.g. GSM, UMTS, WiMAX, TETRA, Radio, Television, DECT cordless phone technology, WLAN..., and refer to peak measurements. They do not apply to radar signals.

More critical RF sources like pulsed or periodic signals (mobile phone technology, DECT, WLAN, digital broadcasting...) should be assessed more seriously, especially in the higher ranges, and less critical RF sources like non-pulsed and non-periodic signals (FM, short, medium, long wave, analog broadcasting...) should be assessed more generously especially in the lower ranges.

Former Building Biology Evaluation Guidelines for RF radiation / HF electromagnetic waves (SBM-2003): pulsed < 0.1 no, 0.1-5 slight, 5-100 strong, > 100 µW/m² extreme anomaly; non-pulsed < 1 no, 1-50 slight, 50-1000 strong, > 1000 µW/m² extreme anomaly

DIN/VDE: occupational up to 100000000 µW/m², general up to 10000000 µW/m²; ICNIRP: up to 10000000 µW/m²; Salzburg Resolution / Vienna Medical Association: 1000 µW/m²; BioInitiative: 1000 µW/m² outdoor; EU-Parliament STOA: 100 µW/m²; Salzburg: 10 µW/m² outdoor, 1 µW/m² indoor; EEG / immune effects: 1000 µW/m²; sensitivity threshold of mobile phones: < 0.001 µW/m²; nature < 0.000001 µW/m²

4 DC ELECTRIC FIELDS (Electrostatics)

Surface potential in volt	**V**	**< 100**	**100 - 500**	**500 - 2000**	**> 2000**
Discharge time in seconds	**s**	**< 10**	**10 - 30**	**30 - 60**	**> 60**

Values apply to prominent materials and appliances close to the body and/or to dominating surfaces at ca. 50 % r.h.

TCO: 500 V; damage of electronic parts: from 100 V; painful shocks and actual sparks: from 2000-3000 V; synthetic materials, plastic finishes: up to 10000 V; synthetic flooring, laminate: up to 20000 V; TV screens: up to 30000 V; nature: < 100 V

5 DC MAGNETIC FIELDS (Magnetostatics)

Deviation of flux density (steel) in microTesla	**µT**	**< 1**	**1-6**	**6-20**	**> 20**
Fluctuation of flux density (current) in microtesla	**µT**	**< 1**	**1-2**	**2-10**	**> 10**
Deviation of compass needle in degree	**°**	**< 2**	**2-10**	**10-100**	**> 100**

Values refer to the flux density deviation through metal/steel or flux density fluctuation through direct current.

Germany: DIN/VDE 0848 occupational 67,000 µT and general public 21,200 µT; USA/Austria 5,000-200,000 µT; MRI ca. 2T; earth's magnetic field across temperate latitudes 40-50 µT ± 1 µT; magnetic field of eye 0.0001 nT; brain 0.001 nT; heart 0.05 nT

6 RADIOACTIVITY (Gamma Radiation and Radon)

Increase of equivalent dose rate in percent	**%**	**< 50**	**50-70**	**70-100**	**> 100**

Values refer to the local radiation in the surroundings when the levels in the vicinity are average. In the case of a distinct higher radiation in the vicinity, a percentage wise smaller equivalent-dose rate is applied.

USA federal law: general population < 5mSv and workers < 50 mSv/a; USA average background 1.3mS/a; depending on the local surroundings. Germany: average 0.85 mSv/a (100 nSv/h); BGA: general population 1.67 mSv/a; SSK (Radiation Protection Branch in Germany) general population 1.5mSv/a additional impact and workers 15mSv/a; if unusual deviation from average background radiation is substantial the frame of equivalent dose rate increase must be reduced.

Radon in Becquerel per cubic meter	**Bq/m^3**	**< 30**	**30-60**	**60-200**	**> 200**
Radon in curies per liter	**pCi/L**	**< 0.75**	**0.75-1.5**	**1.5-5**	**> 5**

EPA recommendation 160 Bq/m^3 or 4 pCi/L; Swedish recommendation 200 Bq/m^3 or 5 pCi/L; Radiation Protection Branch Germany (SSK) 250 Bq/m^3 or 6.25 pCi/L

7 TERRESTRIAL RADIATION (Geomagnetic Field, Earth Radiation)

Disturbance of geomagnetic field					
In nanotesla	nT	**< 100**	**100-200**	**200-1000**	**> 1000**
In milliGauss	mG	**< 1**	**1-2**	**2-10**	**> 10**
Disturbance of terrestrial radiation in percent	%	**< 10**	**100-20**	**20-50**	**> 50**

Values refer to the natural geomagnetic field and to the natural radioactive gamma radiation or neutron radiation of the earth.

Natural fluctuations of the earth's magnetic field temporal 10-100nT; local (magnetic storms caused by solar eruptions) 100-1,000nT