Outside Air Intake Flow Control

Designing for ASHRAE 62.1-2004, LEED and Risk Management

David S. Dougan, President, *EBTRON*, Inc. Updated February 2007

INTRODUCTION

Changes in LEED guidelines and ASHRAE Standard 62 have reinforced the concept of direct monitoring of outside air intake flow rates for continuous control. Unfortunately, recent trade journal publications are full of misconceived and misguided information for the consulting engineer, which often trivializes the importance of direct outside air flow monitoring and control. The following sheds some light on the proper control of outside air intake flow rates for both non-densely and densely occupied spaces.

LEED 2.2

LEED 2.2 NC now states,

> EQ Credit 1: Outdoor Air Delivery Monitoring
> 1 Point
>
> FOR MECHANICALLY VENTILATED SPACES
> - Monitor carbon dioxide concentrations within all densely occupied spaces (those with a design occupant density greater than or equal to 25 people per 1000 sq.ft.). CO_2 monitoring locations shall be between 3 feet and 6 feet above the floor.
> - For each mechanical ventilation system serving non-densely occupied spaces, provide a direct outdoor airflow measurement device capable of measuring the minimum outdoor airflow rate with an accuracy of plus or minus 15% of the design minimum outdoor air rate, as defined by ASHRAE 62.1-2004.

which limits the application of CO_2DCV to high occupant density spaces and offers a credit for the direct measurement and control of intake flow rates in accordance with ASHRAE 62.1-2004. Similar commentary is made in LEED EB and CS.

ASHRAE 62.1-2004

ASHRAE 62.1-2004 now specifies ventilation rates based on both floor area and occupancy. In the past, the ventilation rates were based solely on occupancy. As a result, both the ventilation rate per person and the corresponding CO_2 setpoint vary with occupancy and are problematic for traditional CO_2DCV control. An example is shown in the table below for a variable population in an area of 1,000 sq.ft.

# People	Total OA CFM 2001 (20 CFM/person)	Ci-Co Setpoint 2001	Total OA CFM 2004	CFM/person 2004	Ci-Co Setpoint 2004
7	140	517 ppm	95	13.5	807 ppm
5	100	517 ppm	85	17	644 ppm
3	60	517 ppm	75	25	438 ppm

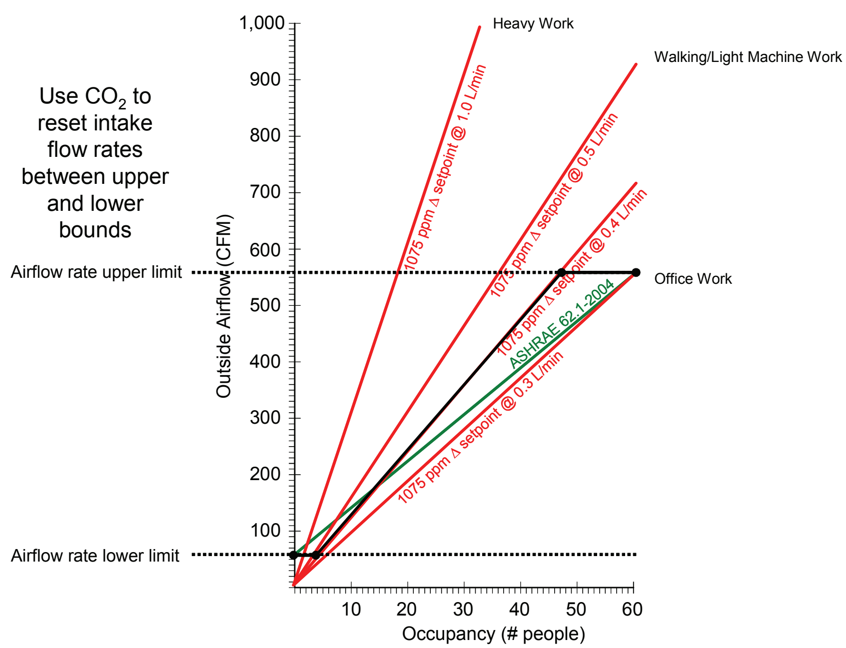
Using a traditional CO_2 setpoint of 517 ppm above outdoor (917 ppm indoor with an assumed OA CO_2 level of 400 ppm) could potentially comply with ASHRAE 62-2001 for office spaces (disregarding assumptions on activity levels, outdoor air CO_2 levels and sensor error, which are signficant). However, a fixed CO_2DCV will over ventilate at high population levels and under ventilate at low population levels under the guidelines of ASHRAE 62.1-2004, a prerequisite for LEED 2.2 compliance on non-densely populated spaces. In addition, the airflow reduction benefit is less substantial in ASHRAE 62.1-2004 as evidenced in the columns comparing the total OA required by the 2001 and 2004 Standards.

