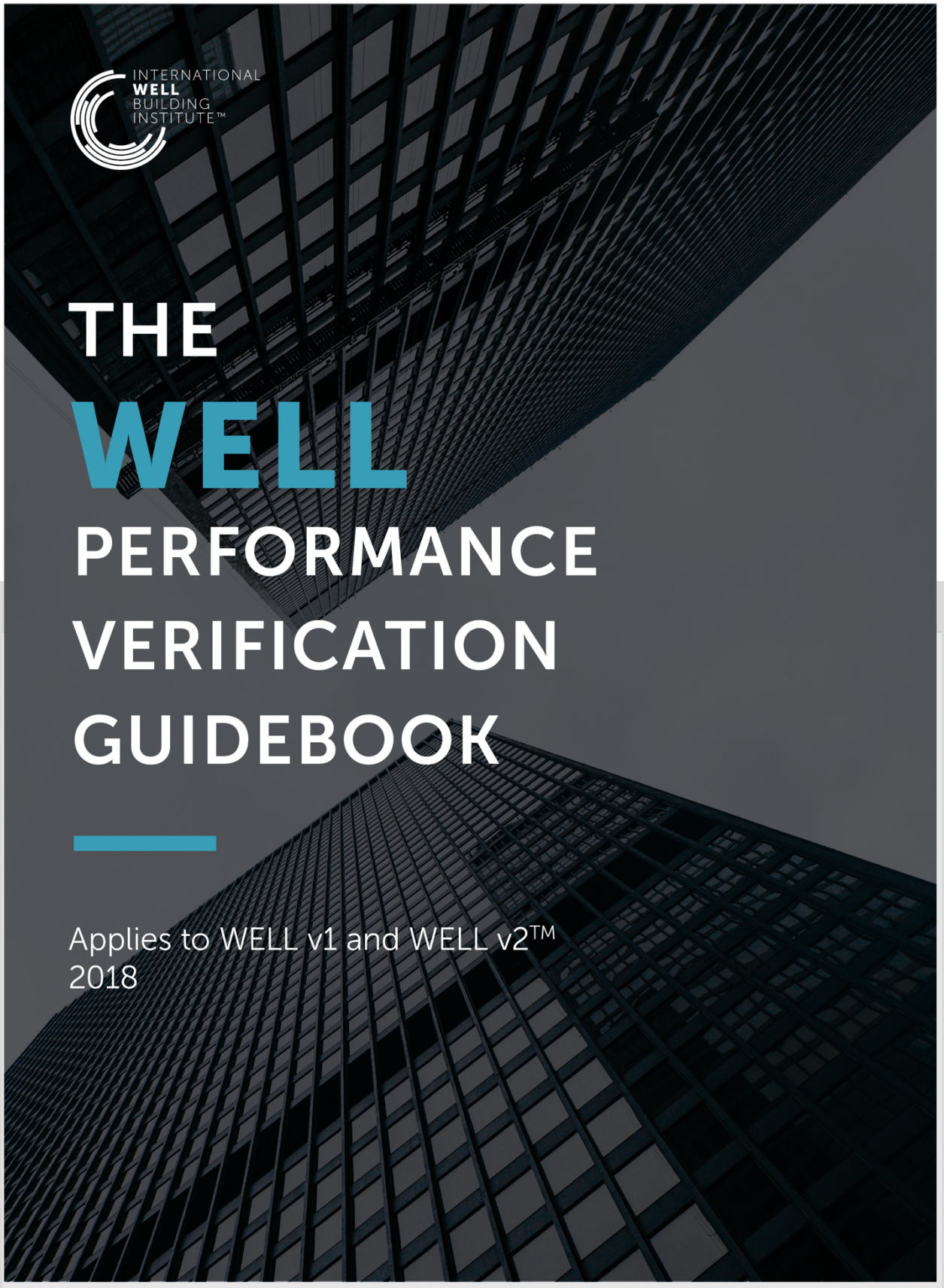


# THE WELL PERFORMANCE VERIFICATION GUIDEBOOK

Applies to WELL v1 and WELL v2™
2018

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# TABLE OF CONTENTS

# Introduction

The WELL Performance Verification Guidebook contains details regarding the Performance Verification phase of WELL Certification. The processes described apply to the WELL Building Standard version 1 (WELL v1), including WELL Core & Shell and pilot building standards, and the WELL Building Standard version 2 pilot (WELL v2), including WELL Core. Information for the WELL v1 pilots for Educational Facilities, Commercial Kitchens, Retail and Restaurants is included (as relevant) in the descriptions for the features themselves. For information on Multifamily Residential, see *Sampling Rates for Multifamily Residential* on page 30.

For more information on WELL Certification and the steps involved in scheduling WELL performance testing, refer to the complete WELL Certification Guidebook.

## Performance Verification

Performance Verification entails a site visit by a performance testing agent who conducts performance tests, followed by a Performance Review by a Green Business Certification Inc. (GBCI) WELL Reviewer. On-site performance testing is a requirement for WELL Certification and the results of the data collected for each applicable feature are reviewed by GBCI to determine whether a feature has been achieved.

## Purpose of this Guidebook

This guidebook dictates the performance testing protocol for each feature that has performance tests included as a part of the verification method.

Performance testing agents are required to ensure that the performance testing activities executed for a given project are conducted in accordance with the instructions and requirements specified in this guidebook. In addition, this guidebook provides information for project teams wishing to engage in their own pre-testing of WELL requirements prior to initiating Performance Verification. Note that the results of any pre-testing do not affect the outcome of performance testing executed by the performance testing agent for the purposes of WELL Certification.

## Performance Testing Agent

During the site visit, the performance testing agent will follow the testing protocol contained in this guidebook. The performance testing agent will ensure that the data collected during performance testing accurately represents the environmental and design conditions in the project at that time.

The performance testing agent is not permitted to interfere, manipulate or alter site conditions in any way that might affect WELL Certification. Data collected on-site by the performance testing agent must be analyzed and the results must be reviewed by GBCI before feature compliance can be determined; therefore, the performance testing agent cannot provide information regarding feature compliance while on site.


 

## General Information and Set Up

For purposes of certification, performance testing must take place after construction is complete and after the project has successfully passed Documentation Review. Core and Shell and WELL Core projects may undertake performance testing prior to their tenants finishing construction and submit to GBCI for Performance Review; however, this may negatively affect results from the on-site tests.

