October 4, 2024
Technical White Paper

How smartIAQ™ Achieves IAQP Compliance

Audwin W. Cash
CEO, GPS Air
acash@gpsair.com

smart IAQ

Executive Overview

Accelerating awareness and adoption of the indoor air quality procedure (IAQP) is a focus for GPS Air. HVAC systems designed according to the IAQP deliver improved indoor air quality, lower initial costs (fast ROI), and reduced operating costs. ASHRAE continues to clarify the IAQP through revisions to the standards, User Manual support, and position documents on filtration and air cleaning.

This guidance addresses a common barrier to IAQP utilization by providing specific guidance, mitigating uncertainty and risk for engineers and building owners who have traditionally favored a ventilation-only approach. The message from ASHRAE is clear:

"The IAQP may allow for a more cost-effective solution to providing good air quality."

ASHRAE 62.1-2019 User's Manual

Another challenge to IAQP adoption is finding practical and cost-effective solutions that owners and engineers trust. The first Dedicated Clean Air System™, smartIAQ™, is a new standards-driven approach to make IAQP compliance simple and effective.

By leveraging the IAQP to balance outdoor airflow with efficient and reliable air cleaning, savings through outdoor airflow reduction of 30% to 60% can be achieved. This reduction allows for the downsizing of heating and cooling systems, resulting in lower project costs and reduced energy consumption by lowering conditioning loads.

Engineered to align with the latest ASHRAE standards and guidance, smartIAQ is designed to manage the design compounds specified in Standard 62.1 through advanced sensing and monitoring capabilities, enabling confident reduction in outdoor air requirements.

Indoor Air Quality Procedure (IAQP)

The IAQP is an engineered approach to achieving indoor air quality. Designs require contaminant source control, primarily air cleaners, operating in conjunction with outdoor air ventilation. ASHRAE Standard 62.1 has become increasingly prescriptive, enabling more confident adoption of the IAQP. The following table illustrates the progression of the IAQP from a designer-defined approach to a standardized methodology.

ASHRAE 62.1 §6.3 IAQP Requirements	-2016 and earlier	-2019 and later
Outdoor Air Quality Evaluation	**STANDARD** resource list	**STANDARD** via EPA website* + **CALCULATOR**
Design Compounds	Undefined	**STANDARD** Table 6-5 + **CALCULATOR**
Design Compound Limits	Undefined	**STANDARD** Table 6-5 + **CALCULATOR**
Define Generation Rates by Sources	Undefined	**STANDARD** + **CALCULATOR**
Mixtures of Compounds	Undefined	**STANDARD** Table 6-6 + **CALCULATOR**
Determine & Air Cleaner Efficiency	Manufacturer Claims	**STANDARD** Tests ASHRAE 145.2 and 52.2
Perform Mass Balance Calculation for O.A.	**STANDARD** Formula	**STANDARD** + **CALCULATOR**
Document Design	**STANDARD** §6.3.6	**STANDARD** §6.6
Evaluate Air Quality	Subjective Evaluation	**STANDARD** approach §7.3

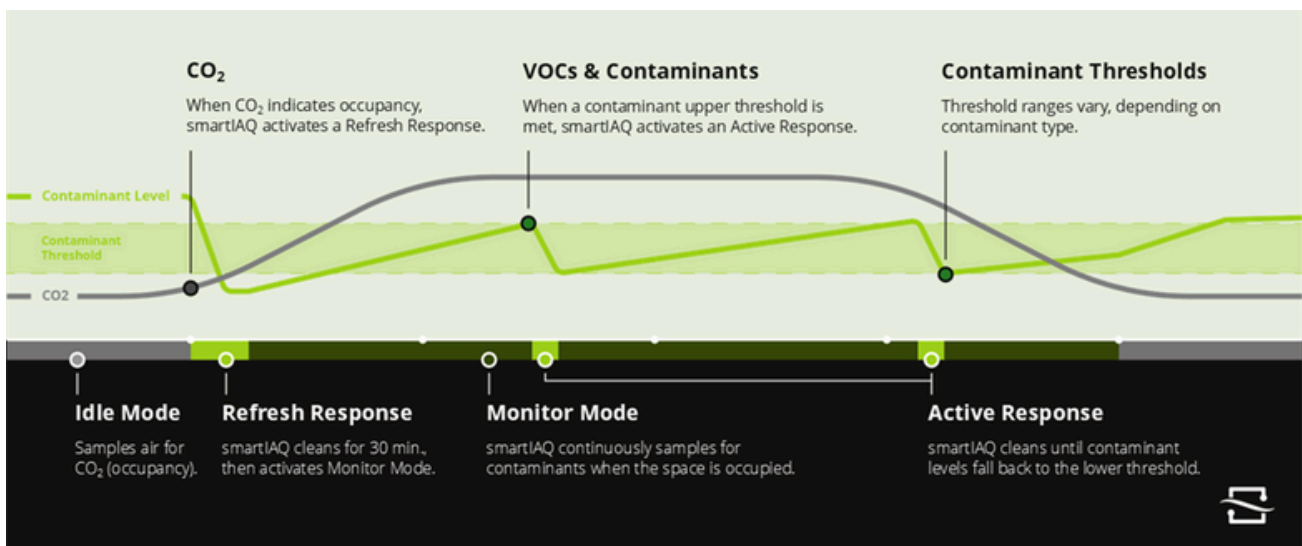* unique site conditions must be evaluated