Consult *EBTRON's* white paper on ASHRAE 62.1-2004 for more information on 62.1-2004 or the white paper on CO_2DCV for more information on the limitations of CO_2DCV, including the effect of activity levels, outdoor air CO_2 variability and sensor error.

RECOMMENDED STRATEGIES FOR OUTSIDE AIR INTAKE FLOW CONTROL

If the spaces are low occupant density (i.e. office space, typically less than 25 people per 1,000 sq.ft.), maintain a fixed outdoor air flow rate in accordance with ASHRAE 62.1-2004. Although the calculations are made using design conditions, which can result in a higher than required intake setpoint, the energy benefit of DCV is low compared to the potential risk of under/over ventilation.

If the spaces are high occupant density (i.e. gathering spaces with 25 people per 1,000 sq.ft. or higher), calculate the ΔCO_2 setpoint to meet ASHRAE Standard 62.1-2004 at a specified occupancy (design occupancy in the example below) using a conservative CO_2 production rate (0.3 L/min or less). Determine the outside airflow rate lower limit based on either a.) an analysis of risk or b.) minimum pressurization requirements. Reset the outside airflow setpoint between the outside airflow rate lower limit and the full design occupancy outside airflow rate upper limit to maintain a constant ΔCO_2 setpoint. The graph below illustrates the typical response of this system. The heavy black lines on the graph indicate the actual outside air that would be delivered using this strategy (this example was for a high occupant density conference room with an occupant CO_2 production rate of 0.4 L/min).



The advantages of this design are that it can meet the requirements of ASHRAE 62.1-2004 and LEED 2.2 while providing demand controlled energy savings.

Install a thermal dispersion airflow measurement device, such as an *EBTRON* GTx116-P, in the outside air intake duct upstream of the intake control damper. The duct velocity at minimum is generally 400 fpm or less and should be monitored with a thermal dispersion type airflow meter designed for low flow applications. Avoid differential pressure or vortex shedding devices in outdoor air intakes because of the inability of such devices to produce an accurate and repeatable signal at low airflow rates. Devices that measure the pressure drop across a louver at a single point rarely result in accurate and repeatable measurement as a result of the low pressure drop and inconsistent velocity pressure profile across the louver. Provide a quality control damper, preferably aluminum extruded blade, airfoil type with quality linkage and bushings and electronic actuator. Provide a modulating return air damper to overcome negative pressure on the intake system from wind and stack effect if there is not a dedicated outside air fan serving the air handler.

Modulate the outside air damper and return air damper (if installed), in sequence, to maintain the minimum outside airflow rate to meet requirements for a.) dilution ventilation or b.) building pressure, whichever is greater. If CO_2DCV is used, **reset the outside airflow rate setpoint** between a specified minimum and maximum value to maintain the specified CO_2 level.

Startup the system with the outside air damper closed and the return air damper opened. Dampers shall be sequenced by first modulating the outside air damper. If the outside air damper reaches its fully opened position, begin to modulate the return air damper closed until the setpoint is maintained. If the system has a return fan, the outside air damper should be opened to a predetermined minimum position (usually 15% to 20%). The return fan should be modulated between its minimum and maximum speed before modulating the return damper when there is no relief at the air handler.

Follow *EBTRON's* recommendations on building pressurization for a complete system solution for outside air and building pressure control. Detailed control sequences can be found in the *EBTRON Standard Product Catalog*. Application assistance is always available by contacting *EBTRON's* application engineering department (800.232.8766 or Ebtron.com) or your local representative.

CONCLUSIONS

LEED 2.2 clearly offers a 1 point credit for the installation of airflow measuring stations in the outside air intake of low occupant density spaces. Demand controlled ventilation strategies using CO_2 can be dramatically improved for compliance under the new guidelines of ASHRAE 62.1-2004 by installing an airflow measuring station in the outdoor air intake and resetting the intake setpoint as occupancy varies. Installation of an outside air intake measuring station reduces energy consumption and provides peace of mind by documenting compliance with ASHRAE 62.1-2004.