BAUBIOLOGY STANDARD SBM 2003

A unique Indoor Environmental Assessment Tool

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1. INTRODUCTION

The professional Baubiology Standard SBM 2003 provides a very unique and comprehensive assessment and evaluation system consisting of over 30 indoor environmental parameters. The standard uses an unorthodox approach because it is not based on single threshold limit values derived from medical dose responses. Instead, the Baubiology Standard uses a gradient scale with four different levels based on what concentration levels are normally encountered in nature or non-problem buildings. The evaluation criteria are determined by the deviations from this normal state and are expressed as categories of change. The categories are *normal environment, slight change, significant change and severe change.* The table below defines the 4 categories used in the Standard and provides an example for carbon dioxide (CO_2) levels.

Normal Environment	Slight Change	Significant Change	Severe Change
Reflects normal environmental conditions or common and inevitable background levels in our civilized environment.	Slightly higher levels following the precautionary principle, long-term mitigation is recommended, especially with sensitive or ill individuals.	Likely to present an elevated risk, short-term mitigation is recommended.	Call for immediate action and mitigation, In many cases international guidelines of occupation exposure limits may be reached or exceeded.
CO_2 <500 ppm	CO_2 500-700 ppm	CO_2 700-1,000 ppm	CO_2 >1000 ppm

The Baubiology Guidelines are based on the precautionary principle. They are based on long-term exposure during the human regeneration phase and were established over decades of experience. These reference values are designed for sleeping areas, not for commercial or industrial work places. The guiding principles are the pro-active approach and achievability. The Baubiology Standard itself is divided into two different sections:

1. Evaluation Guidelines
2. Standard Testing Methodology

The Evaluation Guidelines and Standard Testing Methodology chapters are furthermore differentiated into 3 different groups of environmental parameters:
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Group A. *Indoor Air Climate and Environmental Toxins*
Group B. *Fungi, Bacteria and Allergens*
Group C. *Physical Fields and Radiation*

A comprehensive assessment of potential biological environmental risk factors and its reduction to achievable levels are the tenor of the Standard.

2. BACKGROUND

The Institute for Baubiology and Ecology (IBN) was founded in 1976 by Prof. Anton Schneider of Germany. The German word “Bau” means building, habitat or shelter. The term “biology” refers to the study of living things. The institute studies and addresses the impact buildings have on human health and promotes healthy, environmentally and ecologically friendly construction techniques.

The Standard was between 1987 and 1992 developed by the consulting firm of Baubiologie Maes in conjunction with the IBN, environmental consultants, physicians and scientists. The document was initially published in the German journal *Wohnung & Gesundheit* (Living spaces and Health) in 1992. A 10 member standard committee has been seated and they review and revise the document periodically. The author of this paper is a member of the Standard committee. The next update is expected the end of 2006 or early in 2007. In the meantime, the standard has been internationally accepted as a comprehensive tool for independent indoor environmental assessments in Europe, Australia, New Zealand and is available the United States.

3. EVALUATION GUIDELINES

The three groups of environmental parameters and categories of change are outlined in the following tables. The Baubiology Evaluation Guidelines are proposed for sleeping areas and are not directly related for work places.

Group A: Indoor Air Climate and Environmental Toxins

A	Parameter	Normal environment	Slight change	Significant change	Severe change
1	Carbon dioxide concentration in air (ppm)	<500	500-700	700-1000	>1000
2	Relative humidity in percent (%RH)	40-60	<40 / >60	<30 / >70	<20 />80
3	Formaldehyde concentration in air (ppm)	0.02	0.02-0.05	0.05-0.1	>0.1
4	Total Volatile Organic Compounds in air (µg/m^3)	<100	100-300	300-1000	>1000
5	Total Pesticides concentration in air (ng/m3)	<5	5-50	50-100	>100
6	PCP, Lindane, Permethrin in wood (mg/kg)	<0.2	0.2-5	5-100	>100
7	Dichlorfluanid, Chloropyriphos in dust (mg/kg)	<0.2	0.2-1	1-5	>5
8	PCB’s, fire retardants in dust (mg/kg)	<0.1	0.1-1	1-10	>10

9	Poly Aromatic Hydrocarbons in dust (mg/kg)	<0.5	0.5-5	5-50	>50
10	Plasticizer in dust (mg/kg)	<100	100-250	250-500	>500
11	Small air ions per cm^3	>500	200-500	100-200	<100
12	Electrostatic charge in air (V/m)	<100	100-500	500-2,000	>2,000

