ANSI/ASHRAE/ICC/USGBC/IES Addendum ao to ANSI/ASHRAE/ICC/USGBC/IES Standard 189.1-2020

Standard for the Design of High-Performance Green Buildings

Except Low-Rise Residential Buildings

The Complete Technical Content of the International Green Construction Code®

Approved by ASHRAE and the American National Standards Institute on August 31, 2023; by the International Code Council on July 24, 2023; by the the Illuminating Engineering Society on July 25, 2023; and by the U.S. Green Building Council on August 7, 2023.

This addendum was approved by a Standing Standard Project Committee (SSPC) for which the Standards Committee has established a documented program for regular publication of addenda or revisions, including procedures for timely, documented, consensus action on requests for change to any part of the standard. Instructions for how to submit a change can be found on the ASHRAE® website (www.ashrae.org/continuous-maintenance).

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a. interpretation of the contents of this Standard,
b. participation in the next review of the Standard,
c. offering constructive criticism for improving the Standard, or
d. permission to reprint portions of the Standard.

(This foreword is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

FOREWORD

Addendum ao modifies Section 10, "Construction and Plans for Operation," which was previously modified by published addendum "ax."

- *Section 10.4.2, "IAQ Construction Management and System Startup," is modified to reference specific subsections of Standard 62.1 and to eliminate duplication. This section was previously modified by addendum ax, which can be downloaded at www.ashrae.org/addenda. Additionally, the following changes were made:*
  - *Section 10.4.2(d) strikes the requirement to cover permanent HVAC vents during activities that produce dust, as these activities could prove harmful and unproductive to workers in an unconditioned environment.*
  - *Section 10.4.2(e), is modified to allow operation of permanent HVAC systems during construction provided that they are protected from dirt, dust, and debris and that all filters and controls are in place and operational.*
  - *Section 10.4.2(f) is modified editorially, with no change in the requirement.*
- *Section 10.7.1 (building flush out requirements) is deleted because the committee believes it was little used due to practical limitations and lack of hard data on its effectiveness. The goal of additional ventilation prior to occupancy and during initial occupancy is met by requirements in new Sections 10.7.2 and 10.10.5.*
- *Section 10.7.2 (postconstruction, preoccupancy IAQ monitoring of 36 constituents) is deleted. In its place, Section 10.10.7, "Air Monitoring," requires monitoring of two properties of air and four contaminants during initial occupancy and providing to the owner a report with graphical trends and recommendations. The committee believes this provides meaningful and actionable information to the owner while avoiding delays in occupancy due to monitoring requirements.*
- *New Section 10.7 contains requirements for IAQ preparations prior to occupancy, including the early start of ventilation described above.*
- *Sections 10.9.4 and 10.9.7 are deleted. Some of the requirements were duplication of those already incorporated by reference to Standard 62.1. Others of these requirements are now found, with modifications, in a new Section 10.10, "Plan for Operation: IAQ-Related Activities."*
- *A new Section 10.10 contains all the elements of the plan for operation, some of which are described above. It collects requirements in one section that were previously in several noncontiguous sections.*

Informative Note: In this addendum, changes to the current standard are indicated in the text by underlining (for additions) and ~~strikethrough~~ (for deletions) unless the instructions specifically mention some other means of indicating the changes.

Addendum ao to Standard 189.1-2020

Modify Section 10.4.2 and 10.4.4 as shown.

10.4 Construction Operations and Start-Up Requirements

[. . .]

10.4.2 IAQ Construction Management and System Startup. Ventilation systems shall be constructed and started in compliance with Section 7 of ANSI/ASHRAE Standard 62.1. An IAQ construction management plan shall be developed and implemented. The plan shall include procedures and schedules to accomplish ~~that includes to include~~ the following:

a. ~~Requirements of Section 7~~ Compliance with ANSI/ASHRAE Standard 62.1, Sections 7.1.2, 7.1.3, and 7.1.4

b. Prevention of the use of adhesives, paint, and other volatiles and operations that create dust, including sanding and sawing, after 48 hours prior to occupancy

c. Covering air conveyance materials prior to installation

d. Sealing of HVAC system supply and return air openings when systems are not in use

e. Protection of permanent HVAC systems from dirt, dust, and debris in compliance with ASHRAE Standard 62.1, Section 7.2.4, or prevention of their operation during construction except for preoccupancy ventilation as specified in Section 10.7.2

