LEED BD+C: New Construction | v2009

Indoor air quality procedure - alternative compliance path

EQpc68 | Required

Glossary

Intent

To contribute to the comfort and well-being of building occupants by establishing minimum standards for indoor air quality (IAQ).

Requirements

This prerequisite is available for pilot testing by the following LEED rating systems and building types:

- New Construction
  - Office
  - Multi-family Residential
  - Lodging
  - Warehouses
- Retail NC (excluding restaurants)
- Schools (excluding laboratories within school buildings)
- Commercial Interiors
- Retail CI (excluding restaurants)
- Existing Buildings Operations and Maintenance
  - Office
  - Retail (excluding restaurants)
  - Multi-family Residential
  - Lodging
  - Schools (excluding laboratories within school buildings)
  - Warehouses

Project types not listed above that are interested in pursuing this path, should contact USGBC before registration. See below for more information.

Note: The following Pilot Credit modifications apply to this prerequisite:

- Introductory phone call between project teams pursuing this path and GBCI reviewers.
- Project teams pursuing this pilot prerequisite will be required to fulfill all prerequisite requirements. Unlike with other pilot credits, documenting that a pilot credit is in need of major revision and in unachievable in its current form will not demonstrate compliance for IEQp1.
- No ID points will be awarded.
- If a project team registers and submits documentation noting that space in the project fails testing (chemical or perceived), corrective action must be taken until the project meets all requirements; it will not be acceptable to pursue the Ventilation Rate Procedure in IEQp1 once evidence of not meeting the pilot requirements is submitted. If, however, a project team decides that this path is too costly or otherwise onerous prior to submission, they may go back and use the traditional IEQp1 path.
- BD+C and ID+C projects will still need to meet local code requirements for ventilation if they differ from the IAQP.

BD+C, ID+C

Meet the minimum requirements of ASHRAE Standard 62.1-2007, Sections 4 through 7, Ventilation for Acceptable Indoor Air Quality (with errata). Determine the minimum outdoor air intake flow for mechanical ventilation systems using the In-door Air Quality Procedure, or a local equivalent, whichever is more stringent. Combining the IAQP and VRP is not an acceptable means of compliance with this pilot prerequisite.
Prohibit smoking in the building.
Meet the following requirements for ventilation systems designed in accordance with Section 6.3 Indoor Air Quality (IAQ) Procedure:

1. Contaminant Sources. Identify the outdoor sources, indoor sources, and the expected emission rate for each of the contaminants and mixtures of concern listed in Table 1. Additionally, confirm that the top 10 contaminants by concentration in the building, as identified by mass spectrograph analysis, are included in Table 1. If they are not already included in Table 1, list them.
2. Contaminant Concentration. Refer to Table 1 for maximum allowable concentration limits for each contaminant of concern.
3. Perceived Indoor Air Quality. At least 80% of observers or occupants must determine the perceived indoor air quality to be “acceptable” using a Subjective Evaluation.
4. Design Approach.
   1. Use mass balance analysis. Determine minimum outdoor airflow rates per steady-state mass-balance in Appendix D of the standard.
   2. Project teams using a similar zone as allowed in ASHRAE 62.1, must demonstrate that the similar space selected also complies with all requirements of this prerequisite.
   3. If non-dilution air cleaning technology is utilized, use air cleaning technology consisting of sorptive active agents, in accordance with ASHRAE Standard 145.2-2011, Laboratory Test Method for Assessing the Performance of Gas-Phase Air-Cleaning Systems: Air Cleaning Devices. Electronic air cleaning technology cannot be used.

5. Air Testing. Conduct contaminant-level testing for each of the contaminants of concern as follows:

    1. Each contaminant of concern shall be measured using the test methods in Table 1. If the top 10 contaminant concentrations are not listed in Table 1, separately mitigate these contaminants or provide a ruling by a cognizant health body that they have no known adverse health impact. Testing is to be completed during time of anticipated peak contaminant loading by an appropriately accredited professional. Use current versions of ASTM standard methods or ISO methods. The number of sampling locations depends on the size of the building and number of ventilation systems, but must include the entire building and all representative space uses.
    2. All measurements within each location shall demonstrate compliance with the maximum allowable concentration limits per Table 1. For each sampling point where the concentration exceeds the limit, take corrective action and retest for the noncompliant contaminants as the sampling points. Repeat until all requirements are met.
    3. Provide testing frequency as follows:

        - After construction and before occupancy with all furniture installed and with all finishes applied. Conduct all measurements with the building ventilation system started at the normal daily start time and operated at the minimum outdoor airflow rate for the occupied mode throughout the test.
        - After complete occupancy of the building within the first year of full occupancy.

