

**arbnco™**

# Best Practice Guide

---



**arbnwell™**

For the installation and maintenance of an **arbn** well system.

**Date of Issue: 12 May 2020**

**Version: 1.3**

**Authors:**

Olivia Nile Sobek, PhD

Graeme Jephson, MEng, ACIBSE

John Allison, PhD

Parag Rastogi, PhD, ACIBSE, MASHRAE

# Contents

	<b>How to read this document</b>
<b>05</b>	<b>1. Ubiquitous Measurement of Indoor Environmental Conditions</b> <ul style="list-style-type: none"><li>1.1 The arbn well system</li><li>1.2 Communication</li><li>1.3 Arc starter kit vs. standard installation</li><li>1.4 Selecting measurement points or locations</li><li>1.5 Calculating the number of devices</li></ul>
<b>08</b>	<b>2. arbn well for Arc and LEED</b> <ul style="list-style-type: none"><li>2.1 The Arc platform</li><li>2.2 What does arbn well have to do with Arc / LEED</li><li>2.3 Unit Conversions</li><li>2.4 What is the difference between 'standard' installation and Arc starter kit?</li><li>2.5 How does this kit help me attain LEED points through Arc?</li><li>2.6 Can arbn well update the Arc scores in real time?</li><li>2.7 Can't I just use existing CO<sub>2</sub> monitors in return air ducts?</li></ul>
<b>11</b>	<b>3. Installation &amp; Site Safety</b> <ul style="list-style-type: none"><li>3.1 Sensor device placement</li><li>3.2 Setting up your device</li><li>3.3 Data Readings</li><li>3.4 Permanent fixings</li></ul>
<b>14</b>	<b>4. Post Deployment Maintenance</b> <ul style="list-style-type: none"><li>4.1 Battery replacement</li><li>4.2 Device Breakdown</li><li>4.3 End of contract disposal or abandonment</li><li>4.4 Sensor device removal protocol</li></ul>
<b>16</b>	<b>5. Certification Addendum</b> <ul style="list-style-type: none"><li>5.1 LEED v4.0/v4.1</li><li>5.2 RESET</li><li>5.3 WELL</li></ul>
<b>18</b>	<b>6. GBCI Review (LEED)</b> <ul style="list-style-type: none"><li>6.1 Affirmation</li><li>6.2 Arc Starter Kit<ul style="list-style-type: none"><li>6.2.1 Eligibility</li><li>6.2.2 Supporting Documents</li></ul></li><li>6.3 Standard arbn well Installation<ul style="list-style-type: none"><li>6.3.1 Eligibility</li><li>6.3.2 Supporting Documents</li></ul></li><li>6.4 Advanced/ Optimal Installation</li><li>6.5 Arc Score Calculation</li></ul>
<b>22</b>	<b>7. References</b>

**THIS DOCUMENT IS INTENDED FOR OWNERS OF STANDARD ARBN WELL INSTALLATIONS AND ARC STARTER KITS. IT DESCRIBES HOW TO INSTALL AND MAINTAIN YOUR ARBN WELL SYSTEM.**

## How to read this document

---

It begins with a description of the arbn well system and how the layout of devices in an installation would be estimated by a trained installer or arbnco representative. It then describes the setup and operation of a standard arbn well installation as well as Arc-exclusive starter kits. The guidelines described here lay out the best practices for placement, mounting, and maintenance of your devices. They should be followed as closely as practical. Following these guidelines is not a guarantee of certification by any certifying body or standards, nor the achievement of points. While arbnco maintains these documents with care and regularly updates them with the newest scientific guidelines, errors and misunderstandings can occur.

If you are unclear about anything described in this document or need any other help with your arbn well system, please email [well-support@arbnco.com](mailto:well-support@arbnco.com). The guidelines in this document are not intended to be part of a professional code of practice, codes, standards, or statutory requirements. Happy sensing!

*How to cite this document*

*Sobek, O.N., Jephson, G., Allison, J., Rastogi, P. 2020. Best Practice Guide for the Installation and Maintenance of an arbn well system . Glasgow, UK. Version 1.3, 12 May 2020.*

# 1. Ubiquitous Measurement of Indoor Environmental Conditions

Indoor environmental conditions impact your health and wellbeing. Measuring these conditions is the first step towards understanding and improving the quality of your indoor environment for greater wellbeing, satisfaction, and productivity. arbn well is an innovative new approach to collect, visualise, and analyse real-time measurements of the environmental conditions in your office, school, and home.

## 1.1 The arbn well System

The arbn well service gathers both qualitative and quantitative data, allowing for a full assessment of human experience. A dense network of wireless high-quality indoor sensors provides ubiquitous measurement of the following indoor environmental conditions: carbon dioxide (CO<sub>2</sub>), total volatile organic compounds (TVOC), particulate matter (PM 1, 2.5, 10), temperature and humidity. This is combined with occupant engagement, i.e., feedback on the subjective perception of the environment by occupants.

### The arbn well devices

The basic Arc starter kit consists of 2 arbn well AQ+ devices. A breakdown of the capabilities of these devices can be seen below in Table 1. Individual specifications, including electrical and radio characteristics, are attached.

