smartIAQ™

GPS AIR WHITE PAPER

# smartIAQ® Compliance to Standard 62.1
# The Indoor Air Quality Procedure (IAQP)

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## IAQP Trajectory

ASHRAE defines structure for the Indoor Air Quality Procedure (IAQP) in Standard 62.1. Since 2019, the standard, supported by position papers, Guideline 42, the User's Manual, and a society-published calculator address the open-ended aspects of earlier releases of the IAQP. This in turn reduces the risk for error when designing compliant ventilation systems. Now, the IAQP is prescriptive like the more common ventilation rate procedure. The goal is to increase adoption of the IAQP because spaces with IAQP designs are more sustainable and may offer a significant return on investment (ROI).

> **"The IAQP may allow for a more cost-effective solution to providing good air quality."** ASHRAE 62.1-2019 User's Manual

The IAQP is an engineered approach to ventilation design that achieves healthy indoor air through contaminant source control, active air cleaning, and outdoor airflow. Compliant systems identify design compounds (contaminants), generation rates for these compounds, concentration limits, air cleaner rating, and outdoor airflow required. Project-specific inputs in an IAQP calculator like the smartIAQ Calculator or the ASHRAE IAQP spreadsheet (D-86925) make system configuration very efficient.

Insights on the IAQP:

- Applied to reduce outdoor air, saving money and lowering moisture in a ventilation system
- Saves energy because less outdoor needs to be conditioned, also requiring smaller HVAC systems
- Provides the best ROI in spaces with more than 20 people per 1,000 ft$^2$
- Ventilation system designs within a building may combine IAQP, VRP, or Natural Ventilation

## IAQP Economic Benefit

IAQP designs unlock equipment savings up front and lower operating cost because lower outdoor airflow lowers equipment conditioning load. Despite these benefits and ASHRAE support, the leading reasons for low adoption have been: a perception of more risk, more work, and lower air quality. This is likely based on outdated information. In reality, there is less risk, a consistent workflow, and verifiable results when applying the IAQP with smartIAQ®.

## Confidently Deploying the IAQP

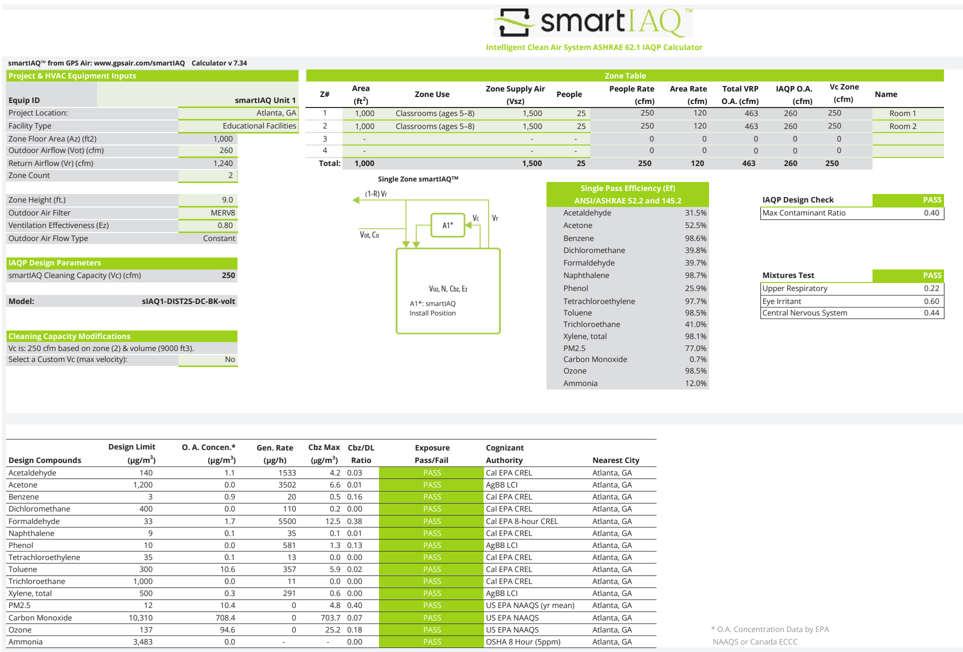
Early versions of the IAQP were open to interpretation and risky for some designers. Following the -2019 version of Standard 62.1, the IAQP is now highly precise. The table below summarizes the impact of recent developments and references to the content. With these changes, updated IAQP guidance is driving adoption of the approach.

