

SECTION 01 81 13 – SUSTAINABLE DESIGN REQUIREMENTS

Guidance for designers and specifiers, with suggested language to be modified and incorporated into project specifications.

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes general requirements and procedures for achieving the most environmentally conscious Work possible within the limits of the Construction Schedule, Contract Sum, and available materials, equipment, and products.

1.2 OBJECTIVES

- A. To obtain acceptable Indoor Air Quality (IAQ) for the completed project and minimize the environmental impacts of the construction and operation, the Contractor during the construction phase of this project shall implement the following procedures singly or in combination:
 - 1. Select products that minimize consumption of non-renewable resources, consume reduced amounts of energy and minimize amounts of pollution to produce, and employ recycled and/or recyclable materials. To help purchasers incorporate environmental considerations into purchasing decisions, it is the intent of this project to conform with EPA's Five Guiding Principles on environmentally preferable purchasing. The five principles are:
 - a. Include environmental considerations as part of the normal purchasing process.
 - b. Emphasize pollution prevention early in the purchasing process.
 - c. Examine multiple environmental attributes throughout a product's or service's life cycle.
 - d. Compare relevant environmental impacts when selecting products and services.
 - e. Collect and base purchasing decisions on accurate and meaningful information about environmental performance.
 - 2. Control sources for potential IAQ pollutants by controlled selection of materials and processes used in project construction in order to attain superior IAQ.
 - 3. Products and processes that achieve the above objectives to the extent currently possible and practical have been selected and included in these Construction Documents. The Contractor is responsible to maintain and support these objectives in developing means and methods for performing the work of this Contract and in

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proposing product substitutions and/or changes to specified processes.

1.3 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and other Division 1 Specification Sections, apply to this Section.
- B. Related Sections include the following:
 - 1. Divisions 2 through 48 Sections for Sustainable Design Requirements specific to the Work of each of those Sections.
 - 2. 01 74 19 Construction Waste Management
 - 3. 01 81 09 Testing for Indoor Air Quality
 - 4. 01 91 00 General Commissioning Requirements

1.4 DEFINITIONS

- A. Agrifiber Products: Composite panel products derived from agricultural fiber
- B. Biobased Product: As defined in the 2002 Farm Bill, a product determined by the Secretary to be a commercial or industrial product (other than food or feed) that is composed, in whole or in significant part, of biological products or renewable domestic agricultural materials (including plant, animal, and marine materials) or forestry materials
- C. Biobased Content: The weight of the biobased material divided by the total weight of the product and expressed as a percentage by weight
- D. Certificates of Chain-of-Custody: Certificates signed by manufacturers certifying that wood used to make products has been tracked through its extraction and fabrication to ensure that it was obtained from forests certified by a specified certification program
- E. Composite Wood: A product consisting of wood fiber or other plant particles bonded together by a resin or binder
- F. Construction and Demolition Waste: Includes solid wastes, such as building materials, packaging, rubbish, debris, and rubble resulting from construction, remodeling, repair and demolition operations. A construction waste management plan is to be provided by the Contractor as defined in Section 01 74 19.
- G. LEED: The Leadership in Energy & Environmental Design green building rating systems developed and adopted by the U.S. Green Building Council

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(USGBC). The systems certify levels of environmental achievement based on a point and credit scoring system.

- H. LEED NC: The Leadership in Energy & Environmental Design green building rating system developed and adopted by the USGBC for new construction and major renovations of buildings
- I. LEED EB: The Leadership in Energy & Environmental Design green building rating system developed and adopted by the USGBC for operating and maintaining existing buildings
- J. Light Pollution: Light that extends beyond its source such that the additional light is wasted in an unwanted area or in an area where it inhibits view of the night sky
- K. Recycled Content Materials: Products that contain pre-consumer or post-consumer materials as all or part of their feedstock
- L. Post-Consumer Recycled Content: The percentage by weight of constituent materials that have been recovered or otherwise diverted from the solid-waste stream after consumer use
- M. Pre-Consumer Recycled Content: Materials that have been recovered or otherwise diverted from the solid-waste stream during the manufacturing process. Pre-consumer content must be material that would not have otherwise entered the waste stream as per Section 5 of the FTC Act, Part 260 "Guidelines for the Use of Environmental Marketing Claims": www.ftc.gov/bcp/grnrule/guides980427
- N. Regional Materials: Materials that are extracted, harvested, recovered, and manufactured within a radius of 250 miles (400 km) from the Project site
- O. Salvaged or Reused Materials: Materials extracted from existing buildings in order to be reused in other buildings without being manufactured
- P. Sealant: Any material that fills and seals gaps between other materials
- Q. Volatile Organic Compounds (VOCs): Any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions. Compounds that have negligible photochemical reactivity, listed in EPA 40 CFR 51.100(s), are also excluded from this regulatory definition.

1.5 SUBMITTALS

- A. General: Additional Sustainable Design submittal requirements are included in other sections of the Specifications.

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- B. Sustainable Design Submittals:
1. Alternative Transportation: Provide manufacturer's cut sheets for all bike racks installed on site, including the total number of bicycle storage slots provided. Also, provide manufacturer's cut sheets for any alternative-fuel refueling stations installed on site, including fueling capacity information for an 8-hour period.
 2. Heat Island Effect:
 - a. Site Paving: Provide manufacturer's cut sheets for all impervious paving materials, highlighting the Solar Reflectance Index (SRI) of the material. Also, provide cut sheets for all pervious paving materials.
 - b. Roofing Materials: Submittals for roofing materials must include manufacturer's cut sheets or product data highlighting the Solar Reflectance Index (SRI) of the material.
 3. Exterior Lighting Fixtures: Submittals must include cut sheets with manufacturer's data on initial fixture lumens above 90° from nadir for all exterior lighting fixtures, and, for parking lot lighting, verification that the fixtures are classified by the IESNA as "full cutoff" (FCO); OR provide documentation that exterior luminaires are IDA-Approved as Dark-Sky Friendly by the International Dark Sky Association (IDA) Fixture Seal of Approval Program.
 4. Irrigation Systems: Provide manufacturer's cut sheets for all permanent landscape irrigation system components and for any rainwater harvesting system components, such as cisterns.
 5. Water Conserving Fixtures: Submittals must include manufacturer's cut sheets for all water-consuming plumbing fixtures and fittings (toilets, urinals, faucets, showerheads, etc.) highlighting maximum flow rates and/or flush rates. Include cut sheets for any automatic faucet-control devices.
 6. Process Water Use: Provide manufacturer's cut sheets for all water-consuming commercial equipment (clothes washers, dishwashers, ice machines, etc.), highlighting water consumption performance. Include manufacturer's cut sheets or product data for any cooling towers, highlighting water consumption estimates, water use reduction measures, and corrosion inhibitors.
 7. Elimination of CFCs AND HCFCs: Provide manufacturer's cut sheets for all cooling equipment with manufacturer's product data, highlighting refrigerants; provide manufacturer's cut sheets for all fire-suppression equipment, highlighting fire-suppression agents; provide manufacturer's cut-sheets for all polystyrene insulation (XPS) and closed-cell spray foam polyurethane insulation, highlighting the blowing agent(s).
 8. Appliances and Equipment: Provide copies of manufacturer's product data for all Energy Star eligible equipment and appliances, including

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office equipment, computers and printers, electronics, and commercial food service equipment (excluding HVAC and lighting components), verifying compliance with EPA's Energy Star program.