### Scope

Table 1 sets forth the performance testing scope that is applicable for each WELL project type. For each project type, all areas described in the table below are subject to performance testing and must be considered by the performance testing agent when choosing sampling zones and sampling points.


 

*Table 1: Scope of Performance Testing Activities*

| WELL PROJECT TYPE | PERFORMANCE TESTING SCOPE |
|---|---|
| WELL v1<br>• New and Existing Buildings<br>• New and Existing Interiors<br>• Educational Facilities, Commercial Kitchens, Retail, and Restaurants Pilots<br><br>WELL v2<br>• All project types except WELL Core | The entire area within the WELL project boundary, including any mechanical spaces and/or water fixtures servicing the project. |
| WELL v1<br>• Core & Shell<br><br>WELL v2<br>• WELL Core | Non-leased spaces, including the common areas of the building and private spaces directly under the control of the building management team, provided this makes up at least 2.5% of total project area. Otherwise, the areas listed above plus enough tenant space to sum to at least 2.5% of total project area.<br><br>Note: Some performance-based optimizations explicitly require testing in tenant spaces for achievement. |
| WELL v1<br>• Multifamily Residential | For initial certification, the entire area within the WELL project boundary, including inside the dwelling units.<br><br>For subsequent recertification, only the spaces directly under the control of the building management team (e.g., common areas). |

## Sampling Point Selection

The performance testing agent will select sample points for each performance test ahead of arriving on site. Upon arriving on site, the performance testing agent will perform a walkthrough of the areas subject to performance testing and familiarize themselves with the building floor plan. In order to ensure access to all sampling areas, the performance testing agent should be guided by an individual from the building management team who is familiar with the space. After this walkthrough, the performance testing agent may make adjustments to the selected sampling locations after observing actual site conditions to comply with


 

testing protocol. For example, the performance testing agent may move a sampling point from an area of low occupancy to an area of typical occupancy.

## Equipment and Laboratories

In all cases, the equipment used must be maintained and calibrated according to the manufacturer's specifications and instructions from the manufacturer must be followed when taking measurements. Any applicable laboratory analyses must be performed in a GBCI-approved third-party laboratory that is accredited by an agency recognized by the International Laboratory Accreditation Cooperative (ILAC) and that has no financial or other interest in the outcome of WELL Certification or Performance Verification. Laboratory samples must be collected, packaged and analyzed in accordance with instructions provided by the third-party laboratory.

Performance testing agents must be aware of restrictions on laboratory operations and transportation and how this affects scheduling performance tests. For example, water samples for coliform analysis are often not permitted to be shipped on a Friday due to the risk of delays in custody transfer and degradation of samples in storage.

## Compliance with Instructions and Protocols

Performance testing agents are required to ensure that performance testing is conducted in accordance with the instructions and requirements specified in this guidebook. If, due to site conditions or other factors beyond the performance testing agent's control, it is necessary to deviate from the protocols described in this guidebook during performance testing, the performance testing agent must note and provide an explanation for the deviation in performance testing documentation and/or final report.

To demonstrate compliance, the performance testing agent must submit full data of all tests taken on site in addition to the summarized value used for comparison of compliance. In addition, the agent must provide:

- List and specs of equipment used to confirm that it meets the requirements described in this guidebook.
- Certificates of calibration for the equipment used confirming that all equipment is properly calibrated.
- Floor plans showing the locations of the sample points along with the date and time each sample is collected.
- Photographs of representative sample locations including, when possible, photographs of the actual measurement device.

### Measurement Tolerance

For projects registered under WELL v2, several parameters include a tolerance that is added to the requirement's threshold. For example, for $PM_{2.5}$, compliance is based on the requirement in WELL + a tolerance of 20%. Thus, since the threshold is 15 $\mu g/m^3$, the acceptable threshold for $PM_{2.5}$ is less than 18 $\mu g/m^3$). These tolerances are not applicable to projects registered under WELL v1.


 

# Performance Testing Protocols for WELL

## Air

### General Guidelines

Unless otherwise noted, these rules apply to all parameters within the Air concept.

#### *Test Locations & Conditions*

- Testing should be done under regular project conditions. For example, for naturally ventilated spaces, the windows should be open during testing.
- The performance testing agent should note whether the HVAC system (or any ventilation or air treatment method) is on or off during the data collection period.
- Sampling points must be representative of typical occupied areas within the sampling zone and located where occupants would typically be situated (e.g., at workstations).
- Sampling points must be at the following heights above the finished floor:
    - 1.1-1.7 m [3.6-5.6 ft] at locations where occupants would typically be seated or standing.
    - In dwelling units, at least one sampling point at 10 cm [4 in].
- Sampling points must be at least 1 m [3.3 ft] away from walls, doors, windows, air supply/exhaust outlets and any occupants that are present during testing.
- For projects with multiple floors, measurements must be distributed across different floors, including the lowest and highest regularly occupied floor.

#### *Test Quantity*

*Table 2: Number of Sampling Points Required Based on Project Area and Number of Floors*

| Floors | TOTAL PROJECT AREA* | |
|---|---|---|
| | <50,000 $ft^2$ <4,600 $m^2$ | ≥50,000 $ft^2$ ≥4,600 $m^2$ |
| 1 | 2 | 3 |
| 2 | 2 | 4 |
| 3-4 | 3 | 5 |
| 5-7 | 3 | 6 |
| 8-10 | 4 | 7 |
| 11-15 | 5 | 8 |
| 16-20 | 6 | 9 |
| >20 | 7 | 10 |

*For Core & Shell and WELL Core projects, to determine the number of sampling points:

- For WELL v2 Feature A01 and WELL v1 Feature 01 (preconditions), use the project's total non-leased area for the purpose of project area in this table. Testing in leased area is not required unless the non-leased area does not make up the minimum required testable area.

- For WELL v2 Feature A05 (optimization), use the project's total area. In addition to testing in non-leased areas, the performance testing agent must have access to test within tenant spaces (either before or after fit-out), representing at least 10% of leased area.