DEVICES	MEASUREMENT	UNITS	POWER
AQ+	TEMPERATURE (TDB)	°C	PLUG IN CABLE (USB-MICRO B)
	RELATIVE HUMIDITY (RH)	%	
	CARBON DIOXIDE (CO <sub>2</sub> )	ppm	
	TOTAL VOLATILE ORGANIC COMPOUNDS (TVOC)	ppb	
	PARTICULATE MATER (PM 1, 2.5, 10)	µg/m <sup>3</sup>	
AQ	TEMPERATURE	°C	BATTERY ONLY
	RELATIVE HUMIDITY	%	
	CARBON DIOXIDE (CO <sub>2</sub> )	ppm	
COMFORT	TEMPERATURE	C	BATTERY ONLY
	RELATIVE HUMIDITY	%	
	AMBIENT LIGHT LEVELS (LUX)	lx	

Table 1: Devices used in standard arbn well deployments

- THE ARBN WELL SYSTEM CONSISTS OF BOTH HARDWARE (DEVICES WITH SENSORS) AND SOFTWARE (PLATFORM FOR STORING, VISUALISING, AND ACTING ON, DATA).
- A STANDARD ARBN WELL INSTALLATION CONSISTS OF A DENSE NETWORK OF HIGH-QUALITY WIRELESS NETWORKED SENSORS.

## 1.2 Communication

If you have a standard arbn well kit, it will come with a gateway. A gateway is like your home router or modem; it receives data from, and sends commands to, the devices. The Arc starter kit does not come with a gateway, instead the AQ+ devices can be connected to a 2.4 GHz WiFi network. See our communication and troubleshooting guide for more information on the communication protocols and practices for arbn well installations.

Figure 1: The arbn well system architecture. This is for a standard installation, so includes all sensor types communicating through a gateway. The arbn well system is currently being tested with the Tridium Niagara software for a future integration.

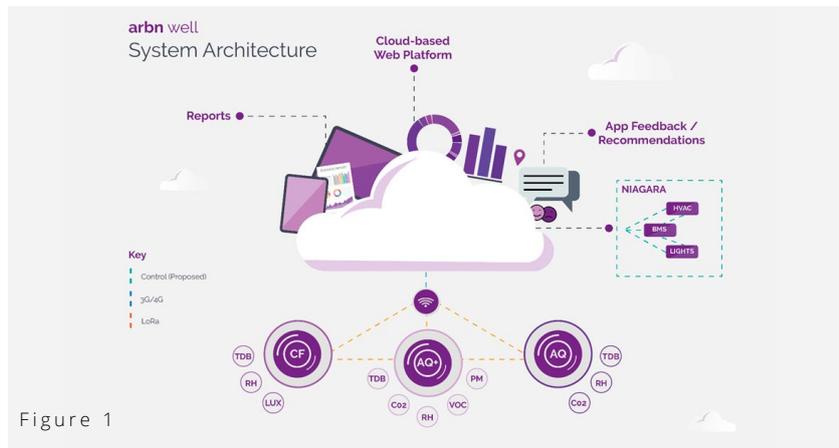
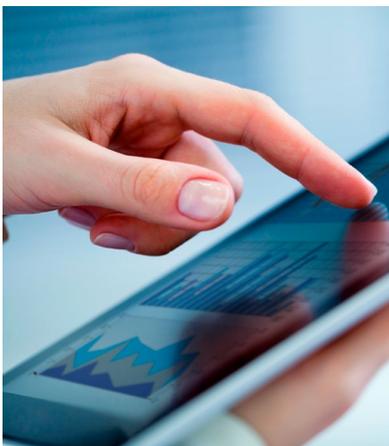


Figure 1



## 1.3 Arc Starter kit vs Standard Installation

The Arc starter kit provides an automated data stream of TVOC and CO<sub>2</sub> measurements for compliance with LEED v4.1 Human Experience Score (in conjunction with the survey available on the arbn well user interface) (USGBC 2019b). As such, this section does not apply to Arc starter kits, which consist of only two AQ+ devices.

## 1.4 Selecting Measurement Points or Locations

A representative or partner of arbnco will have prepared a bespoke quote for you based on the following heuristics.

Before installing an arbn well kit, a trained installer needs to assess which parts of your site/space will require measurement points of each parameter, and what the coverage or density of those measurement points should be. This will depend on how often you occupy a given space (room) and how the space is typically used. Broadly, the measurement points should be located only in occupied spaces, prioritising spaces used regularly. The definition of unoccupied and occupied spaces, and regularly and non-regularly occupied spaces should be based on the guidelines in the Indoor Environmental Quality (EQ) section of LEED v4.0 (O&M) (USGBC 2019b).

## 1.4 Continued

See Table 2 below for guidelines on how to estimate the number of measurement points for different building types. If your building type is not mentioned here, contact arbnco for a custom quote.