9. On-Site Renewable Energy Systems: Provide cut sheets and manufacturer's product data for all on-site renewable energy generating components and equipment, including documentation of output capacity.
10. Measurement and Verification Systems: Provide cut sheets and manufacturer's product data for all controls systems, highlighting electrical metering and trending capability components.
11. Salvaged or Reused Materials: Provide documentation that lists each salvaged or reused material, the source or vendor of the material, the purchase price, and the replacement cost if greater than the purchase price.
12. Recycled Content: Submittals for all materials with recycled content (excluding MEP systems equipment and components) must include the following documentation:
 - a. Cost of each material or product, excluding cost of labor and equipment for installation
 - b. Manufacturer's product data, product literature, or a letter from the manufacturer verifying the percentage of post-consumer and pre-consumer recycled content (by weight) of each material or product
 - c. An electronic spreadsheet that tabulates the Project's total materials cost and combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value) expressed as a percentage of total materials cost. This spreadsheet shall be submitted every third month with the Contractor's Certificate and Application for Payment. It should indicate, on an ongoing basis, line items for each material, including cost, pre-consumer recycled content, post-consumer recycled content, and combined recycled content value.

The submittal frequency suggestion of every third month is not based on LEED or any other requirement, and should be revised to reflect the needs of the specific Project.

13. Regional Materials: Submittals for all products or materials expected to contribute to the regional calculation (excluding MEP systems equipment and components) must include the following documentation:
 - a. Cost of each material or product, excluding cost of labor and equipment for installation

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- b. Location of product manufacture and distance from point of manufacture to the Project Site
- c. Location of point of extraction, harvest, or recovery for each raw material in each product and distance from the point of extraction, harvest, or recovery to the Project Site
- d. Manufacturer's product data, product literature, or a letter from the manufacturer verifying the location and distance from the Project Site to the point of manufacture for each regional material
- e. Manufacturer's product data, product literature, or a letter from the manufacturer verifying the location and distance from the Project Site to the point of extraction, harvest, or recovery for each regional material or product, including, at a minimum, gravel and fill, planting materials, concrete, masonry, and GWB
- f. An electronic spreadsheet that tabulates the Project's total materials cost and regional materials value, expressed as a percentage of total materials cost. This spreadsheet shall be submitted every third month with the Contractor's Certificate and Application for Payment. It should indicate on an ongoing basis, line items for each material, including cost, location of manufacture, distance from manufacturing plant to the Project Site, location of raw material extraction, and distance from extraction point to the Project Site.

The submittal frequency suggestion of every third month is not based on LEED or any other requirement, and should be revised to reflect the needs of the specific Project.

14. Biobased Products:

- a. Rapidly Renewable Products: Submittals must include written documentation from the manufacturer declaring that rapidly renewable materials are made from plants harvested within a 10-year or shorter cycle and must indicate the percentage (by weight) of these rapidly renewable components contained in the candidate products, along with the costs of each of these materials, excluding labor and delivery costs.

The Project Team should determine if it wants to follow LEED guidance regarding rapidly renewable materials or consider an alternative approach. This is a highly controversial issue. As an introduction to the contention, please refer to 'Dealing with Wood and Biobased Materials in the LEED Rating System' – a White Paper to the USGBC board by Alex Wilson, President of BuildingGreen, Inc.

This requirement is consistent with the LEED-NC rapidly renewable materials credit.

- b. Certified Wood: Submittals for all wood-based materials must include a statement indicating the cost of each product containing FSC Certified wood, exclusive of labor and delivery costs, and certificates of chain-of-custody from manufacturers certifying that specified certified-wood products were made from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC 1.2 "Principles and Criteria."
- 15. Outdoor Air Delivery Monitoring: Provide manufacturer's cut sheets highlighting the installed carbon dioxide monitoring system components and sequence of controls shop drawing documentation, including CO₂ differential set-points and alarm capabilities.
- 16. Interior Adhesives and Sealants: Submittals for all field-applied adhesives and sealants, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content.
 - a. Provide manufacturers' documentation verifying all adhesives used to apply laminates, whether shop-applied or field-applied, contain no urea-formaldehyde.
- 17. Interior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on indoor air, must include manufacturer's MSDSs or other Product Data highlighting VOC content
- 18. Exterior Paints and Coatings: Submittals for all field-applied paints and coatings, which have a potential impact on ambient air quality, must include manufacturer's MSDSs or other manufacturer's Product Data highlighting VOC content.
- 19. Floorcoverings:
 - a. Carpet Systems: Submittals for all carpet must include the following:
 - 1) A copy of an assessment from the Building for Environmental and Economic Sustainability (BEES) software model, either Version 3.0 or 4.0, with parameters of the model set as described by this specification section.

BEES analysis is frequently a task completed by the designer; however, it is preferable to obtain a BEES assessment from the product manufacturer. The process of acquiring the BEES analysis serves an educational purpose for the manufacturer and is driven by manufacturer motivation to win the bid.

- 2) Manufacturer's product data verifying that all carpet systems meet or exceed the testing and product requirements of the Carpet and Rug Institute Green Label Plus program.

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- b. Resilient Flooring: Submittals for all resilient floorcovering must include manufacturer's product data verifying certification under either the Greenguard for Children & Schools or FloorScore indoor emissions testing program.
 - c. Engineered Wood Flooring and Bamboo Flooring: Submittals for all engineered wood flooring and bamboo flooring must include manufacturer's product data verifying certification under either the Greenguard or FloorScore indoor emissions testing program.
20. Composite Wood and Agrifiber Binders: Submittals for all composite wood and agrifiber products (including but not limited to particleboard, wheatboard, strawboard, agriboard products, engineered wood components, solid-core wood doors, OSB, MDF, and plywood products) must include manufacturer's product data verifying that these products contain no urea-formaldehyde resins.
21. Systems Furniture and Seating: Provide manufacturer's product data verifying that all systems furniture and seating products meet the requirements of one of the following:
- a. Greenguard certification
 - b. SCS Indoor Advantage certification
 - c. SCS Indoor Advantage Gold certification
 - d. BIFMA Standard X7.1-2005, as tested to BIFMA method M7.1-2005 and as verified by an independent laboratory
 - e. Calculated indoor air concentration limits for furniture systems and seating determined by the U.S. EPA's Environmental Technology Verification Large Chamber Test Protocol for Measuring Emissions of VOCs and Aldehydes (September 1999) testing protocol as conducted in an independent air quality testing laboratory
22. Entryway Systems: Provide manufacturer's cut sheets for all walk-off systems installed to capture particulates, including permanently installed grates, grilles, slotted systems, direct glue-down walk-off mats, and non-permanent roll-out mats.
23. Air Filtration: Provide manufacturer's cut sheets and product data highlighting the following:
- a. Minimum Efficiency Reporting Value (MERV) for filtration media in all air handling units (AHUs)
 - b. Minimum Efficiency Reporting Value (MERV) for filtration media installed at return air grilles during construction if permanently installed AHUs are used during construction
24. Mercury in Lighting: Provide manufacturer's cut sheets or product data for all fluorescent or HID lamps highlighting mercury content.

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25. Lighting Controls: Provide manufacturer's cut sheets and shop drawing documentation highlighting all lighting controls systems components.
 26. Thermal Comfort Controls: Provide manufacturer's cut sheets and shop drawing documentation highlighting all thermal comfort-control systems components.
 27. Blended Cement: It is the intent of this specification to reduce CO₂ emissions and other environmentally detrimental effects resulting from the production of portland cement by requiring that all concrete mixes, in aggregate, utilize blended cement mixes to displace 40% of the portland cement typically included in conventional construction. Provide the following submittals:
 - a. Copies of concrete design mixes for all installed concrete
 - b. Copies of typical regional baseline concrete design mixes for all compressive strengths used on the Project
 - c. Quantities in cubic yards of each installed concrete mix
 28. Gypsum Wall Board: Provide manufacturer's cut sheets or product data verifying that all gypsum wallboard products are moisture and mold-resistant.
 29. Fiberglass Insulation: Provide manufacturer's cut sheets or product data verifying that fiberglass batt insulation contains no urea-formaldehyde.
 30. Duct Acoustical Insulation: Provide manufacturer's cut sheets or product data verifying that mechanical sound insulation materials in air distribution ducts consists of an impervious, non-porous coatings that prevent dust from accumulating in the insulating materials.
 31. Green Housekeeping: Provide documentation that all cleaning products and janitorial paper products meet the VOC limits and content requirements of this specification section.
- C. Project Materials Cost Data: Provide a spreadsheet in an electronic file indicating the total cost for the Project and the total cost of building materials used for the Project, as follows:
1. Not more than 60 days after the Preconstruction Meeting, the General Contractor shall provide to the Owner and Architect a preliminary schedule of materials costs for all materials used for the Project organized by specification section. Exclude labor costs and all mechanical, electrical, and plumbing (MEP) systems materials and labor costs. Include the following:
 - a. Identify each reused or salvaged material, its cost, and its replacement value.
 - b. Identify each recycled-content material, its post-consumer and pre-consumer recycled content as a percentage the product's

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weight, its cost, its combined recycled content value (defined as the sum of the post-consumer recycled content value plus one-half of the pre-consumer recycled content value), and the total combined recycled content value for all materials as a percentage of total materials costs.