## $PM_{2.5}$ and $PM_{10}$

### *Features*

- WELL v1: Feature 01, Part 2
- WELL v2: Features A01, Part 1; A05, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- Measurement method: real-time direct reading instrument.
- Duration of measurement: minimum of one continuous hour (10 minutes of acclimation time followed by 50 minutes of measurement time), with measurements recorded at least once every minute.

### *Test Quantity*

- See Table 2 in *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the median value collected during the measurement time at each sampling point compared against the requirement in WELL + a tolerance of 20%.

### *Device Requirements*

- Instrument type: light scattering airborne particle counter
- Measurement range: 1-1,000 $\mu g/m^3$
- Instrument accuracy (at the size specified by the manufacturer): $\leq$ 15%
- On-screen resolution: 1 $\mu g/m^3$
- Lower detectable limit: 1 $\mu g/m^3$
- Reporting interval: 1 minute maximum
- Calibration: instrument must be calibrated within manufacturer's specification (maximum interval: one year), NIST traceable

## Formaldehyde

### *Features*

- WELL v1: Feature 1, Part 1
- WELL v2: Features A01, Part 2; A05, Part 2

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- Samples are through active collection in accordance with ISO 16000-6, ASTM D5197, NIOSH 2016, EPA TO-11 (or 11A) or EPA Compendium Method IP-6 (or 6A).


 

- Minimum of one continuous hour OR the duration of sampling volume prescribed by the referenced testing methodology.
- A minimum of one exposure field blank sample must be prepared and analyzed per day of sampling.

### *Test Quantity*

- See Table 2 in *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the measured concentration at each location compared against the requirement in WELL + a tolerance of 20%.

### *Device Requirements*

- Laboratory materials and/or samplers must be prepared according to the referenced testing methodology and meet the referenced testing methodology requirements.
- Air sampling pumps utilized in active collection measurements must be capable of meeting the air flow rates prescribed by the referenced testing methodology (if applicable).

## VOCs (other than Formaldehyde)

### *Features*

Total VOCs

- WELL v1: Feature 01, Part 1

Component VOCs:

- v1: Feature 01, Part 1 AAP
- WELL v2: Features A01, Part 2; A05, Part 2

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- Samples are through active collection in accordance with ISO 16000-3-2011, ASTM D5197 or EPA TO-17.
- A minimum of one exposure field blank sample per day of sampling must be prepared and analyzed.

### *Test Quantity*

- See Table 2 for number of sampling locations.
- Minimum of one continuous hour OR the duration of sampling volume prescribed by the referenced testing methodology.

### *Reporting & Compliance*

- For tests for WELL v2 Features A01 or A05, compliance is based on the measured concentration at each location compared against each VOC's requirement in WELL + a tolerance of 5%.


 

- For tests of WELL v1 Feature 01, compliance is based on each location either meeting the conditions above or the measured TVOC concentration compared against the requirement in WELL.

### *Device Requirements*

- Laboratory materials and/or samplers must be prepared according to the referenced testing methodology and meet the referenced testing methodology requirements.
- Air sampling pumps utilized in active collection measurements must be capable of meeting the air flow rates prescribed by the referenced testing methodology (if applicable).

## Carbon monoxide

### *Features*

- WELL v1: Feature 1, Part 2
- WELL v2: Features A01, Part 3; A04, Part 3

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- Minimum of one continuous hour (10 minutes of acclimation time followed by 50 minutes of measurement time), with measurements recorded at least once every minute.

### *Test Quantity*

- See Table 2 in *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the median value collected during the measurement time at each sampling compared with the WELL requirements.

### *Device Requirements*

- Real-time direct reading instrument.
- Measurement range: 0-25 ppm
- Instrument resolution: 0.1 ppm
- On-screen resolution: 1 ppm
- Lower detectable limit: 0.1 ppm
- Calibration: instrument must be within calibration period

## Ozone

### *Features*

- WELL v1: Feature 01, Part 2
- WELL v2: Features A01, Part 3; A04, Part 3

### *Test Locations & Conditions*

- See *General Guidelines*.


 

### *Test Method*

- Minimum of one continuous hour (10 minutes of acclimation time followed by 50 minutes of measurement time), with measurements recorded at least once every minute.

### *Test Quantity*

- See Table 2 in *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the median value collected during the measurement time at each sampling point compared against the requirement in WELL + a tolerance of 5%.

### *Device Requirements*

- Real-time direct reading instrument.
- Measurement range: 0-500 ppb
- On-screen resolution: 1 ppb
- Lower detectable limit: 3 ppb
- Calibration: instrument must be within calibration period

## Nitrogen dioxide

### *Features*

- WELL v2: Features A01, Part 3; A04, Part 3

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- Duration: up to one hour

### *Test Quantity*

- See Table 2 in *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the median value collected during the measurement time at each sampling point compared against the requirement in WELL + a tolerance of 20%.

### *Device Requirements*

- Measurement range: 0-500 ppb
- Lower detectable limit: 5 ppb
- Calibration: instrument must be within calibration period

## Radon

### *Features*

- WELL v1: Features 01, Part 3

### *Test Locations & Conditions*

- Measurements are only required in the lowest occupied level of the project site. If the project does not contain the ground floor of the building (defined as the first aboveground floor), or any below-grade floors, radon testing is not required.


 

- Radon samplers must be located:
  - 0.91 m [3 ft] from windows and exterior doors
  - 20.3 cm [12 in] from exterior walls
  - 50.8 cm [20 in] above the finished floor

### *Test Method*

- Active or short- or long-term passive testing samples are permitted.
- Minimum of 48 hours for passive testing samples. The entire length is required for active testing samples.

### *Test Quantity*

- One radon sampler is required in each 2300 $m^2$ [25,000 $ft^2$] of project area on the lowest occupied level.

### *Reporting & Compliance*

- Compliance is based on every test location complying with the requirement in WELL.

### *Device Requirements*

- Passive or active radon sampler.

## Water

### General Guidelines

Unless otherwise noted, these rules apply to all parameters within the Water concept.

### *Test Locations & Conditions*

- These tests use a sample of water from the cold-water fixture, when possible. If conditions exist preventing adjustment of the water temperature, perform the testing at the temperature of the water provided and make note of conditions.

### *Test Method*

- Run the water for at least 30 seconds before gathering a water sample (unless the sample is drawn immediately following a previous sample).

