Our
Seal of Approval
promotes a healthy
living environment

Tested and recommended
Institut für Baubiologie Rosenheim GmbH
IBR ®
Product tested for
VOC · biocides · heavy metals
and radioactivity

Prüfsiegelrichtlinien

Seal of Approval Guidelines

IBR

Institut für **Baubiologie**
Rosenheim GmbH

IBR Institut für **Baubiologie** GmbH D-83022 Rosenheim Münchener Straße 18
Tel. +49 (0)8031 / 3675-0 Fax +49 (0)8031 / 3675-30 Internet www.baubiologie-ibr.de

Preliminary Remarks

It is the objective of Institut für Baubiologie Rosenheim GmbH, referred to as IBR below, to identify non-polluting building products for healthy living for the consumer by awarding the seal of approval "TESTED AND APPROVED BY THE IBR". The seal of approval was created by the IBR in 1982 to enable consumers with awareness for health and ecological matters to protect themselves against health hazards caused by building materials and furniture in their residential environment. The seal of approval is awarded to products which ensure healthy living with respect to building biology and at the same time protect the environment.

The aim of awarding the seal of approval to as many products as possible is to enable an increasing number of consumers and end users to make criteria related to building biology a critical part of their decision when purchasing products for building and furnishing their homes.

When awarding the seal of approval, the IBR only uses scientific and technical analysis methods which are based on normative regulations as well as the current state-of-the-art of laboratory analytics so that they should be understood both by third-party experts and by end consumers.

The current status of the seal of approval guidelines is documented in the closing remarks.

The seal of approval guidelines are updated as needed and at least once a year. This may be due to normative changes, laboratory technology requirements or technical innovations. The IBR reserves the right to update the seal of approval guidelines without notice. Only the respective latest version is valid. All older versions are rendered invalid when an updated version of the seal of approval guidelines is published. The current version is available on the internet under www.baubiologie-ibr.de/Prüfsiegelrichtlinien .

Awarding the seal of approval is based on the version of the seal of approval guidelines received by the applicant and subsequent user of the seal of approval at the time the order is placed. When the seal of approval is renewed on the two-year cycle, the respective current version at the time of the follow-up testing applies.

Because of copyright protection, this document may only be used in the context of awarding the seal of approval "TESTED AND APPROVED BY THE IBR". Any other uses, even of excerpts or quotations, must be explicitly approved by the IBR.

Any names of companies, products or brands mentioned in IBR expert reports are protected by copyright. The fact that we mention them is neither to be construed as a valuation nor as a recommendation in this context. The seal of approval guidelines were developed according to our best knowledge and abilities.

All information comes from sources for which the IBR holds copyrights and/or has acquired them through order placement. Questions about the seal of approval guidelines within the scope of these explanations are answered by the IBR.

TABLE OF CONTENTS

1. Financing the IBR

The IBR values transparency in disclosing the financing of the IBR seal of approval in order to make the neutrality of the seal of approval credible for the public.

The services of the IBR are not financed by advertising nor interest groups.

Product tests are commissioned by the IBR in its own name and on its own account as external services.

Economically independent laboratories are commissioned for the required investigations and tests. This allows the IBR to ensure that the results are not stated in terms of possible customer interests.

All results are archived and can be reviewed by the customer. All results are therefore obtained by qualified, independent third parties. The IBR is merely responsible for interpreting the test results.

The IBR is financed by surpluses from the proceeds for the reimbursement of costs for initial and follow-up tests as well as the fees for the commercial use of the IBR seal of approval.

1.1 Initial Test

Before the application to award the seal of approval is accepted, the applicant is provided with the cost framework for the initial test (basic costs). It encompasses all costs for testing and preparing expert reports and documents, both in digital form and hard copy. It covers all internal and external costs of the IBR for awarding the seal of approval. Consulting services, meetings and cost estimates of any kind are generally free of charge for the applicant.

When the order is placed for initial testing to award the seal of approval, a prepayment of 50 % of the agreed basic costs is due. The remaining 50 % of the basic costs are due after the work is completed and the seal of approval is awarded. The seal of approval is awarded by sending out the expert reports and certificates as PDF files.

1.2 Follow-Up TEST

The authorisation to use the seal of approval is reviewed by a follow-up test on a 2-year cycle. Depending on time an effort, the IBR charges the user of the seal of approval between 35 and 40 % of the basic costs for the follow-up test.

1.3 License Fees for Commercial Use

For the commercial use of the seal of approval, the user is charged an annual license fee of 25 % of the basic costs. The IBR provides the following services in return:

- Answering questions from end users directed to the IBR, free of charge.

- Protecting the seal of approval against abuse by unauthorised third parties.
- Expanding and developing the test procedures.
- Promoting the seal of approval to the public.

2. Field of Application

The evaluation and test provisions apply for all products produced by the applicant's company according to the evaluation and test provisions, or that are manufactured in other operations by order of the applicant.

3. Testing and Monitoring Conditions

The testing and monitoring conditions generally apply to all construction, raw and auxiliary materials in construction and residential applications, as well as all building elements, installations and furnishing made from said materials.

Employees of the IBR or persons charged by the IBR may at any time, even without prior notice, visit the applicant's production site.

Product samples are collected in the course of official sample collection or by IBR employees.

An official sample collection may be performed e.g. by an employee of the municipal administration who confirms the neutral and uninfluenced collection of samples from ongoing production with the official seal of the respective public authority. Alternatively, samples can also be collected by officially appointed calibrators. The form for official sample collection is provided as an attachment to the seal of approval guidelines.
In the interest of consumers, follow-up testing of the products must be performed in due time before the seal of approval expires. The applicant will have to reapply for these tests.