- c. Identify each regional material, its cost, its manufacturing location, the distance of this location from the Project site, the source location for each raw material component of the material, the distance of these extraction locations from the Project site, and the total value of regional materials as a percentage of total materials costs.
 - d. Identify each biobased material, its source, its cost, and the total value of biobased materials as a percentage of total materials costs. Also provide the total value of rapidly renewable materials (materials made from plants that are harvested in less than a 10-year cycle) as a percentage of total materials costs.
 - e. Identify each wood-based material, its cost, the total wood-based materials cost, each FSC Certified wood material, its cost, and the total value of FSC Certified wood as a percentage of total wood-based materials costs.
2. Provide final versions of the above spreadsheets to the Owner and Architect not more than 14 days after Substantial Completion.
- D. Construction Waste Management: See Section 01 74 19 "Construction Waste Management" for submittal requirements.
- E. Construction Indoor Air Quality (IAQ) Management: Submittals must include the following:
1. Not more than 30 days after the Preconstruction Meeting, prepare and submit for the Architect and Owner's approval, an electronic copy of the draft Construction IAQ Management Plan in an electronic file including, but not limited to, descriptions of the following:
 - a. Construction procedures for meeting or exceeding the minimum requirements of the Sheet Metal and Air Conditioning National Contractors Association (SMACNA) IAQ Guidelines for Occupied Buildings Under Construction, 1995, Chapter 3, including procedures for HVAC Protection, Source Control, Pathway Interruption, Housekeeping, and Scheduling
 - b. Construction procedures for protecting absorptive materials stored on-site or installed from moisture damage
 - c. Schedule of submission to Architect of photographs of on-site construction IAQ management measures such as protection of ducts and on-site stored oil installed absorptive materials

- d. Construction procedures if air handlers must be used during construction, including a description of filtration media to be used at each return air grille
 - e. Construction procedure for replacing all air-filtration media immediately prior to occupancy after completion of construction, including a description of filtration media to be used at each air handling or air supply unit
2. Not more than 30 days following receipt of the approved draft CIAQMP, submit an electronic copy of the approved CIAQMP in an electronic file, along with the following:
- a. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for all filtration media to be installed at return air grilles during construction if permanently installed AHUs are used during construction.
 - b. Manufacturer's cut sheets and product data highlighting the Minimum Efficiency Reporting Value (MERV) for filtration media in all air handling units (AHUs).
3. Not more than 14 days after Substantial Completion provide the following:
- a. Documentation verifying required replacement of air filtration media in all air handling units (AHUs) after the completion of construction and prior to occupancy and, if applicable, required installation of filtration during construction.
 - b. A minimum of 18 Construction photographs: Six photographs taken on three different occasions during construction of the SMACNA approaches employed, along with a brief description of each approach, documenting implementation of the IAQ management measures, such as protection of ducts and on-site stored or installed absorptive materials.
4. A copy of the report from testing and inspecting agency documenting the results of IAQ testing, demonstrating conformance with IAQ testing procedures and requirements defined in Section 01 81 09 "Testing for Indoor Air Quality."

Note: This requirement that the Contractor provide IAQ testing results is only applicable if the Contractor is responsible for getting the IAQ testing done. In some cases it may be more appropriate for the Owner to contract separately for this testing.

- F. Commissioning: See Section 01 91 00 "Commissioning Requirements" for submittal requirements.
- G. Sustainable Design Progress Reports: Concurrent with each Application for Payment, submit reports for the following:

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1. Construction Waste Management: Waste reduction progress reports and logs complying with the requirements of Section 01 74 19 "Construction Waste Management."
2. Construction IAQ Management: See details below under Section 3.2 Construction Indoor Air Quality Management for Construction IAQ management progress report requirements.

1.6 QUALITY ASSURANCE

- A. General: Perform the work of this Section as a supplement and in accordance with applicable requirements of Division 1 "Contractor Quality Control Program."
- B. Preconstruction Meeting: After award of Contract and prior to the commencement of the Work, schedule and conduct meeting with Owner, Architect, and all Subcontractors to discuss the Construction Waste Management Plan, the required Construction Indoor Air Quality (IAQ) Management Plan, and all other Sustainable Design Requirements. The purpose of this meeting is to develop a mutual understanding of the Project's Sustainable Design Requirements and coordination of the Contractor's management of these requirements with the Contracting Officer and the Construction Quality Manager.
- C. Construction Job Conferences: The status of compliance with the Sustainable Design Requirements of these specifications will be an agenda item at all regular job meetings conducted during the course of work at the site.

PART 2 - PRODUCTS

2.1 PRODUCT ENVIRONMENTAL REQUIREMENTS

- A. Site Clearing: Topsoil shall be provided by the Contractor from on-site material which has been stockpiled for reuse. Off-site borrow should only be used when on-site sources are exhausted. Chip and/or compost on site all vegetated material identified for removal.

Site Clearing: Using topsoil from the site and chipping woody material on site for mulch reduces transportation impacts and avoids the effect of producing topsoil and mulch at remote sites. During site-selection and design, any ecologically sensitive areas should be identified and addressed via protection and/or mitigation. Plant rescue should be carried out if appropriate.

Managing landscape waste can be part of a green site management plan for the LEED-EB Green Site and Building Exterior Management credit.

- B. Do not burn rubbish, organic matter, etc. or any material on the site. Dispose of legally in accordance with Specifications Sections 01 74 19.

Burning of rubbish, organic material, and other material on-site contributes to air pollution.

- C. Site Paving: All site impervious paving must be light colored, with a Solar Reflectance Index (SRI) of at least 29.

Site Paving: Light-colored, high-reflectance paving is a way of reducing the localized heat build-up around paved surfaces that contributes to the urban heat island effect. Asphalt paving is not desirable in a cooling climate due to its tendency to absorb and reradiate heat, and the potential for emissions and runoff of petroleum byproducts during its installation and use. During design, consider using porous pavement to manage stormwater and reduce urban heat islands.

This requirement exceeds the requirement for achieving the LEED-NC and LEED-EB heat island reduction credits.

- D. Roofing Materials: All roofing systems, other than vegetated roof systems, must comply with the following requirements:

1. Low-Sloped roofing less than or equal to 2:12 slope must have an SRI of at least 78.
2. Steep-Sloped roofing greater than 2:12 slope must have an SRI of at least 29.

Roofing Materials: Light-colored, reflective, and high-emissivity roofing helps to reduce localized heat build-up from roof surfaces that contribute to the urban heat island effect.

This requirement significantly exceeds the requirement for achieving the LEED-NC and LEED-EB heat island reduction credits; exceeding LEED's requirement here is appropriate in urban areas and hot climates, but may not be appropriate elsewhere.

- E. Exterior Lighting Fixtures:

1. All exterior luminaires must emit 0% of the total initial designed fixture lumens at an angle above 90° from nadir and/or meet the requirements of the Dark Sky certification program.
2. Exterior lighting cannot exceed 80% of the lighting power densities defined by ASHRAE/IESNA Standard 90.1-2004, Exterior Lighting Section, without amendments.
3. No lighting of building facades or landscape features is permitted.