**ASHRAE 62.1 §6.3**

| **IAQP Requirements** | **-2016 and earlier** | **-2019 and later** |
|---|---|---|
| Design Compound List | Undefined | **Standard 62.1** Table 6-5 |
| Design Compound Limits | Undefined | **Standard 62.1** Table 6-5 |
| Design Compound Generation Rates | Undefined | **ASHRAE** D-86925 **Calculator** |
| Mixtures of Compounds | Undefined | **Standard 62.1** Table 6-6 |
| Air Cleaner Efficiency | Manufacturer Claims | **Standard 62.1** Standards 145.2 & 52.2 |
| Mass Balance Calculation | **Standard 62.1** Appendix E | **Standard 62.1** Appendix F |
| Document Design | **Standard 62.1** §6.3.6 | **Standard 62.1** §6.6 |
| Evaluate Air Quality | Manufacturer Claims | **Standard 62.1** §7.3 |

# Design

Selecting the IAQP for the ventilation design requires an engineer to configure the system using a calculator to determine the zone outdoor airflow and air cleaner configuration. The smartIAQ® IAQP calculator applies ASHRAE requirements and generation rates with mass balance analysis for smartIAQ. Because it uses the same algorithm as the ASHRAE calculator, the smartIAQ calculator will deliver matching results to the ASHRAE tool. Calculator interface shown below.




| Project & HVAC Equipment Inputs | |
|---|---|
| Equip ID | smartIAQ Unit 1 |
| Project Location: | Atlanta, GA |
| Facility Type | Educational Facilities |
| Zone Floor Area (Az) (ft2) | 1,000 |
| Outdoor Airflow (Vot) (cfm) | 260 |
| Return Airflow (Vr) (cfm) | 1,240 |
| Zone Count | 2 |
| Zone Height (ft.) | 9.0 |
| Outdoor Air Filter | MERV8 |
| Ventilation Effectiveness (Ez) | 0.80 |
| Outdoor Air Flow Type | Constant |

| IAQP Design Parameters | |
|---|---|
| smartIAQ Cleaning Capacity (Vc) (cfm) | **250** |
| **Model:** | **sIAQ1-DIST2S-DC-BK-volt** |

| Cleaning Capacity Modifications | |
|---|---|
| Vc is: 250 cfm based on zone (2) & volume (9000 ft3). | |
| Select a Custom Vc (max velocity): | No |

Zone Table

| Z# | Area (ft²) | Zone Use | Zone Supply Air (Vsz) | People | People Rate (cfm) | Area Rate (cfm) | Total VRP O.A. (cfm) | IAQP O.A. (cfm) | Vc Zone (cfm) | Name |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1,000 | Classrooms (ages 5–8) | 1,500 | 25 | 250 | 120 | 463 | 260 | 250 | Room 1 |
| 2 | 1,000 | Classrooms (ages 5–8) | 1,500 | 25 | 250 | 120 | 463 | 260 | 250 | Room 2 |
| 3 | - | | - | - | 0 | 0 | 0 | 0 | 0 | |
| 4 | - | | - | - | 0 | 0 | 0 | 0 | 0 | |
| **Total:** | **1,000** | | **1,500** | **25** | **250** | **120** | **463** | **260** | **250** | |

| Single Pass Efficiency (Ef) ANSI/ASHRAE 52.2 and 145.2 | |
|---|---|
| Acetaldehyde | 31.5% |
| Acetone | 52.5% |
| Benzene | 98.6% |
| Dichloromethane | 39.8% |
| Formaldehyde | 39.7% |
| Naphthalene | 98.7% |
| Phenol | 25.9% |
| Tetrachloroethylene | 97.7% |
| Toluene | 98.5% |
| Trichloroethane | 41.0% |
| Xylene, total | 98.1% |
| PM2.5 | 77.0% |
| Carbon Monoxide | 0.7% |
| Ozone | 98.5% |
| Ammonia | 12.0% |

| IAQP Design Check | PASS |
|---|---|
| Max Contaminant Ratio | 0.40 |

| Mixtures Test | PASS |
|---|---|
| Upper Respiratory | 0.22 |
| Eye Irritant | 0.60 |
| Central Nervous System | 0.44 |