### *Test Quantity*

- For each configuration of in-building water treatment, determine the total number of fixtures for drinking water, handwashing, showers/baths and for cooking purposes.
- Of these, test at 5% (round up), with a maximum of three per configuration.
- Include the most distal (furthest from the main supply) outlet in the tests.

### Turbidity

### *Features*

- WELL v1: Feature 30, Part 1
- WELL v2: Feature W01, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- This parameter is tested at drinking water fixtures, handwashing fixtures, fixtures for showers and baths, and water fixtures used for cooking purposes for commercial kitchens (as applicable).

### *Test Method*

- See *General Guidelines*.
- Mix the sample to thoroughly disperse the solids. Wait until air bubbles disappear, then pour the sample into the turbidimeter tube.
- Repeat turbidity test twice, for a total of three samples at water fixture.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- At each fixture, average the turbidity of the three samples and round the result to the nearest 0.05 (if less than 1 NTU) or 0.10 (if greater than 1 NTU).
- Compliance is based on the rounded average at each fixture meeting the requirements listed in WELL.

### *Device Requirements*

- Turbidimeter meets or exceeds requirements of EPA Method 180.1.
- Measurement range: 0-40 NTU or greater
- Reporting resolution: 0.02 NTU or finer
- Accuracy: ±2% of reading
- Lowest detectable limit: 0.05 NTU or lower
- Maintain device calibration in accordance with manufacturer's instructions.

## Coliforms

### *Features*

- WELL v1: Feature 30, Part 2
- WELL v2: Feature W01, Part 2

### *Test Locations & Conditions*

- See *General Guidelines*.
- This parameter is tested at drinking water fixtures, handwashing fixtures, fixtures for showers and baths, and water fixtures used for cooking purposes for commercial kitchens (as applicable).

### *Test Method*

- See *General Guidelines*
- Do not "flame" (sanitize) or remove aerator from faucet.
- Package and ship sample to testing laboratory per the laboratory's instructions. Total coliforms sampling analysis is time sensitive and the samples should be shipped overnight


 

to the laboratory the same day they are collected, or couriered or driven to the laboratory the day they are collected.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- Each sample analyzed must comply with the requirement in WELL.

### *Laboratory Requirements*

- Water samples are evaluated by a GBCI-approved third party laboratory in accordance with 40 CFR 141.74(a)(1) or, ISO 9308-1:2001.

## Disinfectants

### *Features*

- WELL v1: Feature 34, Part 1
- WELL v2: Feature W02, Part 6 b and c

### *Test Locations & Conditions*

- See *General Guidelines*.
- This parameter is tested at drinking water fixtures and water fixtures used for cooking purposes for commercial kitchens (as applicable).

### *Test Method*

- See *General Guidelines*.
- Take measurements of total and free chlorine of samples by adding the appropriate reagents as specified by the chlorine meter manufacturer. To calculate residual chloramines, subtract the free chlorine value from the total chlorine value.
- Repeat process twice, for a total of three samples per water fixture tested.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- At each fixture, the average of the three samples must comply with the requirements in WELL.

### *Device Requirements*

- Measurement range: 0-5 mg/L
- Reporting resolution: 0.01 mg/L or finer
- Accuracy: ±0.02 mg/L at 1.00 mg/L

## Laboratory-based Contaminants

### *Features*

- WELL v1: Features 31, Part 1; 32, Part 1; 33, Parts 1 and 2; 34, Part 3; 37, Part 1
- WELL v2: Features W02, Parts 1, 2, 3, 4, 5 and 6a; W03, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.

### *Test Method*

- See *General Guidelines*.
- Appropriate sampling vials must be obtained from laboratory prior to performance testing.
- Follow all laboratory procedures for collecting and packaging the sample.
- Package and ship sample to third party testing laboratory per the laboratory's instructions.
- This parameter is tested at drinking water fixtures and water fixtures used for cooking purposes for commercial kitchens (as applicable).

### *Test Quantity*

- See *General Guidelines*

### *Reporting & Compliance*

- The sample from every fixture tested must meet the requirements in WELL for each of the contaminants being tested.
- For Styrene samples, a "Not Detected" measurement with a limit of detection of .001 mg/L is considered acceptable.

## Light

### Visual Lighting

### *Features*

- WELL v1: Feature 53
- WELL v2: Features L02; L08, Part 2

### *Test Locations & Conditions*

- This parameter is measured at the horizontal plane.
- For WELL v1 Feature 53, the surface of a desk may be considered as the working plane for both sitting and standing desk surfaces. For WELL v2 Feature L02, working plane heights and target illumination levels are to be provided by project teams.
- This parameter is to be measured using only electric lighting. Take measurements at night to avoid daylight contribution.
- If supplemental lighting is used, the lighting should be turned on and positioned as per regular conditions. All supplemental lighting must meet the requirements outlined in section *Supplemental Lighting*.
- The performance testing agent may follow instructions by the project team to turn screens on or off. However, agents are not to alter field conditions in any other way including influencing or controlling lighting automation (changing brightness levels, color or color temperature) and/or directing the adjustments made by the project team.

### *Test Method*

- The measuring instrument is placed in the center of the flat surface of the working plane with the aperture facing upward.


 

- Ensure that the shadow of the performance testing agent does not fall on the measuring instrument while the measurements are taken.

### *Test Quantity*

- The measurements must be conducted at various locations across the project boundary, including both interior and exterior spaces.
- Measurements are conducted across one floor in projects that consist of one to four floors. If the project has more than five floors, measurements are to be conducted across two floors.
- The floor that is identified for measurements must be regularly used by a representative sample of the occupants. For example, if a project has four floors out of which one consists of the lobby and the other three consist of offices, the measurements must be conducted in one floor that contains offices.
- To identify sampling points, apply a 9.3 $m^2$ [100 $ft^2$] grid across the entire floor that has been identified for measurement.
- Within each square, measurements are to be taken at a point that is representative of the occupant's position. For example, for a work station, the sampling point would lie at the center of the desk in front of the occupant; for a corridor, the sampling points would be at the center of the corridor.
- Ensure that at least three measurements are taken for each task and/or application submitted by project team. Tasks/applications may include, but are not limited to:
  - Circulation corridor
  - Reception desk
  - Aerobic exercise area
  - Food preparation
  - Reading and writing in a classroom
- This may require multiple measurements in a single grid square.
- All sampling points must be representative of typical occupied areas within the sampling zone.

