

LEED®

—

A new challenge for low VOC emitting materials

Reinhard Oppl

**Eurofins Product Testing A/S
Galten, Denmark and San Ramon, CA**

Dr. Roland Augustin

**Eurofins Consumer Product Testing GmbH
Hamburg, Germany**

Global Presence Eurofins (Product Testing)



- **Sustainable building rating system**
- **LEED®**
 - **Leadership in Energy and Environmental Design**
 - **Latest version as of 2009**
 - **Created and administered by US Green Building Council
US GBC®**
- **LEED® building projects**
 - **Project teams – collecting points**
 - **Audits – checking realization of plans**
 - **Green Building Certification Institute – assigning
sustainability level**
- **Products can NOT be certified**



■ LEED® criteria are on:

- Energy savings
- Water efficiency
- CO2 emissions reduction
- Indoor environmental quality
- Resources
- Waste
- Transport

■ LEED® specifications:

- Commercial Interior
- New construction
- Existing buildings
- Core and Shell
- Schools
- Homes
- Retail (draft)
- Healthcare (draft)
- Neighbourhood (draft)

- **Established and administered by
US Green Building Council US GBC®**
- **Copies and modifications in:**
 - **Italy**
 - **Dubai**
 - **Australia**
 - **China**
 - **...**
- **In most cases copies of 2005 version of LEED**

- **Large variety**
- **USA: GBI (Green Building Initiative)**
- **UK: BREEAM**
- **F: Démarche HQE**
- **D: DGNB**
 - **Harmonization approach within Europe:**
 - **SB Alliance**
- **Many other initiatives, e.g.**
 - **Sentinel house**
 - **EPEA “cradle-to-cradle” approach**
 - **...**

- **Products can NOT be certified**
 - Building projects earn points for achieving high ranking
 - Use of low VOC products can help earning such points by fulfilling specifications, “credits”
 - Product testing may deliver essential documentation for showing compliance with IEQ credits
 - Final decision on acceptance is with the GBCI auditor
- **US GBC® logo on a product means nothing more than:**
 - Manufacturer is member of US GBC®
- **Challenge for European manufacturers:**
 - Have to show compliance with US standards
 - European labels are not accepted (EMICODE, GUT, Blue Angel, M1, ...)



- **Developed as purchase criteria in California**
 - In conjunction with CHPS for schools
- **Based on VOC emission testing**
 - After 10 days storage, then 4 days in test chamber
 - Results calculated for class room and office room
- **Testing:**
 - After (in total) 11, 12 and 14 days
- **Evaluation:**
 - Limit values: CREL (chronic respiratory exposure levels)
 - 40-50 of VOCs are on CREL list of 2003
 - No TVOC limit value in California
 - Other applications added TVOC 500 $\mu\text{g}/\text{m}^3$ (e.g. FloorScore)
- **Revision is on-going in 2009 / 2010**

- **SCAQMD: South Coast Air Quality Management District (around and including Los Angeles)**
 - **Limitation of VOC content (against ground level ozone)**
 - Different limits per US State, and even per county
 - Most stringent: SCAQMD – taken as LEED limit values
 - SCAQMD rules 1113 & 1168 & method 304, EPA method 24:
 - Total volatiles by weight loss after 1h drying at 110 °C
 - Total volatiles may include water:
 - Subtraction of water fraction of the product
 - Water-based paints are rated worse than in EU
 - Total volatiles may include non-ozone generating VOC:
 - Subtraction of “exempt” compounds

$$\frac{(W_{vm} - W_w - W_e)}{(100 - V_w - V_e)}$$

- **SCAQMD method – severe drawbacks**
 - **Reactive products**
 - **May stand 1 hour before testing**
 - **Low VOC products**
 - **High uncertainty**
 - **Partial solution: Direct injection method similar as for Decopaint Directive**
 - **Problems with Karl-Fisher water determination**
 - **Bad solubility, e.g. with reactive products, and with concrete based products**
- **Within LEED:**