1. All filters and controls shall be in place and operational during such HVAC system operation.

f. Replacement of installed materials that exhibit biological growth

~~b. Use of construction filters in all operating HVAC systems, including installation, inspection, and replacement.~~

~~c. Sealing of HVAC system supply and return air openings when systems are not in use and during activities that produce high dust.~~

~~d. Managing migration of airborne contaminants associated with construction within the building by boundary sealing, pressure differentials or other methods.~~

~~e. Managing building pressures to control entry of outdoor humidity after the building enclosure is complete.~~

~~f. Prohibition inside the building and within 25 ft (8 m) of the building entrance of smoking of any kind, and of electronic smoking devices.~~

~~g. Scheduling of construction and interior build-out such that absorptive materials (including carpet, textiles and porous ceiling tiles) are protected or installed later than materials that emit volatile compounds (including adhesives, mastics and coatings).~~

~~h. Exhaust systems to remove product emissions from construction and staging areas.~~

~~i. Sealing of ducts, air terminals and air stream surfaces to protect them from moisture, particulates and other contaminants.~~

~~j. Regular cleaning during construction to remove contaminants and accumulated moisture.~~

~~k. Performance and reporting responsibilities of subcontractors and suppliers.~~

~~l. Verification and recordkeeping of the above activities.~~

[. . .]

10.4.4 Construction Activity Pollution Prevention—Protection of Occupied Areas. The construction documents shall identify operable windows, doors, and air intake openings that serve occupied spaces, including those not associated with the building project, that are in the area of construction activity or within 35 ft (11 m) of the limits of construction activity. Such windows, doors, and air intake openings that are under control of the *owner* shall be closed, or other measures shall be taken to limit contaminant entry.

Management of the affected buildings not under the control of the ~~building project~~ *owner* shall be notified in writing of planned construction activity and possible entry of contaminants into their buildings.

Delete Section 10.7, and replace it with the following new Section 10.7:

~~**10.7 [JO] Postconstruction Building Flush-Out and Air Monitoring.** After construction ends, prior to occupancy and with all interior finishes installed, a postconstruction, preoccupancy building flush-out as described under Section 10.7.1, or postconstruction, preoccupancy baseline IAQ monitoring as described under Section 10.7.2, shall be performed.~~

~~**10.7.1 Postconstruction, Preoccupancy Flush-Out.** A total air volume of *outdoor air* in total air changes as defined by Equation 10-1 shall be supplied while maintaining an internal temperature of a minimum of 60°F (15°C) and relative humidity no higher than 60%. For buildings located in nonattainment areas, filtration and/or air cleaning as described in Section 8.3.1.3 shall be supplied when the Air Quality Index forecast exceeds 100 (category orange, red, purple, or maroon). One of the following options shall be followed:~~

~~a. **Continuous postconstruction, preoccupancy flush-out.** The flush-out shall be continuous and supplied at an outdoor airflow rate no less than that determined in Section 8.3.1.1.~~

~~b. **Continuous postconstruction, preoccupancy/postoccupancy flush-out.** If occupancy is desired prior to completion of the flush-out, the *space* is allowed to be occupied following delivery to the *space* of half of the total air changes calculated from Equation 10-1. The *space* shall be ventilated at a minimum rate of 0.30 cfm per ft^2 (1.5 L/s per m^2) of *outdoor air*, or the outdoor airflow rate determined in Section 8.3.1.1, whichever is greater. These conditions shall be maintained until the total air changes calculated according to Equation 10-1 have been delivered to the *space*. The flush-out shall be continuous.~~