Exterior Lighting Fixtures: Light trespass represents wasted energy, diminishes views of the night sky, creates potentially unsafe visual conditions, and interferes with critical functions of nocturnal wildlife.

Exterior lighting should be designed in accordance with IESNA RP-33 and RP-20. The International Dark-Sky Association's Fixture Seal-of-Approval program, and a list of approved fixtures, can be found at <http://www.darksky.org>.

This requirement is consistent with the LEED-NC light pollution reduction credit.

- F. Herbicides and Pest Control: Herbicides shall not be permitted, and pest control measures shall utilize EPA-registered biopesticides only.

Herbicides and Pest Control: Herbicides should be avoided because they can have unwanted side-effects and may accumulate in water and soils. Unwanted plants can be removed or managed manually. Biopesticides are usually inherently less toxic than chemical pesticides, are highly targeted, and are not usually persistent. Integrated pest management provides the effective management of pests using the least-toxic available strategies; for more, see <http://www.epa.gov/pesticides/ipm>.

- G. Irrigation Systems: Any permanent landscape irrigation systems must be supplied entirely by collected rainwater or graywater and must be comprised of below-grade drip emitters controlled by moisture sensors. Timer controls shall not be permitted.

Irrigation systems: Use of potable water to irrigate is a poor use of resources and infrastructure. Even when landscape irrigation is supplied by rainwater and/or graywater, irrigation systems should be as efficient as possible to minimize the need for back-up potable water and make those alternative sources available for other uses, such as toilet flushing.

This specification meets the requirements for two points under the LEED-NC and LEED-EB water efficiency credits.

- H. Water-Conserving Fixtures: Plumbing fixtures and fittings shall use in aggregate at least 40% less water than the water use baseline calculated for the building after meeting the Energy Policy Act of 1992 fixture performance requirements. Flow and flush rates shall not exceed the following:

1. Toilets: no more than 1.3 gallons per flush, otherwise be dual flush 1.6/0.8 gallons per flush, and have documented bowl evacuation capability per MaP testing of at least 400 grams
2. Urinals: no more than 0.125 gallons per flush or use
3. Lavatory Faucets: 0.5 gpm with automatic faucet controls
4. Kitchen Sink Lavatories: 2.2 gpm
5. Showerheads: no more than 1.5 gpm

Water Conserving Fixtures: Required flow rates are based on readily available technologies; collectively they should achieve the specified 40%

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water savings requirement, but that needs to be verified. The calculation may vary based on gender distribution and occupancy.

The 40% water use reduction level does not, on its own, meet the requirements of the LEED-NC innovative wastewater treatment credit. That credit can be achieved by using graywater to flush toilets, by installing composting toilets, or by providing on-site wastewater treatment.

The 40% level exceeds the requirements for two points under the LEED-NC water efficiency credit and can be used to request an innovation point.

- I. Process Water Use: Employ strategies that in aggregate result in 20% less water use than the process water use baseline for the building after meeting the commercial equipment and HVAC performance requirements as listed in the Table below. For equipment not addressed by EPEAT 2005 or the list below, additional equipment performance requirements may be proposed provided documentation supporting the proposed benchmark or industry standard is submitted.

1. Clothes Washer: 7.5 gallons/cubic foot/cycle

Consistent with LEED for Schools ballot draft, which cites Consortium for Energy Efficiency standards: Commercial CEE Tier 3a – Residential CEE Tier 1.

2. Dishwasher with Racks: 1.0 gallons/rack

Consistent with LEED for Schools ballot draft.

3. Ice Machine: 20 gallons/100 pounds ice for machines making over 175 pounds of ice per day; 30 gallons/100 pounds ice for machines making less than 175 ice per day. Avoid water-cooled machines.

Consistent with LEED for Schools ballot draft, which cites Consortium for Energy Efficiency Tier 3 standard.

4. Food Steamer: 2 gallons/hour. Use only boilerless steamers.

Consistent with LEED for Schools ballot draft.

5. Pre-Rinse Spray Valves: 1.4 gallons/minute

Consistent with LEED for Schools ballot draft.

6. Kitchen Pot-Washing Sinks: 2.2 gallons/minute

7. Cooling Towers: 2.3 gallons/ton-hr. water loss

- a. Use atrazine-based corrosion inhibitors and reducing bleed-off by increasing cycles of concentration (at least 5, or with water quality problems limit to 4).
- b. Install meters on make-up water and discharge blow-down.
- c. Install conductivity controller for blow-down.
- d. Provide overflow alarm connected to central building controls.

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- e. Install drift eliminators.
- f. Provide makeup water from sources other than potable water supply.

Cooling Tower Water Use: Threshold of 2.3 gallons per ton assumes reasonably aggressive water management and moderate-mineral-content in replacement water. Note that some chemicals used to treat cooling tower water are toxic, and their use should be minimized.

In all cases: Prohibit once-through cooling systems and non-recirculating evaporative coolers.

J. Elimination of CFCs AND HCFCs:

- 1. Ozone Protection: Base building cooling equipment shall contain no refrigerants other than the following: HCFC-123, HFC-134a, HFC-245fa, HFC-407c, or HFC 410a.

CFC Reduction; Ozone Depletion

Selected refrigerants are low in both ozone-depletion potential and global warming potential. Their conformance with the LEED requirement depends on leakage rates and other parameters of the equipment, so this specification does not ensure conformity with LEED's requirements.

- 2. Fire suppression systems may not contain ozone-depleting substances.
- 3. Extruded polystyrene insulation (XPS) and closed-cell spray foam polyurethane insulation shall not be manufactured with hydrochlorofluorocarbon (HCFC) blowing agents.

Extruded polystyrene (XPS) is the only rigid insulation material that is currently made with ozone-depleting compounds. The use of these blowing agents is slated for phase-out by 2010; in the meantime, XPS made without them is available from select manufacturers.

Spray foam closed-cell polyurethane insulation is also still often blown with HCFCs; open-cell (low density) foams do not use CFCs.

K. Appliances and Equipment: All Energy Star eligible equipment and appliances, including office equipment, computers and printers, electronics, and commercial food service equipment (excluding HVAC and lighting components), shall be qualified by EPA's Energy Star program.

Energy Star qualification ensures reasonable levels of energy efficiency.

L. HVAC Distribution Efficiency:

- 1. All duct systems shall be constructed of galvanized sheet metal, aluminum, or stainless steel as deemed appropriate based on the application requirements. No fiberglass duct board shall be permitted.

2. All medium- and high-pressure ductwork systems shall be pressure-tested in accordance with the current SMACNA standards.
3. All ductwork shall be externally insulated. No interior duct liner shall be permitted.
4. Where possible, all air terminal connections shall be hard-connected with sheet metal ductwork. If flexible ductwork is used, no flexible duct extension shall be more than six feet in length.
5. All HVAC equipment shall be isolated from the ductwork system with flexible duct connectors to minimize the transmittance of vibration.
6. All supply and return air branch ducts shall include the appropriate style of volume damper. Air terminal devices such as grilles, registers, and diffusers shall be balanced at duct branch dampers, not at terminal face.

- M. Measurement and Verification: Install controls and monitoring devices as required by division 15 and 16 in order to comply with International Performance Measurement & Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003, Option D.

The IPMVP provides guidance on situation-appropriate application of measurement and verification strategies.

This specification is consistent with the LEED-NC Energy and Atmosphere credit for Measurement and Verification.

- N. Salvaged or Reused materials: There shall be no substitutions for specified salvaged and reused materials and products.

Salvaged materials: Use of salvaged materials reduces impacts of disposal and manufacturing of replacements.

