CASPR WHITE PAPER

The Strategic Advantage of IAQP: Safety, Sustainability, and Cost Efficiency in Modern HVAC Design

A Technical White Paper by Brett Duffy

1. EXECUTIVE SUMMARY

Historically, the HVAC industry has relied on the Ventilation Rate Procedure (VRP) to achieve acceptable indoor air quality. However, as energy costs soar and sustainability mandates tighten, VRP's prescriptive "dilution via outside air" approach has become an economic and environmental liability. The Indoor Air Quality Procedure (IAQP), as outlined in ASHRAE Standard 62.1, offers a performance-based alternative. By combining rigorous mass-balance safety standards with advanced air-cleaning technologies like CASPR, designers can significantly reduce outdoor air intake. This shift not only guarantees superior air quality through direct contaminant control but also drives dramatic improvements in energy efficiency, sustainability, and overall lifecycle costs. The recent 2025 ASHRAE updates further enforce the need for active management, making IAQP the most robust choice for modern facilities.

2. THE REGULATORY & SAFETY FRAMEWORK: MOVING BEYOND VRP

The fundamental flaw of the VRP is that it operates as a proxy. It assumes that by introducing a calculated volume of outdoor air, indoor contaminants will be sufficiently diluted to meet safety standards. It does not actively measure or control specific pollutants, nor does it account for outdoor air that may be contaminated (e.g., by smog or wildfires).

The IAQP shifts the paradigm from assumed safety to proven performance:

- **Direct Contaminant Control:** IAQP mandates the active control of known harmful Design Compounds (DCs) such as Formaldehyde, Benzene, and Toluene, as well as particulate matter (PM2.5), below strict limits defined by cognizant authorities like CARB, EPA, and OEHHA.
- **Mathematical Rigor:** Safety is verified through steady-state or dynamic mass-balance equations. Designers must account for indoor emission rates, outdoor concentrations, and the air-cleaning removal efficiency of the selected technology. Utilizing a "Location B" air cleaning approach (treating mixed/supply air) ensures both outdoor and recirculated air are filtered before reaching the breathing zone.
- **2025 ASHRAE Refinements:** The 2025 standard updates mandate the use of End-of-Useful-Life (EEOL) filter efficiency rather than initial efficiency specifically when

calculating the mass-balance removal efficiency for formaldehyde, ensuring safety does not degrade over time. It also introduces new emergency control modes: the Infection Risk Management Mode (IRMM) to mitigate infectious aerosols, and the Outdoor Pollution Mode, which addresses outdoor pollution spikes by allowing Economizer Shutdown and reducing reliance on outdoor air dilution. Additionally, it lowers the PM2.5 threshold to 9.0 $\mu g/m^3$ based on the latest EPA guidance.

Note: While these changes have been published by ASHRAE, as of the writing of this paper, they have not been incorporated into building code requirements.

3. POST-CONSTRUCTION VERIFICATION & SUBJECTIVE EVALUATION

Unlike VRP, which relies purely on design-phase calculations, IAQP requires physical, post-construction verification in the completed space.

- **Objective Evaluation:** Designers must perform physical measurements of design compounds and PM2.5 in the completed building to verify that design limits are met. The measurement equipment must be positioned in the breathing zone while the HVAC system is in normal operation and at the lowest outdoor air intake setting expected during the year. The number of measurement points scales based on the total occupied floor area, such as requiring 6 measurement points for spaces over 100,000 sq ft.
- **Subjective Evaluation:** A subjective occupant survey must be conducted in the completed building to demonstrate an acceptability level of 80% or more within each zone served by the system.
    - *Note: While the VRP does not specifically require this survey, the definition of acceptable indoor air quality within the standard points out this 80% threshold as the metric for the entire standard. Engineers should be aware that this can be interpreted by some to mean it should be verified as true no matter which calculation method you use.*
- **2025 Standard Update:** The Operations and Maintenance section of the 2025 version introduces a requirement for a root cause analysis connected to the objective evaluation. Specifically, if any objective design limit (DL) is exceeded during verification, a root cause analysis must be performed to determine if flow rates need adjustment or if air-cleaning equipment needs repair or replacement.