Table 10.7.2 Maximum Concentration of Air Pollutants Relevant to IAQ

Contaminant	Maximum Concentration, µg/m^3 (Unless Otherwise Noted)
Nonvolatile Organic Compounds	
Carbon monoxide (CO)	9 ppm and no greater than 2 ppm above outdoor levels
Ozone	0.075 ppm (8 h)
Particulates (PM2.5)	35 (24 h)
Particulates (PM10)	150 (24 h)
Volatile Organic Compounds	
Acetaldehyde	140
Acrylonitrile	5
Benzene	60
1,3-butadiene	20
t-butyl methyl ether (methyl t-butyl ether)	8000
Carbon disulfide	800
Caprolactam [a]	100
Carbon tetrachloride	40
Chlorobenzene	1000
Chloroform	300
1,4-dichlorobenzene	800
Dichloromethane (methylene chloride)	400
1,4-Dioxane	3000
Ethylbenzene	2000
Ethylene glycol	400
Formaldehyde	33
2-Ethylhexanoic acid [a]	25
n-Hexane	7000
1-methyl-2-pyrrolidinone [a]	160
Naphthalene	9
Nonanal [a]	13
Octanal [a]	7.2
Phenol	200
4-phenylcyclohexene (4-PCH) [a]	2.5
2-propanol (isopropanol)	7000
Styrene	900
Tetrachloroethene (tetrachloroethylene,perchloroethylene)	35
Toluene	300
1,1,1-trichloroethane (methyl chloroform)	1000
Trichloroethene (trichloroethylene)	600
Xylene isomers	700
Total volatile organic compounds (TVOC)	— [b]

a. This test is only required if carpets and fabrics with styrene butadiene rubber (SBR) latex backing material are installed as part of the base building systems.
b. TVOC reporting shall be in accordance with CDPH/EHLB/Standard Method and shall be in conjunction with the individual VOCs listed.

~~$$\text{TAC} = V_{ot} \times \frac{1}{A} \times \frac{1}{H} \times 60 \text{ min/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(I-P)}$$~~

~~$$\text{TAC} = V_{ot} \times \frac{1 \text{ m}^3}{1000L} \times \frac{1}{A} \times \frac{1}{H} \times 3600 \text{ s/h} \times 24 \text{ h/day} \times 14 \text{ days} \quad \text{(SI)}$$~~ ~~(10-1)~~

~~where~~

~~TAC = total air changes~~

~~V_{ot} = system design *outdoor air* intake flow, cfm (L/s) (according to ANSI/ASHRAE Standard 62.1)~~

~~A = floor area, ft^2 (m^2)~~

~~H = ceiling height, ft (m)~~

~~**10.7.2 Posteonstruction, Preoccupancy Baseline IAQ Monitoring.** Baseline IAQ testing shall be conducted after construction ends and prior to occupancy. The ventilation system shall be operated continuously, within ±10% of the outdoor airflow rate provided by the ventilation system at design occupancy, for a minimum of 24 hours prior to IAQ monitoring. Testing shall be performed using protocols consistent with the USEPA Compendium of Methods for the Determination of Toxic Organic Pollutants in Ambient Air, TO-1, TO-11, TO-17, and ASTM Standard Method D 5197. The testing shall demonstrate that the *contaminant* maximum concentrations listed in Table 10.7.2 are not exceeded in the return airstreams of the HVAC systems that serve the *space* intended for occupancy. If the return airstream of the HVAC system serving the *space* intended for occupancy cannot be separated from other *spaces*, then for each portion of the building served by a separate ventilation system the testing shall demonstrate that the *contaminant* maximum concentrations at *breathing zone* listed in Table 10.7.2 are not exceeded in the larger of~~

~~a. no fewer than one location per 25,000 ft^2 (2500 m^2) or~~
~~b. in each contiguous floor area.~~

~~For each sampling point where the maximum concentration limits are exceeded, conduct additional flush-out with *outdoor air*, and retest the specific parameters exceeded to demonstrate that the requirements are achieved. Repeat procedure until all requirements have been met. When retesting noncomplying building areas, take samples from the same locations as in the first test.~~

10.7 Preoccupancy IAQ

10.7.1 Cleaning. Spaces shall be cleaned in accordance with Section 10.2.2.1.4.5 not less than 12 hours prior to occupancy.

