BEYOND
SMART CITIES
INDOOR ENVIRONMENTAL QUALITY - GREEN BUILDING TECHNOLOGY TRAINING PROGRAM
FOR GREEN BUILDING AND SUSTAINABILITY SPECIALISTS
KRISHNAJI PAWAR,LEED AP BD+C,GSAS CGP,ISO 14001:2015,GCP
GREEN BUILDING SPECIALIST CURRICULUM

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LOW-EMITTING MATERIALS - CREDIT
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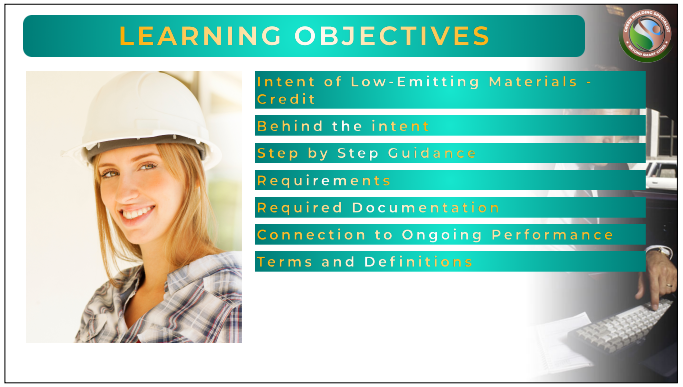

LEARNING OBJECTIVES
Intent of Low-Emitting Materials - Credit
Behind the intent
Step by Step Guidance
Requirements
Required Documentation
Connection to Ongoing Performance
Terms and Definitions

IEQ- CR(3) - CONSTRUCTION

LOW-EMITTING MATERIALS

Intent

To reduce concentrations of chemical contaminants that can damage air quality and the environment, and to protect the health, productivity, and comfort of installers and building occupants.

Requirements

Use materials on the building interior (everything within the waterproofing membrane) that meet the low-emitting criteria below. Points are awarded according to Table 1:

Table 1. Points for low-emitting materials

2 product categories	1 point
3 product categories	2 points
4 product categories	3 points
5 product categories	3 points + exemplary performance
Reach 90% threshold in at least three product categories	Exemplary performance *or 1 additional point if only 2 points are achieved.*

Potential Technologies & Strategies

Project teams should specify products that meet the compliance thresholds established by recognized standards, or choose products classified as inherently nonemitting (see Further Explanation, About the Referenced Standards). Ideally, all interior building materials—from furniture and furnishings to thermal and acoustic insulation and the interior finishes of all floors, walls, and ceilings—would be compliant. This credit, however, uses a holistic systems approach that rewards teams for partial compliance, recognizing compliance of product assemblies even if some of their elements do not meet the applicable standard.

Implementation

REQUIRED DOCUMENTATION

Documentation	Option 1	Option 2
USGBC low-emitting materials calculator	X	X
Product information (e.g., MSDS, third-party certifications, testing reports)	X	X

BEHIND THE INTENT

BEHIND THE INTENT

Many types of chemicals, both engineered and naturally occurring, are present everywhere. Volatile organic compounds (VOCs) are chemicals that are released into the air from numerous materials—some of them natural, humanmade, plant-based, and from animals, including people. Prolonged exposure to high concentrations of some VOCs has been linked to a wide range of chronic health problems such as asthma, chronic obstructive pulmonary disease, and cancer. Short-term exposure to VOCs can also cause acute reactions, such as eye, nose, and throat irritation.

Some VOCs are present in the natural environment; however, higher concentrations of VOCs are typically found indoors, where reduced air ventilation and numerous sources of VOCs may exist. Although completely eliminating exposure to all VOCs is impossible, specifying low-emitting and nonemitting products will significantly reduce the strength and quantity of VOC exposure indoors.

Project teams should specify products that meet the compliance thresholds established by recognized standards, or choose products classified as inherently nonemitting (see *Further Explanation, About the Referenced Standards*). Ideally, all interior building materials—from furniture and furnishings to thermal and acoustic insulation and the interior finishes of all floors, walls, and ceilings—would be compliant. This credit, however, uses a holistic systems approach that rewards teams for partial compliance, recognizing compliance of product assemblies even if some of their elements do not meet the applicable standard.