Certain movement away from these content-based VOC specification for next LEED version in 2012

- **LEED® credits for products and indoor air quality:
Indoor Environmental quality IEQ credits 4.1 - 4.6**
 - **Not all LEED® specifications contain all IEQ credits**
 - **Content of IEQ credits may vary between specifications**

 - **IEQ 4.1: Adhesives and sealants**
 - **IEQ 4.2: Paints and coatings**
 - **IEQ 4.3: Floorings**
 - **IEQ 4.4: Composite Wood and Agrifiber products**
 - **IEQ 4.5: System furniture and seating**
 - **IEQ 4.6: Ceiling and wall systems**

■ Mostly:

■ Limitation of VOC content (against ground level ozone)

- Even though NO direct correlation between VOC content and VOC long-term emissions

- Was taken as surrogate for indoor air criteria

■ SCAQMD rule 1168, EPA method 24, SCAQMD method 304:

■ Examples (Total volatiles minus water ...):

- Flooring adhesives 50 g/l

- Rubber floor adhesives 60 g/l

- Wood floor adhesives 100 g/l

- Indoor sealants 250 g/l

■ LEED for schools:

- Compliance with California Section 01350

■ Mostly:

- Limitation of VOC content (against ground level ozone)
 - Even though NO direct correlation between VOC content and VOC long-term emissions
 - Was taken as surrogate for indoor air criteria
- SCAQMD rule 1113, EPA method 24, SCAQMD method 304
- Higher limits than in EU Decopaint Directive
- Examples (Total volatiles minus water ...):
 - Interior wall and ceiling coatings 50 / 150 g/l
 - Wood coating 350 – 550 g/l
 - Floor coatings 100 g/l

■ LEED for schools:

- Compliance with California Section 01350

- **Carpet and Rug Institute (CRI) Green Label Plus (GLP)**
 - 14 days test (California Section 01350)
 - Annual / quarterly test, TVOC / 13 specific VOC
- **Option 1:**
 - Meet testing and product requirements of CRI GLP program. Proof: CRI certification
- **Option 2:**
 - Meet testing and product requirements of CRI GLP program. Proof: Testing in an independent laboratory
- **Option 3:**
 - Meet requirements of California Section 01350 specification
Proof: Testing in an independent laboratory
- **All flooring adhesives < 50 g/l “VOC”**

- **Option 1:**
 - **FloorScore certification (emissions limits as in California Section 01350 specification)**
Proof: FloorScore certification by SCS, working with BAA and Eurofins as testing labs
- **Option 2:**
 - **Meet testing and product requirements of California Section 01350 specification**
Proof: Testing in an independent laboratory
- **All concrete, wood, bamboo, and cork floor finishes shall comply with IEQ credit 4.2**

- **Covering:**
 - Particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, door cores.
- **Mostly:**
 - Must contain no added urea-formaldehyde resins when used on the interior of the building.
 - Same applies to lamine adhesives used in composite wood and agrifiber assemblies.
 - Testing is not required.
- **LEED for schools:**
 - Compliance with California Section 01350

- **Limit values to be respected in a model office room:**
 - **System furniture:**
 - **TVOC - 0.5 mg/m³**
 - **Formaldehyde - 50 ppb**
 - **Total aldehydes - 100 ppb**
 - **4-Phenylcyclohexene - 0.0065 mg/m³**
 - **Seating:**
 - **Half the values of system furniture**

- **Proof of compliance:**

- **Option 1:**
 - **ANSI BIFMA X7.1/M7.1 compliance, proved by testing in an independent laboratory, or certification by SCS or NSF**

- **Option 2:**
 - **Greenguard Indoor Air Quality Certified**

- **Option 3:**
 - **Testing in an independent laboratory in line with 1999 EPA Large Chamber Test Protocol**