## 1.5 Calculating the Number of Devices

The number of devices of each type should be calculated as follows:

1. AQ+ devices = Number of TVOC/PM measurement points
2. AQ devices = Number of CO<sub>2</sub> measurement points – AQ+ devices
3. Comfort devices = Temperature/Humidity points – AQ+ devices – AQ devices



BUILDING TYPE	SUB TYPE	TEMPERATURE + HUMIDITY		CO <sub>2</sub>		TVOC / PM	
		MIN COVERAGE (1 PER / % COVERAGE)	OPTIMUM (1 PER / % COVERAGE)	MIN COVERAGE (1 PER / % COVERAGE)	OPTIMUM (1 PER / % COVERAGE)	MIN COVERAGE (1 PER / % COVERAGE)	OPTIMUM (1 PER / % COVERAGE)
COMMERCIAL OFFICE	OPEN PLAN <sup>1</sup>	6 PERSONS <sup>2</sup> OR 60 sqm	2 PERSONS OR 20 sqm	20 PERSONS OR 200 sqm	8 PERSONS OR 80 sqm	DISTINCT AIR ZONE <sup>3</sup>	DISTINCT AIR ZONE + SOURCE <sup>4</sup>
	SINGLE OFFICE	2 ROOMS / 50%	ROOM / 100%	2 ROOMS <sup>3</sup> / 50%	ROOM / 100%	N/A	N/A
	CONFERENCE ROOM	2 ROOMS / 50%	ROOM / 100%	2 ROOMS <sup>5</sup> / 50%	ROOM <sup>6</sup> / 100%	N/A	N/A
EDUCATION	N/A	CLASSROOM <sup>7</sup> / 100%	4 PERSONS / 25%	2 CLASSROOMS / 50%	CLASSROOM 100%	AT MOST 5 CLASSROOMS <sup>8</sup> / 20%	AT MOST 3 CLASSROOMS + SOURCE / > 33%
RESIDENTIAL	N/A	REGULARLY OCCUPIED ROOM / 100%	ROOM 100%	MASTER BEDROOM / 100%	BEDROOM / 100%	KITCHEN / 100%	KITCHEN / 100%
OTHER	RETAIL, HOTELS, STADIA, HOSPITALS, MUSEUMS ETC	REGULARLY OCCUPIED ROOM / 100%	ROOM 100%	2 ROOMS / 50%	ROOM / 100%	5 ROOMS / 20%	3 ROOMS + SOURCE / >33%

Table 2: Estimating measurement points in various spaces. All units below are for 1 Measurement Point, e.g., 1 CO<sub>2</sub> point per 20 persons minimum. The minimum coverage is not recommended to take advantage of the full functionality and benefits of ubiquitous sensing. Using a minimum measurement layout may not meet the requirements of certification or standards such as LEED, WELL, and RESET.

<sup>1</sup> Including shared or group working spaces.

<sup>2</sup> We assume an average allocation of 10 m<sup>2</sup> / 100 ft<sup>2</sup> per person.

<sup>3</sup> A distinct air zone is a part of the building served by a single AHU. If an AHU serves several floors, each floor should be considered a distinct zone.

<sup>4</sup> Sources of TVOC/PM could be: Kitchens/cafes, printing/copying areas, or bin stores.

<sup>5</sup> Select the most intensively used rooms, ensuring at least half of the regularly-occupied rooms are covered.

<sup>6</sup> Conference rooms smaller than 14 m<sup>2</sup> (150 ft<sup>2</sup>) can be excluded.

<sup>7</sup> This includes all regularly occupied teaching spaces, e.g., lab areas, activity rooms, etc.

<sup>8</sup> There must be one TVOC/PM measurement point per floor at least.

## 2. arbn well for Arc and LEED

---

- arbn well hardware meets the requirements for indoor air quality measurements for LEED v4.0 and v4.1
- The Arc starter kit is composed of 2 AQ+ devices. This is sufficient for a trial in a small building (less than 2,000m<sup>2</sup> or 20,000ft<sup>2</sup>) though additional options can be created for larger buildings.

### 2.1 The Arc Platform

Arc is a technology platform that was established to help create better buildings and places for people and the environment. Arc empowers its users to understand and enhance their sustainability performance, promote human health and wellbeing and contribute to a higher quality of life. The platform allows buildings, city and community projects to collect data, manage and benchmark progress, measure their impact and improve sustainability.

The Arc platform is used by organisations across more than 80 countries to collect, manage, analyse, score and communicate information about the operational performance of spaces, buildings, places and entire portfolios. It provides a systematic assessment of operational performance, collecting data on different green building parameters and scoring it on a scale ranging from 0-100.

### 2.2 What does arbn well have to do with Arc/LEED?

arbn well automatically streamlines human experience data to Arc. This enables Arc to generate scorable metrics and offer a larger suite of measured performance without hassles. This means that collecting and maintaining high quality data on the human aspect of operational performance will now be quicker and easier for Arc users. This data is composed of aggregated CO<sub>2</sub> and TVOC readings and survey responses. The scores calculated by Arc based on this data can be used to recertify a building under the LEED v4.0 Reference Guide for Operations & Maintenance (USBGC 2019b)

### 2.3 Unit Conversions

While the arbn well platform reports TVOC in ppb, GBCI requires TVOC to be reported in µg/m<sup>3</sup>. To convert TVOC values to µg/m<sup>3</sup> exactly, you need to know the relative concentrations and molecular masses of the gases to which the sensor is reacting. Since the type of continuous TVOC sensor used in our devices cannot distinguish between different gases (hence, 'total' VOC), we use the properties of Toluene for LEED.