10.7.2 Ventilation. Occupiable ventilation zones shall be ventilated with outdoor air at the rate required by Section 8.3.1.1 calculated using the design zone population of each zone. Ventilation shall begin not less than 48 hours prior to occupancy and shall operate for not less than 12 hours per day. During such operation, the HVAC systems shall

a. Operate with ventilation reductions from demand-control ventilation disabled
b. Maintain occupied period temperature and humidity set points
c. Operate with filters required by Section 8.3.1.3 installed

10.7.3 Third-Party Review. Prior to occupancy, a review of the spaces to be occupied and their HVAC systems shall be conducted, and a report on the results of that review shall be prepared by an *approved* third party and provided to the *owner*. The report shall address the following items and contain recommended corrective actions:

a. Date and time of observations
b. Description of any deviations of occupancy categories and density from *construction document*s ventilation calculations
c. Review of proximity of contaminant sources to outdoor air intakes for compliance with ASHRAE Standard 62.1, Section 4.2.
d. A check of HVAC systems for
    1. Position of outdoor air dampers as designed and commissioned
    2. Cleanliness of accessible airstream surfaces
    3. Cleanliness of heating and cooling coils, condensate pan, and drain
    4. Particle filtration condition and MERV rating

e. Review of test and balance data applicable to ventilation and exhaust compared to *construction documents* and *owner's project requirements (OPR)*
f. Description of observed indoor contaminant sources not shown on *construction documents* or not mitigated by local exhaust
g. Description of observed odors, irritants, water intrusion and visibly water-damaged materials
h. Review of location of outdoor designated smoking areas for compliance with Section 8.3.1.7(b) and signage for compliance with Section 8.3.1.7(a), *construction documents* and *OPR*

Modify Section 10.9.10 as shown.

10.9.10 Maintenance Plan. A maintenance plan shall be developed for mechanical, electrical, plumbing and fire protection systems. The plan shall include the following:

a. The plan shall be in accordance with ASHRAE/ACCA Standard 180 for HVAC systems in all buildings within the scope of ~~that meet the definition of commercial buildings in~~ Standard 180.
b. The plan shall ~~address all elements of ASHRAE/ACCA Standard 180, Section 4, and shall develop~~ describe required inspection and maintenance tasks and frequency ~~similar to ASHRAE/ACCA Standard 180, Section 5,~~ for electrical and plumbing systems ~~in buildings that meet the definition of commercial buildings in ASHRAE/ACCA Standard 180~~.
c. Outdoor air delivery monitors required by Section 8.3.1.2 shall be visually inspected at least once each quarter and cleaned or repaired, as necessary, and calibrated at the manufacturer's recommended interval or not less than once per year, whichever is more frequent.
d. For systems with a damper indicator and with less than 2000 cfm (1000 L/s) of supply air, the system components that control the minimum outdoor airflow shall be visually inspected every two years. Records of this inspection shall be maintained on-site either in electronic or written form.
e. Documentation of the plan and of completed maintenance procedures shall be maintained on the building site at all times in
    1. electronic format for storage on the building energy management system (EMS), building management system (BMS), computerized maintenance management system (CMMS), or other computer storage means, or
    2. maintenance manuals specifically developed and maintained for documenting completed maintenance activities.

Delete Sections 10.9.4 and 10.9.7. Note that the requirements of Section 10.9.7 appear in modified form in section 10.10.8. Renumber the remaining 10.9 subsections accordingly.

~~**10.9.4 IAQ.** The plan for operation shall include the requirements of ASHRAE Standard 62.1, Section 8, and shall describe additional procedures for implementing a regular indoor environmental quality M&V program after building occupancy.~~

~~**10.9.4.1 Outdoor Airflow Measurement.** The plan for operation shall document procedures for implementing a regular outdoor airflow monitoring program after building occupancy and shall meet the following requirements:~~

~~a. For each mechanical ventilation system where direct outdoor airflow measurement is required according to Section 8.3.1.2, a procedure shall be in place to respond when there is notification that the *minimum outdoor airflow* is in an outdoor air fault condition. For systems that use a damper indicator instead of a direct measurement, per the exception to Section 8.3.1.2, a procedure shall be in place to respond when there is notification that the indicator identifies that the damper is out of position.~~
~~b. For each mechanical ventilation system where direct *minimum outdoor airflow* measurement is required according to Section 8.3.1.2, the *minimum outdoor airflow* shall be recorded every three months in either electronic or written form.~~
~~c. For systems that use a damper indicator per the exception to Section 8.3.1.2, the *minimum outdoor airflow* shall be measured and recorded in either electronic or written form every two years for air-handling systems with a design supply airflow rate of more than 2000 cfm (1000 L/s). The *minimum outdoor airflow* shall be measured using methods as described in ANSI/ASHRAE Standard 111 and with an accuracy of ±10% or better.~~

