

outdoor air fraction for the zone (Z_{pz}) is determined in accordance with Section 6.2.5.1.

A1.2.2 Secondary Recirculation Systems. For secondary recirculation systems wherein all or part of the supply air to each ventilation zone is recirculated air (air that has not been directly mixed with outdoor air) from other zones, zone ventilation efficiency (E_{vz}) shall be determined in accordance with Equation A1.2.2-1. Examples of secondary recirculation systems include dual-fan dual-duct and fan-powered mixing-box systems, and systems that include transfer fans for conference rooms.

$$E_{vz} = (F_a + X_s \times F_b - Z_{pz} \times E_p \times F_c) / F_a \quad (\text{A1.2.2-1})$$

where system air fractions F_a , F_b , and F_c are determined in accordance with Equation A1.2.2-2, A1.2.2-3, and A1.2.2-4, respectively.

$$F_a = E_p + (1 - E_p) \times E_r \quad (\text{A1.2.2-2})$$

$$F_b = E_p \quad (\text{A1.2.2-3})$$

$$F_c = 1 - (1 - E_z) \times (1 - E_r) \times (1 - E_p) \quad (\text{A1.2.2-4})$$

Where the zone primary air fraction (E_p) is determined in accordance with Equation A1.2.2-5, zone secondary recirculation fraction (E_r) is determined by the designer based on system configuration, and zone air distribution effectiveness (E_z) is determined in accordance with Section 6.2.2.2.

$$E_p = V_{pz} / V_{dz} \quad (\text{A1.2.2-5})$$

where V_{dz} is zone discharge airflow.

Informative Notes:

1. For plenum return systems with secondary recirculation (e.g., fan-powered VAV with plenum return), E_r is usually less than 1.0, although values may range from 0.1 to 1.2, depending upon the location of the ventilation zone relative to other zones and the air handler. For ducted return systems with secondary recirculation (e.g., fan-powered VAV with ducted return), E_r is typically 0.0, while for those with system-level recirculation (e.g., dual-fan dual-duct systems with ducted return), E_r is typically 1.0. For other system types, E_r is typically 0.75.
2. For single-zone and single-supply systems, E_p is 1.0.

A1.3 System Ventilation Efficiency. The system ventilation efficiency shall equal the lowest zone ventilation efficiency among all ventilation zones served by the air handler in accordance with Equation A1.3.

$$E_v = \text{minimum } (E_{vz}) \quad (\text{A1.3})$$

A2. DESIGN PROCESS

The system ventilation efficiency and, therefore, the outdoor air intake flow for the system (V_{ot}) determined as part of the design process are based on the design and minimum expected supply airflows to individual ventilation zones as well as the design outdoor air requirements to the zones. For VAV system design purposes, zone ventilation efficiency (E_{vz}) for each ventilation zone shall be found using the mini-

mum expected zone primary airflow (V_{pz}) and using the highest expected system primary airflow (V_{ps}) at the design condition analyzed.

Informative Note: Increasing the zone supply airflow values during the design process, particularly to the critical zones requiring the highest fraction of outdoor air, reduces the system outdoor air intake flow requirement determined in the calculation.

A2.1 Selecting Zones for Calculation. Zone ventilation efficiency (E_{vz}) shall be calculated for all ventilation zones.

Exception: Because system ventilation efficiency (E_v) is determined by the minimum value of the zone ventilation efficiency (E_{vz}) in accordance with Equation A1.3, calculation of E_{vz} is not required for any ventilation zone that has an E_{vz} value that is equal to or larger than that of the ventilation zone for which a calculation has been made.

Informative Note: The value of E_{vz} for a ventilation zone will be equal to or larger than that for another ventilation zone if all of the following are true relative to the other ventilation zone:

- a. Floor area per occupant (A_z/P_z) is no lower.
- b. Minimum zone discharge airflow rate per unit area (V_{dz}/A_z) is no lower.
- c. Primary air fraction (E_p) is no lower.
- d. Zone air distribution effectiveness (E_z) is no lower.
- e. Area outdoor air rate (R_a) is no higher.
- f. People outdoor air rate (R_p) is no higher.

A3. SYMBOLS

A_z	zone floor area: the net occupiable floor area of the ventilation zone, ft ² (m ²).
D	occupant diversity: the ratio of the system population to the sum of the zone populations.
E_p	primary air fraction: the fraction of primary air in the discharge air to the ventilation zone
E_r	secondary recirculation fraction: in systems with secondary recirculation of return air, the fraction of secondary recirculated air to the zone that is representative of average system return air rather than air directly recirculated from the zone.
E_v	system ventilation efficiency: the efficiency with which the system distributes air from the outdoor air intake to the breathing zone in the ventilation-critical zone, which requires the largest fraction of outdoor air in the primary airstream. E_v shall be determined in accordance with Section 6.2.5.2 or Section A1.
E_{vz}	zone ventilation efficiency: the efficiency with which the system distributes air from the outdoor air intake to the breathing zone in any particular ventilation zone.
E_z	zone air distribution effectiveness: a measure of the effectiveness of supply air distribution to the breathing zone. E_z is determined in accordance with Section 6.2.2.2.