## 2.3 Continued

This gives a multiplication factor of 3.767, as used in the following conversion formula:

$$\text{VOC } \mu\text{g}/\text{m}^3 = \frac{\text{g} \cdot \text{VOC } \text{ppb}}{24.45}$$

g = gram molecular weight of Toluene = 92.14 g/mol

$$\text{VOC } \mu\text{g}/\text{m}^3 = 3.767 \cdot \text{VOC } \text{ppb}$$

Other parameters are measured in SI units, and conversion factors to other common units are given below:

**Temperature:**  $^{\circ}\text{F} = (^{\circ}\text{C} \cdot \frac{9}{5}) + 32$

**Light:**  $fc = \frac{lx}{10.76391}$

**CO<sub>2</sub>:**  $\text{ppm} = \frac{\text{mg}/\text{m}^3}{1.8}$

For a graphical representation of the process of calculating TVOC and CO<sub>2</sub> values to Arc/LEED, please see Section 6.5.

## 2.4 What is the difference between a 'standard' arbn well installation and an Arc Starter Kit?

A standard arbn well installation provides a rich, detailed, and dynamic picture of the indoor environment. It is more than sufficient to meet the requirements of LEED v4.1 for recertification, both in terms of spatial and temporal density of measurement (USGBC 2019b). That is, in a standard installation, measurements of TVOC and CO<sub>2</sub> (the two measurements required for recertification or initial v4.1 certification) are made in more places, more frequently, and for much longer than strictly required by Arc/LEED.

A starter Arc kit is recommended for those wishing to familiarise themselves with the collection and use of big datasets for optimal building operation. Since it consists of only 2 AQ+ devices, i.e., only two measurement points for LEED-mandated TVOC and CO<sub>2</sub>, we do not recommend using it for more than one floor. A comparison between the capabilities of the two types of kits is given in Table 3 below.

FEATURE	ARC STARTER KIT	STANDARD DEPLOYMENT
NO. OF SENSORS	2 SENSORS	> 2 SENSORS (SEE TABLE 2)
SENSOR TYPES	AQ+ : CO <sub>2</sub> AND TVOC ENABLED	AQ+: TDB, RH, CO <sub>2</sub> , TVOC, PM AQ: TDB, RH, CO <sub>2</sub> COMFORT: TDB, RH, LUX
MEASUREMENT DENSITY	2 PER BUILDING / PROJECT	APPROX. 1 MEASUREMENT POINT PER 4 REGULAR OCCUPANTS + AT LEAST 1 PER EACH REGULARLY OCCUPIED ROOM
CONNECTIVITY	WIFI	DEDICATED GATEWAY (OR WIFI)

Table 3: Comparison between Arc starter kit and the standard, full-featured arbn well deployment

## 2.5 How does this kit help me attain LEED points through Arc?

The devices provided by arbnco automatically collect and push data to the Arc platform. Thus, the kit makes data reporting for compliance smooth and painless.

Just purchasing the devices does not guarantee points, since the points are calculated based on a 'score' assigned to the actual environmental conditions as per LEED v4.1 (USGBC 2019b). If the building's environment is indeed within the bounds that are deemed suitable for human health and wellbeing by LEED standards, then the building will have a high Arc score and, consequently, more points when the data is submitted for recertification. Installing the arbn well kit allows buildings to detect trends or problem spots and improve their IEQ early and continuously, well before recertification.

The arbn well system is designed to enable building owners to identify issues and patterns in their data, and improve the quality of the indoor environment. A single annual spot-check does not provide a building operator with actionable insights about what is wrong with a building that might be affecting the wellbeing of the occupants, and what needs improvement.

## 2.6 Can arbn well update the Arc Scores in real time?

Yes, once the connection is made between a building in arbn well and one on the Arc platform, the data is pushed to Arc every day automatically.

## 2.7 Can't I just use existing CO<sub>2</sub> monitors in return air ducts?

The LEED v4.0 O&M guide does not consider CO<sub>2</sub> monitors in return air ducts to be suitable to attain the relevant Environmental Quality credits (USGBC 2018). This also applies to monitors connected to the Building Automation System (BAS) / Building Management System (BMS).

## 3 Installation and site safety

---

We do not currently recommend installing the devices outdoors.