4. Data Privacy

Tests are commissioned by the IBR in the interest of consumers, users and manufacturers of building biology products.

The test results are archived by the IBR and can be reviewed by the applicant.

The IBR obligates itself to always answer consumer's questions neutrally for products that were awarded the seal of approval.

The respective expert reports or related tests results are not made available to consumers. This information is only shared with third parties if it is expressly released by a written directive issued by the user of the seal of approval. Such directives remain in effect until they are revoked.

The IBR obligates itself to maintain secrecy towards third parties regarding all information that becomes known to it and is declared as confidential by the user of the seal of approval.

5. Test Criteria and Evaluation System

5.1 Basic requirements and conditions

5.1.1 Data required by the applicant

- Technical datasheet
- Safety datasheet according to Regulation (EC) 1907/2006
- Complete declaration of the substances of content
- If sample material is not collected by the customer, an official sample collection record has to be submitted
- Building authority approval if applicable, or any existing studies that are useful for the assessment of the product being tested
- If nanotechnology is used, this has to be noted

5.1.2 Immediate exclusion criteria for certification

- Substances that are carcinogenic, mutagenic or toxic to reproduction and, according to the CLP regulation (Regulation (EC) No. 1272/2008 or the superseded Directive 67/548/EEC), fall into categories 1 A, 1B and 2 (Carc. Cat. 1-3, Mut. Cat. 1-3, Repr. Cat. 1-3) and/or are listed in the Ordinance on Hazardous Substances (GefStoffV) and Technical Guideline for the Handling of Hazardous Materials (TRGS) 905
- Substances that require approval according to Annex XIV of the REACH regulation
- Substances on the candidate list (SVHC = substances of very high concern) – ECHA
- Prohibited substances according to the CLP regulation (Regulation (EC) No. 1272/2008 or in the superseded Directive 67/548/EEC), GefStoffVO and TRGS 905

5.2 Test Routines

5.2.1 Tests performed for all products

An itemisation of the various test routines follows, depending on the material properties that are examined in the course of the initial test and/or follow-up tests.

- Testing for volatile organic substances is performed using test chamber processes according to the standards of the "Ausschuss zur gesundheitlichen Bewertung von Bauprodukten" (Committee for the Health Assessment of Building Products) (AgBB 2015).

- Testing for radioactivity (ACI)
- Biocides, pyrethroids, phthalates, PCB, EOX, AOX,
- Determination of heavy metals depending on the product: Original substance and eluate for disposal (recycling) according to LAGA (working group of the German federal states on waste issues) or migration of heavy metals according to EN 71-3

The tests described above have to be passed by all products. Failing to meet individual criteria leads to refusal of the seal of approval, regardless of the results of the remaining tests.

5.2.2 Product-specific Tests

- Fine dust testing is only meaningful for materials where suspicion of possible fine dust emission is justified. These may be fibre-reinforced or fibre composite materials such as mineral insulation felt, fibre composite concrete panels etc., or products with a material composition that indicates the possibility of fine dust emissions.
- Formaldehyde testing is generally performed only on materials where it separates due to the nature of the process, e.g. wood-based materials bonded with urea-formaldehyde resins such as chipboard, prefabricated parquet or laminate or other aminoplastics that require formaldehyde for cross-linking. However, aldehyde testing is generally performed on all materials as part of VOC testing. Formaldehyde emission quantities over an extended period of time are only recorded for the products mentioned above.
- All other tests are performed depending on the requirements on a case-by-case basis or by request of the applicant.
- The decision regarding the required tests is always made on a case-by-case basis according to the IBR requirements.

5.2.3 Optional Tests

Tests in addition to those already described can be performed by request of the applicant. The significance of such analyses cannot be uniformly structured within the scope of this outline, since it is necessary to evaluate on a case-by-case basis whether and which of these tests appear meaningful for the respective product. A few examples of additional tests follow.

- Biocompatibility (Ames test)
- Analysis of allergy prevention surfaces
- Analysis of special types of dust, e.g. free quartz
- Analysis of the growth inhibition of mould on surfaces

- Electrostatic behaviour
- Determination of water vapour diffusion resistance
- Determination of heat conductivity
- Analysis of clean room suitability

Further specific tests can be performed by agreement, provided the requirements profile can be realised economically within the laboratory technology framework.

5.3 Evaluation Criteria

- In the evaluation of radioactivity according to the ACI standard, exceeding the official standard value of the European Commission leads to rejection on principle.
- The evaluation of biocides according to type and volume is always performed on a case-by-case basis by the laboratory chemists, e.g. according to GSBL, IGS, GefStoffV, ChemVerbotsV, TRGS, AGW, DGUV and others. Here the basis for decision making is always what is known as the NIK ("niedrigst interessierende Konzentrationen", lowest concentration of interest), in other words concentrations that are only just still of interest from a toxicology perspective.
- Substance groups such as halogenated hydrocarbons or substances with carcinogenic, mutagenic and/or reproduction toxicity potential (CMR substances) lead to rejection on principle insofar as they are not explicitly covered by normative regulations.
- The evaluation of volatile organic compounds (VOCs) is performed as described in section 6.3.
- The LAGA criteria serve as comparative values in the evaluation of heavy metals.
- The requirements of the current TVO (drinking water ordinance) only represent an additional evaluation level here.
- For fine dust tests according to DIN 53803 through 53811 as well as DIN EN ISO 1973 and 12341, rejection takes place if the fine dust content exceeds 6 mg/m³ of air volume. Finding asbestos fibre content for which the Technical Guideline for the Handling of Hazardous Materials (TRGS) 519 would apply in Germany also leads to rejection.
- Further tests as described under 5.2.3 are incorporated in the overall rating.

The tests described above have to be passed by all products. Failing to meet individual criteria leads to refusal of the seal of approval, regardless of the results of the remaining tests.

