

Holistic Building Biology Assessments according to the

STANDARD OF BUILDING BIOLOGY TESTING METHODS

SBM-2024

The Building Biology Standard summarizes the physical, chemical, biological, indoor climate and other risk factors found in sleeping areas, living spaces, workplaces and properties and provides information on how to perform professional testing and assessments. All test results, measuring instruments and procedures are documented in writing. If potential problems are identified, effective remediation strategies are developed.

The individual Standard points describe crucial indoor risk factors. With its professional approach, the Standard helps identify, minimize and avoid these risk factors within an individual's framework of feasibility. The Standard's goal is to create indoor living environments that are as healthy, natural and unpolluted as practicable by considering all Standard points and diagnostic methods in an holistic manner. Measurements, assessments and remediation strategies are above all guided by the building biology experience, the precautionary principle and what is feasible, while taking scientific findings into account. Any risk reduction is worth it.

This original multipart Standard with the accompanying Guideline Values, Testing Conditions and Guiding Principles has been the basis of building biology testing practices and precautionary assessments since 1992, in Germany and worldwide. The 2002-established Building Biology Association 'Verband Baubiologie VB' makes the Standard the foundation of its activities.

A FIELDS, WAVES, RADIATION

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

Source: AC voltage in electrical installations, cables, appliances, outlets, walls, floors, beds, overhead and high-voltage power lines...

Measurement of low frequency electric **field strength** (V/m) and human **body voltage** (mV) including identification of dominant **frequency** (Hz) and dominant **harmonic**

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

Source: AC current in electrical installations, cables, appliances, transformers, motors, overhead/underground/high-voltage power lines, railway...

Measurement and long-term data logging of low frequency magnetic **flux density** (nT) from power grids or railway networks including identification of dominant **frequency** (Hz) and dominant **harmonics**

3 RADIO FREQUENCY RADIATION (High Frequency, Electromagnetic Waves)

Source: wireless communication technologies, microwave radio relay, broadcasting, radar, military, cordless/cell phones, WLAN, mobile devices...

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

4 STATIC ELECTRIC FIELDS (Electrostatics)

Source: synthetic carpeting, drapes and textiles, vinyl wallpaper, varnishes, laminates, stuffed toy animals, screens...

Measurement of electrostatic **surface potential** (V) including its **discharge time** (s) and **air electricity** (V/m)

5 STATIC MAGNETIC FIELDS (Magnetostatics)

Source: 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** (μT , metal) or as a **temporal fluctuation of magnetic flux density** (μT , direct current) including **compass deviation** ($^\circ$)

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

Source: 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** (%) including measurement and long-term data logging of **radon concentration** (Bq/m^3)

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

Source: 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** (cps) and its dominant **disturbances** (%)

8 SOUND WAVES (Airborne and Structure-borne Sound)

Source: road traffic, aircraft and railway noise, industry, buildings, devices, machines, motors, transformers, wind turbines, sound bridges...

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

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

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

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

B INDOOR TOXINS, POLLUTANTS, INDOOR CLIMATE

1 FORMALDEHYDE and other Toxic Gases

Source: varnishes, glues, particleboards, wood composite products, furnishings, 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)

Source: paints, varnishes, glues, plastics, building materials, particleboards, 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)

Source: wood preservatives, leather and carpet chemicals, glues, plastics, caulking, coatings, mothproofing agents, pest-control agents...

Measurement of **semivolatile organic compounds** (mg/kg, ng/m^3) as biocides, insecticides, fungicides, wood preservatives, carpet chemicals, fire retardants, plasticizers, pyrethroids, PCBs, PAHs, PFAS, dioxins

4 HEAVY METALS and other Similar Toxins

Source: wood preservatives, building materials, building moisture, PVC, paints, glazes, plumbing pipes, industry, toxic waste, environment...

Measurement of **inorganic substances** (mg/kg, ng/m^3) 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...)

Source: aerosols, airborne particles, dust, smoke, soot, building/insulating materials, 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 moisture and materials, ventilation, heating, furnishings, breathing, electric fields, radiation, dust, environment...

Measurement of **air and surface temperature** ($^{\circ}\text{C}$), **air humidity** and **material moisture** (% RH, AH), **oxygen** (vol.%), **carbon dioxide** (ppm), **air pressure** (mbar), **air movement** (m/s), **air exchange rate** (/h) and **air ions** (/cm³), identification of **odors**

C FUNGI, BACTERIA, ALLERGENS

1 MOLDS and their Spores and Metabolites

Source: 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) including their metabolites (MVOC, mycotoxins...)

2 YEASTS and their Metabolites

Source: moisture-prone areas, hygiene problems, food storage, garbage, kitchen appliances, water purification systems, plumbing installations...

Measurement and identification of **yeasts** ($/\text{m}^3$, $/\text{dm}^2$, /g, /l) and their metabolites

3 BACTERIA and their Metabolites

Source: moisture-prone areas, fecal contamination, hygiene problems, food storage, garbage, water purification, plumbing installations...

Measurement and identification of **bacteria** ($/\text{m}^3$, $/\text{dm}^2$, /g, /l) and their metabolites

4 DUST MITES and other Allergens

Source: dust mites, their feces and metabolites, insects, mold, pollen, hygiene, house dust, pets, scents, moisture, environment...

Measurement and identification of **mite number** and **feces**, **pollen**, **animal hair**, **allergens** ($/\text{m}^3$, /g)

As part of the Building Biology Standard, additional measurements, analyses, inspections, consultations and assessments are carried out: e.g. tap and drinking water tests for pollutants, microbial contamination and others; tests for contaminants in building materials, furniture, appliances and other furnishings; identification of house and wood pests; also consulting and planning services for building, remediation and renovation projects and construction supervision.

The Building Biology Standard includes (a) the Evaluation Guidelines for Sleeping Areas that are specifically developed for long-term risks and the especially sensitive time of restoration, (b) the Testing Conditions, Instructions and Additions that specify the building biology testing methods and procedures in more detail and (c) the Guiding Principles that describe the fundamental values and principles guiding building biology testing practices.

The Building Biology Standard was 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 contributed to this work. The Standard was first published in May 1992. Since 1999 the Standard, Guideline Values, Testing Conditions and Guiding Principles have been further developed by the SBM Standard Committee of experienced building biology professionals with the support of independent scientists from physics, chemistry, biology and architecture including experts from analytical laboratories, environmental medicine specialists and others. This current SBM-2024 is the 9th edition, which was released in August 2024.