This specification is consistent with the LEED-NC materials reuse and LEED-EB alternative materials credits in recognizing salvaged materials as those coming from other buildings. While other materials are commonly referred to as "salvaged," no consistent and defensible definition has been developed that would include other materials while excluding ones that are not consistent with the intent of this document, hence the decision to follow LEED in this language.

- O. Recycled Content of Materials:

1. Provide building materials with recycled content such that post-consumer recycled content value plus half the pre-consumer recycled content value constitutes a minimum of 30% of the cost of materials used for the Project, exclusive of all MEP equipment, labor, and delivery costs. The Contractor shall make all attempts to maximize the procurement of materials with recycled content.

- a. The post-consumer recycled content value of a material shall be determined by dividing the weight of post-consumer recycled content by the total weight of the material and multiplying by the cost of the material.
- b. The pre-consumer recycled content value of a material shall be determined by dividing the weight of pre-consumer recycled content by the total weight of the material and multiplying by the cost of the material.
- c. Do not include mechanical and electrical components in the calculations.
- d. Do not include labor and delivery costs in the calculations.
- e. Recycled content of materials shall be defined according to the Federal Trade Commission's "Guide for the Use of Environmental Marketing Claims," 16 CFR 260.7 (e).
- f. Utilize all on-site existing paving materials that are scheduled for demolition as granulated fill, and include the cost of this material had it been purchased in the calculations for recycled content value.
- g. At a minimum, the materials in the following list must contain the minimum recycled content indicated:

Category	Minimum Recycled Content
Compost/mulch	100% post-consumer
Asphaltic Concrete Paving	25% post-consumer
Cast-in-Place Concrete	6% pre-consumer
CMU: Gray Block	20% pre-consumer
Steel Reinforcing Bars	90% combined
Structural Steel Shapes	90% combined
Steel Joists	75% combined
Steel Deck	75% combined
Steel Fabrications	60% combined
Steel Studs	30% combined
Steel Roofing	30% post-consumer

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Aluminum Fabrications	35% combined
Rigid Insulation	20% pre-consumer
Batt insulation	30% combined
Cellulose Insulation	90% combined
Rock Wool Insulation	75% pre-consumer
Fireproofing	20% combined
Steel Doors and Frames	35% combined
Gypsum Wallboard	100% combined
Carpet	40% combined
Ceramic Tile Flooring	60% combined
Rubber Flooring and Base	60% combined
Acoustical Ceiling Tile (ACT)	40% post-consumer
ACT Suspension System	90% post-consumer
Toilet Partitions	60% post-consumer

Recycled content thresholds listed in this table are largely derived from EPA's Comprehensive Procurement Guidelines selected to balance embodied energy with solid-waste impacts and are based on availability. Even though manufacturers must follow the reporting guidelines from the Federal Trade Commission, claims should be certified by an independent third party whenever possible.

Following this requirement is likely to earn 2 points under the LEED-NC credit for recycled content, but achievement will depend on the results of LEED's recycled content value calculation. Similarly, it can contribute to achieving one or more points under the LEED-EB credit for optimizing use of alternative materials depending on the total value of environmentally preferable products purchased in the performance period.

- P. Regional Materials: Provide a minimum of 20 percent of building materials (by cost) that are manufactured and extracted/harvested within a 500 mile radius of the project site, exclusive of labor and delivery costs. The Contractor shall make all attempts to maximize the procurement of materials within this specified 500 mile radius.

The specification exceeds the requirements of the LEED-NC credit for regional materials, and may qualify for an exemplary performance innovation credit.

The 500-mile radius conforms with LEED's requirement, but in industrialized areas it may be feasible to reduce it further.

Q. Biobased Products:

1. Use only biobased concrete form-release products.
2. Solid Wood Products: All new solid-wood-based materials will be certified as "FSC 100%" by an independent third party in accordance with FSC Forest Stewardship Council "Principles and Criteria" and will have received Chain-of-Custody Certification as certified by an accredited certification group such as Smartwood or Scientific Certification Systems (SCS).
3. Other Wood Products: All other new wood-based materials will be certified by an independent third party in accordance with any of the following standards:
 - a. FSC: Forest Stewardship Council "Principles and Criteria" and has received Chain-of-Custody Certification as certified by an accredited certification group such as Smartwood or Scientific Certification Systems (SCS)

FSC labels new-wood-based material as either "FSC 100%" or "FSC Mixed." Products with the FSC 100% label come entirely from FSC certified forests. Products with the FSC mixed label come from company controlled sources and recycled material as well as FSC certified forests. Company controlled sources exclude illegally harvested timber, among other requirements.

4. Preservative-treated lumber with chromated copper arsenate (CCA) treatments is not permitted, and lumber with copper-based treatments (such as ACQ) is permitted only for ground-contact applications.

For preservative treatments, chromated copper arsenate (CCA) is no longer allowed for many building applications but is still used in other applications. It should be avoided whenever possible. Nontoxic options are now available, including borates for protected applications and sodium-silicate mineralization treatment for all applications. The latter is quite new, however, and has limited track record in the field. For ground-contact, copper-based preservatives may still be considered, as long as they are not used in situations in which the copper could leach into surface waters (copper is highly toxic to fish).

5. Wood-based materials include but are not limited to the following materials (when made from wood), engineered wood products, or wood-based panel products:
 - a. Rough carpentry

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- b. Miscellaneous carpentry
- c. Heavy timber construction
- d. Wood decking
- e. Particleboard
- f. Plywood
- g. Metal-plate-connected wood trusses
- h. Structural glued-laminated timber
- i. Finish carpentry
- j. Architectural woodwork
- k. Wood paneling
- l. Wood veneer wall covering
- m. Wood flooring
- n. Wood lockers
- o. Wood cabinets
- p. Wood doors
- q. Non-rented temporary construction, including bracing, concrete formwork, pedestrian barriers, and temporary protection

Biobased Materials: There are now USDA-designated biobased products in some emerging (as opposed to mature) markets, which have been screened using the BEES LCA software. As very few biobased materials have been designated as preferable by USDA, the specifier may want to include additional materials. It is the intent of these specifications to encourage the use of biobased materials such as agricultural byproducts, linoleum, bamboo, cork, insulation from recycled cotton, PLA, and wool. Alternatively, the designer may seek to specify any material that is available as an alternative for comparison in the Building for Environmental and Economic Sustainability (BEES), either Version 3.0 or 4.0, and whose score is better (lower) than any chosen alternative in the BEES software available at <http://www.bfrl.nist.gov/oea/software/bees/scores.html>

- R. Brominated Flame Retardants: For new furniture, do not utilize cushioned office seating, and for lounge seating, do not utilize cushioned seating with brominated flame retardants.

Brominated Flame Retardants: These compounds, and especially polybrominated diphenyl ethers (PBDEs), are persistent and bioaccumulative in the environment and are suspected of varying degrees of toxicity.

- S. Outdoor Air Delivery Monitoring:

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1. All spaces with an occupant density greater than 1 person per 40 square feet must include at least one CO₂ monitor located between 3 feet and 6 feet above the finished floor.
2. All spaces with occupant density less than 1 person per 40 square feet must include a direct outdoor airflow monitor, capable of measuring the minimum outdoor airflow rate within 15% accuracy.
3. Monitoring equipment must be configured to generate a building automation system alarm and a visual or audible alert when CO₂ concentrations vary by 10% or more from set point.

Outdoor Air Delivery Monitoring: Carbon dioxide (CO₂) is used as an indicator of fresh air delivery to occupied areas—high CO₂ concentrations indoors relative to outdoors indicate a lack of adequate air change. Set points for CO₂ concentration differentials should comply with ASHRAE Standard 62.1-2004 “Effective Ventilation Rates” which vary by occupancy and activity.

This section has the same requirements as the LEED-NC outdoor air delivery monitoring credit, which is also based on ASHRAE Standard 62.1-2004.