If you are installing at a site that requires you to be outdoors travelling between multiple buildings/sensor device locations, we recommend wearing the following personal protective equipment, or PPE:

- Closed-toe shoes with reinforced toes
- Hard hats, in situations where falling debris is possible
- Hi-visibility vests
- Weather appropriate clothing, including gloves

When installing indoors, we recommend:

- Wearing closed-toe shoes
- Not wearing loose-flowing clothing or dangling jewellery

### 3.1 Sensor Device Placement

After determining the spaces or rooms in which you would like to install arbn well devices, you will need to determine their best possible placement. In general, the recommendations here are based on research conducted by a collaborative team of personnel from arbnco and the Energy Systems Research Unit at the University of Strathclyde (Cóstola and Flett 2018), and guidelines contained in documents such as LEED v4.0 Reference Guide for Building Operations & Maintenance (US Green Building Council 2018) and RESET (GIGA 2018).

All devices should be placed approximately 0.9-1.8m (3-6ft) from the ground in an unobstructed spot where they are unlikely to be covered, knocked off, or disturbed in any way. The goal is to sample the “breathing zone” actually experienced by occupants. The AQ+ devices (that measure TVOC/PM) should preferably be near power sockets to avoid long power cables. Avoid placing devices on objects which are temporary or are moved within the space, such as room dividers in conference rooms, or on windows and doors.

When selecting the exact position for a device, try to avoid:

- a. Direct sunlight;
- b. Direct exposure to heating sources (appliances, radiators, equipment);
- c. Areas of high traffic where sensor devices may be damaged or tampered;
- d. Mechanical ventilation outlets/inlets<sup>9</sup>

These will either damage the internal sensors of the devices or potentially give an unreasonable estimate of the average conditions in a room. When these conditions cannot be avoided entirely, please report them

<sup>9</sup> This position is acceptable if people are sitting directly in the path of incoming airflow. For example, a desk bank is located underneath an air-conditioning duct.

### 3.1 Continued

to the arbnco team so that your sensor readings may be contextualised accordingly in data analysis.

Once the best placements for your devices are selected, temporarily place them as close to those placements as possible without permanently affixing them. Ensure the AQ+ devices are plugged into power sources.

### 3.2 Setting up your Device

Once all sensor devices are placed (but not fixed) in the optimal locations, use the following instructions to check the signal strength on each sensor device:

1. Wake up the AQ and Comfort devices (if you have any) by pressing the button for short duration.
2. Wake up the AQ+ devices:
  - a) Plug the devices into their supplied USB cords/adapters
  - b) Ensure the device's front LED flashes red and green and then green and then stops
3. If you are using WiFi to connect your kit, follow the AQ+ Device WiFi Configuration Guide to connect your AQ+ devices to WiFi. After the AQ+ device is connected, press the button for a short duration. If you are using a gateway skip this step.
4. Login to your arbn well account and navigate to the current installation (if you have more than one installation on your account).
5. Wait 30-60 minutes to ensure your devices are reporting.

### 3.3 Data Readings

After your devices have started reporting to the platform, you should confirm that the data from their specific sensors is within expected ranges, as defined in Table 4:

PARAMETER	BASE RANGE	PARTIALLY OCCUPIED	FULLY OCCUPIED
TEMPERATURE (°C)	18-25	18-28	18-30
RELATIVE HUMIDITY (%)	20-40	20-50	20-60
LIGHTING (lux)	80-650	80-650	80-650
Co <sub>2</sub> (ppm)	300-700	350-3000	400-3000
PM (µg/m <sup>3</sup> )	<60	<80	<100
TVOC (ppb)	<350	<350	<350

Table 4: Expected data range, per parameter.

These are values typically seen in offices. A value outside of these may not indicate a sensor fault, but rather that your location has unusually high/low values. For a conditioned building, if your readings are outside those ranges, you should consider re-positioning your devices.

### 3.3 Continued

If there are no other suitable placements away from sunlight, heat sources, or any other adverse factor listed in Sensor Device Placement, contact arbnco so that your readings may be adjusted accordingly.

### 3.4 Permanent Fixings

Once you've decided on their permanent placements, you can attach your sensor devices permanently, using 3M® Command Strips. To do this follow the guidance below ensuring the Command Strip tabs are visible for ease of removal. (Figure 2)

As mentioned above, when attaching your sensor devices to walls, place sensor between 0.9 – 1.8m where possible. For partitions and furniture, place sensors between 1-1.5m. Examples of each are shown. (Figure 3+4)

If you are applying for RESET certification, please see the Compliance Addendum for RESET compliance heights and sensor device densities.



Figure 2: AQ+ device fixtures



Figure 3: Partition Mounting



Figure 4: Wall Mounting

## 4 Post Deployment and Maintenance

---

Your arbn well devices should be maintained by keeping them dry and free of tampering. Tampering with the device can damage the internal sensors. Your devices should be kept away from any sources of water or mist including, but not limited to, humidifiers, water fixtures, or leaks.

### 4.1 Battery Replacement

The devices have an approximate useful lifespan of 3 years. This varies based on operating conditions. The batteries are high performance industrial batteries, so cannot be replaced with store-bought consumer batteries. Please see section 4.4 for advice on how to send your devices back to arbnco or otherwise dispose of them.

### 4.2 Device Breakdown

If your device has begun malfunctioning or has stopped working entirely, contact arbnco to troubleshoot. If the device had a manufacturing defect, it will be replaced or repaired as per the terms of your contract. If the cause of the breakdown is due to usage or tampering, you may be charged for a replacement device.