- **Compliance with California Section 01350**

Global list of some low VOC labels



- **DIBt, Germany** (floorings)
- **VOC regulations and AFSSET, France** (several building products)
- **M1, Finland**
(all building products)
- **Blue Angel, Germany**
(many different products)
- **Umweltzeichen, Austria**
(many different products)
- **Indoor Air Comfort, Europe**
(several products)
- **Danish Indoor Climate Label**
(many building products)
- **Nordic Ecolabel ("Swan")**
(several building products)
- **GuT, Europe** (carpets)
- **EMICODE, Europe**
(adhesives, sealants and more)
- **CertiPUR, Europe** (PUR foam)
- **CertiPUR US** (PUR foam)
- **Californian Section 01350 / LEED**
(many building products + furniture)
- **FloorScore, USA** (floorings)
- **BIFMA, USA** (office furniture)
- **Indoor Advantage, USA**
(several products)
- **CRI, USA** (carpets)
- **Green Label, Hong Kong**
(several products)

Global labels – accepted in LEED credits



- *DIBt, Germany (floorings)*
- *VOC regulations and AFSSET, France (several building products)*
- *M1, Finland (all building products)*
- *Blue Angel, Germany (many different products)*
- *Umweltzeichen, Austria (many different products)*
- *Indoor Air Comfort, Europe (several products)*
- *Danish Indoor Climate Label (many building products)*
- *Nordic Ecolabel ("Swan") (several building products)*
- *GuT, Europe (carpets)*
- *EMICODE, Europe (adhesives, sealants and more)*
- *CertiPUR, Europe (PUR foam)*
- *CertiPUR US (PUR foam)*
- **Californian Section 01350 / LEED (many building products + furniture)**
- **FloorScore, USA (floorings)**
- **BIFMA, USA (office furniture)**
- **Indoor Advantage, USA (several products)**
- **CRI, USA (carpets)**
- *Green Label, Hong Kong (several products)*

- **Now: Double testing necessary**
if a product with low VOC emissions shall be placed on different national markets
- **VOC workshop at Healthy Building Conference 2009:**
 - Increase mutual knowledge of the different rating systems
 - Open up for starting a process of
 - Mutual recognition of low VOC emission labels
 - Mutual recognition of test results, if necessary by changing the respective test methods
 - No change expected within few months, but why not within next few years
 - No easy task because many experts think that his home system is the only true one

- **Comparable elements between Europe and USA:**
 - Temperature, relative humidity (23°C / mostly 50% RH)

- **Easy to solve differences**
 - Geometry of reference rooms
(residential vs. office and class room scenarios)
 - Ventilation in reference rooms
 - Loading factor (m²/m³) in reference rooms
 - Can be solved by simple recalculation
 - e.g. double ventilation => 50% air concentration
 - Ventilation and loading in test chamber
 - Can be solved by allowing larger tolerance interval
 - e.g. air change: 0.25 – 1.5 per hour

- **Difficult to solve differences**
 - Limit values
 - TVOC or no TVOC
 - Single VOC limit values