T. Adhesives and Sealants:

1. All adhesives and sealants used inside the building’s thermal envelope must be third-party certified under one of the following programs:
 - a. Indoor Advantage Plus from Scientific Certification Systems, Inc.
 - b. Greenguard Children and Schools from Greenguard Environmental Institute
 - c. Collaborative for High Performance Schools

All these programs reference California’s chronic reference exposure levels (CRELs) for occupant exposure likely to result from use of the materials, which are being adopted widely as a standard for IAQ performance.

2. All adhesives and sealants, regardless of where they are used, must comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24):
 - a. Concrete Curing Compound: 60 g/L
 - b. Concrete Sealer: 10 g/L
 - c. Concrete Form Release Agents: 0g/L
 - d. Garage Deck Sealer: 50g/L
 - e. Wood Glues: 20 g/L

- f. Millwork and Casework Adhesives: 20g/L
 - g. Metal to Metal Adhesives: 30 g/L
 - h. Adhesives for Porous Materials (Except Wood): 50 g/L
 - i. Subfloor Adhesives: 50 g/L
 - j. Plastic Foam Adhesives: 50 g/L
 - k. Carpet Adhesives: 50 g/L
 - l. Carpet Pad Adhesives: 50 g/L
 - m. Carpet Seam Sealer: 50g/L
 - n. VCT and Sheet Vinyl Adhesives: 50 g/L
 - o. Cove Base Adhesives: 50 g/L
 - p. Rubber Floor Adhesives: 60 g/L
 - q. Wood Flooring Adhesives: 100 g/L
 - r. Ceramic Tile Adhesives: 65 g/L
 - s. Gypsum Board and Panel Adhesives: 50 g/L
 - t. Gypsum Drywall Joint Compound: 20 g/L
 - u. Portland Cement Plaster: 20 g/L
 - v. Multipurpose Construction Adhesives: 70 g/L
 - w. Cast Resin Countertop Silicone Sealant: 20g/L
 - x. Plastic Laminate Adhesives: 20 g/L
 - y. General Contact Adhesive: 80 g/L
 - z. Structural Glazing Adhesives and Compounds: 100 g/L
 - aa. Silicone Sealant: 50 g/L
 - bb. Pipe Thread Sealant: 50 g/L
 - cc. Duct Sealant: 10 g/L
 - dd. Plastic Cement Welding Compounds: 250 g/L
 - ee. ABS Welding Compounds: 400 g/L
 - ff. CPVC Welding Compounds: 270 g/L
 - gg. PVC Welding Compounds: 150 g/L
 - hh. Adhesive Primer for Plastic: 250 g/L
 - ii. Architectural Sealants: 250 g/L
 - jj. Single-Ply Roofing Membrane Adhesives: 250 g/L
3. Interior sealants shall not contain: mercury, butyl rubber, neoprene, SBR (styrene butadi-ene rubber), or nitrile.

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4. Sealants and glazing compounds formulated with aromatic solvents (organic solvent with a benzene ring in its molecular structure) fibrous talc or asbestos, formaldehyde, halo-genated solvents, mercury, lead, cadmium, hexavalent chromium, or their components shall not be used.
5. Adhesives used to apply laminates, whether shop-applied or field-applied, shall contain no urea-formaldehyde.

Adhesives and Sealants: The thresholds for allowable VOCs in this specification are not limited to interior field-applied applications (even though LEED's requirements are limited to those applications) because VOCs emitted on the exterior, at fabrication sites, and at factories also adversely affect ambient air quality. The specific thresholds and restrictions represent the most restrictive of the following sources: EPA Spec Section 01120 from the First Environments Early Learning Center project; Green Seal standard GS-36; Bay Area Air Quality Management District Regulation 8, Rule 51; South Coast Air Quality Management District Rule #1168; and LEED.

Meeting this specification should at least meet the requirements of the LEED-NC low-emitting materials credit and the LEED-EB credit for optimizing use of IAQ compliant products.

U. Paints and Coatings:

1. Interior Paints and Coatings: For interior field-applied applications, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the chemical restrictions (Restricted Components listed below) of Green Seal Standard GS-11, Paints, First Edition, May 20, 1993; Green Seal Standard GC-03, Anti-Corrosive Paints, Second Edition, January 7, 1997; and South Coast Air Quality Management District Rule 1113, Architectural Coatings, rules in effect on January 1, 2004, as follows:
 - a. Flat Paints and Coatings: Not more than 10 grams of VOC per liter of coating less water and exempt compounds, including pigments
 - b. Non-Flat Paints and Coatings Except High Gloss: Not more than 50 grams of VOC per liter of coating less water and exempt compounds, including pigments.

Including pigments in the calculation for allowable VOCs makes this standard much more stringent, especially for more saturated colors, but this level is justifiable because several major manufacturers offer paints with VOC-free pigment systems for their zero-VOC paint lines.

- c. High Gloss Paints and Coatings: Not more than 150 grams of VOC per liter of coating less water and exempt compounds, including pigments. High Gloss Coatings are coatings that

register a gloss of 70 or above on a 60-degree meter according to ASTM Test Method D 523 as specified in paragraph (e)(6).

- d. Water-Based Polychromatic Finish Coatings: Not more than 150 g/L (150 g/L for primer and flat polychromatic paint)
- e. Anti-Corrosive Coatings: Not more than 100 grams of VOC per liter of coating less water and exempt compounds
- f. Sanding Sealers: Not more than 50 grams of VOC per liter of coating less water and exempt compounds
- g. Waterproofing Sealers: Not more than 100 grams of VOC per liter of coating less water and exempt compounds
- h. Concrete Slab Sealers: Not more than 10 grams of VOC per liter of coating less water and exempt compounds

The choice of 10 g/L VOCs for concrete sealers is much lower than the California Air Quality management district's limit of 100 VOCs but is justified based on the widespread availability of complying materials.

- i. Polyurethanes: Not more than 100 grams of VOC per liter of coating less water and exempt compounds
 - j. Stains: Not more than 250 grams of VOC per liter of coating less water and exempt compounds
- 2. Interior field applied varnishes and lacquers are not permitted.
 - 3. Interior paints shall not contain antimicrobial additives (such as fungicides and biocides).

Fungicides and biocides are banned from interior paints because those are needed primarily to extend shelf life. Instead paint should be used promptly and any remaining paint should be recycled.

- 4. Exterior Paints and Coatings: For exterior applications, use paints and coatings that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA method 24) and the chemical restrictions (Restricted Components listed below) of Green Seal's Standard GS-11:
 - a. Flat Paints and Coatings: Not more than 50 grams of VOC per liter of coating less water and exempt compounds, including pigments
 - b. Non-Flat Paints and Coatings: Not more than 150 grams of VOC per liter of coating less water and exempt compounds, including pigments
 - c. High Gloss Paints and Coatings: Not more than 150 grams of VOC per liter of coating less water and exempt compounds, including pigments. High Gloss Coatings are coatings that register a gloss of 70 or above on a 60-degree meter according to ASTM Test Method D 523 as specified in paragraph (e)(6)

- d. Anti-Corrosive Coatings: Not more than 100 grams of VOC per liter of coating less water and exempt compounds
 - e. Varnishes and Sanding Sealers: Not more than 275 grams of VOC per liter of coating less water and exempt compounds
 - f. Stains: Not more than 250 grams of VOC per liter of coating less water and exempt compounds
5. Aromatic Compounds: Paints and coatings shall not contain more than 1% (by weight) total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
6. Restricted Components: Paints and coatings shall not contain any of the following:
- a. Acrolein
 - b. Acrylonitrile
 - c. Aniline dyes
 - d. Antimony
 - e. Benzene
 - f. Butyl benzyl phthalate
 - g. Cadmium
 - h. Di (2-ethylhexyl) phthalate
 - i. Di-n-butyl phthalate
 - j. Di-n-octyl phthalate
 - k. 1,2-dichlorobenzene
 - l. Diethyl phthalate
 - m. Dimethyl phthalate
 - n. Ethylbenzene
 - o. Formaldehyde
 - p. Hexavalent chromium
 - q. Isophorone
 - r. Lead
 - s. Mercury
 - t. Methyl ethyl ketone
 - u. Methyl isobutyl ketone
 - v. Methylene chloride
 - w. Naphthalene
 - x. Toluene (methylbenzene)

- y. 1,1,1-trichloroethane
- z. Vinyl chloride
- aa. Xylene

The list of banned ingredients closely follows Green Seal's Standard GS-11, with the addition of xylene.