The measured values shown in the templates correspond to the laboratory technology measuring standards. The individual detection limits of the substance groups are laboratory bench-

marks. As long as the results are below these benchmark values, health hazards due to the substances can be excluded with very high probability.

When the measured values exceed the detection limits significantly, a comparative evaluation is performed in this sequence:

a) DIN, ISO, EN, TRGS and other bodies of rules and regulations are used first in the evaluation.

b) Other applicable bodies of rules and regulations are used next, e.g. NIK values, AgBB requirements, LAGA and others.

c) Third, the requirements of relevant institutions such as UIM München, Bremer Umweltinstitut, DIBt and the long-term empirical values of our specialist laboratories are used.

d) What are known as "internal standards" are established when requirements from a) through c) are lacking. We select these according to the principle of "on the safe side" – findings according to the requirements of our specialist laboratories.

Additional:
Other criteria in addition to laboratory technology aspects as such are also included in the evaluation. These may be for example:

- Is the company certified according to DIN EN ISO 9001:20xx for maintaining consistent product quality?
- Are monitoring contracts in place with other organisations?
- Is production subject to continuous internal and external monitoring?
- Are complete and current safety datasheets on hand?
- Are there issues with respect to safe disposal?
- Are possible risks in processing or use communicated openly?
- Are hazardous components to be disclosed?
- Is the manufacturing process associated with potential hazards for employees?
- Is a complete declaration of the component materials available?
- Are all raw materials sources disclosed in full?
-
-

The process for the various test routines is described in detail on the following pages.

6. Tests

6.1 Radioactivity

In the discussion about the risks of nuclear energy, the public's interest focuses almost exclusively on the population's radiation exposure caused by nuclear plants. Radiation exposure in buildings on the other hand fades into the background. The main part of the natural radiation exposure comes from ambient radiation and the absorption of natural radioactive substances by the body. It must also be considered that the radioactive gas radon may be emitted from building materials into the ambient air. Breathing it in over a long period of time may expose the lungs to radioactive radiation. Human beings absorb this gas and its decay products together with the inhaled air. While most radon particles are exhaled again, its radioactive decay products can be deposited in the lungs. The German Strahlenschutzverordnung (radiation protection ordinance) from 2001 lowered the admissible additional radiation exposure of the population from 1.5 mSv per year to 1 mSv per year. In 1999, the Radiation Protection 112 document issued by the European Commission proposed an Activity Concentration Index (ACI) for building materials. The ACI value for building materials is calculated using a total formula which is based on a dose criterion of 1 mSv per year.

The following formula is used to determine the ACI value:

$$ACI = A\,(K\text{-}40) / 3000 + A\,(Ra\text{-}226) / 300 + A\,(Th\text{-}232) / 200 < 1$$

where A(K-40) is the activity of potassium-40, A(Ra-226) the activity of radium-226 and A(Th-232) the activity of thorium-232, all given in Bq/kg. Adding the 3 measured values A(K-40), A(Ra-226) and A(Th-232) will yield the total ACI.

The activity of radium 226 can be measured indirectly via the daughter product lead 214 and the activity of thorium 232 via the daughter product lead 212. Radionuclide testing is performed using γ-spectrometry.

Example of final evaluation:

Nuclides	**Activity [Bq/kg]**
Radium 228 (228Ra)	43 ± 2
Radium 226 (186 keV)	6 ± 1,5
Thorium 232 (232Th)	8 ± 2
Potassium 40 (40K)	31 ± 4
Caesium 134 (134Cs)	< 1
Caesium 137 (137Cs)	< 1

Test result: For the tested product, an ACI value of 0.05 was determined.

Artificial radioactivity from Chernobyl or from the above-ground atomic bomb tests carried out in the 1960s could not be identified in the examined samples.

Limit or reference values	Requirement
Activity Concentration Index (ACI) for building materials stipulated by the European Commission	ACI ≤ 1.00
Reference value stipulated by the Institut für Baubiologie Rosenheim GmbH	ACI ≤ 0.75

Sample evaluation: The tested product complies with the official reference value of ACI ≤ 1 and with the test requirement ACI ≤ 0.75 stipulated by the Institut für Baubiologie.

6.2 Biocides, OHCs, pyrethroids, phthalates

6.2.1 Biocides

Test method: Addition of internal standards (alpha-HCH, 2,4,6-tribromophenole, PCB 209) to validate the test procedure. Extraction using n-hexane/acetone and a carbonate solution. Acetylation of the phenols. Fractionation of extracts using silica gel for each specific category of substances. Analysis using capillary gas chromatography and flame ionisation/electron capture detectors (GC/FID/ECD) or mass spectrometry (GC/MS). Calibration and assay using external standards.

The products are also tested for organohologens (e. g. added for fire protection). Organohalogens are detected as chloride concentration in AOX and POX (absorbable and purgeable organic halides). If halides are found in the above tests we expand the testing to extractable organic halides (EOX) according to DIN 1485.