### 4.3 End of Contract Disposal or Abandonment

When you have decided to end your contract or otherwise remove your arbn well devices, please dispose of the devices responsibly at an electronics disposal site. You can also send the devices back to arbnco for proper recycling and disposal (email [well-support@arbnco.com](mailto:well-support@arbnco.com) for details).

### 4.4 Sensor device removal protocol

When you need to remove or move a device, we recommend the following protocol.

1. Clean devices.
  - a. Wear disposable gloves when removing devices.
  - b. Wipe down the devices with disinfecting wipes before handling them.
2. Remove the device from its mounting plate.
  - a. Lever the device off the mounting plate by wedging a flathead screw driver into the small gap between the device and the plate.
  - b. The device should pop off the plate without much force.
3. Remove / clean the mounting plate
  - a. If you are removing the device completely, remove the mounting plate by pulling the Command Strip tabs until they come apart from the surface.

#### 4.4 Continued

- b. If you are installing another arbnco device of the same size, leave the mounting plate on and simply wipe it with a cloth. The new device will mount on the same plate.
- 4. Clean the device and pack.
  - a. Wipe down the surface of the device and mounting plate using alcohol-based wipes or sprays containing at least 70% alcohol. Make sure to dry the surfaces thoroughly.
  - b. Pack the devices with adequate filling/padding to ensure they do not break in transit.

## 5 Certification Addendum

---

### 5.1 LEED v4.0/4.1

There are two types of installations provided by arbnco for LEED: an Arc starter kit and a 'standard' installation. Each installation type is suitable for different credits in LEED, as explained in Section 6 – GBCI review (LEED). In addition to the credits outlined there, a project that installs an arbn well system with optimal spatial and temporal coverage may be eligible for Innovation Credits, subject to GBCI review. If you are applying for LEED credits using your arbn well installation, please proceed to Section 6 – GBCI review (LEED).

To get started with an Arc starter kit, or if you are not sure whether an Arc starter kit is right for you, please contact us at [arc@arbnco.com](mailto:arc@arbnco.com). We will be happy to walk through the options with you.

### 5.2 RESET

For installations as part of RESET certification, follow the procedures outlined in this document (GIGA Ltd):

1. Wall Mounted Monitors are to be wall mounted between 900 mm and 1800 mm (3 - 6 feet) above the floor. This location provides a good representation of the breathing zone.
2. Measurement points should cover 80% of occupied spaces for full Commercial Interiors (CI) certification, 30% of occupied spaces for partial CI certification, and 30% of total air volume for Core and Shell (C&S) certification.

### 5.3 WELL

WELL follows a point-based system with certification levels of silver, gold, and platinum (50 points, 60 points, 80 points respectively). Installing an arbn well system helps earn points for WELL certification in two ways: for the installation itself, and through usage of the monitors to maintain good indoor environmental conditions. Continuous monitoring of the indoor environment and alerts allow project managers to react to any issues which could result in a drop in certification points. We can work with you to design a solution for your space to obtain up to 19 points.

The following categories of points and preconditions are addressed wholly or partly by the arbn well system:

1. A07 Operable Windows<sup>10</sup>
  - Part 2 Manage Window Use (max: 1 pt)
2. A08 Air Quality Monitoring and Awareness
  - Part 1 Implement Indoor Air Monitors (max: 1 pt)
  - Part 2 Promote Air Quality Awareness (max: 1 pt)<sup>11</sup>
3. T06 Thermal Comfort Monitoring
  - Part 1 Monitor Thermal Environment (max: 1 pt)

<sup>10</sup>Outdoor pollution-based window operation recommendations coming soon (est. Q3 2020).

<sup>11</sup>We are building our knowledge base to comply with the IWBI requirements. This should be available by Q3 2020.

### 5.3 Continued

To meet the conditions of IEQ monitoring in WELL (A08 Air Quality Monitoring and Awareness):

1. arbn well devices must be placed at a height of 1.1–1.7 m.
2. There must be at least one device per 930 m<sup>2</sup> of regularly occupied space
3. A website or phone application must be available to access data.

All three conditions are exceeded by a standard arbn well installation, at minimum or better density.

The following categories of points are supported by an arbn well installation, but attainment requires additional performance tests or surveys from third parties:

1. A01 Fundamental Air Quality
2. A05 Enhanced Air Quality (max: 4pt)
3. A06 Enhanced Ventilation (max: 3pt)
4. L02 Visual Lighting Design
5. L03 Circadian Lighting Design (max: 3pt)
6. T01 Thermal Performance
7. T02 Enhanced Thermal Performance (max: 3pt)
8. T07 Humidity Control (max: 1pt)
9. C01 Health and Wellness Awareness
10. C03 Occupant Survey
11. C04 Enhanced Occupant Survey (max: 3pt)

## 6 GBCI Review (LEED)

### 6.1 Affirmation

Please fill out this affirmation when submitting your arbnco-powered air quality measurement network for review by Green Business Certification Inc. (GBCI).