- 7. Coordinate with paint manufacturers for implementing a "take-back program" for all unused paint. Set aside scrap and unused paint to be returned to the manufacturer for recycling into new product. Close and seal all partially used containers of paint to maintain quality as necessary for reuse.

Paint consists of substances that represent valuable resources and are best reused by the original manufacturer. For optimum indoor air quality, the above requirements can be replaced with a requirement that all paints used indoors be third-party certified for compliance with a standard based on California's chronic reference exposure levels (CRELs), such as Greenguard Children & Schools, Indoor Air Advantage Gold, or Collaborative for High Performance Schools.

Meeting this specification should meet or exceed the requirements of the LEED-NC and LEED-EB credits for VOC levels in paint and coatings.

V. Floorcoverings:

- 1. Carpet shall achieve an Environmental Performance Score of 0.0200 as determined through an assessment in the Building for Environmental and Economic Sustainability (BEES) software model, either Version 3.0 or 4.0. The parameters of the model must be set in the following way for this assessment:
 - a. "Environmental vs. Economics Performance Weights" shall be set at 100% Environmental Performance.
 - b. "Environmental Impact Category Weights" shall be set using the EPA Scientific Advisory Board weights.
 - c. "Transportation from "Manufacture to Use" shall be set at the lowest distance possible.
 - d. In the "Nylon Carpet Parameters" dialogue box, set "Carpet Type" as "Carpet Tile" and "Installation Glue" as "Low VOC Glue."

Floorcoverings: BEES—Building for Environmental and Economic Sustainability—is a software tool from the National Institute for Standards and Technology that contain life-cycle assessment data for a range of generic and some proprietary building products. The one category in which there are sufficient products to consider using BEES results as a selection method is carpet. The threshold score of 0.0200 was selected to differentiate the best-performing carpets in BEES 3.0. BEES 4.0 will have

more carpet products, some of which should also achieve this threshold (although it will be necessary to check that the scoring system hasn't shifted and adjust the threshold for BEES 4.0 use).

Low-Emitting Materials–Carpet Systems: Self-adhering carpet tile is the adhesive method that requires the least adhesive and the lowest associated VOC emissions.

2. All carpet systems, including adhesives, must meet or exceed the Carpet and Rug Institute Green Label Plus Indoor Air Quality Test Program.
3. Carpet cushion shall not contain brominated flame retardants.
4. Carpet tile applications shall be self-adhering.
5. All resilient floorcovering must be certified under the Greenguard or FloorScore indoor emissions testing programs.

FloorScore is a third-party certification program for floorcoverings other than carpet that is based on the State of California's chronic reference exposure levels (CRELs) for allowable concentrations of selected compounds. Polished concrete is a good option for indoor air quality, where acoustical requirements are not too stringent, because no adhesives or potentially volatile materials are added to the space, and cleaning is possible with low-impact cleaning agents. Other hard surface flooring options are similarly attractive.

6. Engineered wood flooring and bamboo flooring must be certified under the Greenguard or FloorScore indoor emissions testing programs.

Bamboo products should be certified as low-emitting under FloorScore or Greenguard to confirm that formaldehyde has not been added during manufacturing, due to confusion from some suppliers on this matter.

- W. Composite Wood and Agrifiber Binders: All composite wood, agrifiber products, and wood doors shall contain no added urea-formaldehyde resins.

Formaldehyde has been classified as a human carcinogen. Of the available formaldehyde-based binders, urea-formaldehyde offgasses at the highest levels. Agrifiber products are not made with urea-formaldehyde, as it is not effective as a binder on those materials.

The LEED-NC low-emitting materials credit, and the LEED-EB credit for optimizing use of IAQ compliant products both require the avoidance of composite wood products made with urea-formaldehyde, so this specification conforms with those requirements.

- X. Systems Furniture and Seating:

1. All systems furniture and seating meet the requirements of one of the following:
 - a. Greenguard certification
 - b. SCS Indoor Advantage certification
 - c. SCS Indoor Advantage Gold certification
 - d. BIFMA Standard X7.1-2005, as tested to BIFMA method M7.1-2005 and as verified by an independent laboratory
 - e. Calculated indoor air concentration limits for furniture systems and seating determined by the U.S. EPA's Environmental Technology Verification Large Chamber Test Protocol for Measuring Emissions of VOCs and Aldehydes (September 1999) testing protocol as conducted in an independent air quality testing laboratory

Systems Furniture and Seating: These products often contain contaminants that are harmful to occupants. Several certification programs and testing programs are available to limit, reduce, or eliminate such contaminants. The specification allows five such programs and protocols.

2. Systems furniture and seating made with coatings or sealants that contain any of the following solvents are not permitted: naphtha, benzene, toluene, xylene, hexavalent chromium.

- Y. Entryway Systems: Walk-off systems to capture particulates shall be installed at least 12 feet long in the direction of entry travel at all entryways directly connected to the outdoors that are used as regular entry points by building users. Acceptable entryway systems include:
1. Permanently installed grates, grilles, or slotted systems that allow for cleaning beneath them
 2. Permanently installed direct glue-down walk-off mats
 3. Non-permanent roll-out mats, but only if a service organization is contracted for maintenance on a weekly basis

Entryway Systems: Pollutants tracked in on the shoes of people entering a building are a significant source of contamination.

The LEED-NC credit for indoor chemical and pollutant source control requires a 6-foot-long walk-off system to contain these pollutants, but studies indicate that less than 50% of pollutants are captured in that distance. This specification requires a 12-foot-long walk-off system, which should capture 80% of the pollutants.

- Z. Air Filtration: Install air filtration media that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better in all air handling units for processing both return and outside air that is delivered to the air supply

system. Replace all filtration media after the completion of construction and prior to occupancy.

Air Filtration: MERV 13 filters are equivalent to an 85% to 90% efficiency, helping to control airborne contaminants. Replacing these filters between construction and occupancy is important to ensure that contaminants from the construction process do not adversely affect occupants.

AA. Mercury in Lighting:

1. Provide only low-mercury fluorescent or HID lamps with mercury content limited to the following:
 - a. T-5 and T-8 fluorescent lamps: 80 picograms per lumen hour

Performance parameters for Compact Fluorescent Lamps and HID Lamps should be generally in alignment with the requirements stated above, but applicable to those lamps.

2. Measurement Standards: Lumens to be measured according to IES LM9 for linear fluorescent lamps, IES LM66 for compact fluorescent lamps, and LM51 for HID lamps; mercury content to be measured according to U.S. EPA "Total Mercury by Cold Vapor Absorption Method" 7471A.

Mercury in Lighting: Fluorescent and high-intensity discharge lamps are a significant source of mercury in buildings. All such lamps should be recycled by a qualified service.

In addition to the requirements here, LEED-EB requires (as a prerequisite for participating in LEED-EB) that, on average over the facility, mercury-containing lamps not exceed 100 picograms per lumen hour. The LEED-EB additional toxic material reduction credit restricts that further to 80 picograms per lumen hour. The Green Guide to Health Care restricts mercury in fluorescent lamps to 5 milligrams of mercury per lamp—in a typical T-8 or T-5 fluorescent lamp this should be consistent with the 80 picogram limit in the specification. Major lamp manufacturers have recently started offering data on their lamps for verifying compliance with the LEED-EB requirement.