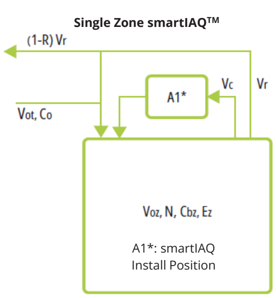
| Design Compounds | Design Limit (μg/m³) | O. A. Concen.* (μg/m³) | Gen. Rate (μg/h) | Cbz Max (μg/m³) | Cbz/DL Ratio | Exposure Pass/Fail | Cognizant Authority | Nearest City |
|---|---|---|---|---|---|---|---|---|
| Acetaldehyde | 140 | 1.1 | 1533 | 4.2 | 0.03 | PASS | Cal EPA CREL | Atlanta, GA |
| Acetone | 1,200 | 0.0 | 3502 | 6.6 | 0.01 | PASS | AgBB LCI | Atlanta, GA |
| Benzene | 3 | 0.9 | 20 | 0.5 | 0.16 | PASS | Cal EPA CREL | Atlanta, GA |
| Dichloromethane | 400 | 0.0 | 110 | 0.2 | 0.00 | PASS | Cal EPA CREL | Atlanta, GA |
| Formaldehyde | 33 | 1.7 | 5500 | 12.5 | 0.38 | PASS | Cal EPA 8-hour CREL | Atlanta, GA |
| Naphthalene | 9 | 0.1 | 35 | 0.1 | 0.01 | PASS | Cal EPA CREL | Atlanta, GA |
| Phenol | 10 | 0.0 | 581 | 1.3 | 0.13 | PASS | AgBB LCI | Atlanta, GA |
| Tetrachloroethylene | 35 | 0.1 | 13 | 0.0 | 0.00 | PASS | Cal EPA CREL | Atlanta, GA |
| Toluene | 300 | 10.6 | 357 | 5.9 | 0.02 | PASS | Cal EPA CREL | Atlanta, GA |
| Trichloroethane | 1,000 | 0.0 | 11 | 0.0 | 0.00 | PASS | Cal EPA CREL | Atlanta, GA |
| Xylene, total | 500 | 0.3 | 291 | 0.6 | 0.00 | PASS | AgBB LCI | Atlanta, GA |
| PM2.5 | 12 | 10.4 | 0 | 4.8 | 0.40 | PASS | US EPA NAAQS (yr mean) | Atlanta, GA |
| Carbon Monoxide | 10,310 | 708.4 | 0 | 703.7 | 0.07 | PASS | US EPA NAAQS | Atlanta, GA |
| Ozone | 137 | 94.6 | 0 | 25.2 | 0.18 | PASS | US EPA NAAQS | Atlanta, GA |
| Ammonia | 3,483 | 0.0 | - | - | 0.00 | PASS | OSHA 8 Hour (5ppm) | Atlanta, GA |

* O.A. Concentration Data by EPA NAAQS or Canada ECCC

# IAQP Calculation

Evaluating concentrations of contaminants, to determine if a design will pass requires selecting outdoor air contaminant concentration, generation rates from occupants, materials, activities, and the air cleaning capacity of the air cleaner. The algorithm for this is iterative, evaluating one contaminant at a time via a mass balance calculation. There are two calculations within the smartIAQ calculator, one for distributed units (standalone air cleaning for 1 to 4 zones) and the other for centralized units where smartIAQ cleans a portion of the HVAC system return airflow. The equation is the same for both.

