(This appendix is not part of this standard. It is merely informative and does not contain requirements necessary for conformance to the standard. It has not been processed according to the ANSI requirements for a standard and may contain material that has not been subject to public review or a consensus process. Unresolved objectors on informative material are not offered the right to appeal at ASHRAE or ANSI.)

INFORMATIVE APPENDIX E
ACCEPTABLE MASS BALANCE EQUATIONS FOR USE WITH THE IAQ PROCEDURE

When applying the IAQ Procedure from Section 6.3, mass balance analysis may be employed to determine outdoor air ventilation requirements to control indoor contaminant levels. Table E-1 presents mass balance equations for analysis of single-zone systems. Figures E-l and E-2 show representative single-zone systems. A filter may be located in the recirculated airstream (location A) or in the supply (mixed) airstream (location B).

Variable-air-volume (VAV) single-zone systems reduce the circulation rate when the thermal load is lower than the design load. This is accounted for by a flow reduction fraction (F_r).

A mass balance equation for the contaminant-of-concern may be written and used to determine the required outdoor airflow or the breathing zone contaminant concentration for the various system arrangements. Six permutations for air-handling and single-zone air distribution systems are described in Table E-l. The mass balance equations for computing the required outdoor airflow and the breathing-zone

TABLE E-1 Required Zone Outdoor Airflow or Space Breathing Zone Contaminant Concentration with Recirculation and Filtration for Single-Zone Systems

Required Recirculation Rate				
Filter Location	**Flow**	**Outdoor Airflow**	**Required Zone Outdoor Airflow (V_{oz} in Section 6)**	**Space Breathing Zone Contaminant Concentration**
None	VAV	100%	$V_{oz} = \frac{N}{E_z F_r (C_{bz} - C_o)}$	$C_{bz} = C_o + \frac{N}{E_z F_r V_{oz}}$
A	Constant	Constant	$V_{oz} = \frac{N - E_z R V_r E_f C_{bz}}{E_z (C_{bz} - C_o)}$	$C_{bz} = \frac{N + E_z V_{oz} C_o}{E_z (V_{oz} + R V_r E_f)}$
A	VAV	Constant	$V_{oz} = \frac{N - E_z F_r R V_r E_f C_{bz}}{E_z (C_{bz} - C_o)}$	$C_{bz} = \frac{N + E_z V_{oz} C_o}{E_z (V_{oz} + F_r R V_r E_f)}$
B	Constant	Constant	$V_{oz} = \frac{N - E_z R V_r E_f C_{bz}}{E_z [C_{bz} - (1 - E_f)(C_o)]}$	$C_{bz} = \frac{N + E_z V_{oz} (1 - E_f) C_o}{E_z (V_{oz} + R V_r E_f)}$
B	VAV	100%	$V_{oz} = \frac{N}{E_z F_r [C_{bz} - (1 - E_f)(C_o)]}$	$C_{bz} = \frac{N + E_z F_r V_{oz} (1 - E_f) C_o}{E_z F_r V_{oz}}$
B	VAV	Constant	$V_{oz} = \frac{N - E_z F_r R V_r E_f C_{bz}}{E_z [C_{bz} - (1 - E_f)(C_o)]}$	$C_{bz} = \frac{N + E_z V_{oz} (1 - E_f) C_o}{E_z (V_{oz} + F_r R V_r E_f)}$

Symbol or Subscript	Definition
A, B	filter location
V	volumetric flow
C	contaminant concentration
E_z	zone air distribution effectiveness
E_f	filter efficiency
F_r	design flow reduction fraction factor
N	contaminant generation rate
R	recirculation flow factor
Subscript: *o*	outdoor
Subscript: *r*	return
Subscript: *b*	breathing
Subscript: *z*	zone