This credit addresses each layer of wall, flooring, and ceiling interior finish—a methodology that is conservatively protective of occupants, given that the emissions from layers that are not directly exposed to air are tested separately.

Air concentration measurements from chamber testing are a much better predictor of emissions over time than VOC content limits. However, chamber emissions testing is generally more expensive, less widely adopted for wet-applied products, and unable to evaluate emissions generated at the time of application. The credit still limits VOC for on-site wet-applied products, in part to avoid environmental damage (e.g., smog formulation) and in part to protect the people who apply these products or are exposed to them during installation.

STEP-BY-STEP GUIDANCE

STEP 1. DETERMINE HOW PROJECT IS VENTILATED

Determine whether the project will use mechanical ventilation, natural ventilation, or a mixed-mode approach (see EQ Prerequisite Minimum Indoor Air Quality Performance).

STEP 2. SELECT ONE OR BOTH OPTIONS

Determine which option(s) and strategies the project will pursue, based on the information in Table 2 and the credit requirements.

- Option 1 requires implementing all strategies applicable to the project's ventilation system type.
- Option 2 requires implementing one strategy applicable to the project's ventilation system type. If multiple ventilation system types are used (i.e, mixed mode), only one strategy needs to be attempted. For example, if a space is both naturally and mechanically ventilated, the project team could select carbon dioxide monitoring and implement this strategy by installing monitors that operate whenever the space is operating in mechanical ventilation mode. Similarly, if the project has both naturally and mechanically ventilated spaces, it could also select carbon dioxide monitoring and implement this strategy by installing monitors in all mechanically ventilated spaces.

TABLE 2. Ventilation systems and credit requirements

Option 1. Enhanced IAQ strategies					
	Entryway systems	Interior cross-contamination prevention	Filtration	Natural ventilation design calculations	Mixed-mode design calculations
Mechanically ventilated space	Required	Required	Required	N/A	N/A
Naturally ventilated space	Required	N/A	N/A	Required	N/A
Mixed-mode system	Required	Required	Required	Required	Required

Option 2. Additional enhanced IAQ strategies					
	Exterior contamination prevention	Increased ventilation	Carbon dioxide monitoring	Additional source control and monitoring	Natural ventilation room-by-room calculations
Mechanically ventilated space	Select 1 of 4				N/A
Naturally ventilated space	Select 1 of 3	N/A	N/A	Select 1 of 3	
Mixed-mode system	Select 1 of 4		N/A	Select 1 of 4	

STEP-BY-STEP GUIDANCE +

STEP 1. RESEARCH AND SPECIFY LOW- OR NONEMITTING FINISHES AND FURNITURE

Review project documents to identify all applicable products and specify them as low- or nonemitting.

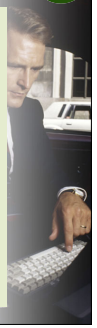
Research products that meet the requirements by having one or more of the following characteristics:

- The product is inherently nonemitting. Examples of nonemitting products are stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete, clay brick, and unfinished or untreated solid wood flooring, provided they do not include integral organic-based surface coatings, binders, or sealants (see *Further Explanation, Inherently Nonemitting Materials*).
- The manufacturer has self-declared the product's compliance and provides appropriate documentation, as outlined in the credit requirements.
- The product has third-party certification of compliance.

In most cases, turning to third-party certification to recognized guidelines, such as California Department of Public Health (CDPH) Standard Method v1.1, is the easiest way to find and specify products; in other cases, self-declared compliance to a standard, such as South Coast Air Quality Management District (SCAQMD) Rule 1113, is widespread and sufficient. Check that the appropriate version of the testing method was used to test the product. Check the USGBC website for an up-to-date listing of certification programs that test to the referenced standards. (see *Further Explanation,Testing Standards*).

Provide the contractor with detailed specifications to ensure that the team has the information needed to meet the credit requirements. The design team should specifically call out products that have been researched and confirm that they meet the credit requirements.