### *Reporting & Compliance*

- The average light levels across identical tasks must meet the target illuminance throughout the project boundary.
- The lowest light level measured across workspaces must be at least half of target illuminance.

### *Device Requirements*

- All illuminance measurements are to be conducted with a cosine corrected illuminance meter.
- Range: 5-50,000 lux
- Accuracy: ±5% (at values up to 2000 lux)
- Resolution: 1 lux (at values up to 2000 lux)
- The illuminance meter is calibrated as per manufacturer specifications in an ISO/IEC 17025 Accredited Calibration Lab, or calibration must be NIST traceable.


 

## Circadian Lighting

### *Features*

- WELL v1: Feature 54
- WELL v2: Feature L03

### *Test Locations & Conditions*

- This parameter is to be measured on the vertical plane to stimulate the light entering the eye of the occupant.
- Sampling points must be representative of common occupant position in the space under regular conditions.
- For space types with workstations, this parameter must be measured 45 cm [18 in] above working plane (the surface of a desk may be considered as the working plane for both sitting and standing desk surfaces).
- If no working planes are present in the space type (for instance, a living room or a commercial interior before tenant buildout), four measurements are to be conducted at the height indicated in the feature language in orthogonal directions. The median value of the four measurements is to be used as the measurement value for each sampling point.
- If supplemental lighting is used, the lighting should be turned on and positioned as per regular conditions. All supplemental lighting must meet the requirements outlined in section *Supplemental Lighting*.
- The performance testing agent may follow instructions by the project team to turn computer screens (if present) on or off. However, they are not to alter field conditions in any other way, including influencing or controlling lighting automation (changing brightness levels, color or color temperature), modifying furniture and/or directing the adjustments made by the project team.
- The measurements of WELL v1 Feature 54, Part 1.b and WELL v2 Feature L03 are taken under electric lighting only. Take measurements at night to avoid daylight contribution.
- The measurements of WELL v1 Feature 54, Part 1.a include the contributions of daylight and are measured between 9:00 am and 1:00 pm. Thus, for WELL v1 projects, take measurements under both daylight and nighttime conditions.

### *Test Method*

- Measurements must be recorded on a vertical plane (perpendicular to the floor) to stimulate the light entering the eye of the occupant.
- The measuring instrument must be mounted on a tripod and placed on a stable surface for each measurement.
- Ensure that the shadow of the performance testing agent does not fall on the measuring instrument as the measurements are taken.

### *Test Quantity*

- For applicable areas that are not dwelling units, the total number of tests for this parameter is $n = \frac{68N}{N+67}$, where $N$ is the total number of workstations and desks within classrooms. For a commercial interior before tenant buildout, use default occupancy assumptions to determine $N$.


 

- The measurements must be distributed across different floors (if applicable).
- For dwelling units, take one sample per 2.3 $m^2$ [25 $ft^2$] of area in the applicable rooms.

### *Reporting & Compliance*

- Report the lux levels and the spectral power at 5 nm increments from 380 nm to 730 nm. The methodology described in Table L2 in WELL (EML = lux × melanopic ratio) will be used to calculate the equivalent melanopic lux using the recorded spectral power values.
- For WELL v1 Feature 54, Part 1.b in v1 and WELL v2 Feature L03, the median light levels must meet the EML threshold and the lowest value must be at least half the threshold.
- For WELL v1 Feature 54, Part 1.a, the 25$^{th}$ percentile of the measurements must meet the EML threshold.

### *Device Requirements*

- All measurements are to be conducted with a cosine corrected optical spectrometer.
- The instrument must function within the limits of the performance specifications in the below requirements when operated in accordance with the operation manual:
  - Wavelength range: 380-780 nm
  - Accuracy: ±5%
  - Optical Resolution: 5 nm or less
  - Range: 5-50,000 lux
  - Resolution: 1 lux (at values up to 2000 lux)
- The meter is calibrated as per manufacturer specifications in an ISO/IEC 17025 Accredited Calibration Lab, or calibration must be NIST traceable.

### *Alternate Device Requirements & Protocol*

- A spectrometer which is *not* cosine corrected but which meets the other device requirements may be used for testing this parameter in conjunction with a photometer that meets the device requirements for Visual Lighting parameter. In this case, measurements from both the photometer and spectrometer are taken in the same position, as described in Test Method. In the formula EML = lux × melanopic ratio, the melanopic ratio is calculated using the data from the spectrometer and the lux value is taken from the cosine-corrected photometer.

## Supplemental Lighting

Supplemental lighting includes all additional light fixtures that are connected to plug loads and/or are not part of the ambient lighting system in a space. Supplemental lighting fixtures must be controllable by each occupant. If supplemental lighting is used, the following conditions apply during measurements:

- Glare: the light fixture should be positioned to ensure that the light does not create glare or create visual discomfort for the occupant. If LED light source is used, ensure that the point sources are not seen by the occupant under regular conditions.
- Position: the light fixture should be positioned to minimize disruption to the occupant's movement in the space. For example, light fixtures may not be placed near the center of a desk for a work space.

- Control: as with ambient lighting conditions, the performance testing agent may not influence or control the brightness or color of supplemental lighting.
- Shadow: the light fixture must not cause high contrast shadows on the work surface by regular movement or disrupt visual comfort of occupants.
- Location: the light fixture must be at least 23 cm [9 in] from edge of the desk or other work surface (horizontal distance). If the same set of supplemental light fixtures are moved across the space for measurements, the light fixtures must be moved, positioned and controlled by the project team.

## Thermal Comfort

### General Guidelines

Unless otherwise noted, these rules apply to all parameters within the Thermal Comfort concept.

#### *Test Locations & Conditions*

- Sampling points must be representative of typical occupied areas within the sampling zone.
- Sampling points must be located at least 1 m [3.3 ft] away from windows, walls, doors, direct sunlight, air supply/exhausts, mechanical fans, heaters or any other significant source of heat or cold.
- For projects with multiple floors, the measurements must be distributed across different floors, including the lowest and the highest regularly occupied floor.
- The measurements must be conducted at various locations across the building floor area, including both interior space and in proximity to façades with different orientations.

#### *Test Method*

- Total of 10 minutes, with measurements recorded at least once every minute.
- The performance testing agent should note whether the HVAC system (or any ventilation and air treatment method) is on or off during the data collection period.

