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***Title: Testing for Indoor Air Quality  
Section 01 81 09***

## **SECTION 01 81 09 - TESTING FOR INDOOR AIR QUALITY**

### **PART 1 - GENERAL**

#### **1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions, other Division 1 Specification Sections, and specifications of materials mentioned in this section, apply to this Section.

#### **1.2 SUMMARY**

- A. General: This section provides requirements for Baseline Indoor Air Quality (IAQ) Testing for maximum indoor pollutant concentrations for acceptance of the facility.

#### **1.3 RELATED SECTIONS**

- A. All work shall comply with Division 1 Section 01 81 13.
- B. Coordinate with Commissioning activities specified in Section 01 91 00.
- C. All work shall comply with Division 23, the section on "Testing, Adjusting and Balancing."

#### **1.4 SUBMITTALS**

- A. Baseline IAQ Testing: Submit a report for each test site specified for IAQ baseline testing as prescribed herein below and in Division 23, in the section on "Testing, Adjusting, and Balancing." Report on air concentrations of targeted pollutants identified in Subsection 3.1 of this section.

#### **1.5 SEQUENCING AND SCHEDULING**

- A. Identify, program, and schedule all IAQ testing well in advance of construction in a manner to prevent delays to the performance of the work of this Contract in order to perform and complete all testing after the completion of construction activities and prior to occupancy.

### **PART 2 - PRODUCTS (Not Used)**

### **PART 3 - EXECUTION**

#### **3.1 BASELINE IAQ TESTING**

- A. HVAC System Verification: To assure compliance with recognized standards for indoor air quality including ASHRAE Standard 62.1-2004, the Contractor's independent testing and balancing agency shall verify the performance of each HVAC system prior to Indoor Air Quality testing, including space temperature and space humidity uniformity, outside air quantity, filter installation, drain pan operation, and any obvious contamination sources.
- B. Indoor Air Quality Testing: Upon verification of HVAC system operation, the Contractor shall hire an independent contractor, subject to approval by the Contracting Officer's Representative, with a minimum of 5 years experience in performing the types of testing specified herein, to test levels of indoor air contaminants for compliance with specified requirements.
  - 1. Conduct baseline IAQ testing using testing protocols consistent with the United States Environmental Protection Agency Compendium of Methods for the Determination of Air Pollutants in Indoor Air.
  - 2. A test plan shall be submitted for the approval of the Contracting Officer's Representative. The plan shall specify procedures, times, instrumentation, and sampling methods that will be employed.
  - 3. Perform IAQ testing for at least the minimum number of required sampling locations, determined as follows: For each portion of the building served by a separate ventilation system, the number of sampling points shall not be less than one per 25,000 sq. ft., or for each contiguous floor area, whichever is larger, and include areas with the least ventilation as calculated by Ventilation Rate Procedure of ASHRAE Standard 62.1-2004 and greatest presumed source strength as identified by Owner. Collect air samples on three consecutive days and average the results of each three-day test cycle to determine compliance or non-compliance of indoor air quality for each air handling zone tested.

*The sampling area of not less than one sampling point per 25,000 sq. ft. meets the requirements for LEED-NC Construction Air Quality Management credit.*

*Note that the 2004 version of Standard 62.1 determines allowable ventilation based not only on occupancy but also on assumed pollutant emissions from furnishings, so the "areas with least ventilation" will have to be determined accordingly.*

- a. Verify areas to be tested with the Contracting Officer's Representative. Areas with 100% outside air ventilation rates such as laboratories are excluded from these testing requirements. The Contracting Officer's Representative is the sole judge of areas exempt from testing.
- 4. Perform IAQ testing following the completion of all interior construction activities and prior to occupancy. The building shall have

all interior finishes installed including, but not limited to, millwork, doors, paint, carpet, and acoustic tiles. Perform testing prior to installation of furniture, workstation components, and casework.

*Performing initial testing prior to upfit activities ensures that construction and ventilation meet IAQ requirements and also provides a measurement baseline. Because systems furniture and other owner upfit activities may be a source, it is also wise to test after installation of furniture. This allows for allocation of accountability for any problems.*

5. Perform IAQ testing within the breathing zone, between 3'-0" and 6'-0" above the finished floor and over a minimum 4-hour period.

*The 4-hour minimum requirement is the same as required in the LEED-NC credit for a construction IAQ management plan before occupancy.*

6. Collect air samples during normal occupied hours (prior to occupancy) with the building ventilation system starting at the daily normal start times and operated at the minimum outside air flow rate for the occupied mode throughout the duration of the air testing.
7. Sample and record outside air levels of formaldehyde and TVOC contaminants at three outside air locations (as determined by Owner) simultaneously with indoor tests to establish basis of comparison for these contaminant levels by averaging the three outdoor readings for each contaminant.
8. Perform airborne mold and mildew air sampling and speciation with simultaneous indoor and outdoor readings.
  - a. Samples are to be collected using a 12 liter-per-minute pump and a 0.45 micron polycarbonate filter, with a 4-hour duration for each sample.
  - b. Speciation shall be done with DNA detection using the quantitative polymerase chain reaction (QPCR) method. To ensure that filters are not precontaminated with mold, a field blank filter cartridge shall be tested after every eighth sample is tested.