Request the specific documentation that will be required for the certification review, such as material safety data sheets (MSDS), third-party certificates, and test reports from subcontractors; this will help in procuring compliant products. Certificates must state the testing methodology and the model as



STEP-BY-STEP GUIDANCE +

appropriate. The units must be stated and be consistent with those as required. For wet-applied products, the manufacturer must state each product's classification and application according to the referenced standard's definitions or be otherwise justified; how it's used in the project does not count as justification. For example, a defined roof coating is not a carpet adhesive simply because it was used this way on the project. If the product is classified as a roof coating under SCAQMD, it must meet the appropriate limit for roof coatings.

Specifying only compliant products is the easiest way to ensure that the credit requirements are met and the building will have the lowest possible emissions. But Option 2 allows project teams to substitute a noncompliant product if necessary.

For the options that apply to interior applied products, the credit requirements need to be met for all products and materials installed within the waterproofing membrane (see *Further Explanation, Definitions of Building Interior and Exterior*).

STEP 2. PERFORM CONSTRUCTION SUBMITTAL REVIEWS

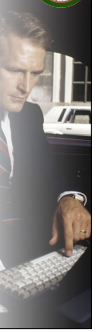
During construction, coordinate a review of the construction submittals to ensure that selected products meet the credit requirements and do not exceed the allocated VOC emissions.

- Because meeting these credit requirements is not typical for all construction teams and suppliers, conducting a LEED-specific preconstruction meeting to review the credit requirements in detail and stress their importance will aid in successful product procurement.
- Any product substitutions should be carefully reviewed by the design team and contractor for compliance with credit requirements. Some manufacturers have a list of LEED compliant products on their websites. Such lists are good resources for design teams and contractors to consult when sourcing products that may meet the requirements of this credit.

STEP 3. SELECT ONE OPTION

Based on the research performed and products purchased in each category identified in the credit requirements, determine which option is more appropriate for the project.

- Option 1 is simpler but less flexible, since partial credit (i.e., less than the minimum percentage compliance required) in one category cannot be combined with partial credit in another category. If the minimum percentage compliance cannot be attained in a category, project teams must use Option 2.
- Option 2 offers a budget calculation method that categorizes building interior products and materials into six "assemblies." If at least 50% of an assembly is compliant, partial credit for that assembly can be combined with partial credit from another assembly to earn points, which ensures that teams can receive partial credit for specifying compliant low-emitting products or materials in each assembly category if full compliance is not readily achievable.
- Option 2 may also allow the project to achieve more points and demonstrate higher overall compliance, even if the Option 1 requirements are also feasible.



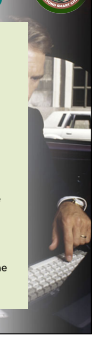
STEP-BY-STEP GUIDANCE +

Option 1. Product Category Calculations

STEP 1. IDENTIFY ALL APPLICABLE PRODUCTS

List all specified interior paints, coatings, adhesives, sealants, flooring, composite wood, ceilings, walls, thermal and acoustic insulation, and furniture, as applicable to the project's scope of work.

- During the construction submittal review process, obtain manufacturer documentation confirming compliance for each product category. All products must comply with each applicable threshold requirement. If two requirements exist, the product must comply with both requirements.
- The most effective way to track this credit is for one team member to keep a running list of products and their compliance information (e.g., VOC content, emissions testing, emissions percentage by volume), with manufacturers' documentation.
- Healthcare and Schools projects have an additional category, exterior products, that they may choose to pursue.
- Furniture is considered part of the scope if it is installed at the time of occupancy, regardless of who specified or provided it.
- Adhesives, sealants, paints, and coatings used on site with flooring products are considered interior adhesives and sealants or interior paints and coatings, as appropriate. The flooring itself must meet the requirements of the flooring product category.



STEP-BY-STEP GUIDANCE +

- For wet-applied product categories, 90% of products must meet emissions criteria and 100% must meet VOC content criteria.
- To demonstrate the project's overall attainment of 100% of the VOC content criteria, compare the baseline case and the design case in a VOC content budget. If the design (or actual) level is less than the baseline, the credit requirement is satisfied. The values used in the comparison calculation are the g/L of VOCs contained in the product. To determine the budget, multiply the volume of the product used by the threshold VOC level for the baseline case from the appropriate referenced standard; use the actual product VOC level for the design case. If a product with high VOC levels is applied unintentionally, use the VOC budget approach to determine whether compliance can nevertheless be attained.
- Example. SCAQMD Rule 1113 sets the allowable VOC content limit for faux finishing coatings—brown-applied coatings at 350 g/L. A subcontractor mistakenly used 50 liters of a faux finish coating with 450 g/L VOC content. The project team must now create a budget for all paints and coatings installed in the project to offset this product, which does not meet the Rule 1113 limits.