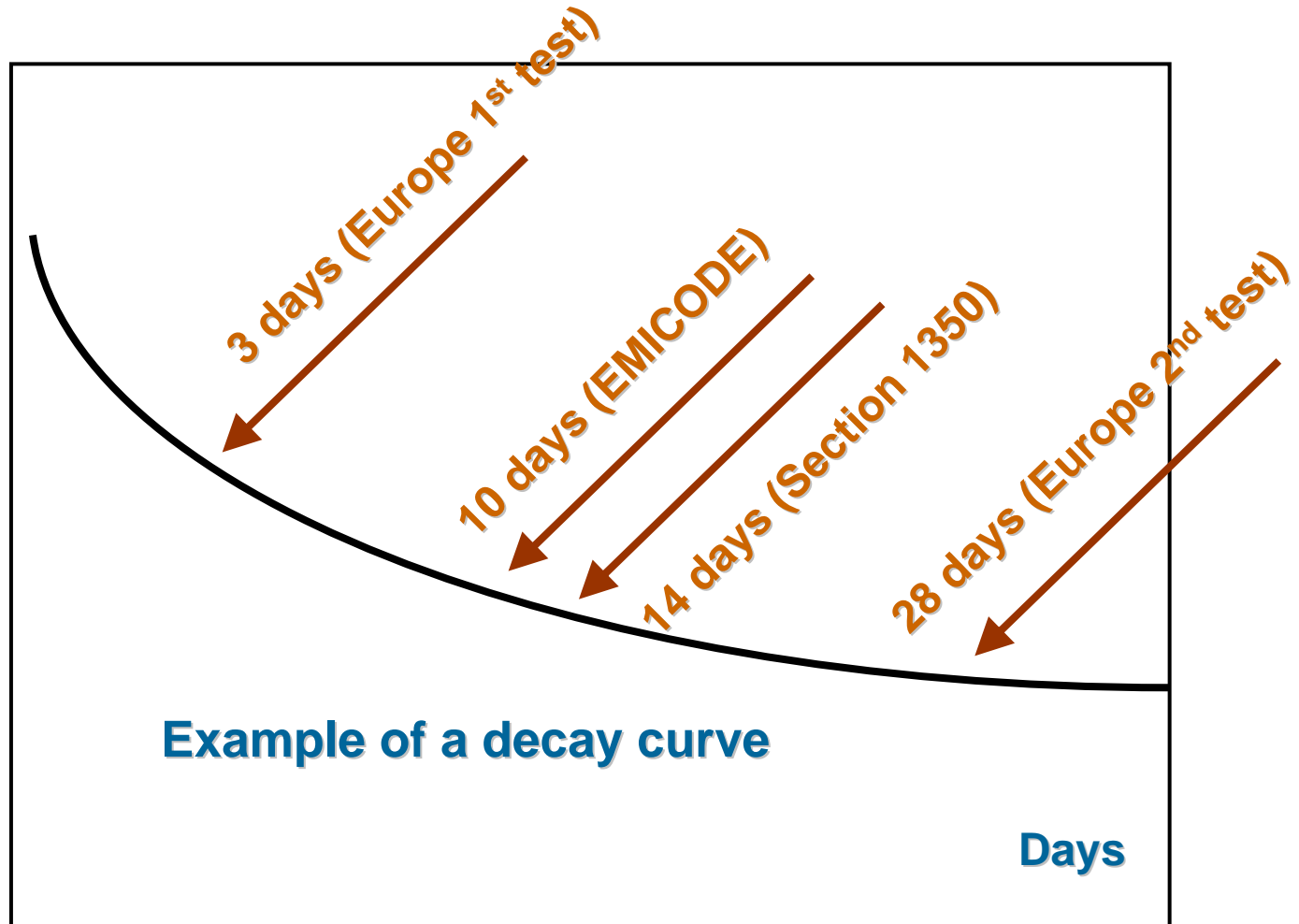
 - Time schedule of testing
 - After 3 days plus 28 days?
 - After 28 days only?
 - After 14 days?
 - After 10 days, 7 days,

	ISO 16000-9	New CEN standard	CA office	CA classroom
Floor m²	7	12	11.1	89.2
Height m	2.5	2.5	2.7	2.6
Volume m³	17.4	30	30.6	231
Loading m²/m³	depending on what product (wall, floor, ...)			
Temperature °C	23	23	23	23
Relative Humidity %	50	50	50	50
Effective air change / h	0.5	0.5	0.675	0.81

	ISO 16000-9	New CEN standard	EN 717-1	CA Section 01350
Size	open	min. 20 l	0.225 – 12 m³	20 – 100 l
Loading, floor	(0.4)	0.4	–	0.3 – 0.7
Loading, wall	(1.4)	1.0	1.0	0.3 – 0.7
Effective air change / h	(0.5)	0.25 – 1.5	1.0	1.0 ± 0.05
Temperature °C	23 ± 2	23 ± 1	23 ± 0.5	23 ± 1
Relative Humidity %	50 ± 5	50 ± 5	45 ± 3	50 ± 5