The smartIAQ Calculator determines steady state design compound concentrations, compares concentrations to design limits, and evaluates compound mixtures per the standard. This process iterates quickly, allowing designers to select various outdoor airflow rates and air cleaner configurations. This shows the IAQP as a streamlined alternative to the ventilation rate procedure (VRP).

The IAQP may be used in nearly every 62.1 occupancy category. It is most compelling in spaces that have higher population densities like schools or highly variable populations like lecture halls, auditoriums, fitness centers, and religious facilities. ASHRAE supports using the IAQP in combination with the VRP so designers can be selective in the deployment of the technology for the best ROI. In these desirable applications, smartIAQ delivers compliant designs and lower first equipment cost due to outdoor air reduction.

smartIAQ Operation

smartIAQ removes design compounds from the breathing zone through an air cleaning cycle when a space is occupied. Occupancy is determined by the CO_2 concentration exceeding 500ppm. During an air cleaning cycle, the unit modulates airflow proportionally to compound intensity, initially increasing and subsequently decreasing as contaminant levels are reduced. Real-time monitoring is achieved through an array of solid-state sensors, including TVOC, formaldehyde, and CO_2 sensors. Once the compounds are within acceptable ranges, smartIAQ monitors air quality with a steady airflow of 50 cfm. This air cleaning cycle repeats as needed or every four hours when a space is occupied, whichever occurs first. During unoccupied periods, smartIAQ enters an idle mode where the unit remains powered, but the fan is inactive. The system performs periodic CO_2 level verifications every 30 minutes during idle. The following graphic summarizes these operating modes:

CO_2
When CO_2 indicates occupancy, smartIAQ activates a Refresh Response.

VOCs & Contaminants
When a contaminant upper threshold is met, smartIAQ activates an Active Response.

Contaminant Thresholds
Threshold ranges vary, depending on contaminant type.

Contaminant Level

Contaminant Threshold

CO2

Idle Mode
Samples air for CO_2 (occupancy).

Refresh Response
smartIAQ cleans for 30 min., then activates Monitor Mode.

Monitor Mode
smartIAQ continuously samples for contaminants when the space is occupied.

Active Response
smartIAQ cleans until contaminant levels fall back to the lower threshold.

smartIAQ operates independently of the HVAC system. It removes air from the space, cleans it, and returns clean air to the space. A simple schematic and mass balance equation for smartIAQ follows:
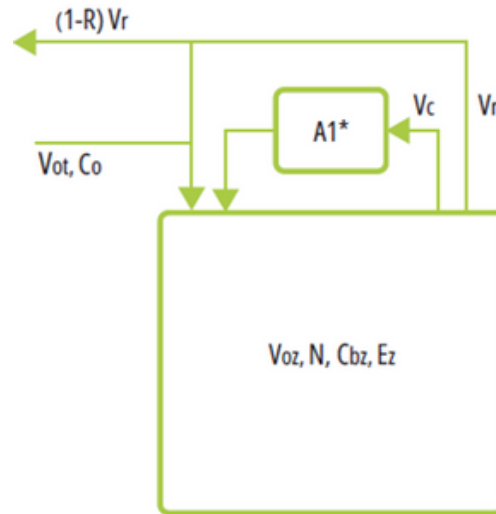
$$C_{bz} = \frac{N_i + E_z V_{oz} C_{oi}}{E_z \left(V_{oz} + V_c E_{fi} \right)}$$

where:

N = contaminant generation rate for contaminant i (ug/m³)

E = ventilation effectiveness from Table 6-4 (unitless)

V   = outdoor airflow rate (cfm)