## Mass Balance Calculation - Distributed




$$C_{bz} = \frac{N + E_z V_{oz} C_o}{E_z (V_{oz} + V_c E_f)}$$

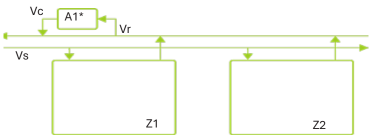
Note: convert all cfm values to m³/h to calculate $C_{bz}$ in μg/m³

where

- $C_{bz}$ concentration of a contaminant (μg/m³)
- N contaminant generation rate (μg/h)
- $E_z$ ventilation effectiveness (unitless)
- $V_{oz}$ outdoor airflow rate (cfm)
- $C_o$ contaminant concentration in outdoor air (μg/m³)
- Vc volume of air cleaning (cfm)
- Ef filter efficiency of the air cleaner for the contaminant

# IAQP Calculation (continued)

### Mass Balance Calculation - Centralized




$$C_{bz} = \frac{N + E_z V_{oz} C_o}{E_z (V_{oz} + V_c E_f)}$$

Notes: $V_c$ must exceed supply system return air as entered. Zones share outdoor airflow and cleaned airflow. Zone concentrations are determined independently (calculator does this).

where

- $C_{bz}$ concentration of a contaminant (µg/m³)
- N contaminant generation rate (µg/h)
- $E_z$ ventilation effectiveness (unitless)
- $V_{oz}$ outdoor airflow rate (cfm)
- $C_o$ contaminant concentration in outdoor air (µg/m³)
- Vc volume of air cleaning (cfm)
- Ef filter efficiency of the air cleaner for the contaminant

# Air Cleaner Ratings

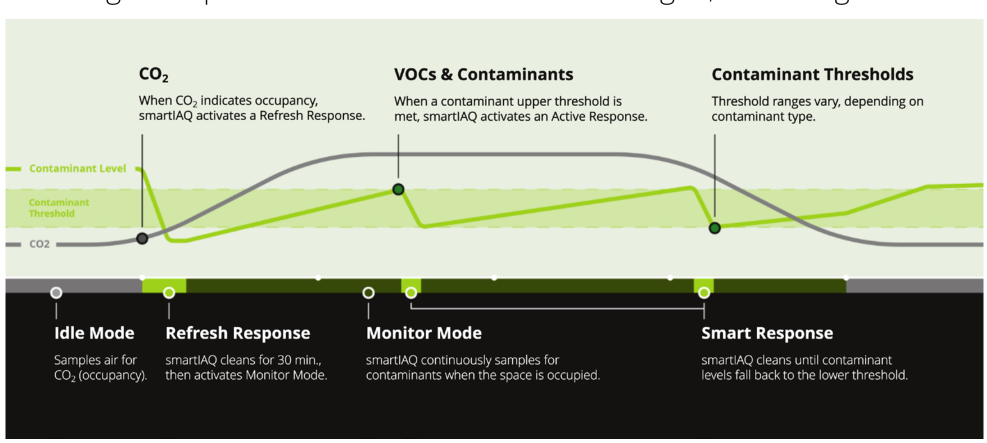
smartIAQ® cleans air with Standard 52.2 (particle) and 145.2 (gas phase) rated filtration. Therefore, smartIAQ meets the requirements for air cleaner under all versions of Standard 62.1, the most stringent being 62.1-2022 Addendum N.

# Documentation

Plan inspectors require documentation justifying selected outdoor airflow rates. Screen captures of the calculator output applied to mechanical drawings (outdoor airflow, air cleaner configuration, contaminant test, contaminant mixtures analysis, and outdoor air quality analysis) are typically sufficient evidence.

# smartIAQ® Operation

smartIAQ continuously monitors air quality, confirming the IAQP ventilation design achieves the calculated result. This on-demand approach confirms air quality, achieves long filter life, and minimizes sound levels. smartIAQ also reports when design compound thresholds cannot be managed; indicating a need for filter service and/or an acute air quality concern. Monitoring and feedback go beyond what is required in the standard to increase confident adoption of the IAQP. As the graphic demonstrates, smartIAQ activates when a space is occupied and modulates cleaning as needed, returning to an idle state once a space is unoccupied.




