

ANSI/ASHRAE Addendum ae to  
ANSI/ASHRAE Standard 62-2001



# ASHRAE<sup>®</sup> STANDARD

## Ventilation for Acceptable Indoor Air Quality

Approved by the ASHRAE Standards Committee on June 28, 2003; by the ASHRAE Board of Directors on July 3, 2003; and by the American National Standards Institute on September 29, 2003.

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**AMERICAN SOCIETY OF HEATING,  
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1791 Tullie Circle, NE • Atlanta, GA 30329

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**Foreword to Addendum 62ae**

*This addendum addresses a number of issues. It adds definitions of the terms “indoor air,” “cognizant authority,” and “industrial space”; it modifies three existing definitions in an attempt to clarify language; and it updates the references section of the standard. It also revises Appendix D to be consistent with the revised Indoor Air Quality Procedure. Finally, it deletes Appendix F, which is no longer referred to in the standard and which is more appropriate for the guideline being developed as a companion document to Standard 62.*

**Addendum 62ae**

*Add the following definitions to Section 3:*

**air, indoor:** the air in an enclosed occupiable space.

**cognizant authority:** an agency or organization that has the expertise and jurisdiction to establish and regulate concentration limits for airborne contaminants; or an agency or organization that is recognized as authoritative and has the scope and expertise to establish guidelines, limit values, or concentrations levels for airborne contaminants.

**industrial space:** an indoor environment where the primary activity is production or manufacturing processes. The

processes in these spaces may generate contaminants with characteristics and in quantities dictating that principles of worker safety and industrial hygiene be used to define contaminant control strategies, including ventilation. Also, the primary occupants of these spaces consist of the individuals involved in these processes.

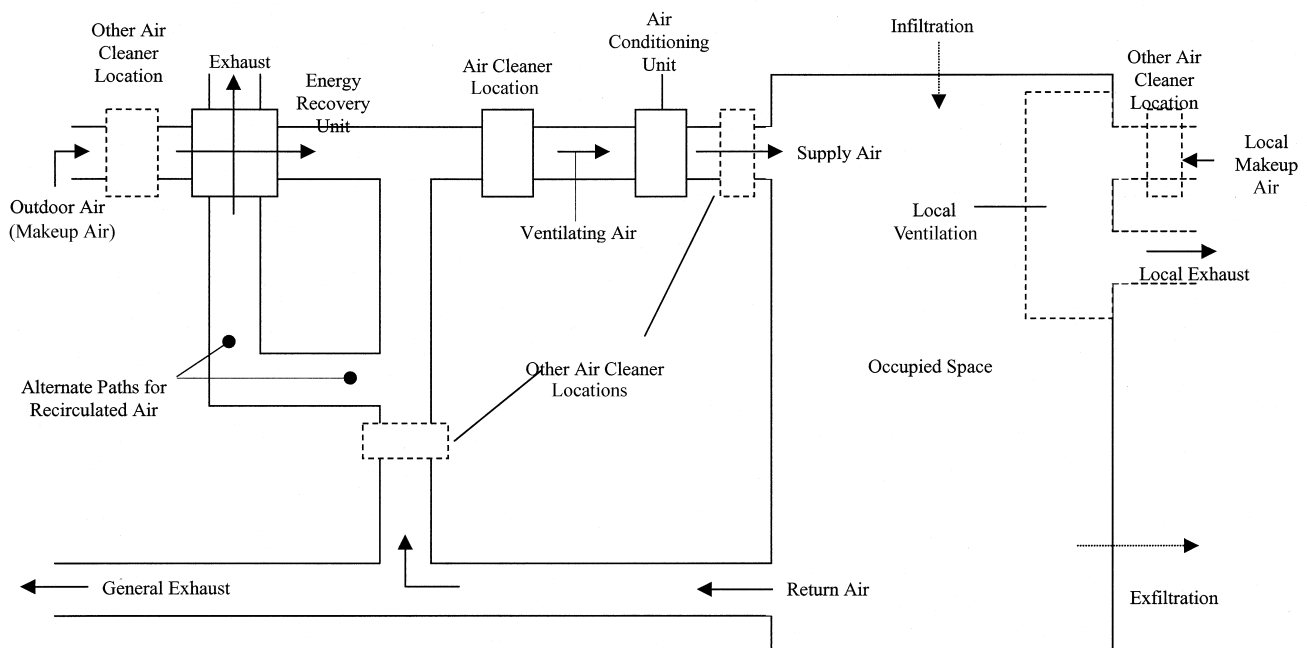
**Modify the following definitions in Section 3 as indicated:**