~~**10.9.4.2 Outdoor Airflow Scheduling.** Ventilation systems shall be operated such that spaces are ventilated when these spaces are expected to be occupied.~~

~~**10.9.4.3 Outdoor Airflow Documentation.** The following documentation shall be maintained concerning outdoor airflow M&V:~~

a. A list of each air system requiring direct outdoor airflow measurement.

b. Monitoring procedures and monitoring frequencies for each monitored sensing device, including a description of the specific response measures to be taken if needed.

c. Ventilation systems shall be operated such that spaces are ventilated when these spaces are expected to be occupied.

d. Operation and calibration check procedures and the records associated with operation checks and recalibration.

10.9.4.4 IAQ Maintenance and Monitoring. The plan for operation shall document procedures for maintaining and monitoring IAQ after building occupancy and shall contain the following:

a. For buildings located in nonattainments areas for PM2.5, as defined by USEPA, air filtration and/or air cleaning equipment, as defined in Section 8.3.1.3(a), shall be operated continuously during occupied hours or when the USEPA Air Quality Index exceeds 100 or equivalent designation by the local authorities for PM2.5.

Exception to (a): Spaces without mechanical ventilation.

b. For buildings located in nonattainments areas for ozone, as defined by the USEPA, air cleaning equipment, as defined in Section 8.3.1.3(b), shall be operated continuously during occupied hours during the local summer and fall seasons or when the USEPA Air Quality Index exceeds 100 or equivalent designations by the local authorities for ozone.

Exception to (b): Spaces without mechanical ventilation.

c. Biennial monitoring of IAQ by one of the following methods:

1. Performing IAQ testing as described in Section 10.7.1.2.
2. Monitoring occupant perceptions of IAQ by any method, including but not limited to occupant questionnaires.
3. Each building shall have an occupant complaint/response program for IEQ.

d. For buildings where radon mitigation is required under Section 10.8, operation, maintenance, and monitoring procedures shall include all of the following:

1. Quarterly inspection to verify operation of fans and other mechanical components.
2. Biennial radon testing in accordance with AARST MALB to verify that radon concentrations remain below 2.7 pCi/L (100 Bq/m³). Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m^3) or greater, mitigation shall be conducted in accordance with AARST RMS-LB, and the building shall be retested to verify that the radon concentration is below 2.7 pCi/L (100 Bq/m³). Where the required effectiveness of mitigation systems is consistently demonstrated for a period of not less than eight years, and such systems are inspected quarterly to verify fan operation, radon testing shall be repeated at intervals of not less than every five years. 3. Biennial inspection and repair as needed for mitigation system performance indicators, fans, and visible mitigation system components, including piping, fasteners, supports, labels, and soil-gas barrier closures at exposed membranes, sumps, and other openings between soil and interior space.
3. Documentation and retention of inspection and repair records and testing reports.

10.9.4.5 Outdoor Air Ozone Air Cleaners. Ozone air cleaning devices required under Section 8.3.1.3 shall be operated whenever outdoor ozone concentrations are forecast to exceed applicable regulatory limits.

[. . .]

10.9.7 Indoor Environmental Quality Survey. The plan for operation shall include an indoor environmental quality occupant survey complying with all of the following:

a. The survey shall be implemented within a period of 6 to 18 months after issuance of the certificate of occupancy. The survey shall be repeated not less often than once every three years.

b. The survey questions shall include satisfaction questions and diagnostic questions for IAQ, lighting, acoustics, and thermal comfort. The survey questions shall use a seven-point satisfaction scale and comply with ANSI/ASHRAE Standard 55, Section 7.3.1.1.

c. A plan for reporting the survey results shall be produced that includes the following:

1. The survey report shall state where the response rate was less than the response rates specified in ASHRAE Standard 55, Section 7.3.1.
2. The survey report shall indicate the percentage of satisfaction for each question in accordance with ASHRAE Standard 55, Section 7.4.1(a).