ISO: The ratio between ventilation and loading is fixed, not absolute values

Emissions



Combination of different tests, examples:

Test Parameter	AgBB, DIBt, Blue Angel	AFSSET French law	EMICODE	Section 1350	M1
TVOC 3 d	X	X —	—	(11 + 12 d)	
TVOC 28d	X	X X	(10 d)	(14 d)	X
TSVOC 28 d	X	— —	—	(11 + 12 d)	
Aldehydes 28 d	X	X X	(1 day)	(14 d)	X
LCI, R value (total LCI)	X	X individual limits	—	CREL	—
Odor	—	—	—	—	After 28 d

- **Paints, coatings, adhesives, sealants:**
 - EU Decopaint Directive is more stringent than LEED limits
 - EU labels with VOC emission limitation are more stringent than LEED VOC content requirements
 - EU labels with VOC emission limitation are more stringent than LEED VOC emission requirements
- **Floorings, furniture, wall elements:**
 - EU labels with VOC emission limitation are more stringent than LEED VOC emission requirements
 - Mainly because of lower limits, and limits for more VOC
- **Composite wood products:**
 - LEED is more stringent than European labels

- **EMICODE showed to be at least comparable with Section 01350**
- **GUT showed to be at least comparable with CRI GLP**
- **US limit values seem lower than they are because of higher ventilation in reference room (higher ventilation = more dilution of emissions)**
- **Nevertheless, as of today:**
 - **NO European ecolabel is accepted as proof for LEED compliance of products**
 - **Work is ongoing for a change, but when ... ?**

- **Wooden products and any floorings:**
 - **E1 formaldehyde class, no regulated wood preservatives**
- **Suspended ceiling tiles:**
 - **E1 formaldehyde class applies, and no asbestos is used.**
- **Flooring adhesives:**
 - **No carcinogens & no sensitizers emitted as EN 13999-1**
- **Wall coverings:**
 - **Low emissions of formaldehyde & vinyl chloride monomer**
 - **Low migration of heavy metals & other toxic substances**
- **Adhesive for hanging flexible wall coverings**
 - **No harmful substances, preservatives of minimum toxicity.**
- **Decorative paints and varnishes**
 - **VOC content: Phase 2 EU Decopaint Directive.**
 - **Fungal and algal resistant.**

- **Indoor air measurement after completing the building.**
- **Use of low emitting products - additional points**
 - **ISO 16000 emissions test by accredited test lab**
 - **Accepted as proof:**
AFFSSET, AgBB, EMICODE, GUT, M1, formaldehyde E1
- **Points are granted a.o. for:**
 - **Knowledge of VOC and formaldehyde emission level for 25%, 50% or 100% of interior surfaces**
 - **CMR substances within limits of the accepted labels**
 - **Emissions of all products on floor, wall and ceiling below**
 - **1000 or below 250 $\mu\text{g}/\text{m}^3$ - TVOC**
 - **62.5 or 40 or 20 or 10 $\mu\text{g}/\text{m}^3$ - formaldehyde**
 - **5 or 2.5 or 1 $\mu\text{g}/\text{m}^3$ - class 1 and class 2 carcinogens**

- **Indoor air measurement**
 - max. 4 weeks after completing the building

- **Use of low emitting products**
 - **no additional points**
 - **But this may help achieving good result of indoor air measurement**

- **Growing movement**
- **Surviving US economic crisis**
- **Driven by economics:**
 - **Sustainability of a building gives**
 - **Higher ranking in balance – good for share price**
 - **Higher rental price**
 - **Higher sales price**
- **Regional specifics will gain importance**
 - **Within LEED – regional credits planned**
 - **With more different local rating schemes**
 - **By market and competition driving forces**
- **Additional push for low VOC products**

Further reading

- [Eurofins.com](#)
- [Print this page](#)
- [Contact us via email](#)
-

Eurofins Worldwide

Select a country



Careers at Eurofins

Select a country

Eurofins Product Testing - Your Industry. Our Focus.