Group B: Fungi, Bacteria and Allergens

B	Parameter	Normal environment	Slight change	Significant change	Severe change
1	Colony forming units in the air (CFU/m^3)	<200	200-500	500-1,000	>1,000
2	Colony forming units on the surface (CFU/dm^3)	<20	20-50	50-100	>100
3	Mold Counts (spores or colony forming units)	I. Mold counts should be less or similar levels when compared to surrounding outdoor environments or non-problem buildings			
		II. Mold types of the indoor air should be similar to those present in the outside air			
		III. Particular toxic species such as Aspergillus or Stachybotrys and yeast-like fungi such as Candida or Cryptococcus and coliform bacteria should be present in low concentration levels			
		IV. Any suspected microbial colonization (water damage, odors, material deterioration, high RH or building history) should be investigated			

Group C: Physical Fields and Radiation

C	Parameter	Normal environment	Slight change	Significant change	Severe change
1	AC Electric Fields in the air (V/m)	<1	1-5	5-50	>50
2	AC Electric fields on body (mV)	<10	10-100	100-1000	>1000
3	AC Magnetic Fields, flux density (mG)	<0.2	0.2-1	1-5	>5
4	Microwaves in power density pulsed (uW/m^2)	<0.1	0.1-5	5-100	>100

5	Microwave power density un-pulsed (uW/m^2)	<1	1-50	50-1,000	>1,000
6	DC Electrostatic charge surface (V)	<100	100-500	500-2,000	>2,000
7	DC Electrostatic charge discharge time (s)	<10	10-20	20-30	>30
8	DC Magnetic fields – deviation (µT)	<1	1-2	2-10	>10
9	DC Magnetic fields – deviation (degree)	<2	2-10	10-100	>100
10	Ionizing radiation in increase in %	<50	50-70	70-100	>100
11	Radon gas in air (Bq/m^3)	<20	20-50	50-200	>200
12	Terrestrial radiation – deviation (nT)	<100	100-200	200-1,000	>1000
13	Terrestrial radiation – deviation in %	<10	10-20	20-50	>50

4. THE STANDARD TESTING METHODOLOGY

This section of the Standard describes in summary fashion the instrumentation, methodology and the environmental data to be obtained during a Baubiology survey. Independently, the German association of baubiologists (Verband Deutscher Baubiologen or VDB) has published their own extremely comprehensive Standard Operating Procedures (164 pages of methodologies) for testing of environmental parameters with direct reading instruments and the collection of environmental samples. The 2 volumes can be purchased through the VDB website www.Baubiologie.net, click on "VDB Richtlinien" to view the documents and download order forms. However, be aware they are written in the German language. Below is an example of the condensed version of the Baubiology Standard Testing Methodology:

4.1. GROUP A: *INDOOR AIR CLIMATE AND ENVIRONMENTAL TOXINS*

Air and Ions (Room climate)

Measurement of the general room air quality, e.g. oxygen (Vol.%), CO_2 (ppm), humidity (%RH), pressure (millibar), temperature (^oF, ^oC), air movement (ft./s). Measurements of the small ions in the room air (#/cm^3) and their polarity.

Sources: Humidity in building structure, air exchange rate, temperature difference, air conditioning, heating, furnishings, electrostatic, ionizing radiation, fine dust, smog, appliances, environment etc.

Volatile Organic Compounds

Measurement of volatile organic compounds (ppm, µg/m^3) Qualitative pre-analysis and/or quantitative analysis of single gasses or total concentration levels such as aldehydes, alcohols, amines, ethers, esters, glycols, isocyanides, keytones, terpenes, aliphatic, aromatic and chlorinated hydrocarbons such as benzol, formaldehyde, perchloroethylene, styrene, toluol, trichloroethylene, vinyl chloride, xylol.

Sources: Paints, glues, plastics, particle board, building materials, furniture, etc.