#### *Test Quantity*

- Measurements are recorded in 8% of the total number of each regularly occupied room type in the project (at least one of each room type).

### Dry-bulb Temperature

#### *Features*

- WELL v1: Feature 76, Parts 1, 2 and 3
- WELL v2: Features T01, Part 1; T02, Part 1

#### *Test Locations & Conditions*

- See *General Guidelines*.
- Each sampling point is tested at three heights: 0.1 m, 0.6 m and 1.1 m (4 in, 24 in and 43 in, respectively) for seated occupants or 0.1 m, 1.1 m and 1.7 m (4 in, 43 in and 67 in, respectively) for standing occupants.


 

### *Test Method*

- See *General Guidelines*.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- The median value of the average of the measurements at the three test heights collected during the measurement time at each sampling point is reported and used to determine compliance with the WELL requirements.

### *Device Requirements*

- Method of measurements: real-time direct reading instrument
- Measurement range: -4°F to 140°F (-20°C to 60°C)
- On-screen resolution: 0.5°C
- Instrument accuracy: ±0.5°C from 0-50°C
- Calibration: instrument must be within calibration period

## Mean Radiant Temperature

### *Features*

- WELL v1: Feature 76, Parts 1, 2 and 3
- WELL v2: Features T01, Part 1; T02, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- Each sampling point is tested at 0.6 m [24 in] for seated occupants or 1.1 m [43 in] for standing occupants.

### *Test Method*

- Mean radiant temperature can be determined in in two ways, both described in ASHRAE Handbook of Fundamentals, Chapter 9.10.:
  - It can be determined with a spherical or ellipsoidal shape globe thermometer method.
  - It can be calculated from the measured temperature of surrounding walls and surfaces and their positions with respect to the person (with the emissivity assumption that all surfaces in the room are considered to be black). This method can be practically accomplished by pointing a radiometer with a 90-degree acceptance cone toward each of the six surrounding surfaces and averaging the readings to produce one mean radiant temperature value.
- Total of 10 minutes, with measurements recorded at least once every minute.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- The median value collected during the measurement time at each sampling point is reported and used to determine compliance with the WELL requirements.

### *Device Requirements*

- Method of measurements: real-time direct reading instrument
- Measurement range: 10 °C to 40 °C (50 °F to 104 °F)
- Instrument resolution: 0.5°C [0.9°F]
- On-screen resolution: 0.5°C [0.9°F]
- Instrument accuracy: ±1°C [1.8 °F]
- Calibration: instrument must be within calibration period

## Relative Humidity

### *Features:*

- WELL v1: Feature 76, Parts 1 and 2
- WELL v2: Features T01, Part 1; T02, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- Sampling points must be 1.1-1.7 m [3.6-5.6 ft] above the finished floor.

### *Test Method*

- See *General Guidelines*.

### *Test Quantity*

- See *General Guidelines*.

### *Reporting & Compliance*

- Compliance is based on the median value collected during the measurement time at each location compared against the requirement in WELL + a tolerance of 2.5% rH.

### *Device Requirements*

- Real-time direct reading instrument.
- Measurement range: 5-95%
- Instrument resolution: 0.3%
- On-screen resolution: 1%
- Instrument accuracy: ±2.5% from 10-90% relative humidity
- Calibration: instrument must be within calibration period

# Sound

## General Guidelines

Unless otherwise noted, these rules apply to all parameters within the Sound concept.

### *Test Locations & Conditions*

- The measurements must be performed when the space is unoccupied (e.g., before or after hours)
- The measurements must be taken at a minimum of 1.2 m [4 ft] above the finished floor.

### *Test Method*

- Avoid transient interior sounds (e.g., people talking, doors closing) during the measurement periods. If there are internal noises (other than the HVAC system) lasting longer than 10 seconds, the measurement should be deleted and restarted.

### *Device Requirements*

- Type 1/Class A sound level meter with whole and ⅓-octave measuring capabilities.
- Measurement Equipment Parameters:
  - Bandwidth: 20 Hz to 20 kHz
  - Accuracy: ±0.5% at 1 kHz
  - Resolution: 0.1 dB
  - The sound level meter must be capable of measuring sound pressure level at each of the following distinct octave band frequencies: 63 Hz, 125 Hz, 250 Hz, 1 kHz, 2 kHz, 4 kHz, 8 kHz.

## Exterior Noise Intrusion (dBA)

### *Features*

- WELL v1: Feature 74, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- The HVAC system must be off during the measurement periods.
- Sound masking systems (if present) must be off for the duration of the measurement period.
- The sample points must be located as close to 1 m [3.3 ft] away from the window wall while still located where an occupant would typically be situated.
- As much as possible, the sample points should be located farthest from sources of mechanical noise, including HVAC system ducts and elevators, while still located where an occupant would typically be situated.
- The distance between any two points of measurement must be at least 3 m [10 ft].
- If the windows are normally closed, the sound level measurements must occur with the windows closed. If the windows are normally open, the sound level measurements must occur with the windows open.

### *Test Method*

- See *General Guidelines*.
- Each measurement should last at minimum 30 seconds at each test location.

### *Test Quantity*

- At least one measurement in each room type listed for 10% of the total number of floors in the project. The preference for the first sampling point is given to the floor that is at or nearest to the ground level. The preference for the second sampling point (if applicable) is the floor at similar height to adjacent rooftop mechanical equipment or other elevated exterior sources of noise. The preference for third sampling point (if applicable) is the floor beneath rooftop mechanical equipment.

### *Reporting & Compliance*

- The time-averaged, A-weighted sound pressure level (Leq) recorded during the measurement period will be used to determine compliance with the WELL threshold.

### *Device Requirements*

- See *General Guidelines*.

## Internally Generated Noise (NC or NR)

### *Features*

- WELL v1: Feature 75, Part 2

### *Test Locations & Conditions*

- See *General Guidelines*.
- The HVAC system must be on during the measurement periods.
- Sound masking systems (if present) must be off during the measurement period.
- The measurements must be located where an occupant would typically be situated within the space.
- As much as possible, measurements should be located in regularly occupied spaces near sources of mechanical noise, including HVAC system ducts and elevators.
- As much as possible, measurements should be located away from walls containing windows.
- The distance between any two points of measurement must be at least 3 m [10 ft].
- Windows and doors in the measurement location must be closed.