4. THE SUSTAINABILITY AND ENERGY IMPERATIVE

Conditioning outside air—heating it in the winter, cooling and dehumidifying it in the summer—is typically the single largest energy load in a commercial HVAC system. By relying purely on dilution, VRP inherently inflates a building's carbon footprint.

IAQP provides a highly sustainable alternative by treating and recirculating indoor air, drastically lowering the burden on the HVAC plant.

- By implementing effective active air disinfection, the reliance on massive volumes of outdoor air is fundamentally reduced.
- Applying CASPR technology qualifies the system for IAQP calculation with typical outside air reductions of 40-60% compared to VRP calculations.

This significant reduction in outdoor air intake directly translates to lower utility consumption, allowing facilities to easily meet aggressive ESG targets and strict local energy codes.

5. THE ECONOMIC CASE: CAPITAL AND OPERATIONAL EFFICIENCY

The financial advantages of transitioning from VRP to IAQP are realized in both initial capital expenditures (CapEx) and ongoing operating expenses (OpEx).

- **CapEx Reductions:** Because IAQP reduces the total volume of outside air that must be conditioned, engineers can safely downsize primary HVAC equipment. Smaller chillers, boilers, and air handling units lead to immediate, substantial savings during the construction phase.
- **OpEx Savings:** The 40-60% reduction in outdoor air translates directly into year-over-year utility savings, heavily offsetting the cost of any added air-purification equipment.
- **Low Implementation Cost:** Integrating advanced active technology is highly economical; typical MSRP for CASPR implementation is between $0.10-0.20/CFM and $0.15-0.25/SqFt.

6. ENABLING IAQP WITH CASPR TECHNOLOGY

To successfully execute an IAQP design, engineers require reliable, proven air-cleaning technologies capable of neutralizing the mandated Design Compounds. CASPR Medik units deliver this capability efficiently and safely.

- **Technology Snapshot:** The energy from the CASPR unit's bulb interacts with a proprietary cell coating to create a photocatalytic reaction. This converts oxygen and water molecules in the air into hydrogen peroxide (H_2O_2) molecules. These gas molecules expand to fill the space beyond the airstream, eliminating pathogens and VOCs in every corner.
- **Safety:** This gaseous form of Hydrogen peroxide exists at extremely safe levels of 0.01-0.04 ppm (well below the OSHA safety limit of 1 ppm/8 hrs) and is safe for use in all occupied spaces. CASPR is designed to run 24/7 providing continuous protection and is certified to CARB/UL2998 ozone standards and UL safety standards.

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- **Proven Performance:** CASPR passed all safety tests associated with ASHRAE 241. Third-party lab testing shows a 90%+ reduction in Formaldehyde. Furthermore, large chamber testing demonstrated a 99%+ net reduction of MS2 surrogate within 60 minutes.
- **Unit Sizing & Coverage:** Selection is straightforward based on CFM and square footage. The Medik 14 (M14) handles up to 13,750 CFM (11,000 SqFt), the Medik 9 (M9) covers 7,150 CFM (5,720 SqFt), and the Medik 6 (M6) handles 4,950 CFM (3,960 SqFt). Multiple units can be dispersed for higher capacity systems.
- **Installation & Maintenance:** Units are installed post-fan on the supply side, requiring an air velocity of 100-900 ft/min. Maintenance is minimal, requiring an 18-month bulb replacement and a 3-year bulb and cell replacement.

CONCLUSION

Transitioning to the Indoor Air Quality Procedure (IAQP) is no longer just an alternative path; it is the optimal engineering strategy for modern facilities. By shifting away from the energy-heavy VRP dilution method and utilizing active air treatment, engineers can deliver buildings that are quantifiably safer, environmentally responsible, and highly cost-effective. Integrating CASPR technology provides the necessary contaminant reduction and safety certifications to make IAQP compliance seamless, ensuring both operational excellence and occupant well-being.