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Pentachlorophenol PCP	-	0.1
2,3,4,5 – Tetrachlorphenol	-	0.1
2,3,5,6 – Tetrachlorphenol	-	0.1
beta – HCH	-	0.3
gamma – HCH (Lindane)	-	0.3
Dichlofluanid	-	0.3
Tolylfluanid	-	0.3
Chlorthalonil	-	0.3
alpha – Endosulfan	-	0.3
beta – Endosulfan	-	0.3
Endosulfan – sulphate	-	0.3
Furmecyclox	-	0.3

Hexachlorobenzene	-	0.3
Methylparathion	-	0.3
Ethylparathion	-	0.3
Chlorpyrifos	-	0.3
Heptachlor	-	0.3
Aldrin	-	0.3
cis – heptachlor epoxide	-	0.3
trans – heptachlor epoxide	-	0.3
cis – chlordane	-	0.3
trans – chlordane	-	0.3
Endrin	-	0.3
Dieldrin	-	0.3
Bromophos	-	0.3
Mirex	-	0.3
Malathion	-	0.3
Hexachlorophene	-	0.3
o,p – DDT	-	0.3
o,p – DDT	-	0.3
o,p – DDD	-	0.3
p,p – DDD	-	0.3
o,p – DDE	-	0.3
p,p – DDE	-	0.3
Eulan	-	0.3
Chloronaphtalene	-	0.3
Dichlorvos	-	0.3
IPBC	-	0.3
Propiconazole	-	0.3
Tebuconazole	-	0.3
Cyproconazole	-	0.3
Silafluofen	-	0.3
Etofenprox	-	0.3
Resmethrin	-	0.3
Deltamethrin	-	0.3
Tetramethrin	-	0.3
Cypermethrin	-	0.3
Cyfluthrin	-	0.3
cis – trans – Permethrin	-	0.3
Allethrin	-	0.3
Phenothrin	-	0.3
Cyhalothrin	-	0.3

6.2.2 Polychlorinated biphenyls

Test method: Addition of internal standards (PCB 209) to validate the test procedure; extraction using n-hexane; fractionation of extracts using silica gel for each specific category of substances and concentration; analysis using capillary gas chromatography and electron capture detectors (GC/ECD); calibration and assay using external standards. Determination according to the German PCB-Abfallverordnung (ordinance on the ban of PCB)

Substance	**Measured value [mg/kg]**	**Limit of detection [mg/kg]**
Polychlorinated biphenyls (PCB) no.: 28	-	0.02
Polychlorinated biphenyls (PCB) no.: 52	-	0.02
Polychlorinated biphenyls (PCB) no.: 101	-	0.02
Polychlorinated biphenyls (PCB) no.: 138	-	0.02
Polychlorinated biphenyls (PCB) no.: 153	-	0.02
Polychlorinated biphenyls (PCB) no.: 180	-	0.02
Polychlorinated biphenyls (PCB) – total:	-	0.1

6.2.3 Phthalates

Substance	**Measured value [mg/kg]**	**Limit of detection [mg/kg]**
Phthalic acid anhydride	-	1
Dimethyl phthalate	-	1
Diethyl phthalate	-	1
Bis–2-methylpropyl phthalate DiBP	-	1
Dibutyl phthalate DBP	-	1
Benzyl butyl phthalate BBP	-	1
Dioctyl phthalate DOP	-	1
Diisononyl phthalate DINP	-	1
Didecyl phthalate	-	1
Di(2-ethylhexyl) adipate	-	1
Diethylhexyl phthalate DEHP	-	1

Note: Due to their frequency of occurrence, concentrations of phthalic acid esters totals below 5 mg/kg are assumed to be unspecific secondary contaminations. The esters are mostly used as softening agents in the polymer production.

6.2.4 Flame retardants

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
Pentabromo diphenyl ether (Penta-BDE)	-	1
Octabromo diphenyl ether (Octa-BDE)	-	1
Decabromo diphenyl ether (Deca-BDE)	-	1
Tetrabromobisphenol A (TBBPA)	-	1
Hexabromocyclododecane (HBCD)	-	1
Polybrominated bipyhenyle (PBB)	-	1
Polybrominated diphenyl ether (PBDE)	-	1
Chloro paraffins	-	100
Mirex	-	1
Tris(2-chloro ethyl)phosphate (TCEP)	-	0.1
Tris(2-ethylhexyl)phosphate (TEHP)	-	0.1
Tris(monochloropropyl)phosphate (TDCPP)	-	0.1
Tris(2-butoxyethyl)phosphate	-	0.1
Triphenylphosphate (TPP)	-	0.1
Trikresylphosphate (TKP)	-	0.1
Isopropylierte Triphenylphosphates (ITP)	-	1
Resorcin-bis-diphenylphoshate (RDP)	-	1
Bisphenol-A-bis(diphenylphosphate) (BDP)	-	1

6.2.5 EOX /AOX

Test method: Detection of halogenated organic compounds: Coulometry according to DIN 38414-S18 for AOX – adsorbable organic halides and according to DIN 38414-S17 for EOX – extractable organic halides according to DIN 1485.

Substance	Measured value [mg/kg]	Limit of detection [mg/kg]
AOX	-	10
EOX	-	1

Sample evaluation: A measurable concentration was not detected for any of the tested substances. All measured values are below the specific limit of detection set for each analysis. The tested substances are not expected to have a harmful effect.

6.3 Solvents and odiferous substances – VOC

Determination using VOC emission chamber measurements according to the AgBB requirements

With an increasing presence of chemical substances at our workplaces and in everyday life, the ambient air quality in indoor environment has deteriorated continually. For workplaces, TLV values (threshold limit values) reflecting the concentration of harmful substances have been defined. For habitable rooms, however, where people spend much more time, there are still no legally stipulated maximum quantities or limit values for harmful substances in the indoor air. It is the declared objective of the new federal building codes in Germany and the European Construction Products Directive to protect the health of building users. The corresponding board which is responsible for finding and establishing VOC limit values is called ECA (European Collaborative Action). As early as in 1997, this board recommended the use of the so-called LCI (Lowest Concentration of Interest) as an evaluation scheme, i.e. concentrations that are just of interest from a toxicological point of view. With the exception of pesticides, volatile organic substances were classified according to the WHO definitions with respect to their boiling ranges or the volatility resulting from it. The tested materials all have boiling points, which fall into the range shown below.