    4. For Major Renovation projects, confirm complete implementation of maintenance plans for the following contaminants or document status of “no further remediation” required:

        - Asbestos Containing Materials (ACMs)
        - Lead
        - Radon
        - Mold

6. Subjective Evaluation. Complete the following tasks:

    1. Prior to occupancy, select a panel of 20 observers to render perceived observations about the quality of the indoor air at a representative area of each space type. Panel members are to be non-smokers, without medically diagnosed odor sensing impairments, or chemical sensitivities, ages 18 to 55. Observers are to render an opinion within 15 seconds of entering the test space as to whether the air is "acceptable" and again at 6 minutes.
    2. Post-occupancy, distribute a seven-point scale questionnaire to at least 30% of the space/building occupants, as described in IEQ Credit 7.2: Thermal Comfort - Verification. The questionnaire is to be designed to address perceived indoor air quality particularly with a focus on odors and irritation responses.
    3. Either in conjunction with the panel testing, or, alternatively, as part of the post-occupancy survey, observers/occupants should render an opinion after spending a minimum of 30 continuous minutes within the space.

Table 1.

Contaminant Compound (CAS#)	Concentration Limit (µg/m3)	Test Method
Volatile Organic Compounds (VOCs)		
Acetaldehyde 75-07-0	140	ISO 16017-1, 2; ISO 16000-3, 6; ASTM D6345-10
Benzene 71-43-2	60	
Carbon disulfide 75-15-0	800	
Carbon tetrachloride 56-23-5	40	
Chlorobenzene 108-90-7	1000	
Chloroform 67-66-3	300	
Dichlorobenzene (1,4-) 106-46-7	800	
Dichloroethylene (1,1) 75-35-4	70	
Dimethylformamide (N,N-) 68-12-2	80	
Dioxane (1,4-) 123-91-1	3000	
Epichlorohydrin 106-89-8	3	
Ethylbenzene 100-41-4	2000	
Ethylene glycol 107-21-1	400	
Ethylene glycol monoethyl ether 110-80-5	70	
Ethylene glycol monoethyl ether acetate 111-15-9	300	
Ethylene glycol monomethyl ether 109-86-4	60	
Ethylene glycol monomethyl ether acetate 110-49-6	90	
Formaldehyde 50-00-0	33	BS-ISO 16000-3, 4; ASTM D5197; BS ISO 16000-4
Hexane (n-) 110-54-3	7000	ISO 16017-1, 2; ISO 16000-3, 6; ASTM D6345-10
Isophorone 78-59-1	2000	
Isopropanol 67-63-00	7000	
Methyl chloroform 71-55-6	1000	
Methylene chloride 75-09-2	400	
Methyl t-butyl ether 1634-04-4	8000	
Naphthalene 91-20-3	9	
Phenol 108-95-2	200	
Propylene glycol monomethyl ether 107-98-2	7000	
Styrene 100-42-5	900	
Tetrachloroethylene 127-18-4	35	

Toluene 108-88-3	300	
Trichloroethylene 79-01-6	600	
Vinyl acetate 108-05-4	200	
Xylenes-total 108-38-3, 95-47-6, and 106-42-3	700	
Inorganics		
Carbon Monoxide	9	ISO 4224
Ozone	147 (0.075 ppm)	ISO 13964; ASTM D5149-02
Particulate Matter PM2.5	15	ISO 7708
Ammonia	200	NIOSH Manual of Analytical Methods
Carbon Dioxide	700 above outdoor ppm	EPA compendium infared

Submittals

General

REGISTER FOR PILOT ACP 68

- Participate in the LEEDuser pilot credit forum
- Complete the feedback survey:

CREDITS 1-27

CREDITS 28-38

CREDITS 39-41

CREDITS 42-56

CREDITS 57-67

BD+C specific:

1. Provide local code calculations, if different than calculation performed for the IAQP (Optional).

Credit Specific:

1. Provide a design narrative describing the approach used to comply with the IAQ Procedure for the project building. If applicable, document which systems are utilizing the Ventilation Rate Procedure or Natural Ventilation Procedure Method and not the IAQ Procedure. Document the status of any required maintenance plans or a status of no further remediation required for ACMs, lead, radon, and mold. Lastly, include a milestone timeline for implementation of the IAQ Performance Method at the project building listing dates of all tests, corrective actions, and date of compliance.
2. Complete the IAQ Procedure Calculator. The calculator includes the mass balance calculations used to determine predicted contaminant concentrations and a table for comparing predicted concentrations to actual concentrations from the contaminant-level testing. Additionally, list the top ten (10) contaminants by concentration as identified through mass spectrograph analysis. For any contaminants not listed in Table 1 include:
   1. Chemical Abstracts Service (CAS) Number for the contaminant, if available
   2. Exposure limit and cognizant health authority referenced for that limit
3. Provide a copy of all test results used for compliance including an executive sum-mary by the appropriately accredited professional explaining the testing procedures, confirmation of compliance with HERS or APPA sampling methods as appropriate, specific laboratory test results, and a table of corrective actions required to address non-compliant results.
4. Provide a narrative of the Perceived Indoor Air Quality analysis including an executive summary explaining the results and a table of corrective actions required to address non-compliant results.
5. For non-dilution air cleaning technology provide the type of air cleaning products used and the performance data as specified in ASHRAE Standard 145.2. Product removal efficiency shall be reported for the test challenge surrogate gases listed in the table below for the four classes of gases likely to be present in the building. However, if the chemical contaminant mixture in the building is known to include another challenge gas as found in Table 6.1.4.1 of the ASHRAE Std. 142.2, then the appropriate performance data for the challenge gas selected should be provided. Provide a preventative maintenance plan for maintaining the non-dilution air cleaning products. Plan shall include the estimated life of the products and any strategy to be used for determining product change out frequency (e.g. remaining life analysis of sorptive agent media using carbon activity and/or remaining concentration of chemical impregnation via titrimetry).

