



## Arc™ Testing: Instrumentation for the “Human Experience”

Arc™ is a digital platform the Green Business Certification Inc. (GBCI) launched through Arc Skoru Inc. in 2016<sup>1</sup>. To inspire efforts to sustain the built environment, the platform allows for any project to measure improvements and benchmark against itself or local projects. Arc allows an entry point for all buildings looking to earn US Green Building Council (USGBC) LEED certification and verify performance for existing certified buildings on an annual basis. Arc is a complement to LEED and other green building systems, acting as an interface. The LEED Dynamic Plaque can be considered the predecessor to Arc where a similar procedure was used. Arc intends to add other GBCI rating systems to the platform, such as GRESB, WELL, PEER, SITES, and Parksmart.



There are five categories that Arc uses to calculate a performance score out of 100, based on global data and action-oriented strategies. This gives valuable feedback to owners and building managers to make educated decisions to optimize the building for people, profit, and the environment. The five categories that are scored are energy, water, waste, transportation, and the human experience<sup>2</sup>. GrayWolf instrumentation can be applied to the measurement parameters of interest for the human experience category.

### Human Experience, Air Testing

For the human experience, total volatile organic compounds (TVOCs) and carbon dioxide (CO<sub>2</sub>) must be measured within every 12-month period and

within a representative location of a building (each 25,000 ft<sup>2</sup>, 2325 m<sup>2</sup>). TVOCs must be monitored in micrograms per cubic meter (µg/m<sup>3</sup>) and CO<sub>2</sub> in parts per million (ppm). There are three ways that measurements can be obtained, either by fixed sensors, portable sensors, or samples to be sent out to labs.

Providing data in all categories is not a requirement, but doing so will lead to a more accurate and comprehensive score. Participants can update the data more frequently than identified above. The performance score is as dynamic as the data it receives.

### TVOC Testing

TVOC levels must be below the LEED v4 BD+C not-to-exceed target concentration of 500 µg/m<sup>3</sup> (200 µg/m<sup>3</sup> for healthcare facilities). For TVOCs LEED references measurements following EPA TO-1, EPA TO-15, EPA TO-17, EPA Compendium Method IP-1, and/or ISO 16000-6, methods which all utilize air samples sent to a laboratory for analysis via gas chromatography and mass spectrometry (GCMS). However, these tests are time exhausting, and can be expensive. **Photoionization detectors (PIDs) are also an approved method for measuring TVOCs for Arc** (as they also are for the LEED Dynamic Plaque). When using a PID, the measurements must be taken within the breathing zone, between 3 and 6 ft (90 and 180 cm) above the floor. Three measurements at each sampling point are required at a minimum interval of 30 minutes apart. Unlike sending out samples for analysis this will yield immediate results. Note that not all PIDs are appropriate for IAQ air monitoring. Of the 6 PID sensors that GrayWolf offers, only two (both low range, and with good stability) would be recommended for the Arc application. Automated µg/m<sup>3</sup> compensation for altitude is available on some GrayWolf units. Frequent user cal of the PID sensors would also be prudent for this application. GrayWolf has calibration kits available to accommodate user cals and on-board software that hand-holds users through the cal process.

### Carbon Dioxide Testing

There are two ways to monitor CO<sub>2</sub>; one year of indoor levels for each location, or perform an indoor air quality audit. When performing the indoor air quality audit, the test must occur when the HVAC

<sup>1</sup> <http://www.usgbc.org/articles/arc-new-technology-venture-launched-facilitate-leed-certification-measure-performance-and-b>

<sup>2</sup> <http://arcskoru.com/>





system starts at the normal start time, and while delivering outdoor air at the minimum rate during normal occupied hours. All of these measurements must also be taken for a minimum of four hours within the breathing zone of 3 and 6 ft (90 and 180 cm) above the floor. There must be multiple CO<sub>2</sub> measurements taken during the 4-hour testing period, each with a minimum of 30-minute intervals.

For CO<sub>2</sub> concentrations<sup>3</sup> on US projects, LEED references ASHRAE Standard 62.1-2010 “or a local equivalent (whichever is more stringent)”. As per appendix C of ASHRAE 62.1, when steady state CO<sub>2</sub> concentrations remain about 700 ppm above outdoor concentrations the indicative minimum ventilation rate will typically lead to a satisfactory occupant experience. Outdoor CO<sub>2</sub> concentrations can vary, often higher in urban areas, but current worldwide averages are approximately 400 ppm<sup>4</sup>.

Projects outside the US may alternatively use CEN Standards EN 15251-2007 and EN13779-2007. EN 15251<sup>5</sup> has four different categories of CO<sub>2</sub> concentrations ranging from 350ppm (best) to >800 ppm above outdoor concentrations. EN13779-2007<sup>6</sup> also has four separate categories for CO<sub>2</sub> concentrations vs. the outdoor air values, ranging from <400 ppm to >1000 ppm higher.



**GrayWolf AdvancedSense® PRO meter and DirectSense® probe with installed CO<sub>2</sub> and TVOC (+ 4 optional) sensors.**

<sup>3</sup> <http://www.usgbc.org/credits/retail-new-construction/v4-draft/eqp>

<sup>4</sup> <http://www.esrl.noaa.gov/gmd/ccgg/trends/>

<sup>5</sup> EN 15251-2007: Indoor Environmental Input Parameters for Design and Assessment of Energy Performance of Buildings Addressing Indoor Air Quality, Thermal Environment Lighting and Acoustics. Annex B1, Table B4.

<sup>6</sup> EN 13779: Ventilation for non-residential buildings -Performance requirement for ventilation and room-conditioning systems. Table A10. April 2007.



***While easily portable, a tripod kit or secure monitoring case are available for trend logging in the “occupied zone”.***

Utilizing a GrayWolf meter with a non-dispersive infrared (NDIR) sensor for CO<sub>2</sub> and a low-range PID for TVOCs will satisfy the Arc requirements for testing. These sensors are specifically sourced by GrayWolf for indoor air quality (IAQ) and green building applications, delivering high accuracy, precision measurements. The sensors also exhibit rapid response which is important for quick checks of the local outdoor levels.

Arc states that for the indoor air survey there must be a narrative describing the procedures, dates, times and results from each test. GrayWolf excels in highly efficient documentation and reporting. There is the ability to create descriptive names for the data files (on-site), along with text notes for additional narrative, and even the ability to add photos/videos/audio along with the recorded data.

CO<sub>2</sub> and TVOC data can be shared through a spreadsheet, which can be found in the Data Input section of the [www.leedon.io](http://www.leedon.io) software and very easily populated from GrayWolf’s included WolfSense® PC software.

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