~~3. The percentage satisfaction results shall be compared to a nationally recognized survey benchmarking database where the building occupancy category is represented in the databases of nationally recognized organizations.~~

Insert new Section 10.10 as shown. Renumber sections 10.10 and 10.11 accordingly.

10.10 Plan for Operation: IAQ-Related Activities. An IAQ plan for operation shall be prepared and provided to the *owner* prior to occupancy. The plan for operation shall include activities and schedules as required by Sections 10.10.1 through 10.10.8.

10.10.1 Operation and Maintenance (O&M) Manual. An O&M manual shall be prepared that complies with ASHRAE Standard 62.1, Section 8.2.

10.10.2 Outdoor Airflow Monitoring. The procedures for a regular outdoor airflow monitoring program after building occupancy shall be specified and shall comply with the following.

10.10.2.1 For each mechanical ventilation system, including direct outdoor airflow measurement as required by Section 8.3.1.2.2, and all 100% outdoor air systems, operation and calibration procedures and schedules shall be provided. Records shall be maintained for operation checks and recalibration efforts and shall be reported at intervals of not more than three months. Records of verifications and recording of *minimum outdoor airflow* required by Section 8.3.1.1 shall be provided.

10.10.2.2 For each constant-volume system with supply airflow greater than 2000 cfm (1000 L/s) with damper indicators as permitted by the exception to Section 8.3.1.2.2, procedures to verify and record the *minimum outdoor airflow* required by Section 8.3.1.1 shall be provided. Such procedures shall use methods specified in ANSI/ASHRAE Standard 111 and implemented at intervals of not more than two years.

10.10.2.3 For each mechanical ventilation system, procedures shall be provided to respond to notification of an outdoor air fault condition or to indications that the outdoor air damper is out of position.

10.10.3 Outdoor Air Filtration and Cleaning

10.10.3.1 The outdoor air filtration systems installed in each mechanical ventilation system, including required MERV levels, shall be identified.

10.10.3.2 Where ozone filters are provided in ventilation systems to comply with Section 8.3.1.3(b), and such filters are intended for use when the USEPA Air Quality Index exceeds 100 or equivalent designation by the local authorities, procedures to determine when such filters will be used and procedures for operating with such filters shall be provided.

10.10.4 Radon Mitigation. For buildings where radon mitigation is required under Section 10.8, operation, maintenance, and monitoring procedures shall include the following:

a. Quarterly inspection and repair, as needed, of fans and other mechanical components
b. Biennial inspection and repair as needed of all components of the mitigation system not addressed by Section 10.10.6(a), including, but not limited to, performance indicators and visible mitigation system components, piping, fasteners, supports, labels, soil-gas barrier closures at exposed membranes, sumps, and other openings between soil and interior space
c. Radon testing in accordance with AARST MALB. Where radon testing indicates that the indoor radon concentration is 2.7 pCi/L (100 Bq/m^3) or greater, mitigation shall be performed in accordance with AARST RMS-LB. The building shall be retested and mitigation repeated as needed to achieve a radon concentration less than 2.7 pCi/L (100 Bq/m^3). Radon testing shall be performed at intervals of not more than two years except where testing over the preceding eight years has not shown levels that exceed 2.7 pCi/L (100 Bq/m^3). In that case, radon testing shall be performed at intervals of not more than five years.
d. Documentation and retention of inspection and repair records and testing reports

10.10.5 Ventilate Occupied Spaces. Ventilation of newly constructed occupied spaces with ventilation reductions from demand control ventilation disabled shall continue for not less than 14 days. Procedures for re-enabling demand-control ventilation shall be provided.

10.10.6 Periodic IEQ Review. During the first 90 days of initial postconstruction occupancy, and annually thereafter, a review meeting the requirements of Section 10.7.3 shall be conducted and a report prepared of occupied spaces and their HVAC systems.

10.10.7 Air Monitoring. Within the initial 90 days of occupancy and annually, air monitoring shall be performed by an *approved* third party or a qualified building management system team.

