INTERPRETATION IC 62-~~1989~~1999-~~23~~ 04 OF
ANSI/ASHRAE STANDARD 62-~~1989~~1999
VENTILATION FOR ACCEPTABLE INDOOR AIR QUALITY

~~June 26, 1995~~
REVISION APPROVED: 2/5/2000

Originally issued as interpretation of Standard 62-1989 on June 26, 1995, but revised based on approval of addendum 62f and publication of Standard 62-1999. The approved revision applies to only question #2 to reflect Standard 62-1999 language.

Request from: Robert L. Towell, P.E. and Steven G. Liescheidt, P.E., Hellmuth, Obata & Kassabaum, Inc. (HOK), One Metropolitan Square, 211 North Broadway, Suite 600, Saint Louis, MO 63102-2733

Note: Text in the Background sections has been edited for sake of brevity, including deletion of two exhibits and four spreadsheets attached to the HOK letter.

References. This request refers to ANSI/ASHRAE Standard 62-1989, Clause 3 Definitions, 6.1.3 Ventilation Requirements, 6.1.3.1 Multiple Spaces, 6.1.3.3 Ventilation Effectiveness, 6.1.3.4 Intermittent or Variable Occupancy, and 6.2 Indoor Air Quality Procedure, Table 3.

HOK Background 1. Clause 3 includes definitions for *air, return; air, supply; air, transfer;* and *air, ventilation*. The definition of *air, supply* is not clear.

Question 1. Is it consistent with the Standard that air referred to as *supply air* (i.e., *air, supply*) (V_{st} and V_{sc} per 6.1.3.1) may be composed of both *ventilation air* and *transfer air*?

ASHRAE Answer 1. Yes.

HOK Background 2. The carbon dioxide (CO_2) level of ~~1000~~ 700 ppm above outdoors noted in 6.1.3 and 6.2 including Table 3 appears to be provided as a recommended guideline rather than a mandatory requirement.

Question 2. Can the carbon dioxide level in a space ever exceed the referenced value of ~~1000~~ 700 ppm above outdoors, and still remain in compliance with the Standard?

ASHRAE Answer 2. Yes.

Comment. The CO_2 level of ~~1000~~ 700 ppm above outdoors is a guideline ~~for comfort acceptability~~ based on the perception of human bioeffluents, not a ceiling value for air quality.

HOK Background 3. When applying 6.1.3.1 for multiple spaces, if the critical space requires 100% outdoor air, the entire HVAC unit which serves the multiple spaces must be designed to provide 100% outdoor air.

Question 3a. Is it the intent of the Standard for systems which serve multiple spaces, that if any one space supplied by the system has an outdoor air fraction of 100% per Equation 6-1, the system must operate on 100% outdoor air, as shown in Spreadsheet No. 1?

ASHRAE Answer 3a. Yes.

Question 3b. Can toilet rooms with 100% exhaust, at 50 cfm/fixture in compliance with the Standard, be omitted from the critical space analysis ($Z = V_{oc}/V_{sc}$) required by 6.1.3.1?

ASHRAE Answer 3b. Yes.

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Comment. See Comments column in Table 2 of 62-1989, Public Spaces, Public Restrooms.

HOK Background 4. When applying 6.1.3.1 for multiple spaces, it may be helpful to increase the quantity of supply air for a particular space to reduce the critical space outdoor air fraction (Z) for the entire system.

Question 4a. Which of the following methods would be considered consistent with the Standard for increasing the supply air (V_{sc}) to a critical space such as a conference room (shown in spreadsheet not included in this response)?

Concept 1. Increase the primary supply air (ventilation air) from the HVAC system and provide a constant volume terminal unit with reheat coil to compensate for the over cooling that may result from the excess primary air.

Concept 2. Provide an exhaust fan with ducted discharge to the ceiling plenum of an adjacent space, to mix primary supply air from the HVAC system (ventilation air) with transfer air drawn from an adjacent space to produce increased total airflow (supply air).

Concept 3. Provide a VAV air mixing device, such as a fan terminal unit, to mix primary supply air from the HVAC system (ventilation air) with plenum air to produce increased total airflow (supply air).