**air, ambient:** the air surrounding a building—~~an object; the source of outdoor air brought into a building.~~

**exfiltration:** uncontrolled outward air leakage outward from conditioned spaces through unintentional openings in cracks and interstices and through ceilings, floors, and walls to unconditioned spaces or the outdoors caused by pressure differences across these openings due to wind, inside-outside temperature differences (stack effect), and imbalances between supply and exhaust airflow rates of a space or building.

**infiltration:** uncontrolled inward air leakage to conditioned spaces inward through unintentional openings in cracks and interstices and through ceilings, floors, and walls from unconditioned spaces or the outdoors caused by the same pressure differences that induce exfiltration of a space or building.

**Replace Figure 1 with the following: [This version is identical to that in Standard 62-2001 but has been updated in terms of fonts and electronic format.]**



**Delete Figure 2. [Reference to this figure was deleted by Addendum 62s, which was approved for publication in June 2001, but the figure itself was not.]**

**Add the following to Section 7:**

**7.1.5 Air Duct System Construction.** Air duct systems shall be constructed in accordance with the following standards, as applicable:

- (a) Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) *HVAC Duct Construction Standards—Metal and Flexible* (Second Edition, 1995)
  - Section S1.9.g, Sealing Ducts
  - Section 2.6, Installation Standards for Rectangular Ducts Using Flexible Line
  - Section 3.5, Duct Installation Standards
  - Section 3.6, Specifications for Joining and Attaching Flexible Duct
  - Section 3.7, Specifications for Supporting Flexible Duct
  - Sections 6.1, 6.3, 6.4, and 6.5 of Casing and Plenum Construction Standards
- (b) Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA) *Fibrous Glass Duct Construction Standards* (Sixth Edition, 1992): All Sections.
- (c) National Fire Protection Association Standards for the Installation of Air-Conditioning and Ventilating Systems, NFPA No. 90A, and Installation of Warm Air Heating and Air-Conditioning Systems, NFPA No. 90B.

**Change the title, but not the content, of Section 7.2.5 as follows:**

**7.2.5 Testing Damper Controls—Outdoor Air Dampers.**

Prior to occupancy, each ventilation system shall be tested to ensure that outdoor air dampers operate properly in accordance with the system design.

**Update References 1 and 2 in Section 9 as follows:**

- <sup>1</sup> ~~ANSI/ASHRAE Standard 55-1992, Environmental Conditions for Human Occupancy. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA. 30329. 1981 1992.~~
- <sup>2</sup> ~~UL 181, Factory-Made Air Ducts and Air Connectors, 9<sup>th</sup> Edition. Underwriters' Laboratories, Northbrook, IL. 1981 1996.~~

**Delete References 3 through 6. [The text that contained these references was deleted in Addendum 62w.]**

- <sup>3</sup> ~~NFPA 90A 1985, Standard for the Installation of Air Conditioning and Ventilating Systems. National Fire Protection Association, Quincy, MA 02269.~~
- <sup>4</sup> ~~NFPA 90B 1984, Standard for the Installation of Warm Air Heating and Air Conditioning Systems. National Fire Protection Association, Quincy, MA 02269.~~
- <sup>5</sup> ~~SMACNA 1985 First ed. HVAC Duct Construction Standards—Metal and Flexible. Sheet Metal and Air-Conditioning Contractors National Association, Inc., 8224 Old Courthouse Road, Tysons Corners, Vienna, VA 22180.~~