I \_\_\_\_\_<sup>12</sup> have followed the guidelines outlined in this document<sup>13</sup> for the installation and operation of the air quality network at \_\_\_\_\_<sup>14</sup> associated with LEED/WELL project ID \_\_\_\_\_ (if applicable).

I have used:

1. An Arc starter kit
2. A standard arbn well installation

Signed \_\_\_\_\_

Date \_\_\_\_\_

Place \_\_\_\_\_

### Attachments

I have attached supporting documents as outlined by section 6 below, including an indication of the specific certification and points for which this affirmation is being submitted.

<sup>12</sup> Person submitting this document on behalf of the project.

<sup>13</sup> Sobek, O. N., Jephson, G., Allison, J., Rastogi, P., Best Practice Guide for the installation and maintenance of an arbn well system. arbnco, Glasgow, UK. April 2020.

<sup>14</sup> Address of the project site where the network is installed.

## 6.2 Arc Starter Kit

An Arc starter kit is the smallest air quality measurement system available from arbnco, and it is suitable for a limited number of cases, as laid out in this section. A standard installation, even one with the minimum density, exceeds the spatial and temporal coverage of the Arc starter kit. Since it provides a larger suite of measurements, a standard arbn well kit can be used to meet the requirements of other LEED credits as outlined in Section 6.3.

### 6.2.1 Eligibility

To determine whether only an Arc starter kit may be sufficient, determine if:

1. The project is applying for re-certification or initial certification under LEED v4.1 Operations & Maintenance (Beta).
2. The project floor area is  $\leq 20,000$  ft<sup>2</sup> / 1900 m<sup>2</sup> AND number of floors = 1.
3. The project includes 2 or fewer space usage types.

If any of the eligibility conditions are not met, see the requirements in section 6.1.

### 6.2.2 Supporting Documents

If all three eligibility conditions are met, the following documents should be submitted. These documents can be directly submitted from the arbn well platform to Arc.

Picture of installed devices (upload to arbn well platform).

A narrative describing where each device is installed, preferably marked on a floor plan. A narrative describing the devices installed, including the location of each device, preferably with a marked-up floor plan. The description should include details such as measurement frequency, alarm thresholds, ticketing/response system responsibilities, etc. Include any special circumstances such as unusual device mounting conditions.

(optional) A CSV file of 1 year of raw hourly CO<sub>2</sub> and TVOC data from each device, submitted as a supporting document to Arc. Data is submitted yearly for 3 years to achieve recertification.

## 6.3 Standard arbn well installation

### 6.3.1 Eligibility

A standard arbn well installation of measurement density greater than or equal to the minimum specified in Table 2 is recommended for certification. The devices must be placed to ensure maximum spatial coverage, prioritising areas of regular occupancy. There is no perfect measurement network, and each installation should account for the differing priorities of each project. A trained engineer from arbnco will work with you to determine the best layout and configuration for your project. If you are planning to submit the system for one of the LEED credits, please let us know so we can design the correct system and help provide the correct documentation. A non-exhaustive list of supporting documents required for submission are outlined in Section 6.3.2.

Installations that only meet the minimum measurement point density laid out in Table 2 will require additional CO<sub>2</sub> measurement points (sensor devices), as specified by the individual credits. Installations that meet the optimum density and other requirements outlined in this document will meet the criteria set out by the credits from different LEED certifications below.

**NB:** arbnco monitors do not provide an “audible or visual indicator” on the sensor itself. Rather, the alerts are visible on a platform, can be sent to a Building Automation System, and/or individual managers can be notified.

1. LEED v4.0 BD&C – EQ Prerequisite (Applicable to Naturally Ventilated Spaces only)
  - At least one CO<sub>2</sub> measurement per thermal zone.
2. LEED v4.0 BD&C – EQ Credit: Enhanced Indoor Air Quality Strategies (Option 2 for NC, CS, Schools, Retail, Data Centres, Warehouses & Distribution Centres, Hospitality, and Healthcare) – Mechanically Ventilated Spaces (Option C)
  - At least one CO<sub>2</sub> monitor within each densely-occupied space.
3. LEED v4.0 O&M – EQ Credit: Enhanced Indoor Air Quality Strategies (Option 2, Additional Enhanced IAQ Strategies, for Existing Buildings, Schools, Retail, Data Centers, Hospitality, and Warehouses and Distribution Centers)
  - Ensure CO<sub>2</sub> is measured at intervals of 30 minutes or less.
  - Set a visual alarm if the differential CO<sub>2</sub> concentration exceeds the set-point by more than 15%.
4. LEED v4.0 O&M – EQ Credit: Thermal Comfort
  - At least one Temperature and one RH measurement point per thermal zone.
  - Ensure measurement at intervals of 15 minutes or less.

### 6.3.2 Supporting Documents

To demonstrate compliance with these credits, the following documents should be submitted:

Floor plan with sensor layout provided by arbnco. The plan will also indicate unoccupied spaces, e.g., lift shafts.