Description	Boiling Range
1. Very Volatile Organic Compound (VVOC)	< 0 to 50...100 °C
2. Volatile Organic Compound (VOC)	50...100 to 240...260 °C
3. Semi Volatile Organic Compound (SVOC)	240...260 to 380...400 °C
4. Organic compound associated with particulate matter or particulate organic matter (POM)	380 °C

Test method: The assays are done using VOC emission chamber measurements according to DIN EN ISO 16000-9 and also correspond to CEN/TC 351. The air exchange rate was adapted to the surface size of the test body. The following test parameters were selected:

Chamber volume	Laoding factor	Air exchange rate	Specimen surface	Air temperature	Relative humidity
60 l	1. m^2/m^3	0.5/h ± 0.05/h	600 cm^2	23 ± 1 °C	50 ± 3 %

Volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOC) were concentrated by adsorbing them to activated charcoal. After 3, 7 and depending on meeting the stop criteria also 28 days, the VOCs were isolated by gas chromatography following carbon di-

sulphide-mediated desorption. The VOCs were then identified using mass spectrometry. The individual substances were either quantified against an external toluene standard or quantified substance-specifically by mass spectrometry.

Evaluation basis: The evaluation was performed according to the standards of the "Ausschuss zur gesundheitlichen Bewertung von Bauprodukten" (Committee for the Health Assessment of Building Products) (AgBB). It was founded in 1997 by the state workgroup "Umweltbezogener Gesundheitsschutz" (Environmental Health Protection" (LAUG) of the "Arbeitsgemeinschaft der Obersten Landesgesundheitsbehörden" (Working Committee of the Upper State Health Authorities) (AOLG).

The AgBB requirements, which is updated regularly, constitutes an approach to the health assessment of VOC emissions from building products that are used on the interior of buildings.

Volatile organic compounds according to this schema encompass compounds in the retention range from C6 to C_{16}, that are examined as individual substances and sum parameters within the scope of the TVOC concept (Total Volatile Organic Compounds), as well as semi-volatile organic compounds (SVOC) in the retention range from C16 to C_{22}. The cumulative SVOC value indicates the sum of all individual substances with a detection limit of 5 µg/m³. A detection limit of 1 µg/m³ is applied for all other individual substances.

All CMR substances (carcinogenic, mutagenic, toxic to reproduction/fertility) according to the Ordinance on Hazardous Substances are not included. These always to be considered as a criterion for exclusion.

The quantification of the identified substances with NIK and CMR values is performed by substance. The quantification of the identified substances without NIK values and the unknown substances is respectively performed against toluol equivalents.

Stop criteria: The test can be terminated no sooner than 7 days after loading, if the determined values are less than half the requirements for the 28-day values and there is no significant increase in the concentration of individual substances compared to the measurement on the 3rd day.

Evaluation criteria for test performance after 3 days:

▪ Cumulative TVOC value ($TVOC_3$) ≤ 10 mg/m³

▪ CMR substances ≤ 0.01 mg/m³ as individual substances

Evaluation criteria for test performance after 7 days:

▪ Review of the results as above to determine whether the stop criteria are met.

Evaluation criteria for test performance after 28 days: ▪

▪ Cumulative TVOC value ($TVOC_{28}$) ≤ 1.0 mg/m³

▪ Cumulative value $SVOC_{28}$ ≤ 0.1 mg/m³

▪ CMR substances ≤ 0.001 mg/m³ as individual substances

▪ A sensory test is performed as well.

▪ All CAS numbers are specified when reporting on the individual substance evaluations.

▪ VOCs according to the NIK list are incorporated in the evaluation with a detection limit of 5 µg/m³.

▪ For the VOC evaluation according to the NIK list, the ratio Ri is used with $R_i = C_i / NIK_i$ where it can be assumed that there is no effect when R_i does not exceed the value 1.

If several compounds with concentrations over 5 µg/m³ are identified, the cumulation of the effects is assumes. This circumstance is represented by the cumulative value R: Where

R Cumulative value Ri of the individual measurements from the quotient total $R_i = \sum C_i / NIK_i$

C_i Substance concentration in the test chamber air

R_i Individual measurement

With the condition R > 1, the product is rejected according to the AgBB requirements.

In order to avoid having a product classified as harmless even though it emits larger amounts of VOCs that cannot be evaluated, a quantity limit is established for non-identifiable VOCs or those without a NIK value which, for the cumulative value, makes up 10 % of the allowable TVOC value. A product meets the criteria if the VOCs that cannot be evaluated with a concentration of 0.005 mg/m³ and up do not exceed 0.1 mg/m³ in total.

Significantly higher values lead to rejection according to the AgBB requirements.

Further details are found in the current information of the Federal Environmental Agency www.umweltbundesamt.de on the health assessment of VOC emissions from building products.

Evaluation: When a product meets all requirements as described above, the IBR classifies it as not hazardous to health for use in the interior rooms of buildings.

Summary substance lists (example below)

Substance list by measurment duration of 3 days as positive list

Substance	Boiling range	CAS number	Measured value in µg	Measured value in µg/m³	NIK in µg/m³	Ri
a- pinene	VOC	80-56-8	0.18	3.06	1500	0,002
β- pinene	VOC	127-91-3	0.07	1.19	1500	0.0008
Cumulative value						

Substance list by measurement duration of 7 days as positive list

Substance	Boiling range	CAS number	Measured value in µg	Measured value in µg/m³	NIK in µg/m³	Ri
Cumulative value						

no detectable VOCs SVOCs

Substance list by measurement duration of 7 days as positive list

Substance	Boiling range	CAS number	Measured value in µg	Measured value in µg/m³	NIK in µg/m³	Ri
Cumulative value						

no detectable VOCs SVOCs

Final evaluation according to the AgBB requirements

Example of final evaluation:

Test results after a measurement duration of 3 days

Substance group	Results	Requirements
TVOC C6 to C16	4.25 µg/m³	≤ 10 mg/m³
∑ SVOC C16 to C22	- -	- -
∑ CMR substances	- -	≤ 0.01 mg/m³
∑ VOC without NIK	- -	- -
R from ∑ Ri	0.028	- -
Formaldehyde	0.023 µg/m³	≤ 0.06 mg/m³

Test results after a measurement duration of 7 days

Stoffgruppe	Ergebnisse	Abbruchkriterien
TVOC C6 to C16	3.16 µg/m³	≤ 0,5 mg/m³
∑ SVOC C16 to C22	- -	≤ 0.05 mg/m³

∑ CMR substances	- -	≤ 0.001 mg/m³
∑ VOC without NIK	- -	≤ 0.05 mg/m³
R from ∑ Ri	0.025	≤ 0,5
Formaldehyde	0.021 µg/m³	≤ 0.06 mg/m³

Notes on the stop criteria

The test can be terminated after 7 days if the stop criteria listed above are met.

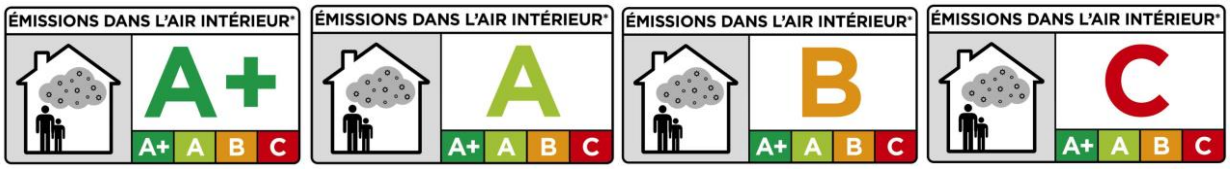
Alternatively, the entire test period of 28 days is used since the stop criteria could not be met after 7 days.

Sample evaluation: The tested substances are not expected to have a harmful effect.

Our results show that the tested materials meet the requirements of the AgBB (Committee for the Evaluation of the Effects of Construction Materials on Human Health) as well as the approval standards of the DIBt (German Institute for Construction).

French VOC ordinance (optional)

In order to be brought to market in France, all building products as well as decorative elements and furnishings have to be identified with an emission class since January 2012 (A+, A, B, C) based on VOC emission testing according to the ISO 16000 series of standards. For products that were already available in the French market prior to January 2012, this rule only becomes mandatory starting in September of 2013. A+ identifies products that are virtually free of emissions, while the C rating represents a level that is only just tolerable. The appearance of the labels has been specified in detail.



The building product has to be permanently identified with the emission class in addition to the CE marking with a minimum size of 15 x 30 mm. Products with emissions that significantly exceed these requirements may no longer be brought to market in France. Only metallic building elements, mineral glass products and products used only on the exterior are exempt. The testing system corresponds to the AgBB (Committee for the Health Assessment of Building Products) requirements in Germany, which are also used as the evaluation standard by the "Deutsches Institut für Bautechnik" (German Institute for Building Technology) (DIBt).

This validation method constitutes a significant simplification compared to the elaborate tests according to the AgBB requirements, and provides sufficiently accurate information on the emission behaviour of a material. Detailed information, e.g. on CMR (carcinogenic, mutagenic, toxic to reproduction) substances cannot be derived.

The classification into emission classes is performed by the manufacturer or operator under its own responsibility. The emission class limit values in µg/m³ refer to the cumulative value of total emissions as well as the evaluation for 10 significant harmful substances:

Substance	**Emission classes according to the French VOC directive**				**Test results**
	[µg/m³]				
	C	B	A	A+	
Formaldehyde	> 120	< 120	< 60	< 10	0
Acetaldehyde	> 400	< 400	< 300	< 200	8
Toluene	> 600	< 600	< 450	< 300	-
Tetrachloroethylene	> 500	< 500	< 350	< 250	-
Xylol	> 400	< 400	< 300	< 200	-
1,2,4-trimethylbenzene	> 2000	< 2000	< 1500	< 1000	-
1,4-dichlorobenzene	> 120	< 120	< 90	< 60	-
Ethylbenzene	> 1500	< 1500	< 1000	< 750	-
2-butoxyethanol	> 2000	< 2000	< 1500	< 1000	-
Styrene	> 500	< 500	< 350	< 250	-
Cumulative valueT-VOC	> 2000	< 2000	< 1500	< 1000	8

Sample evaluation: None of the tested substances could be detected in measurable concentrations. All measured values are below the specific limit of detection set for each analysis.

All tested products are assigned to emission class A+.

7.4 Heavy metals

Metals are basically subdivided into light metals and heavy metals. Contrary to common opinion that only heavy metals have a toxic potential, and light metals do not, the following should be noted: Not all heavy metals are toxic and not all light metals are non-toxic. About 14 of the 80 most common metals are essential to human beings and mammals. With a probability bordering on certainty, sodium, potassium, calcium and magnesium as well as the heavy metals iron, zinc, copper, manganese, nickel, chromium, vanadium, molybdenum and cobalt are to be considered as essential.

It is true that an insufficient supply of essential metals results in deficiency symptoms, but an excessive intake of them can cause poisoning symptoms. Nevertheless, intoxication with essential metals is less probable since the human organism has developed control mechanisms which ensure that, up to a certain degree, excessive quantities can be excreted. If, however, that de-

gree is exceeded, a toxic potential develops. The most notorious toxic and environmentally harmful heavy metals are lead, cadmium and mercury. Identifying the metals can shed a light on the base products used as well as on health risks and possible environmental hazards.