Exemplary Testing:

- [ATEX](#)
- [Chemical Safety](#)
- [Electrical Safety](#)
- [EMC](#)
- [LEED Compliance](#)
- [VOC Emission Testing](#)
- [Migration Testing](#)
- [Panel Testing](#)
- [Performance Testing](#)
- [Photovoltaic Testing](#)

Exemplary Consulting:

- [Eco-label application](#)
- [Individual testing programs](#)
- [Indoor Air Comfort certification](#)
- [Machinery Safety](#)
- [REACH and GHS](#)
- [RoHS compliance](#)

Exemplary Inspections:

- [Pre-Shipment Inspections](#)
- [Lift & Elevator Inspections](#)
- [Factory Inspections](#)

Industries:

- [Automotive](#)
- [Chemical](#)
- [Construction Products](#)
- [Cosmetics](#)
- [Furniture](#)
- [Household Appliances](#)
- [Hygiene](#)
- [IT](#)
- [Medical Devices](#)
- [Packaging](#)
- [Professional Appliances](#)
- [Renewable Energy](#)
- [Toys](#)
- [Wireless/Radio](#)

Services for Retailers

Tested Products

Certification of Products and Sites



[Home](#) > [Testing](#) > [Safety - Chemical/Electrical/Fire](#) > [Chemical Safety](#) > [Emission into Indoor Air](#) > [Indoor air limit values \(LCI, NIK, CLI, CREL, ...\)](#)

Eurofins Product Testing - Indoor air limit values (LCI, NIK, CLI, CREL, ...)

Back to [main page on emission testing](#).

LCI, CLI, NIK, and CREL values are used by several emission rating schemes as limit values for evaluating emissions of VOC into indoor air (

**** Updated by July 20, 2009 ****

[Here you can download](#) a **comparison of limit values** for emission into indoor air.

The sources are:

German [LCI / NIK values](#) -

- in German: www.umweltbundesamt.de/bauprodukte/agbb.htm

- in English: www.umweltbundesamt.de/building-products/agbb.htm

French [AFSSET](#) - CLI values:

- in French: www.afsset.fr

Californian CREL values, used for [Section 01350](#), [BIFMA](#), [Floor Score](#), [CRI GLP](#), [Indoor Advantage Gold](#), CHPS, and more programmes: [www](#)
note: These programmes require 1/2 CREL shall not be exceeded for any substance, with the exception of formaldehyde and acetaldehyde.

LCI, CLI, NIK, and CREL values will determine partly future product development and technical trends for a number of interior finishing products.
air.

[Eurofins.com](#)[Print this page](#)[Contact us via email](#)[CE marking](#)[Compliance with law](#)[CPSIA](#)[Customer Specifications](#)[= Ecolabels, Quality Labels](#)[Indoor Air Comfort - Eurofins certified products](#)[LEED](#)[Indoor Advantage \(SCS\)](#)[AgBB / DIBt](#)[German Ü mark](#)[AFSSET Guideline](#)[EMICODE label](#)[GUT label](#)[German Blue Angel](#)[M1 Finnish label](#)[Section 01350](#)[FloorScore label](#)[CRI Green Label](#)[BIFMA labels](#)[Danish Indoor Climate label](#)[Home](#) > [Topics](#) > [Ecolabels, Quality Labels](#)

Eurofins Product Testing - Ecolabels, Quality Labels

For more information

- on legal requirements [please click here](#)
- on VOC emission testing [please click here](#)
- on LEED and Green Buildings [please click here](#).