- <sup>6</sup> ~~SMACNA. 1979. Fibrous Glass Duct Construction, Fifth ed. Sheet Metal and Air Conditioning Contractors National Association Inc., 8224 Old Courthouse Road, Tysons Corners, Vienna, VA 22180. 1979.~~

**Add a new Reference 3. [It should have been added by Addendum 62w.]**

- <sup>3</sup> ~~ASTM C 1338-00, Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings. American Society for Testing and Materials, West Conshohocken, PA. 2001.~~

**Renumber and update Reference 7. [Text containing this reference will be deleted by Addenda 62r and 62n, but its number needs to be changed here and in the body until then.]**

- <sup>7A</sup> ~~ACGIH. 1986 1998. Industrial Ventilation—A Manual of Recommended Practice. 1986 23<sup>rd</sup> ed. American Conference of Governmental Industrial Hygienists, Committee on Industrial Ventilation, P.O. Box 16153, Lansing, MI 48901.~~

**Delete References 8 and 9. [Text containing these references was deleted by Addendum 62s.]**

- <sup>8</sup> ~~MIL Standard 282 Filter Units, Protective Clothing, Gas Masks, 1956 with notices 1974 and 1989, U.S. Department of Defense, Global Engineering Documents, Irvine, CA 92714.~~
- <sup>9</sup> ~~ASHRAE Handbook—1983 Equipment Volume, Chapter 11, Table 1. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., Atlanta, GA 30329. 1983.~~

**Renumber Reference 10. [Text containing this reference will be deleted by Addendum 62x, but its number needs to be changed here and in the body until then.]**

- <sup>10B</sup> ~~Sterling, E.M., A. Arundel, T.D. Sterling. 1985. "Criteria for human exposure to humidity in occupied buildings." *ASHRAE Transactions*, Vol. 91, Part 1B, pp. 611-622.~~

**Delete References 11 through 17. [Text containing these references was deleted by Addendum 62i.]**

- <sup>11</sup> ~~Janssen, J.E., and A. Wolff. 1986. "Subjective response to ventilation." In *Managing Indoor Air for Health and Energy Conservation, Proceedings of the ASHRAE Conference IAQ '86*. Atlanta: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.~~
- <sup>12</sup> ~~Raijshans, G.S. 1983. "Indoor air quality and CO<sub>2</sub> levels." *Occupational Health in Ontario* 4:160-167.~~
- <sup>13</sup> ~~Berg Munch, B., Clausen, B.G., and P.O. Fanger. 1984. "Ventilation requirements for the control of body odor in space occupied by women." In *Environment International*, Vol. 12 (1986), pp. 195-199.~~
- <sup>14</sup> ~~Leaderer, B.P. and W. Cain. 1983. "Air quality in buildings during smoking and non-smoking occupancy." *ASHRAE Transactions*, Vol. 89, Part 2B, pp. 601-613.~~
- <sup>15</sup> ~~Thayer, W.W. 1982. "Tobacco smoke dilution recommendations for comfortable ventilation." *ASHRAE Transactions*, Vol. 88, Part 2, 291-306.~~
- <sup>16</sup> ~~Bell, S.J. and B. Khati. 1983. "Indoor air quality in office buildings." *Occupational Health in Ontario*, 4:103-118.~~
- <sup>17</sup> ~~Hicks, J. 1984. "Tight building syndrome: When work makes you sick." *Occupational Health and Safety*, Jan. pp. 51-56.~~

**Renumber Reference 18 as Reference 6 because prior references have been deleted.**

<sup>186</sup> National Primary and Secondary Ambient Air Quality Standards, Code of Federal Regulations, Title 40 Part 50 (40 CFR50), as amended July 1, 1987. U.S. Environmental Protection Agency.