C   = concentration of contaminant i in outdoor air (ug/m³)

V = volume of air cleaning capacity for the air cleaner (cfm)

E = filter effectiveness (removal value) for contaminant i (%)

The smartIAQ Calculator automates the work of mass balance calculation. This tool allows operators to select one or more smartIAQ units for larger spaces or divide a unit between two zones, applying half of the cleaning capacity to each room.

smartIAQ Validation and Standards

smartIAQ is validated under the latest standards and directives from ASHRAE on air cleaner effectiveness. Filter effectiveness is determined by Standard 52.2 Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size and Standard 145.2 Laboratory Test Method for Assessing the Performance of Gas-Phase Air-Cleaning Systems: Air Cleaning Devices. smartIAQ is tested safe under ASHRAE standard 241 Appendix A. Electrical safety is validated by UL 867.

smartIAQ for IAQ and Standard 241

While primarily designed for IAQP projects, smartIAQ demonstrates exceptional versatility as a standalone air cleaner with integrated MERV14 filter and gas phase removal with the long-life molecular filter. In spaces with concentrations of TVOCs, formaldehyde, particles, etc. smartIAQ will operate as an air cleaner for general IAQ.
The unit's software allows for customized configuration to manage specific contaminants continuously, via control input, or through sensor threshold activation.

For applications seeking ASHRAE standard 241 compliance, smartIAQ is configured with a MERV14 filter, which has a removal value (εPR of 88%) under the standard. Higher rated filters are available as well. In Standard 241 applications it may make sense to operate the unit at 100% capacity when a space is occupied, which is supported through software when ordering the equipment. Therefore, with a MERV14 filter operating under a Standard 241 Infectious Risk Management Mode smartIAQ will deliver a minimum VACS of 440cfm.

Using Third Party Filters

smartIAQ supports any filter 12" x 24" (h x w). Filter depths range between 1" to 4" each. smartIAQ holds up to 6" of total filter width. Owners may select their own filters for sites where the filter ratings will meet the required removal values. In specialty applications, like healthcare laboratories where treating formaldehyde is the focus, dedicated formaldehyde filters can be used for extended operation.

Conclusion

smartIAQ simplifies IAQP implementation through its standards-based design and on-demand control. The system's low maintenance requirements, simple BMS integration, and filter flexibility make it adaptable to various facility needs. The smartIAQ Calculator streamlines IAQP design, revealing ROI and savings compared to VRP. ASHRAE's standardization and the on-demand innovation of smartIAQ usher in a new era of ventilation procedures, where the growing demand for efficiency and cost-effectiveness drives increased IAQP awareness while delivering superior indoor air quality.

Appendix

The smartIAQ calculator provides system sizing and ROI information for most locations in North America. The following are references to indicate the means of first cost and energy savings.

Equipment & Operating Cost with smartIAQ

Three different scenarios are modeled for outdoor airflow demands when following the VRP. The IAQP assumes a 500cfm air cleaner with 145.2 and 52.2 removal values that average 50% on ASHRAE listed design compounds. The VRP-IAQP airflow savings are translated into HVAC tonnage reduction assuming the project is in Atlanta with a summer design day enthalpy of 40. For example, in a classroom at $2,000 per HVAC ton the project would save $6,000 per classroom in equipment savings.

Outdoor Air (O.A.) Savings

Space Type	Area (ft²)	Pop.	Ez	Outdoor Airflow (cfm) VRP	Outdoor Airflow (cfm) IAQP	O.A. Savings (VRP-IAQP)
Classroom	950	24	0.8	439	125	314 cfm
Lecture Hall	2,000	300	0.8	2,900	1,500	1,400 cfm
Office	5,000	50	0.8	650	200	450 cfm

Operating Cost Savings Model

The preceding scenarios were extended to consider the energy savings available through reduced outdoor air flow. The annual modeled energy per cfm of outdoor air conditioning for Atlanta is 10kWh per cfm.

Equipment Savings

Space Type	Tonnage for O.A. Alone		Tons Avoided	Equipment Savings*	Energy Savings**
	VRP	IAQP			
Classroom	3.0	1.0	2.0	**$4,000**	$600
Lecture Hall	18.0	9.0	9.0	**$18,000**	$2,000
Office	4.0	1.5	2.5	**$5,000**	$850

* Assumes $2,000 per ton of HVAC equipment, does not consider "exotic" equipment or installation costs

** Assumes $0.15/kWh and annual cooling and heating load for the incremental cfm under the V.R.P. and typical space occupancy