ASHRAE Answer. Concepts 1, 2, and 3 are all consistent with the Standard for the example described.

Question 4b. If Concept 3 is acceptable, is either of the following arrangements (options) for this system consistent with the Standard?

Option 1. Plenum air is added to the primary air and is drawn from the plenum space directly above the room served.

Option 2. Plenum air is added to the primary air and is filtered.

ASHRAE Answer 4b. No.

Comment. The portion of air recirculated directly from the room as described in Option 1 does not provide dilution of contaminants produced within the room and therefore should not be included as supply air any more than would air recirculated by a fan within the room. Concerning Option 2, the primary contaminants are not particles.

HOK Background 5a-c. Subclause 6.1.3.1 defines an uncorrected outdoor air flow rate, V_{on}, as the "sum of outdoor air flow rates for all branches of the system." A similar definition is provided for the total supply air flow rate, V_{st}, as the "sum of all supply for all branches of the system." Finally, the last paragraph in

6.1.3.1 states in part, "When spaces are unoccupied, ventilation is not generally required unless it is needed to prevent accumulation of contaminants injurious to people, contents, or structure."

Question 5a. In 6.1.3.1 is it intended that the total supply air flow rate, V_{st}, be the combination of *ventilation air* and *transfer air*?

ASHRAE Answer 5a. No.

Comment. V_{st} refers to air supplied by the system. Adding transfer air would count the same air twice. The article by David Warden in the June 1995 issue of the *ASHRAE Journal* provides an elaboration of this issue.

Question 5b. In 6.1.3.1 does supply air flow rate, V_{st}, refer to the HVAC system primary supply air, i.e., *ventilation air*?

ASHRAE Answer 5b. Yes.

Question 5c. During periods when a space is not occupied and "contaminants injurious to people" are not present, is it consistent with the Standard to not supply any ventilation air, supply air, etc., to the respective space.

ASHRAE Answer 5c. Yes.

HOK Background 5d-h. Typically, HVAC design procedures would incorporate a diversity factor for both the number of people and primary supply air flow rate to account for the reality that not all spaces would have maximum occupancy at the same time.

Question 5d. Is it consistent with the requirements of 6.1.3.1 to calculate outdoor air requirements based on the peak system occupancy and supply air values, in lieu of the sum of the peak branch values, with proper adjustment for the critical zone outdoor air fraction (Z)?

ASHRAE Answer 5d. No.

Question 5g. Is it consistent with the requirements of 6.1.3.4 to allow the system outdoor air (O.A.) flow rate to be calculated based on the average occupancy, but not less than one-half the outdoor air flow rate required by the peak occupancy level, if the peak occupancy period is less than three hours in duration? For example, based on peak total supply air, maximum outdoor air cfm/person (20.0 cfm/person from Table 2), and the critical zone outdoor air fraction (Z) of 40% (6.1.3.1):

System operation from	7 AM to 6 PM (11 hours)	
Occupancy schedule:	7 AM to 8 AM	10 people
	8 AM to 9 AM	50 people
	9 AM to 11 AM	100 people
	11 AM to 12 AM	80 people
	12 AM to 1 PM	10 people
	1 PM to 2 PM	50 people
	2 PM to 4 PM	60 people
	4 PM to 5 PM	40 people
	5 PM to 6 PM	10 people
	Average	52 people

Required outdoor air (V_{on})	=	52 people x 20.0 cfm/person = 1,040 cfm
Total HVAC system S.A.	=	9,370 cfm
Uncorrected O.A. fraction (X)	=	1,040 cfm / 9,370 cfm = 11.1%
Corrected O.A. fraction (Y)	=	11.1% / (1 + 11.1% - 40%) = 15.6%
Corrected total O.A. flow rate	=	15.6% x 9,370 cfm = 1,463 cfm O.A.
Average O.A. per person	=	14.6 cfm/person at peak occupancy

ASHRAE Answer 5g. Yes.

Comment. This answer is predicated on the assumption that the space that is eligible for application of the provision of 6.1.3.4 is the critical space.