Semi-Volatile Organic Compounds
Qualitative pre-analysis, quantitative analysis for single gasses or total concentration levels. Sampling from different sources for biocides (insecticides, fungicides, herbicides, pesticides), used in preservatives and fire retardants of wood, leather and carpets), such as PCP (Pentachlorophenol), Lindane, Chlorodane, DDT, Dichlorofluanid, and Dichlorophos, Endosulfan, Furmecyclox, Heptachlor, Permethrin, and other Pyrethroids, as well as PAKs, plastic softeners such as PCBs, etc.).
Sources: Wood, leather and carpet preservatives, plastics, caulking

Radon Gas
Measuring the radon concentration (pCi/l or Bq/m^3) in room air and/or dust.
Sources: Earth radiation, radioactive building materials, certain appliances, ventilation, environment…

4.2. GROUP B: FUNGI, BACTERIA AND ALLERGENS

Fibers, Particulates, Allergens
Measurements of asbestos and artificial mineral fibers, particulates and aerosols, house and fine dust, pollen, allergens; identification of dust mites and their excrements.
Sources: Building materials, insulation materials, HVAC, furniture, environment…

Bacteria, Mold and Mildew
Colony count and identification of bacteria, mold and yeasts in the room air, on surfaces and in the dust, in materials and in fluids.
Sources: HVAC, water damage, building and insulation materials, furniture, lack of hygiene

Miscellaneous
- Measurement of noise, sound level, ultra and infra sound as well as vibration (dB, m/s^2)
- Measurement of light quality, light intensity and UV radiation (lux, mW/cm^2)
- Measurement of tap water quality, (pH, conductivity, TDS, analysis of contaminants such as nitrate, nitrite, chlorine, heavy metals and microbes)
- Assessment of international regulation and standards of DIN / VDE / VDI / MAK / MRK / TLV / TRK / BGA / TVO / MPR / TCO / EMV / WHO / IRPA / OSHA / EPA
- Building dynamic measurements: moisture content of wood and concrete, heat and cold bridges dew point, R-value, dew point and surface temperature, leakage resistance, conductivity
- Assessment of damage by vermin, especially wood pests such as termites
- Evaluation of building materials, general materials and dust on heavy metals such as lead, chromium, copper, nickel, mercury, zinc, tin…as well as other elements and toxic substances.

4. 3. GROUP C: PHYSICAL FIELDS AND RADIATION

AC Electric Fields (Low Frequency)
Measurement of the electrical field strength (V/m), the human body voltage (mV), the predominant frequency (Hz)
Sources: Alternating voltage in wires, building wiring, appliances, walls, power lines, etc.

AC Magnetic Fields (Low Frequency)

Measurement and data logging of the magnetic flux density (mG or nT), the predominant frequency (Hz) and as well as determination of the field line direction.
Sources: Alternating current in wires, appliances, power lines, water pipes, gas pipes, high tension power lines, ground wiring, etc.

Electromagnetic Fields (High Frequency)
Spot and long term measurements of the high frequency electromagnetic field strength (mV or mA/m) or the power density (nW/cm^2), or the electric field voltage (V/m); determining the low frequency modulation, and other information such as frequency, pulses, and signals. In addition, spectrum analysis, acoustical diagnosis and frequency tests can be performed.
Sources: Radio and TV transmitters, cellular phone networks, radar, military installations, etc.

DC Electric Fields (Electrostatic)
Measurements are taken of the surface charge (V) on materials or appliances that can be electrostatically charged and the discharge time (S) and the air electricity (V/m).
Sources: Synthetic carpets, curtains, vinyl wall paper, plastic surfaces, TV / computer monitors, etc.

DC Magnetic Fields (Magnetostatic and earth magnetic fields)
Measurement of the magnetic flux density (mG, μT) of magnetostatically susceptible materials and appliances; long term measurements of DC (direct currents); measuring the deviation of a compass needle(^{0}). Measurement of the natural earth's magnetic field and the deviation of this field (nT)
Sources: Steel parts in beds, mattresses, furniture, building materials, electric streetcars, etc.
Sources: Underground water veins, faults, fissures, geologic anomalies.

Radioactivity (Gamma radiation and geological disturbances)
Measurement of the dose equivalent power (nSv/h) in enclosed spaces. Measurement of the natural earth radiation and of the geological disturbances (ips).
Sources: Building materials, rocks, tiles and glazes, ashes, appliances, cinders
Sources: Radioactivity of the core of the earth, and anomalies as the result of faults, fissures, water.

5. SUMMARY

This standard makes a quantum leap and abandons the traditional dose-response based on threshold and action levels. It provides background information on normally encountered background levels and establishes gradients for the environmental consultant to put measurement values into a real life proactive perspective. The indoor air community in the U.S. should take a close look at this approach. Currently, two professional Baubiology associations exist in Germany. A satellite office of the Institute is located in Clearwater, Florida and is promoting the Standard, methodology and training in the United States. For more information contact these organizations or the author of the paper.

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