10.10.7.1 Parameters to Be Monitored. All of the following parameters shall be measured at each sample location.

Table 10.10.7 Air Monitoring Following Commencement of Occupancy

Constituent	Method
Temperature	As permitted by ASHRAE Standard 111
Humidity	As permitted by ASHRAE Standard 111
PM10 (coarse particulate matter)	An optical instrument with accuracy in particles/cc certified by the manufacturer at concentrations of 0 to 40,000 particles/cc. Measurements in the return airstream shall be taken at a location with velocity of 0.4 m/s or less.
PM2.5 (fine particulate matter)	See PM 10.
Total volatile organic chemicals (TVOC)	A photoionization detector (PID) accurate ±200 ppbv based on isobutylene and a limit of detection of 5 ppb or less.
CO_2 (carbon dioxide)	A sensor compliant with ASHRAE Standard 62.1, Section 6.2.6.1.3.

10.10.7.2 Sample Locations. The parameters in Table 10.10.7 shall be measured in a sample of occupied spaces or the return airstreams of HVAC systems, as determined by the *approved* third party. Not less than one sample location shall be included for every 25,000 ft^2 (2500 m^2) of conditioned floor area and for every level of a multistory building. Sampling shall be performed with HVAC systems operating in normal occupancy mode.

10.10.7.3 Monitoring Frequency and Period. Each parameter measurement value shall be recorded every 15 minutes for 96 hours or more and shall include at least two occupied days and two unoccupied days.

Exception to 10.10.7.3: Monitoring on unoccupied days is not required in systems that operate continuously in the occupied mode.

10.10.7.4 Report. The results of the monitoring and recommended corrective actions shall be provided as a written report and reviewed with the *owner*. The report shall graphically illustrate one hour moving averages of each measured parameter. The report shall include an evaluation of trends relative to time of day and season and between occupied and unoccupied hours.

Informative Note: Steady-state CO_2 concentrations corresponding to the ventilation requirements in Standard 62.1 range from about 1000 ppmv in office spaces and classrooms with younger students to between 1500 and 2000 ppmv in restaurants, lecture classrooms, and retail spaces to above 2500 ppmv in conference rooms and auditoriums.

10.10.8 Indoor Environmental Quality Survey and Response to Occupants. Occupant responses to indoor environmental quality shall be monitored in accordance with the following:

10.10.8.1 An IEQ survey of all occupants of the building shall be conducted at an interval of not more than three years. The initial survey shall be performed within six months of initial occupancy.

10.10.8.2 The survey questions shall include satisfaction and diagnostic questions addressing IEQ, lighting, acoustics, and thermal comfort. The survey questions shall use a seven-point satisfaction scale and comply with ANSI/ASHRAE Standard 55, Section 7.3.1.1.

10.10.8.3 A plan for reporting the survey results shall be provided that includes the following:

a. The survey report shall state where the response rate was less than the response rates specified in ASHRAE Standard 55, Section 7.3.1.
b. The survey report shall indicate the percentage of satisfaction for each question in accordance with ASHRAE Standard 55, Section 7.4.1(a).
c. The percentage satisfaction results shall be compared to a nationally recognized survey benchmarking database where the building occupancy category is represented in the databases of nationally recognized organizations.

10.10.8.4 Occupant Response. An occupant complaint and response program for IEQ shall be implemented.

POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted Standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the Standards and Guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive Technical Committee structure, continue to generate up-to-date Standards and Guidelines where appropriate and adopt, recommend, and promote those new and revised Standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date Standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating Standards and Guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.

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Standard 189.1 and the International Green Construction Code

Standard 189.1 serves as the complete technical content of the International Green Construction Code® (IgCC). The IgCC creates a regulatory framework for new and existing buildings, establishing minimum green requirements for buildings and complementing voluntary rating systems. For more information, visit www.iccsafe.org.

About ASHRAE

Founded in 1894, ASHRAE is a global professional society committed to serve humanity by advancing the arts and sciences of heating, ventilation, air conditioning, refrigeration, and their allied fields.

As an industry leader in research, standards writing, publishing, certification, and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

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IMPORTANT NOTICES ABOUT THIS STANDARD

To ensure that you have all of the approved addenda, errata, and interpretations for this Standard, visit www.ashrae.org/standards to download them free of charge.

Addenda, errata, and interpretations for ASHRAE Standards and Guidelines are no longer distributed with copies of the Standards and Guidelines. ASHRAE provides these addenda, errata, and interpretations only in electronic form to promote more sustainable use of resources.

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