TABLE 4. SCAQMD Rule 1113

Regulation	Product type	General emissions criteria met?	Volume installed (l)	Allowable VOC content	Actual VOC content	VOC budget	
						Baseline case (g)	Design case (g)
SCAQMD Rule 1113	Faux finishing coatings—brown-applied coatings	YES	50	350	450	17,500	22,500
SCAQMD Rule 1113	Clear wood finishes—sanding sealers	YES	95	275	150	11,125	8,250
					VOC budget baseline case total (g)		32,625
					VOC budget design case total (g)		30,750

STEP 2. PERFORM BUDGET CALCULATION METHOD (AS NECESSARY)

A different budget may be used if threshold requirements cannot be achieved for the material categories specified in the credit requirements. That is, if 100% of the product category does not meet the requirements, use the budget calculation method in Option 2.

Option 2. Budget Calculation Method

STEP 1. IDENTIFY ASSEMBLIES

Break out assembly components for each category (flooring, ceilings, walls, insulation, and if applicable, furniture and exterior applied products).

- For each product in an assembly, calculate the surface area for typical wall, ceiling, and floor areas (see *Further Explanation, Building Products and Systems*).
- Identify products that are full-spread, such as paint or carpet adhesive, according to the manufacturer's documentation for application.

STEP 2. CALCULATE TOTAL PERCENTAGE COMPLIANCE

Use Equation 1 in the credit requirements to calculate the total percentage compliance. Generate take-offs and review estimates from subcontractors to calculate the surface area for each product. Equations 2 and 3 may be required to generate values for Equation 1.

For assemblies, use the following guidelines:

- If all layers of an assembly are compliant, the entire surface area (square footage or square meters) counts. Not-full-spread, wet-applied products are included in the definition of interior finish if they are installed on site.

- If some layers of an assembly are noncompliant, calculate the weighted average using Equation 2.
- At least 50% of an assembly must be compliant to contribute to credit compliance: if less than 50% of the assembly is compliant, it counts as 0%; if 90% of the assembly meets the criteria, it counts as 100% compliant.

If some furniture is noncompliant, calculate the percentage of compliance using Equation 3.

For **Healthcare and Schools** projects, see *Further Explanation, Rating System Variations*.

REQUIREMENTS

Use materials on the building interior (everything within the waterproofing membrane) that meet the low-emitting criteria below. Points are awarded according to Table 1:

Table 1. Points for low-emitting materials	
2 product categories	1 point
3 product categories	2 points
4 product categories	3 points
5 product categories	3 points + exemplary performance
Reach 90% threshold in at least three product categories	Exemplary performance or *1 additional point if only 2 points are achieved.*

Paints and Coatings

At least 75% of all paints and coatings, **by volume or surface area**, meet the *VOC emissions evaluation* AND 100% meet the *VOC content evaluation*. To meet the 100% requirement for VOC content evaluation, a VOC budget may be used.

The paints and coatings product category includes all interior paints and coatings wet-applied on site. Exclude foamed-in place and sprayed insulation (include in Insulation category).

Adhesives and Sealants

At least 75% of all adhesives and sealants, **by volume or surface area**, meet the *VOC emissions evaluation* AND 100% meet the *VOC content evaluation*. To meet the 100% requirement for VOC content evaluation, a VOC budget may be used.

The adhesives and sealants product category includes all interior adhesives and sealants wet-applied on site.

Flooring

At least 90% of all flooring, **by cost or surface area**, meets the *VOC emissions evaluation OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

REQUIREMENTS +

The flooring product category includes all types of hard and soft surface flooring (carpet, ceramic, vinyl, rubber, engineered, solid wood, laminates), raised flooring, wall base, underlayments, and other floor coverings.