Quality labels tell you about product performance, and environmental labels (ecolabels) tell you that the product has lower impact on the environment. These labels are private and voluntary.

Some countries established **compulsory evaluation** of certain properties, such as European [CE marking](#), German [GS marking](#), restriction in [California](#), in [France](#) and in [Germany](#), and quite some more.

Sustainability of the product through its life time is the basis for some but not all **ecolabels**.

VOC emissions from construction products relevant for indoor air quality are regulated in Germany ([AgBB guidance](#) and [DIBt Ü](#) information in [English](#), in [German](#), in [French](#)), [in France](#), and in [Japanese regulations](#). For formaldehyde there is more regulation in the Californian [CARB regulation](#). But in many other countries this issue is subject to voluntary ecolabelling schemes.

Please see also presentations by [different VOC emissions rating schemes](#) and potential for harmonization (VOC workshop at Health

Some examples for such low VOC emission rating schemes are:

- [European Flower](#)
- [Blue Angel](#) (Germany)
- [Nordic Swan](#) (Scandinavia)
- [Umweltzeichen](#) (Austria)
- [EMICODE](#) (Adhesives and more, Germany/Europe)
 - Emicode label (information in [English](#), in [German](#), in [French](#))
- [GUT](#) (Carpets, Germany/Europe)
- prEN 15052, ISO/DIS 10580 (Resilient (flexible) floor coverings),
 - (information in [English](#), in [French](#))

- Eurofins.com
- Print this page
- Contact us via email
- Search
- CE marking
- Compliance with law
- CPSIA
- Customer Specifications
- Ecolabels, Quality Labels
- Energy Saving Lamps
- GHS
- Green Buildings**
- LEED basics
- LEED specifications
- LEED for Adhesives and Sealants
- LEED for Paints and Coatings
- LEED for Textile Flooring Systems
- LEED for non-Textile Flooring Systems
- LEED for Composite Wood and Agrifiber Products
- LEED for System Furniture and Seating
- LEED for Ceiling and Wall Systems
- British BREEAM
- French HQE

Home > Topics > Green Buildings

Eurofins Product Testing - Sustainable or "Green" Buildings

For more information

- on legal requirements [please click here](#)
- on VOC emission testing [please click here](#)
- on ecolabels [please click here](#).

"Green Buildings" is a growing movement in a number of countries, namely in the USA, but other countries are experiencing similar developments towards sustainable buildings.

Sustainable building means that energy consumption, use of resources, impact on environment and on human health are considered and optimised during use and demolition - throughout the whole lifecycle of the building. This is also called sustainable building.

More and more public buildings and large office buildings are built green, but also some residential complexes, schools and hospitals are following the **Motivation** is either to raise quality and the sustainability of a building in general and to support environmental protection, or to contribute to Corporate facilitate marketing of the building with green performance.

There are no uniform **criteria for what is considered to be "Green" or sustainable**. The best known approach is

- [LEED by U.S. Green Building Council \(USGBC\)](#)
- along with
 - [Green Building Council Italia](#)
 - [Emirates Green Building Council](#)
 - [Green Building Council Hongkong](#)

Other criteria have been or are about to be published by

- [French HQE](#)
- [German DGNB](#) ("Nachhaltiges Bauen")
- [British BREEAM](#)
- [Estidama](#), Abu Dhabi
- [Green Building Council of Australia's \(GBCA\)](#)

and more. International initiatives can be monitored on websites of the [International Initiative for a Sustainable Built Environment \(IISBE\)](#), [World Green Building Council](#) [Wikipedia](#). The [SB Alliance](#) is trying to harmonise the Green Building criteria Europe-wide.

LEED®

—

**A new challenge
for low VOC emitting materials**

Reinhard Oppl

**Eurofins Product Testing A/S
Galten, Denmark and San Ramon, CA**

Dr. Roland Augustin

**Eurofins Consumer Product Testing GmbH
Hamburg, Germany**