Surrogate Test Challenge Gases	
Acid Gases	
Sulfur Dioxide	CAS # 7446-09-5
Aldehydes	
Formaldehyde	CAS # 50-00-0
Basic Gases	
Ammonia	CAS # 7664-41-7
Oxidizing Gases	
Ozone	CAS # 10028-15-6
VOCs	
Toluene	CAS #108-88-3

Additional questions

- Would the team apply this method to another building in the future? Why/why not?
- How did the cost of this method compare to the cost of the Ventilation Rate Procedure?

Background Information

Subjective evaluation - Panel

Panel participants may be regular occupants of the project building, visitors to the

build-ing (i.e. customers of a retail establishment), or individuals with no connection to the project building. Composition of the panel in this regard is at the discretion of the project team.

Responses are to be collected via anonymous methods either written or electronic. The Perceived Indoor Air Quality test is considered “passing” if 80% or more of the panel renders the space “acceptable” at each interval. If less than 80% of the panel renders the space “acceptable”, appropriate corrective actions must be implemented to correct the deficiency. Corrective actions must be implemented within six (6) months of the con-clusion of the panel observations.
Subjective evaluation - Questionnaire

The questionnaire is to be designed to address perceived air quality particularly focusing on odors and irritation responses. The responses shall be tabulated. Respondent answers of -1, -2, or -3 on the seven-point scale will be considered as dissatisfied. If more than 20% of respondents are dissatisfied, appropriate corrective actions must be implemented during the performance period.

For EB: O+M projects, at least one occupant survey must be conducted during each monitoring period.

Space sampling for testing

Randomly select spaces to be tested, ensuring that each occupiable space type is adequately represented. Utilize HERS sampling methodologies for multi-family and lodging projects or APPA sampling methodologies for offices, retail, schools, warehouses, and existing buildings.

1. Minimum area and space counts noted in the applicable sampling methodology MUST be met.

    1. For HERS sampling procedures, randomly select one in seven (1 in 7) substan-tially similar spaces. Each sample group would consist of identical spaces, one out of every seven of which are to be tested. A minimum of three tests must be conducted in each sample group.
    2. For APPA, randomly select locations totaling at least 10% of the gross floor area of the building and 10% of the total count of substantially similar spaces provided at least five (5) spaces of each space type are included. For any space types with less than five (5) spaces, include all spaces of that type.

2. Note: different occupiable space types may be combined into common groups if the contaminants and mixtures of concern within those space types are expected to be the same with similar emission rates and the spaces are served by the same ventilation system.

For purposes of determining how many test locations are required, the following shall govern:

1. Testing must occur in at least one location per ventilation system, per occupiable space type. The location(s) selected for testing must represent the worst-case zone(s) where the highest concentrations of contaminants of concern are likely to occur.

    1. For offices, retail, schools, lodging, multi-family residential, and existing buildings, testing must occur within areas no larger than 5,000 square feet. For warehouses or large open spaces within other building types (i.e. ballrooms in lodging, gymnasiums in schools, etc.) a limit of 50,000 square feet may be used. If there is evidence that the air within the space is well-mixed and sources of contaminants of concern are uniform, project teams may test a single location within that space. Evidence would consist of one of following:

        1. Engineering verification of HVAC system with uniform ventilation distribution, and uniform source of contaminants within that space.
        2. Tracer gas analysis showing uniform air distribution, and initial contaminant measurements showing uniform levels of contaminants of concern.

    2. Real-time sensors may be used to identify the worst-case zones for contaminants of concern; however, final testing results must be measured using the protocols below. Real-time sensor testing is not acceptable for final testing results.
    3. Locations selected may be served by more than one ventilation system provided that each ventilation system serving the location is designed in accordance with Section 6.3.

Additional Resources

1. Reference to CHiPS database of contaminant generation rates
2. Spreadsheet Calculator for compliance purposes
3. Flow chart of compliance steps
4. Example Surveys
5. CEC/LBNL report, “Balancing energy conservation and occupant needs in ventilation rate standards for “Big Box” stores in California: predicted indoor air quality and energy consumption using a matrix of ventilation scenarios”. It is available here