### *Test Method*

- See *General Guidelines*.
- Each measurement should last at minimum 30 seconds in each test location.

### *Test Quantity*

- At least one measurement in each room type specified in WELL v1 Feature 75 for 10% of the total number of applicable floors.
- Preference in selecting which floors are measured must be given firstly to floors where base building mechanical equipment rooms are present, and secondly to floors that locate directly beneath rooftop mechanical equipment.
- In open workspaces, one measurement should be taken for every 46 $m^2$ [500 $ft^2$].

### *Reporting & Compliance*

- The time-averaged, A-weighted sound pressure level (L90) measured at each of the following octave band frequencies is plotted against noise criteria curves and rounded down to the nearest increment of 1 NC/NR for maximum noise level to determine the noise criterion: 31.5 Hz (for Noise Rating), 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, 4 kHz, and 8 kHz (for Noise Criterion).

### *Device Requirements*

- See *General Guidelines*.


 

## Disruptive Noise Limitation

### *Features*

- WELL v1: Feature 75 Part 7

### *Test Locations & Conditions*

- See *General Guidelines*.
- The measurements must be performed when the space is unoccupied (e.g., prior to opening or after hours)
- Music must be off for one ambient measurement, and music must be on for at least one measurement.
- As much as possible, avoid transient sounds (e.g., people talking, traffic noise etc.) during measurement.
- As much as possible, measurements should be taken away from walls and other building structures. The sampling points must be located a minimum of 1.2 m [48 in] above the ground.
- If the conditions specified above are violated during the measurement, the measurement must be halted, data must be discarded, and the measurement must be restarted.

### *Test Method*

- See *General Guidelines*.
- Each measurement should last a minimum of 30 seconds in each test location.

### *Test Quantity*

- At least two measurements (maximum of four) and measured at a distance of 4.5 m [15 ft] outside of the entrance to the space.

### *Reporting & Compliance*

- The time-averaged, A-weighted sound pressure level recorded during the measurement period will be used to determine compliance with the WELL threshold.
- Note any existing intruding sounds that may interfere with an accurate measurement of noise criterion (e.g., traffic noise).

### *Device Requirements*

- See *General Guidelines*.


 

## Background Noise Levels

### *Features*

- WELL v2: Feature S02

### *Test Locations & Conditions*

- See *General Guidelines*.
- The HVAC system must be on during the measurement periods.
- Sound masking systems (if present) must be off for the duration of the measurement period.
- The sample points must be located at the location where an occupant would typically be situated within the space.
- As much as possible, the sample points must be located 1 m [3.3 ft] from any windows or walls, while still located where an occupant would typically be situated.
- The distance between any two points of measurement must be at least 3 m [10 ft].
- If the windows are normally closed, the sound level measurements must occur with the windows closed. If the windows are normally open, the sound level measurements must occur with the windows open.
- With regards to the thresholds for Residential Sleeping Areas, "Daytime" measurements are taken after 7:00 a.m. and before 10:00 p.m. and "Nighttime" measurements are after 10:00 p.m. and before midnight.

### *Test Method*

- See *General Guidelines*.
- Each measurement should last at minimum five minutes at each test location.

### *Test Quantity*

- At least one measurement in each room type listed for 10% of the total number of floors in the project. The preference for the first sampling point is given to floor that is at or nearest to the ground level. The preference for the second sampling point, if applicable, is the floor at similar height to adjacent rooftop mechanical equipment or other elevated exterior sources of noise. The preference for third sampling point (if applicable) is the floor beneath rooftop mechanical equipment.
- In open workspaces, one measurement should be taken for every 46 $m^2$ [500 $ft^2$].

### *Reporting & Compliance*

- Compliance of the Leq values is based on the A-weighted and C-weighted measurement achieving the optimal level within a +4 dB tolerance. Compliance of the Lmax values is based on the A-weighted and C-weighted measurement achieving the optimal level within a +9 dB tolerance.
- All measurements taken in open workspaces should be averaged to a single time-averaged sound pressure level for each criterion (dBA and dBC for both Leq and LMax).

### *Device Requirements*

- See *General Guidelines*.


 

## Sound Masking

### *Features*

- WELL v1: Feature 79, Part 2
- WELL v2: Feature S05, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- The HVAC system must be on during the measurement periods.
- Sound masking system must be on during the measurement periods.
- The measurements must be taken where an occupant would typically be situated.

### *Test Method*

- See *General Guidelines*.
- Each measurement should last at minimum 30 seconds in each test location.

### *Test Quantity*

- 10% of the total number of regularly occupied spaces where sound masking is present (at least one space).

### *Reporting & Compliance*

- The time-averaged, A-weighted sound pressure level recorded during the measurement period will be used to determine compliance with the WELL threshold.

### *Device Requirements*

- See *General Guidelines*.

## Speech Privacy Potential (SPP) and Noise Isolation Class (NIC)

- The Speech Privacy Potential (SPP) is the sum of the background noise and the noise reduction across the partition (NIC):
  - For projects without sound masking, use background noise level (dBA at 1 kHz) of the receiving room, as measured for WELL v2 Feature S02.
  - For projects with sound masking, use the sound level (dBA), as measured in WELL V2 Feature S05.
  - NIC is calculated from L10 of the source measurement, L90 of the receiving location with source on, and L90 of the ambient background level (source off) of the receiving room (see below).

### *Features*

- WELL v2: Feature S03, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.
- The HVAC system must be on during the measurement periods.
- Sound masking systems (if present) must be on during the measurement period.
- The measurements must be located where an occupant would typically be situated within the space.

- As much as possible, measurements should be located away from walls containing windows.
- The distance between any two points of measurement must be at least 3 m [10 ft].
- Windows and doors in the measurement location must be closed.

### *Test Method*

- See *General Guidelines*.
- Loudspeaker should be placed near wall at the opposite side of the room from the wall that is being tested. If a non-omnidirectional speaker is used, to the extent possible, it should be aimed into a trihedral corner along this wall (i.e., where two walls join at right angles).
- Minimum level of the operating loudspeaker should be at least 90 dB.
- Each measurement should last at minimum 15 seconds in each receiving room measurement location. Background noise measurements taken in receiving rooms can satisfy the measurement requirements for WELL v2 Feature S02.