$CO_2$ is used to determine space occupancy, thereby aligning cleaning to times when people are present.

## Third Party Filters & Maintenance

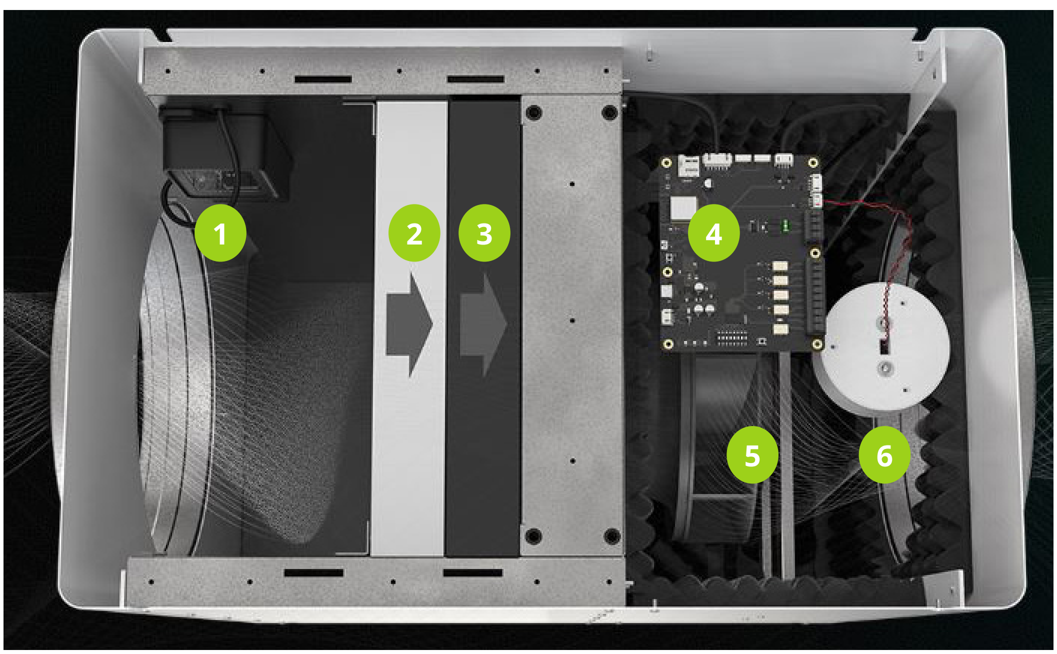
smartIAQ® ships with filters selected for the application for which it is configured. The filters are industry standard size and may be replaced by third party filters. However, if end-users select non-GPS Air filters, they bear responsibility to select filters that have gas-phase contaminant and particle removal values that are appropriate for their application. If after hours of operation, filters are unable to satisfy contaminant thresholds, smartIAQ will provide an alert.

## Building Codes & IAQP Allowance

Most state mechanical codes support the use of the IAQP. Section 403.2 of most state codes (and the IMC) allows a registered design professional to specify a ventilation system with reduced outdoor airflow rate (compared to the VRP). Most state codes do not define the alternative ventilation system as the IAQP. However, the de facto approach is to follow the IAQP. The logic is as follows: since the VRP is the basis for IMC Section 403.3 (Mechanical Ventilation), then the allowed alternative ventilation design would be the IAQP from the same ASHRAE Standard 62.1. Therefore the state code allows application of the IAQP, and it is the most documented and association-supported approach.

## Conclusion

smartIAQ simplifies IAQP implementation through its standards-based approach and standards-driven design tools. The system's low maintenance and closed-loop air quality management brings increased confidence to applying the IAQP standard. With the standard becoming more prescriptive and evaluation criteria more specific, smartIAQ and the enhanced IAQP is a low risk approach to indoor air quality. It is easier than ever to apply the IAQP and achieve up front savings and ongoing operating savings.




Cross section of smartIAQ. From left to right: (1) air quality processor, (2) particle filter, (3) molecular filter, (4) smartIAQ Controller, (5) ECM-backward-curve blower, (6) NPBI® module