Test method: Quantitative determination according to DIN EN ISO 17294-2 using ICP-MS

Principle of analysis: Determination of 62 elements with ICP-MS, using rhodium and rhenium as internal standards;

Calibration of the ICP-MS apparatus using multi-element standards (simple linear).

The ICP-MS (inductively-coupled plasma mass-spectrometry) analysis method allows to detect a large number of elements in a short time and, due to its capability to detect elements reliably, it is one of the most common methods of trace element analytics.

This process is based on ionising the material to be analysed in a plasma at approximately 5000 °C. A high-frequency current is induced in ionising argon to generate the plasma. The resulting ions are transferred to the vacuum system of the mass spectrometer. Then, the beam of ions is divided in the mass spectrometer to yield ions with different masses.

Each element has at least one isotope with a mass that is unique and does not occur with any other natural isotope. Thus, its mass is a characteristic property of each element.

Digestion of the samples: After the vessel has been cleaned, 10 ml of nitric acid and 2 ml of hydrofluoric acid are added. The exact weight of the sample taken is recorded in the weighing protocol. These protocols are added to the process records and archived along with them. According to the work instructions for microwave digestion, the vessel is loaded into the system. Then, the total digestion process is carried out.

After the vessels have cooled down, they are opened carefully under the exhaust. The digestion vessel is filled with 38 ml water and, after mixing the content, part of the solution may be put aside as a blank value. The rest is discarded. Then, the vessel is flushed three times with ultra-pure water. After each use, the vessel must be cleaned again.

6.4.1 Determination in the original substancce

As a reference value, we use the limit values according to LAGA (working group of the German states on waste issues: www.laga-online.de): The assignment values Z 0 to Z 2 are the upper limits for each incorporation class when ground material is used for earthworks, road building, landscaping and landfill work (e.g. cap layers), for the filling of building pits and for land reclamation. In this context, the 'solid matter for soil' assignment values are applicable.

Z 0: Unrestricted incorporation

Z 1.1: Restricted incorporation of waste material for construction purposes in open sites

Z 1.2: Restricted incorporation of waste material for construction purposes in open sites in areas with favourable hydrogeological conditions

Z 2: Restricted incorporation of waste material for construction purposes with defined technical safety measures

Metals (element symbol)	**Measured value [mg/kg]**	**Upper limit assignment values [mg/kg]**				**Limit value IBR [mg/kg]**
		Z 0	**Z 1.1**	**Z 1.2**	**Z 2**	
Arsenic (As)	1	20	30	50	150	-
Cadmium (Cd)	0.2	0.6	1	3	10	-
Cobalt (Co)	< 1	-	-	-	-	200
Chromium (Cr)	4	50	100	200	600	-
Copper (Cu)	2	40	100	200	600	-
Iron (Fe)	800	-	-	-	-	-
Mercury (Hg)	< 0.1	0.3	1	3	10	-
Manganese(Mn)	100	-	-	-	-	-
Nickel (Ni)	8	40	100	200	600	-
Lead (Pb)	5	100	200	300	1000	-
Antimony (Sb)	< 1	-	-	-	-	200
Tin (Sn)	< 5	-	-	-	-	200
Zinc (Zn)	< 5	120	300	500	1500	-

6.4.2 Determination in the eluate

By determining the content in the eluate according to DIN 38414 S 4, a potential hazard to waters caused by metals should be excluded when the material is landfilled after its useful product life. Here the LAGA values are used as stated above. In this context, the 'eluate for soil' assignment values are applicable. In addition, the standards specified in the TVO (German Drinking Water Regulation) are used as reference values.

Principle of analysis: The sample material is eluted with water under defined conditions and the undissolved parts are separated by filtration. The concentrations of the components to be identified are determined from this using the methodology of water analytics.

Metals (element symbol)	Measured value [mg/l]	Upper limit assignment values [mg/l]					Limit value IBR [mg/l]
		Z 0	Z 1.1	Z 1.2	Z 2	TVO	
Arsenic (As)	< 0.005	0.01	0.01	0.04	0.06	0.01	-
Cadmium (Cd)	< 0.001	0.002	0.002	0.005	0.01	0.003	-
Cobalt (Co)	< 0.002	-	-	-	-	-	0.1
Chromium (Cr)	0.005	0.015	0.03	0.075	0.15	0.05	-
Copper (Cu)	< 0.005	0.05	0.05	0.15	0.3	2	-
Iron (Fe)	< 0.1	-	-	-	-	0.2	-
Mercury (Hg)	< 0.001	0.0002	0.0002	0.001	0.002	0.001	-
Manganese(Mn)	< 0.005	-	-	-	-	0.05	-
Nickel (Ni)	< 0.005	0.04	0.05	0.15	0.2	0.02	-
Lead (Pb)	0.001	0.02	0.04	0.1	0.2	0.01	-
Antimony (Sb)	< 0.001	-	-	-	-	0.005	0.1
Tin (Sn)	< 0.01	-	-	-	-	-	0.1
Zinc (Zn)	< 0.005	0.1	0.1	0.3	0.6	-	

Sample evaluation: All measured values are below the permissible limit values. The tested substances are not expected to have a harmful effect.

6.5. Formaldehyde

Formaldehyde (HCHO) is used e.g. as a component of binding agents in wood-based materials and mineral fibre insulation, flooring and carpet adhesives and parquet sealing products, but also in-can preservatives in paints and coatings as well as cleaning agents and detergents.

Formaldehyde is part of the aldehyde substance group. In its free form, it is a colourless gas with a pungent odour that can be smelled even in minimal concentrations. It dissolves readily in water or alcohol and is then called formalin. In nature formaldehyde is found e.g. in the cells of mammals as an intermediate product of the normal metabolism, and is produced by photooxidation in the atmosphere.

