

The Holistic Building Biology Survey according to the

# STANDARD OF BUILDING BIOLOGY TESTING METHODS

SBM-2015

The Building Biology Standard gives an overview of the physical, chemical, biological, indoor climate and other 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 Building Biology 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, while taking scientific findings into account. Any risk reduction is worth aiming at.

This original three-part Building Biology Standard has been the basis of building biology testing practices and precautionary assessments since 1992, meanwhile internationally. The Standard with its Evaluation Guidelines and Testing Conditions also forms the basis of the work of the Verband Baubiologie (VB), which has been established in 2002.

## 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 dominant **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 dominant **harmonics**

### 3 RADIO-FREQUENCY 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 radio-frequency electromagnetic **power density** ( $\mu\text{W}/\text{m}^2$ ), identification of dominant **frequencies** (kHz, MHz, GHz) or RF **sources** and **signal characteristics** (pulses, periodicity, broadband width, modulation...)

### 4 STATIC 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 STATIC MAGNETIC FIELDS (Magnetostatics)

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

Measurement of **earth's magnetic field distortion** as a **spatial deviation** of magnetic flux density ( $\mu\text{T}$ , metal/steel) or as a **temporal fluctuation** of magnetic flux density ( $\mu\text{T}$ , direct current) as well as **compass deviation** ( $^\circ$ )

### 6 RADIOACTIVITY (Alpha, Beta and Gamma Radiation, Radon)

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

Measurement of radioactive radiation as **count rate** (cps), **equivalent dose rate** (nSv/h) and deviation (%) as well as measurement and long-term data logging of **radon concentration** ( $\text{Bq}/\text{m}^3$ )

### 7 GEOLOGICAL DISTURBANCES (Earth's Magnetic Field, Terrestrial Radiation)

Sources: currents and radioactivity in the earth; local disturbances caused by faults, fractures, underground watercourses, geological deposits...

Measurement of **earth's magnetic field** (nT) and **radioactive radiation** (ips) and its dominant **disturbances** (%)

### 8 SOUND WAVES (Airborne and Structure-born Sound)

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

Measurement of **noise, sound, infrasound** and **ultrasound** (dB), **oscillations** and **vibrations** ( $\text{m}/\text{s}^2$ )

### 9 LIGHT (Artificial Lighting, Visible Light, UV and Infrared Light)

Sources: incandescent lamps, halogen light, fluorescent tubes, compact fluorescent lamps, LED, screens, displays, VLC data transmission

Measurement of **electromagnetic fields** (V/m, nT), **light spectrum, spectral distribution** (nm), **light flicker** (Hz, %), **illumination level** (lx), **color rendering index** (CRI,  $R_a$ ,  $R_{1-14}$ ), **color temperature** (K), **ultrasound** (dB)

## **B INDOOR TOXINS, POLLUTANTS, INDOOR CLIMATE**

### **1 FORMALDEHYDE and other Toxic Gases**

Sources: varnishes, glues, particle board, wood products, furnishings, devices, heating, gas leaks, combustion, exhaust fumes, environment...  
Measurement of **toxic gases** ( $\mu\text{g}/\text{m}^3$ , ppm) as formaldehyde, ozone and chlorine, urban and industrial gases, natural gas, carbon monoxide, nitrogen dioxide and other combustion gases

### **2 SOLVENTS and other Volatile Organic Compounds (VOC)**

Sources: paints, varnishes, adhesives, synthetics, building materials, particle board, furniture, coatings, diluents, cleaners...  
Measurement of **volatile organic compounds** ( $\mu\text{g}/\text{m}^3$ , ppm) as aldehydes, aliphatics, alcohols, aromatics, esters, ethers, glycols, ketones, cresols, phenols, siloxanes, terpenes and other organic compounds (VOC)

### **3 PESTICIDES and other Semivolatile Organic Compounds (SVOC)**

Sources: wood, leather and carpet protections, adhesives, plastics, sealers, coatings, moth-proofing agents, pest-control agents...  
Measurement of **semivolatile organic compounds** (mg/kg,  $\text{ng}/\text{m}^3$ ) as biocides, insecticides, fungicides, wood preservatives, carpet chemicals, pyrethroids, fire retardants, plasticizers, PCBs, PAHs, dioxins