Exclude subflooring (include subflooring in the composite wood category, if applicable. Exclude wet-applied products applied on the floor (include in paints and coatings category).

Wall panels

At least 75% of all wall panels, **by cost or surface area**, meet the *VOC emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The wall panels product category includes all finish wall treatments (wall coverings, wall paneling, wall tile), surface wall structures such as gypsum or plaster, cubicle/partition walls, trim, interior and exterior doors, wall frames, interior and exterior windows, and window treatments.

Exclude cabinetry (include built-in cabinetry in the composite wood category and free-standing cabinetry in the furniture category), and vertical structural elements (include structural elements such as structural panels or structural composite wood in the composite wood category, if applicable).

Ceilings

At least 90% of all ceilings, **by cost or surface area**, meet the *VOC emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The ceilings product category includes all ceiling panels, ceiling tile, surface ceiling structures such as gypsum or plaster, suspended systems (including canopies and chords), and glazed skylights.

Exclude overhead structural elements (include structural elements in the composite wood category, if applicable).

Insulation

At least 75% of all insulation, by cost or surface area, meets the *VOC emissions evaluation.*

The insulation product category includes all thermal and acoustic boards, batts, rolls, blankets, sound attenuation fire blankets, foamed-in-place, board fill, blown, and sprayed insulation.

Exclude insulation for HVAC ducts and plumbing piping from the credit; insulation for HVAC ducts may be included at the project team's discretion.

Furniture

At least 75% of all furniture in the project scope of work, **by cost**, meets the *furniture emissions evaluation, OR inherently nonemitting sources criteria, OR salvaged and reused materials criteria.*

The furniture product category includes all seating, desks and tables, filing/storage, free-standing cabinetry, workspaces, and furnishing items purchased for the project.

Exclude office accessories from the credit.

Composite Wood

At least 75% of all composite wood, **by cost or surface area**, meets the *Formaldehyde emissions evaluation OR salvaged and reused materials criteria.*

The composite wood product category includes all particleboard, medium density fiberboard (both medium density and thin), hardwood plywood with veneer, composite or combination core, and wood structural panels or structural wood products.

Exclude products covered in the flooring, ceiling, wall panels, or furniture material categories from this category.

Low-emitting criteria

Inherently nonemitting sources

Product is an inherently nonemitting source if FSCs (stone, ceramic, powder-coated metals, plated or anodized metal, glass, concrete), FSs (rock, and unfinished or unfinished (sold-waxed) and fss no binders, surface coatings, or sealants that include organic chemicals.

Salvaged and reused material

Product is more than one year old at the time of use. If finishes are applied to the product on-site, the finishes must meet the VOC emissions evaluation AND VOC content evaluation requirements.

VOC emissions evaluation

Product has been tested according to California Department of Public Health (CDPH) Standard Method v1.2-2017 and complies with the VOC limits in Table 4 of the method. Additionally, the range of total VOCs (after 14 days [336 hours] was measured as specified in the CDPH Standard Method v1.2 and is reported, including all target VOCs listed in the CDPH Standard Method v1.2-2017, Section 9.

Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use. Products used in any setting other than schools and classrooms must be installed to private-office scenario. For schools projects, modeling to office and/or schools scenario is permitted.

The statement of product compliance must include the exposure scenario(s) used, the range of total VOCs, and must follow the product declaration guidelines in CDPH Standard Method v1.2-2017, Section 7.4.2. Documentation must include the date(s) the tests were run (which must be within the past three years old) and the amount of wet-applied product applied to mass per surface area (if applicable). Organizations that certify manufacturers' claims must be accredited under ISO/IEC 17065.

VOC content evaluation

Product meets the VOC content limits outlined in one of the applicable standards and for projects in North America, formaldehyde (HCHO) and per (HCHO)(R)ene may not be intentionally added.

Testing must be conducted by an accredited laboratory using an ISO/IEC 17025 accredited third-party. Any testing must follow the test method specified in the applicable regulation. If the applicable regulation requires submission of exempt compounds, any content of intentionally added exempt compounds larger than 1% weight by mass (total exempt compounds) must be disclosed.