Formaldehyde may be released from products as a gas under certain circumstances and can represent a health hazard. By far the largest proportion of formaldehyde however goes into the production of plastics, such as urea-formaldehyde resins or other aminomplastics that require formaldehyde for cross-linking. Formaldehyde can be emitted here in the long term as an aerosol.

There is reason to suspect that formaldehyde has carcinogenic potential.

Test procedure: formaldehyde emissions are determined according to the following standards:

- DIN EN 717-1: Formaldehyde emission quantities according to the test chamber method
- DIN EN ISO 14184-1: Determination of free and purgeable formaldehyde
- DIN EN 120: Formaldehyde content according to the perforator method

The respective official standard values of the Federal Ministry of Health and/or the World Health Organisation (WHO) are used to evaluate formaldehyde emissions:

Limit or reference values	**Requirement**
WHO ("concentration with no or low concern")	60 µg/m³ (0.05 ppm)
WHO standard value	96 µg/m³ (0.08 ppm)
Federal Ministry of Health (intervention value)	120 µg/m³ (0.10 ppm)
Reference value stipulated by the Institut für Baubiologie Rosenheim GmbH	60 µg/m³ (0.05 ppm)

The measurements were taken in 3 tests as listed below:

Test	**Formaldehyde concentration in ppm**
1	Not detectable
2	n / a
3	n / a
Average	0.00

Sample evaluation: The tested product meet both the official standard value of the Federal Ministry of Health at 0.1 ppm and the strict standard of the World Health Organisation (WHO) and the IBR of 0.05 ppm. There is no harmful effect from formaldehyde.

6.6 Fine dusts

Dusts are defined as dispersed solid particles in gases. Dust dispersion may be caused by mechanical processes or by forces stirring up particles. Like smoke and mist, dusts are aerosols. Aside from the specific damaging effects inherent in the dust particle, the particle concentration, the exposure period and the particle size also influence the assessment of the health hazards due to dust. This distinguishes the assessment of dust hazards from the assessment of gases or steam. The dust is taken up via the respiratory system. The characteristics of particles in streaming gases largely determine the transport and deposition of the dust inside the respiratory

tract. The smaller the particle size is the deeper it can penetrate the respiratory tract where it settles and causes health problems. Dust may cause problems from allergic reactions of the mucous membranes to certain cancers of the respiratory tract. Limit values for dust exposure at work have existed for a long time. As a general rule, by comparison with the home environment, the dust exposure at work is considerably more pronounced. On the other hand, people spend considerably more time at home than at work. It is therefore important to also assess whether a product is liable to be the source of fine dust in the living environment of people.

Definition: The largest respirable particles settle in the nose and throat area. Particles that are smaller than 25 µm can move and settle in the tracheobronchial tree. Fibrous particles up to 10 µm in length are able to move as far as the alveoli (tiny air sacs in which the gas exchange takes place in the lungs), where they can settle providing the diameters of the fibres are less than 3 µm and their densities resemble the densities of minerals. It is this latter portion of the entire dust content which is assed in the building biology tests. This portion penetrates all parts of the respiratory tract including the alveoli. While a product may appear to create a lot of dust at first glance, this does not necessary mean that it also contains fine dust, which may move to the alveoli and settle there.

Dependent on the particle size, fine dust is separated into two fractions:

PM 10 (aerodynamic diameter < 10 µm) – defined as 'coarse fraction'

PM 2.5 (aerodynamic diameter < 2.5 µm) – defined as 'fine fraction'

The PM 2.5-fraction is a portion of the PM 10-fraction.

Test procedure: The fine dust content is determined according to the following standards:

- DIN 53808-1: Determination of the fibre length – individual fibre measurement
- DIN EN ISO 1973: Fineness
- DIN 53811: Determination of the longitudinal fibre diameter in micro-projection
- DIN 53803-2: Practical execution of the sampling
- DIN EN ISO 12341: Air quality – determination of the PM10-fraction
- VDI-Guideline 3866: Determination of asbestos in technical products

Fibre and fine dust determinations always include assaying the fibre length and fibre diameter as well as the statistical assessment of the existing dust mixture. The stream volume determines what measuring device is used, e. g. LVS (Low Volume Sampler), HVS (High Volume Sampler) and others.

In the performed assays, the average fibre length was ___ µm.

The average measured diameter of the fibres was ___ µm.

Sample evaluation: The use of the tested product is not expected to pose a fine dust hazard. Neither the traces of dust nor the traces of fine dust were present in the fibrous form, which is prerequisite to the inhalation of dust particles into the alveoli.

7. Closing Remarks

These seal of approval guidelines do not claim to be complete. All information is provided according to the best knowledge and ability. Claims due to incompleteness and/or incorrect information regarding test characteristics are excluded.

Within the scope of an internal CIP (continuous improvement process), the IBR always strives to improve, enhance and expand the procedures.

Awarding the seal of approval does not replace the applicable responsibility of the manufacturer to ensure effective internal and/or external monitoring of its products by an accredited facility.

The manufacturer may only use the seal of approval for the specific products for which it was awarded. The manufacturer is obligated to refrain from any attempts to mislead consumers regarding the products for which the seal of approval has and has not been awarded. This also applies to the term "TESTED AND APPROVED BY THE IBR".

The "IBR" mark may only be used as a constituent part of the seal of approval. In case of misuse, the IBR may prohibit the use of the seal of approval without notice.

Tested and recommended
Institut für Baubiologie Rosenheim GmbH
IBR ®
Product tested for
VOC · biocides · heavy metals
and radioactivity

Rosenheim, January 2021

Reimut Hentschel | Managing Director

Dr. Nicole Kniewasser | Dipl.-Chem.