*Four-hour sample collection periods are a minimum requirement—to ensure the collection of representative samples, an 8-hour period could be specified. The QPCR method is more reliable and consistent than conventional morphology using visual identification, which is highly dependent on the experience of the technician.*

9. Acceptance of respective portions of the building by the Owner is subject to compliance with specified limits of indoor air quality contaminant levels.
- C. Indoor air quality shall conform to the following standards and limits:
1. Formaldehyde: <20 microgram/m<sup>3</sup> (16.3 ppb)

2. Sum of VOCs: <200 microgram/m<sup>3</sup>
3. Carbon Monoxide: Not to exceed 9 ppm
4. Other compounds found on the California Office of Environmental Health Hazard Assessment's list of chronic inhalation Reference Exposure Levels (RELs) are not to exceed those levels, as published on: [http://www.oehha.ca.gov/air/chronic\\_rels/AllChrels.html](http://www.oehha.ca.gov/air/chronic_rels/AllChrels.html)

*Use of the California CREL levels is consistent with EPA's program office and supported by IAQ research at Research Triangle Park. The formaldehyde level is higher than the CREL (which is at a level that is often exceeded in outdoor air) but lower than the 27 ppb level that was selected for enforcement in California. The sum of VOCs level was retained from previous versions of this specification as a check against combinations of VOCs that individually are under the limit but may collectively constitute a problem.*

*Allowable Air Concentration Levels meet or exceed the requirements of LEED-NC credit for a construction IAQ management plan before occupancy, with the exception of particulates (PM<sub>10</sub>), which are unlikely to be found in unoccupied buildings, and 4PC, which was once a common pollutant associated with carpet but is no longer a concern, particularly since any carpet to be installed will be certified as Green Label Plus. However, it may be necessary to include those pollutants in the specification to conform to the requirements of the LEED credit.*

5. Airborne Mold and Mildew: The species identified in indoor air cannot vary by more than 10% from those identified in the exterior samples.

*Air sampling for mold and mildew is a rapidly changing science, and the 10% threshold represents a rough estimate of an acceptable differential, but a tighter threshold could also be applied.*

- D. Test Reports: Prepare test reports showing the results and location of each test, a summary of the HVAC operating conditions, and a listing of any discrepancies and recommendations for corrective actions, if required.
  1. Include certification of test equipment calibration with each test report.
- E. For each sampling point where the maximum concentration limits are exceeded, the Contractor is responsible for conducting additional flush-out with outside air and retesting the specific parameter(s) exceeded to indicate the requirements are achieved. Repeat procedure until all requirements have been met. When retesting non-complying building areas, take samples from the same locations as in the first test. Retesting shall be performed at no additional expense to the Government.
- F. For each sampling point where the airborne mold and mildew indoor species distribution varies by more than 10% from exterior sampling speciation, Contractor shall identify the source of the mold and/or mildew

and remediate with corrective action, then retest in accordance with section 3.1.B above until compliant results are attained.

- G. In the event that any non-compliant test results occur, Contractor must provide a written report to the Owner describing the source(s) of the non-compliant condition(s) and the corrective action(s) implemented.

### 3.2 INDEPENDENT MATERIALS TESTING:

- A. **Materials That Must Be Tested:** All materials listed below that are proposed for use on this project shall be tested for permanent, in-place indoor air quality performance in accordance with requirements of these specifications. Results shall be furnished to the Contracting Officer's Representative. Materials meeting the criteria for independent testing are as follows:
  1. Field-applied paint systems on appropriate substrate. Paint primers and intermediate coats (if used) should be applied with a typical drying time allowed between coats (not to exceed 7 days).
  2. Carpet including manufacturer's recommended adhesive. The carpet will be applied to the appropriate flooring per manufacturer's instructions so that the testing is of the "carpet assembly."
  3. Ceiling tile
  4. Any fireproofing material that may be exposed to indoor air, directly or in a plenum, applied to appropriate substrate
- B. **Materials for Testing:** Only test representative samples of actual products selected for use on this project. Tests of products generically and/or technically similar but produced by a manufacturer other than that of the product selected for use on this project are invalid.
- C. **Materials Testing and Evaluation Protocol:** California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers," July 2004. available online: <http://www.dhs.ca.gov/ps/deodc/ehlb/iaq/VOCS/>

*This protocol, commonly known as California's "Section 01350 Specification," is becoming accepted nationally as a standard for emissions testing. It is used in California for state facilities and by the Collaborative for High Performance Schools, and it is the basis for much of the Carpet and Rug Institute's Green Label Plus program and the Greenguard Environmental Institute's "Children & Schools" product certification.*
- D. **Performance Thresholds:** All compounds detected that have chronic reference exposure levels listed in the California DHS Standard Practice

document shall be analyzed and compared to the allowable concentration levels.

- E. Materials Test Reports: Submit test reports to the Contracting Officer's Representative. The report shall include raw emission levels, as well as the calculated resulting concentrations and the assumptions (loading, volume of space, ventilation rates) used to determine those resulting concentrations.

*For projects for which it is impractical to analyze all the parameters needed to predict resulting concentrations, the protocol includes default assumptions for offices and schools that may be used. Based on these default assumptions, there are lists of pre-approved products for which testing may not be necessary. Products on those lists have not been tested in combination with their substrates, however.*

- F. Product/Material Evaluation: All products/materials shown by testing to comply with emissions limits and other criteria specified in this section will be approved for use on this project subject to compliance with all other specified requirements of the Project Manual. Products/materials shown to exceed specified emission limits shall be discussed, test results interpreted, and a determination made as to alternative product uses or selections.

END OF SECTION 01 81 09