- BB. Lighting Controls: Install and calibrate controls as specified by Division 26 – Electrical in order to comply with LEED IAQ lighting controllability requirements.

It is the responsibility of the designers to design a system of lighting and controls that meets the Owner's requirements (and LEED's requirements, if desired). The Contractor must ensure that all specified controls are installed and tested, and respond to any concerns or problems that emerge from commissioning.

- CC. Thermal Comfort: Install and calibrate controls as specified in Division 23 – Heating, Ventilation, and Air-Conditioning.

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This approach meets the LEED v2.1 EQ 7.2 credit for thermal comfort. LEED v2.2 no longer includes this requirement.

DD. Blended Cement Concrete:

1. Cementitious Materials: Provide composite mix of portland cement and ground granulated blast-furnace slag or fly ash or blended hydraulic cement and limit percentage (by weight) of portland cement (ASTM C150) in aggregate (total weighted average of cementitious material weight for all mixes and pours) to 40% less than standard regional concrete mix designs.
2. Limit percentage (by weight) of standard portland cement (C-150), to the following maximum percentages of the cementitious portion of the mix while maintaining the above-40% required reduction in portland cement across the Project's total quantity of concrete:
 - a. Footings: 50%
 - b. Slab on Grade: 60%, except for cold-weather pours
 - c. Insulated Concrete Form Concrete: 40%
 - d. Elevated Slabs: 60%, except for cold-weather pours
 - e. Exterior Concrete: 75%

The purpose of this requirement is to reduce the CO₂ emissions associated with cement production. Care should be taken to coordinate with the structural engineer and the concrete supplier or installing subcontractor to verify needs or modifications for cold weather pours including an assessment of setup times and duration required to achieve specified target strength.

The 40% average reduction in portland cement is consistent with an establishing innovation point threshold in LEED for New Construction.

- EE. Gypsum Wallboard: Standard paper-faced gypsum wallboard can be used only in dry climates, where wetting during or after construction is not anticipated. In humid climates, where dampness and condensation are a concern, use only non-paper-faced gypsum wallboard. In wet locations a cementitious wallboard, made of portland or magnesium oxide cement, must be used.

These guidelines are based on best practices for managing moisture damage in buildings.

- FF. Fiberglass Insulation: Fiberglass batt insulation shall contain no formaldehyde-based binders or shall be third-party certified for conformance with Greenguard Children & Schools or Indoor Advantage Gold.

Most fiberglass batts are bonded with a phenol formaldehyde resin, which can contribute to unwanted indoor emissions.

GG. Duct Acoustical Insulation: Mechanical sound insulation materials within the duct shall consist of an impervious, non-porous coating that prevents dust from accumulating in the insulating materials.

HH. Green Housekeeping:

1. Utilize cleaning products that meet the requirements of the Green Seal GS-37 standard or comply with the requirements and maximum VOC limits of Title 17, California Code of Regulations, Division 3, Chapter 1, Subchapter 8.5, Article 2, Regulation for Reducing VOC Emissions from Consumer Products (September 2001).
2. Utilize janitorial paper products and trash bags that meet the minimum percentages of post-consumer recycled content and recovered content requirements of EPA's Comprehensive Procurement Guidelines.

The requirements in this section are intended to reduce the environmental impacts of housekeeping operations and reduce exposure of maintenance personnel and building occupants to harmful VOC emissions.

This specification meets the requirements for the LEED-EB materials credit for sustainable cleaning products and materials.

PART 3 - EXECUTION

3.1 CONSTRUCTION WASTE MANAGEMENT

- A. Develop and implement a Construction Waste Management Plan (CWMP), as defined in Section 01 74 19 "Construction Waste Management," quantifying material diversion by weight in order to recycle, reuse, and/or salvage at least 95% (by weight) of construction, demolition, and land-clearing waste.
- B. Clean materials which are contaminated prior to placing in collection containers. Deliver materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- C. Utilize any on-site existing paving materials that are scheduled for demolition as granulated fill or subbase material, and include the weight of this material in the calculations for material diverted from landfill disposal.
- D. Arrange for materials collection by or materials delivery to the appropriate recycling or reuse facility.
- E. Tax credits and other savings obtained or revenue generated for recycled or reused materials accrue to the Contractor.

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- F. Discuss CWMP procedures and measures as an agenda item at all regular job meetings conducted during the course of work at the site, and record progress in meeting minutes.
- G. Submit monthly progress reports with Applications for Payment in accordance with Section 01 74 19, documenting the status of the CWMP and current diversion percentage rates.

3.2 CONSTRUCTION INDOOR AIR QUALITY MANAGEMENT

- A. Develop and implement a Construction IAQ Management Plan (CIAQMP) to prevent indoor air quality problems resulting from construction activities, including, at minimum, the following:
 - 1. Construction activities must meet or exceed the minimum requirements of the SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995.
 - 2. During construction, protect all absorptive materials stored on-site or installed from moisture damage as described in the Construction IAQ Management Plan (CIAQMP) defined above. Specifically:
 - a. Exercise special care at all times in the storage of materials to prevent exposure to moisture.
 - b. Avoid installation of gypsum wallboard and other porous materials until the building is weather-tight.
 - c. All standing water which accumulates on interior floors shall be removed on the day that it is observed.
 - d. Any drywall that has retained more than 20% moisture after 48 hours following exposure to moisture, or that has evidence of mold, must be disposed of in accordance with Specification Section 01 74 19 "Construction Waste Management."
 - e. The contractor shall identify and remove all porous building materials that become wet or damaged by moisture within 7 calendar days of such exposure.

These measures are intended to minimize the opportunity for moisture damage and mold growth within the building.

- 3. During construction and HVAC system installation, provide the Architect with photographs of IAQ management measures (such as protection of ducts and on-site or installed absorptive materials), including six photographs on three different occasions depicting implemented SMACNA approaches.
- B. Air Filtration:
 - 1. Install air filtration media that provides a Minimum Efficiency Reporting Value (MERV) of 13 or better in all air handling units for processing both return and outside air that is delivered to the air

supply system; replace all filtration media after the completion of construction and prior to occupancy.

2. Install air filtration media that provides a Minimum Efficiency Reporting Value (MERV) of 8 or better for filtration media installed at return air grilles during construction if permanently installed AHUs are used during construction. Inspect weekly and replace as required.
- C. Discuss CIAQMP procedures and measures as an agenda item at all regular job meetings conducted during the course of work at the site, and record progress in meeting minutes.
- D. Engage an independent testing and inspecting agency to conduct a baseline indoor air quality testing program after the completion of construction and prior to occupancy in accordance with Section 01 81 09 "Testing for Indoor Air Quality."

This section spells out the requirements for managing and protecting indoor air quality during construction. It is written to conform with the construction IAQ management plan credit in LEED-EB and the first credit in LEED-NC for the management plan during construction. For details on a testing plan to meet the requirements of the second LEED-NC credit for the construction IAQ management plan before occupancy, see related Section 01 81 09 "Indoor Air Quality Testing."

3.3 COMMISSIONING

- A. Commissioning: All building energy-related systems and building envelope components shall be commissioned in accordance with the requirements of Specification Section 01 91 00 "Commissioning Requirements" and related commissioning sections in other divisions in order to verify and ensure that fundamental building elements and systems are installed, constructed, calibrated to operate, and perform according to the Owner's Project Requirements, Basis of Design, and Construction Documents.

3.4 MEASUREMENT & VERIFICATION

- A. For new construction, comply with the requirements of the International Performance Measurement & Verification Protocol (IPMVP), Volume III: Concepts and Options for Determining Energy Savings in New Construction, April 2003, Option B or D.
- B. For existing buildings, comply with the requirements of the International Performance Measurement & Verification Protocol (IPMVP), Volume I: Concepts and Options for Determining Energy and Water Savings, 2001, Option B or D.

END OF SECTION 01 81 13

SECTION 01 81 13 – Sustainable Design Requirements

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