### *Test Quantity*

- At least 10% of each regularly occupied space type listed, one measurement per measurement location.
- Preference should be given to rooms that separate two acoustically sensitive spaces such as conference rooms, wellness rooms or where requirement is SPP-80 or greater.
- Preference should be given to walls with any element of glazing and/or doors.

### *Reporting & Compliance*

- The Speech Privacy Potential (SPP), which is calculated by adding the measured NIC/Dw reduction across the partition of interest to the background noise level (dBA at 1 kHz) of the receiving room of interest, will be used to determine compliance with the WELL thresholds.

### *Device Requirements*

- Sound Level Meter:
  - See *General Guidelines*.
- Loudspeaker:
  - Minimum 0.25 m [10 in] diameter
  - 50 Hz - 20 kHz frequency response
  - Maximum output of at least 100 dB
  - Noise generator capable of producing white/pink noise of equal sound energy across all frequencies of interest

## Reverberation Time ($RT_{60}$)

### *Features*

- WELL v1: Feature 78, Parts 1 and 2
- WELL v2: Feature S04, Part 1

### *Test Locations & Conditions*

- See *General Guidelines*.


 

- The HVAC system must be on during the measurement periods.
- Sound masking systems (if present) must be on during the measurements.
- The sampling points should be located at least 1 m [3.3 ft] from any sound-reflecting surfaces.
- The impulse sound source must be at least 1 m [3.3 ft] from both the sound measuring device and sound reflecting surfaces.

### *Test Method*

- See *General Guidelines*.
- For the noise source impulse:
  - If generated via balloon burst, inflate balloon to 0.4 m [16 in] diameter. Then, arm or ready the sound level meter by measuring the baseline background noise level. Once the meter is armed for impulse, burst balloon using a pen or similar. Allow approximately 10 seconds for meter to capture impulse response at all frequencies.
  - If generated via loudspeaker, arm and ready the meter by measuring the baseline background noise level. Then, excite the room by turning the loudspeaker on to approximately 90 dB using a white/pink noise generator. Once sound level meter is armed for impulse measurement, turn off the sound source and wait approximately 10 seconds for the sound level meter to capture the impulse response at all frequencies.

### *Test Quantity*

- Three measurements of approximately 10 seconds (or however long is needed to capture impulse response across all frequencies) per measurement location.
- 10% of total number of applicable spaces, with preference to rooms that require higher degrees of speech intelligibility with the following order of descending priority: lecture rooms, classrooms, conference rooms and enclosed offices.

### *Reporting & Compliance*

- The average $RT_{60}$ value from 500 Hz - 1 kHz of the three measurements per measurement location are used to determine compliance with the WELL threshold.

### *Device Requirements*

- Sound Level Meter:
  - See *General Guidelines*
- Balloon of minimum diameter 0.4 m [16 in]

  *OR*

  Loudspeaker:
  - Minimum 0.25 m [10 in] diameter
  - 50-20 kHz frequency response
  - Maximum output of at least 100 dB
  - Noise generator capable of producing white/pink noise of equal sound energy across all frequencies of interest


 

## Sampling Rates for Multifamily Residential

For multifamily residential buildings, initial performance testing will involve sampling from randomly determined locations in the entire building. However, the scope of Performance Verification during the recertification process will be limited to components of the common areas only (the interiors of occupied living spaces will not be subject to on-site sampling).

Tentative testing locations are typically selected by the performance testing agent prior to arrival on site. However, these tentative testing locations are subject to change once the performance testing agent arrives on site, based on the observed conditions.

Whenever a calculation results in a fractional sampling point, round up to the next whole number. Additionally, please note that the number of sampling locations represents a minimum. The performance testing agent may include additional sampling points.

The project team needs to determine how many different unit types there are based on the following criteria. Every dwelling unit of each unit type must:

- Be under the same ownership and management
- Be part of the same construction contract
- Use the same heating and ventilation methods
- Use the same building materials, finishes and furnishings throughout

Each unit of a given unit type may differ in layout and size (e.g. number of bedrooms, window placements, ceiling heights, difference in area, etc.)

### Air

- Projects with 10 units or fewer: two of each unit type
- Projects with more than 10 units: 5% of each unit type, with a minimum of three and a maximum of 40 units

### Water

- Projects with 20 units or fewer: one unit
- Projects with 21-100 units: two units
- Projects with more than 100 units: three units

### Light and Sound

Sampling should be distributed between different unit types. At least one of each type of room described in the feature in each unit is evaluated.

- Projects with 15 units or fewer: four units
- Projects with 16-50 units: 25% of the units
- Projects with more than 50 units: 15 units


 

## Glossary

Configuration – With water, a configuration refers to the water treatment method used if water is treated at all. For example, a bathroom sink and kitchen sink that both use point-of-use sediment filters are of the same configuration; conversely, a drinking water fountain with a point-of-use filter and another drinking water fountain that uses base building water with no further treatment are of different configurations.

Leased Spaces – All areas within the project boundary that are leased or owned by tenants.

Non-leased Spaces – All areas within the project boundary that are not considered leased space.

On-going Monitoring – Activities required in certain features of WELL wherein projects engage in on-going measurements of environmental parameters.

Parameter – A particular physical condition which is measured (e.g., dry-bulb temperature, formaldehyde concentration).

Performance Testing – On-site component of the WELL process wherein an independent agent, trained in the testing protocols of the WELL Performance Verification Guidebook, conducts tests on environmental parameters, collects samples, submits them to labs and analyzes data.

Performance Testing Agent – An agent who is trained and qualified to conduct performance testing for WELL. This may refer to GBCI agents or individuals from other organizations who are trained and approved by GBCI.

Performance Review – GBCI review of performance testing data to verify that all testing and analysis is accurate and conducted in accordance with the WELL Performance Verification Guidebook.

Performance Verification – The final phase required for WELL Certification, consisting of performance testing and Performance Review.

WELL Reviewer – An agent from GBCI who reviews and approves all documentation and performance test results for WELL. WELL Reviewers are trained to understand proper adherence to testing protocols for evaluating WELL performance criteria and confirm that all design, construction, operational and policy documentation submitted by the project accurately attests to achievement of WELL features.


 