- Paints and coatings
  - South Coast Air Quality Management District (SCAQMD) Rule 1113, Architectural Coatings
  - South Coast Air Quality Management District (SCAQMD) Rule 1113, effective February 5, 2016
- Adhesives and sealants
  - SCAQMD Rule 1168, October 6, 2017

REQUIREMENTS +

Formaldehyde emissions evaluation

Product meets one of the following:

- Certified as ultra-low-emitting formaldehyde (ULEF) product under EPA Toxic Substances Control Act, Formaldehyde Emission Standards for Composite Wood Products (TSCA, Title VI) (EPA TSCA Title VI)or California Air Resources Board (CARB) Airborne Toxic Control Measure (ATCM)
- Certified as no added formaldehyde resins (NAF) product under EPA TSCA Title VI or CARB ATCM
- Wood structural panel manufactured according to PS 1-09 or PS 2-10 (or one of the standards considered by CARB to be equivalent to PS 1 or PS 2) and labeled bond classification Exposure 1 or Exterior
- Structural wood product manufactured according to ASTM D 5456 (for structural composite lumber), ANSI A190.1 (for glued laminated timber), ASTM D 5055 (for I-joists), ANSI PRG 320 (for cross-laminated timber), or PS 20-15 (for finger-jointed lumber).

Furniture emissions evaluation

Product has been tested in accordance with ANSI/BIFMA Standard Method M7.1-2011 (R2016) and complies with ANSI/BIFMA e3-2014e or e3-2019e Furniture Sustainability Standard, Sections 7.6.1 (for half credit, by cost) OR 7.6.2 (for full credit, by cost) , OR 7.6.2 AND 7.6.3 for one and a quarter credit, by cost. Laboratories that conduct the tests must be accredited under ISO/IEC 17025 for the test methods they use.

Seating products must be evaluated using the seating scenario. Classroom furniture must be evaluated using the standard school classroom scenario. Other products should be evaluated using the open plan or private office scenario, as appropriate. The open plan scenario is more stringent.

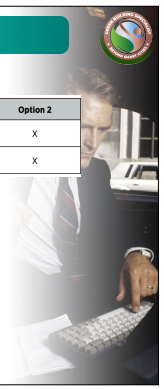
Statements of product compliance must include the exposure scenario(s). Organizations that certify manufacturers' claims must be accredited under ISO/IEC 17065.

CONNECTION TO ONGOING PERFORMANCE

LEED O+M EQ prerequisite Indoor Environmental Quality Performance: Strategies to reduce chemical contaminant levels for improved air quality and human health such as using inherently non-emitting products and/or using products with low VOC content/emissions in newly constructed spaces can contribute to better indoor environmental quality during operations phase.

REQUIRED DOCUMENTATION

Documentation	Option 1	Option 2
USGBC low-emitting materials calculator	X	X
Product information (e.g., MSDS, third-party certifications, testing reports)	X	X



REFERENCED STANDARDS

- ANSI/BIFMA M7.1 Standard Test Method for Determining VOC Emissions from Office Furniture Systems,
- Components and Seating: bifma.org ANSI/BIFMA e3-2011 Furniture Sustainability Standard: bifma.org
- EN 717-1:2004 Wood-based panels - Determination of formaldehyde release - Formaldehyde emission by the chamber method: http://www.en-standard.eu/
- CEN/TS 16516:2013 Construction products - Assessment of release of dangerous substances - Determination of emissions into indoor air: http://www.cen.eu

TERMS AND DEFINITIONS

The building exterior of a structure's primary and secondary weatherproofing systems, including waterproofing membranes and air- and water-resistant barrier materials, and all building elements outside that system building interior: everything inside a structure's weatherproofing membrane

Furniture and furnishings: the stand-alone furniture items purchased for the project, including individual and group seating, open-plan and private-choice workstations, desks and tables, storage units, credenzas, bookshelves, lighting cabinets, and other case goods; wall-mounted visual-display products (e.g., marker boards and tack boards, excluding electronic displays); and miscellaneous items, such as easels, mobile carts, freestanding screens, installed fabrics, and movable partitions. Hospitality furniture is included as applicable to the project. Accessories, such as desktop blotters, trays, tape dispensers, waste baskets, and all electrical items, such as lighting and small appliances, are excluded.