Question 5h. Is it consistent with the Ventilation Rate Procedure that the Corrected Total Outdoor Air Flow Rate may be reduced to reflect lower actual occupancy levels during periods of lower total occupancy? This question addresses, for example, an HVAC system that serves multiple classrooms. If it can be determined that a classroom is not occupied, is it consistent with the Standard to reduce the system outdoor air flow rate during the period of lower occupancy, even though the peak occupancy period my exceed the three hours noted in 6.1.3.4?

ASHRAE Answer 5h. Yes.

Comment. If the total outdoor air supply based on the occupied space is reduced during periods of less occupancy by demand control, it is improper to also apply the variable provision of 6.1.3.4. Concentration of occupant generated contaminants would not then be adequately decreased with reduced occupancy to render the space suitable for future occupancy.

Question 5i. Is it consistent with the Ventilation Rate Procedure that, for a variable air volume (VAV) HVAC system, the Corrected Total Outdoor Air Flow Rate must be provided as a minimum outdoor air intake value under all occupied operating conditions of the system?

ASHRAE Answer 5i. Yes.

Comment. The corrected outdoor air flow rate must be calculated for the most critical case. This outdoor air flow rate may be supplied at all times. Less air may be supplied when conditions are less critical provided the flow is recalculated based on those conditions (e.g., lower occupancy).

HOK Background 6. The term *occupied space* as used in the first sentence of 6.1.3, and in the definition of *occupied zone*, is not defined.

Question 6a. Is it the intent of the Standard that an *occupied space* means the volume of space defined by the inside surfaces of the walls, floors, and ceilings of each room?

ASHRAE Answer 6a. Yes.

Question 6b. Is it the intent of the Standard that *occupied space* means the volume of space defined by the inside surfaces of the walls, floors, and ceilings of the entire building?

ASHRAE Answer 6b. No.

Comment. The occupied space of the building is the sum of the volumes of the occupied spaces as defined by the inside dimensions of each space.

HOK Background 7. Subclause 6.1.3.3 states in part, "The values in Table 2 define the outdoor air needed in the occupied zone for well mixed conditions (ventilation effectiveness approaches 100%)....", and refers to Appendix F for additional information.

Question 7a. If an air distribution design is provided to maximize air mixing, and minimize "ventilation air bypassing the occupants," is it consistent with the Standard to assume an effectiveness of 100%?

ASHRAE Answer 7a. Yes.

Question 7b. If an air distribution design is provided which may result in a portion of the "ventilation air bypassing the occupants," is it required by the Standard to adjust the Table 2 values to correct for the reduced effectiveness?

ASHRAE Answer 7b. Not necessarily.

Comment. The answer is dependent on ventilation effectiveness, not bypass alone. The answer is YES if, having gone through the analysis, the ventilation effectiveness is less than 90%.

Question 7c. If the answer to 7b is YES, is the following calculation procedure consistent with the Standard for an effectiveness of 60%?

Room Type:	Two person office space
Table 2 Requirements:	20 cfm/person outdoor air
Standard ventilation rate:	2 people x 20 cfm/person = 40 cfm outdoor air
Ventilation effectiveness:	60%
Adjusted ventilation rate:	40 cfm / 60% = 66.7 cfm min. outdoor air

ASHRAE Answer 7c. Yes.

Question 7d. If supply air devices are provided that achieve an Air Diffusion Performance Index (ADPI) of 75 or greater, as defined in Chapter 31 Space Air Diffusion of the 1993 ASHRAE Handbook of Fundamentals, is it consistent with the Standard to assume an effectiveness of 100%?

ASHRAE Answer 7d. Yes.

Comment. We note the statement in Fundamentals Chapter 31 (p. 31.15):

"For an office environment in cooling mode, the design goal should be an ADPI greater than 80. The ADPI should not be used as a measure of performance for heating conditions."

The ADPI does not account for the Recirculation Flow Factor, described in Appendices E and F of Standard 62-1989. Therefore, the assurance of a ventilation effectiveness being close to the value of unity (1) with an ADPI of 75 or 80 is less with a 100% outdoor air supply than with a supply containing a significant proportion of recirculated air.