Ventilation for Acceptable Indoor Air Quality Part 1 - Dilution Ventilation and IAQ

David S. Dougan, President



Loris, South Carolina





Indoor Air Quality Affects ...





Steps to Acceptable IAQ







Understand Contaminants of Concern

Building Generated	Biological	Outdoor Generated	Occupant Generated
VOCs	Within Building Envelope	Via HVAC System	Body Odor
Other Chemicals	🔲 In Intake Plenums	Through Doors	Airborne Pathogens
	In Supply Air Plenums	Across Building Envelope	
	Airborne Pathogens		





Maintain Contaminants Below Threshold Levels

No Outdoor Air Dilution or Targeted High Level Filtration





Maintain Contaminants Below Threshold Levels OA Dilution Ventilation





Maintain Contaminants Below Threshold Levels

OA Dilution with Targeted High Level Filtration





Standards, Codes and Rating Systems ALL Require that Outdoor Air Ventilation Rates be Maintained for Compliance!







Our energy standard, ASHRAE 90.1, references ASHRAE 62.1 but often is conflicts with higher ventilation rates for occupant well-being





ASHRAE Standard 62.1-2019

Section 6 - Procedures (includes proposed addendum aa [2020] to IAQP)

6.1.1 Ventilation Rate Procedure. The prescriptive design procedure presented in Section 6.2, in which <u>outdoor air intake rates</u> are determined based on space type/application, occupancy level, and floor area, shall be permitted to be used for any zone or system.

6.1.2 IAQ Procedure. The IAQ Procedure (IAQP) is an alternate ventilation procedure that shall determine the necessary rate of <u>outdoor air flow</u> to maintain concentrations of Design Compounds (DCs) and PM2.5 in the indoor environment at concentrations less than Design Targets, based on indoor and outdoor sources, air cleaning and other variables. Indoor concentrations and outdoor air requirements shall be calculated with mass balance equations. Verification of satisfaction shall be performed after the building is completed and occupied.





IMC-2018 Section 403 – Mechanical Ventilation

403.2 Outdoor air required. The minimum outdoor airflow rate shall be determined in accordance with Section 403.3.

Comment: Section 403.3 is a strict interpretation of ASHRAE 62.1 Ventilation Rate Procedure (not the IAQ Procedure).





ASHRAE Standard 62.1-2019 Section 5 - Systems and Equipment (approved addendum q)

5.1.1.1 Designing for Varying Loads and Operating Conditions. [¬] he ventilation air distribution system for VAV <u>and multispeed CV</u> applications shall be provided with means to adjust the system to achieve at least the minimum ventilation airflow as required by Section 6 under any load condition or dynamic reset condition.

Comment: Some type of active control of outdoor air ventilation rates is required for most systems.





ASHRAE Standard 62.1-2019 Section 5 - Systems and Equipment (approved addendum q)

5.3.1 Il systems shall be provided with manual or automatic controls to maintain not less than the outdoor air intake flow (V_{ot}) required by Section 6 under all load conditions or dynamic reset conditions.

5.3.2 Systems with fans supplying variable primary air (V_{ps}) , shall be provided with any combination of control equipment, methods, or devices to maintain no less than the outdoor air intake flow (V_{ot}) required for compliance with Section 5.3.1.

Comment: This applies to air handling units and fan coils, including DOAS to fan systems and/or fan coils.





ASHRAE Standard 90.1-2019 Section 6 - HVAC

6.5.3.2.1 Supply Fan Airflow Control

Each cooling system listed in Table 6.5.3.2.1 shall be designed to vary the supply fan airflow as a function of load and shall comply with the following requirements:

- a. DX and chilled-water cooling units that control the capacity of the mechanical cooling directly based on space temperature shall have a minimum of two stages of fan control.
- b. All other units, including DX cooling units and chilled-water units that control the space temperature by modulating the airflow to the space, shall have modulating fan control.

Comment: Standard 90.1 requires that most fan systems are VAV or multispeed.



IMC-2018 Section 405 - Systems Control

405.1 General. Mechanical ventilation systems shall be provided with manual or automatic controls that will operate such systems whenever the spaces are occupied. Air-conditioning systems that supply required ventilation air shall be provided with controls designed to automatically maintain the required outdoor air supply rate during occupancy.

403.3.1.4 Variable air volume system control. Variable air volume air distribution systems, other than those designed to supply only 100-percent outdoor air, shall be provided with controls to regulate the flow of outdoor air. Such control system shall be designed to maintain the flow rate of outdoor air at a rate of not less than that required by Section 403. 3 over the entire range of supply air operating rates.



Measurement for the control of fresh air intake

The Standard 62-1989 recommendations for measuring and documenting outdoor air intake flow are discussed

By David W. Solberg, P.E., David S. Dougan and Leonard A. Damiano Member ASHRAE

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Fixed Minimum Position Intake Damper

Intake Flow and Mixed Air Plenum Pressure Variations on Multi-speed Fan Systems







Fixed Minimum Position Intake Damper





Wind Pressure Variations Additional motivation to control all outdoor air intakes!

Wind Pressure on Intake System





Wind Effect















Stack Pressure Variations





Intake Airflow Variations

Additional motivation to control all outdoor air intakes!





Damper Hysteresis





Factors that Influence Intake Flow Rates





Case for Outside Airflow Measurement



Uncontrolled OA Intake Uncertainty





The Logical Conclusion ...



On ALL OA Intakes





Thank You!

Questions? More information?

Contact Technical Air Systems, Inc. NY/NJ EBTRON Representative <u>pscheele@technicalair.com</u> NY: 212-946-4935 NJ:973-285-0333