The floor plan will indicate a spatial and temporal coverage metric as calculated using a formula agreed with GBCI / USGBC. Your deployment must achieve a minimum threshold of each coverage metric to qualify for credits. Unoccupied spaces, e.g., lift shafts, are not considered in these metrics.

An indication of the usage types of each room in which a device has been placed.

Pictures of at least 25% of devices. At least one picture must be from each room type, e.g., private office, shared/open office, conference room.

A narrative describing the deployment, including any special circumstances such as unusual device mounting conditions. The narrative should document the procedure and settings used, according to the relevant LEED guide. These will include details such as maintenance, measurement frequency, alarm thresholds, ticketing/response system responsibilities, etc.

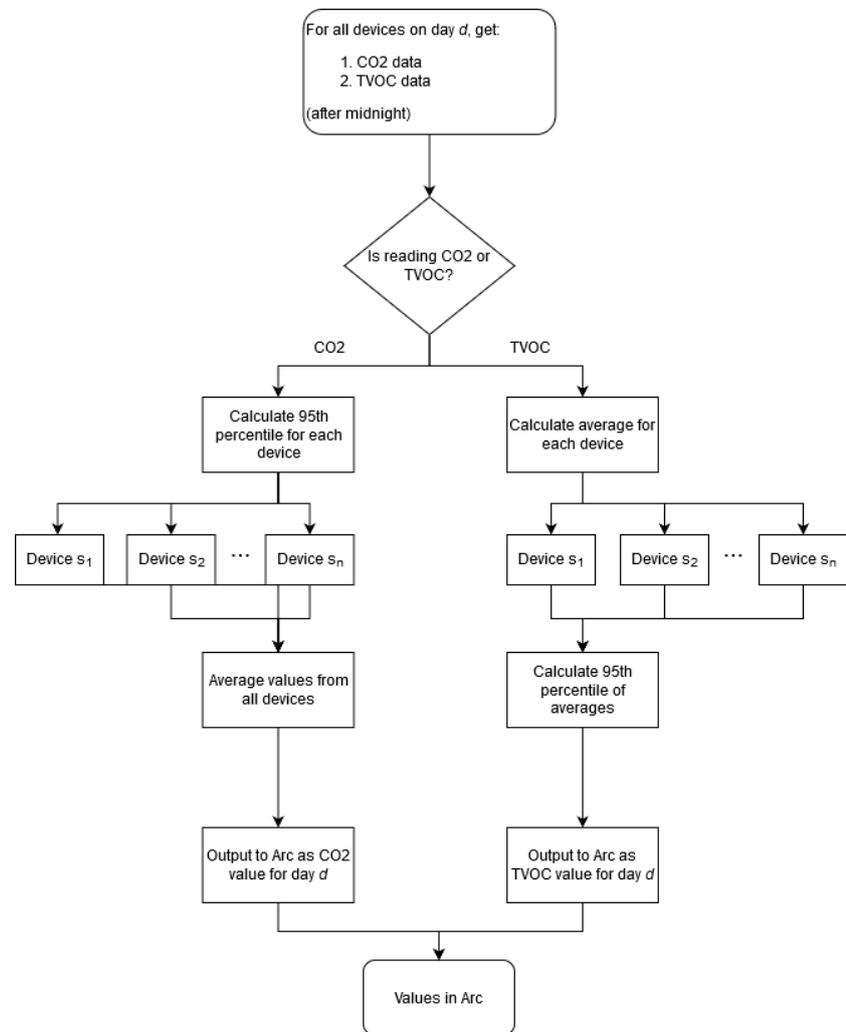
For LEED v4.0 and v4.1 O&M recertification, a CSV file of 1 year of raw data from each device. The frequency will be as mandated by the relevant credit, and described in the narrative.

### 6.4 Advanced / Optimal Installation

An advanced installation will meet or exceed all the criteria laid out for a standard arbn well installation. In addition to the credits available for a standard installation, an advanced installation may be eligible for Innovation Credits. Email [arc@arbnco.com](mailto:arc@arbnco.com) about how to prepare supporting documents for GBCI review.

## 6.5 Arc Score Calculation

(LEED v4.1 Operations and Maintenance Beta)



## 7 References

---

- Cóstola, Daniel and Flett, Graeme. Sensing and Addressing Health and Wellbeing in Buildings: Work programme 2 – Definition of criteria for data post-processing. University of Strathclyde Department of Mechanical and Aerospace Engineering, Energy Systems Research Unit (ESRU). Project funded by Construction Scotland Innovation Centre (CSIC). 21 January 2018.
- GIGA Ltd. RESET Air STANDARD for Commercial Interiors v2.0. 2018.
- International WELL Building Institute. Well Building Standard Q1 2020. Accessed: 01 May 2020
- USGBC. LEED v4 Reference Guide for Building Operations & Maintenance. US Green Building Council, Washington D.C., USA. August 2018.
- USGBC. LEED v4 Building Design and Construction. US Green Building Council, Washington D.C., USA. July 2019.
- USGBC. LEED v4.1 Operations & Maintenance: Getting started guide for Beta Participants. US Green Building Council, Washington D.C., USA. July 2019.