### **4 HEAVY METALS and other Similar Toxins**

Sources: wood preservatives, building materials, building moisture, PVC, paints, glazes, plumbing pipes, industry, toxic waste, environment...  
Measurement of **inorganic substances** (mg/kg) as light and heavy metals (aluminum, antimony, arsenic, barium, lead, cadmium, chromium, cobalt, copper, nickel, mercury, zinc...), metal compounds and salts

### **5 PARTICLES and FIBERS (Fine Particulate Matter, Nanoparticles, Asbestos, Mineral Fibers...)**

Sources: aerosols, airborne particles, dust, smoke, soot, building and insulating material, ventilation and air-conditioning, toner, environment...  
Measurement of **dust**, number and size of **particles**, **asbestos** and other **fibers** (/l,  $\mu\text{g}/\text{m}^3$ , /g, %)

### **6 INDOOR CLIMATE (Temperature, Humidity, Carbon Dioxide, Air Ions, Air Changes, Odors...)**

Source: moisture damage, building materials, ventilation, heating, furnishings, breathing, electric fields, radiation, dust, environment...  
Measurement of **air and surface temperature** ( $^{\circ}\text{C}$ ), **air humidity** and **material moisture** (r.h., a.h., %), **oxygen** (vol.%), **carbon dioxide** (ppm), **air pressure** (mbar), **air movement** (m/s) and **air ions** ( $/\text{cm}^3$ ) as well as **air electricity** (V/m), identification of **odors** and **air exchange rate**

## **C FUNGI, BACTERIA, ALLERGENS**

### **1 MOLDS and their Spores and Metabolites**

Sources: moisture damage, thermal bridges, construction defects, building materials, remediation mistakes, air-conditioning, environment...  
Measurement and identification of culturable and nonculturable **molds**, their spores and fragments ( $/\text{m}^3$ ,  $/\text{cm}^2$ ,  $/\text{dm}^2$ , /g) as well as their metabolites (MVOC, mycotoxins...)

### **2 YEASTS and their Metabolites**

Sources: moist areas, hygiene problems, food storage, garbage, kitchen appliances, water purification systems, sanitary plumbing systems...  
Measurement and identification of **yeasts** ( $/\text{m}^3$ ,  $/\text{dm}^2$ , /g, /l) and their metabolites

### **3 BACTERIA and their Metabolites**

Sources: moisture areas, waste water damage, hygiene problems, food storage, garbage, water purification, sanitary plumbing systems...  
Measurement and identification of **bacteria** ( $/\text{m}^3$ ,  $/\text{dm}^2$ , /g, /l) and their metabolites

### **4 DUST MITES and other Allergens**

Sources: dust mites, their feces and metabolites, insects, mold, pollen, hygiene, house dust, pets, scents, moisture, ventilation, environment...  
Measurement and identification of **mite number** and **feces**, **pollen**, **animal hair**, **allergens** ( $/\text{m}^3$ , /g, %)

Additional measurements, analyses, inspections, consultations and assessments are also part of the Building Biology Standard, e.g. testing tap and drinking water for toxins and microbial contamination, testing of building materials, furniture, appliances and other furnishings as well as for home and wood pests, also consulting and planning services for respective projects as well as consulting and support during remediation, renovation and construction.

The Building Biology Standard also includes the Evaluation Guidelines for Sleeping Areas, which have been developed specifically for averting long-term risks and protecting the sensitive time of regeneration or sleep, as well as the Testing Conditions, Instructions and Additions, which, among other things, specify and describe the building biology testing methods and analyses in more detail.

The Building Biology Standard with its Evaluation Guidelines and Testing Conditions has been developed by *BAUBIOLOGIE MAES* at the request and with the support of the Institut für Baubiologie+ Nachhaltigkeit IBN between 1987 and 1992. Colleagues and medical doctors have also offered their support. It was first published in 1992. Since 1999 experienced building biology professionals with the support of independent scientists from physics, chemistry, biology and architecture as well as experts from analytical laboratories, environmental health care professionals and other experts have helped shape the Building Biology Standard with its Evaluation Guidelines and Testing Conditions. This current SBM-2015 is the eighth update, which was released in May 2015.