**Delete Reference 19. [Text containing this reference is not found anywhere in the standard.]**

<sup>19</sup> ~~Morey, P.R., W.G. Jones, J.L. Clere, and W.G. Sorenson. 1986. "Studies on sources of airborne microorganisms and on indoor air quality in a large office building." In *Managing Indoor Air for Health and Energy Conservation, Proceedings of the ASHRAE Conference IAQ '86*, pp. 500-509. Atlanta: American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc.~~

**Renumber References 20 through 25. [Text containing these references will be deleted by Addendum 62r and 62n, but their numbers here and in the body need to be changed until then.]**

<sup>207</sup> *NIOSH Manual of Analytical Methods*, 2d Ed., April 1977. Pub. No. 77-157, 4 vols. Cincinnati: National Institute for Occupational Safety and Health.

<sup>218</sup> *NIOSH Manual Sampling Data Sheets with Suppl.*, Pubs. Nos. 77-159 and 78-189, March, 1977 and August, 1978. **Note:** The Clearinghouse for Occupational Safety and Health of NIOSH, 4676 Columbia Parkway, Cincinnati, OH 45226, is willing to fill occasional requests for separate sheets of the information on individual air contaminants from these publications on request. National Institute for Occupational Safety and Health, Cincinnati.

<sup>229</sup> *ACGIH Threshold Limit Values and Biological Exposure Indices for 1986-87*. American Conference of Governmental Industrial Hygienists, 6500 Glenway, Bldg. D-7, Cincinnati, OH 45211-4438, 1987.

<sup>2310</sup> Standards Association of Australia. 1980. *Australian Standard AS1668 Part 2, 1980—Ventilation Requirements*, Clause 3.5.2, Appendix A&B. Standards Association of Australia, Standards House, 80 Arthur St., North Sydney, NSW, 2060. 1980.

<sup>2411</sup> Kowalczewski, J.J. 1973. "Quality of air in air conditioning." *AIRAH*, Feb. Australian Institute of Refrigeration, Air Conditioning and Heating.

<sup>2512</sup> Janssen, J.E., T. Hill, J.E. Woods, and E.A.B. Maldonado. 1982. "Ventilation for control of indoor air quality: A case study." *Environment International*, EI 8 487-496.

**Delete References 26 through 28. [Text containing these references is not found anywhere in the standard.]**

<sup>26</sup> ~~U.S. National Academy of Sciences Committee on Toxicology. 1982. *An Assessment of Health Risk of Seven Pesticides Used in Termite Control (Chlordane in Military Housing)*, U.S. National Academy of Sciences Committee on Toxicology, August.~~

<sup>27</sup> ~~Maximum Acceptable Level of Ozone. Code of Federal Regulations. Title 21, Part 801.415. Food and Drug~~

~~Administration, U.S. Department of Health, Education, and Welfare, 1988.~~

<sup>28</sup> ~~Radon Reduction Techniques for Detached Houses, Technical Guidance, 2d ed., Report No. EPA-625/5-87-019, U.S. Environmental Protection Agency, Research Triangle Park, NC. Rev. January 1988.~~

**Renumber References 29 and 30. [Text containing these references will be deleted by Addendum 62h, but their numbers need to be changed here and in the body until then.]**

<sup>2913</sup> ~~NAP 1981 Indoor Pollutants. National Academy Press, Washington, DC.~~

<sup>3014</sup> ~~*The Consequences of Involuntary Smoking*. 1986. U.S. Surgeon General, U.S. Dept. of Health and Human Services.~~

**Delete Reference 31. [Text containing this reference is not found anywhere in the standard.]**

<sup>31</sup> ~~*Radon Measurements In Schools, An Interim Report*, Report No. EPA-520/1-89-010, U.S. Environmental Protection Agency, Washington, DC 20460, March 1989.~~

**Renumber Reference 32 as Reference 15 because prior references have been deleted.**

<sup>3215</sup> ~~ASHRAE. 1999. *ASHRAE Standard 52.2, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size*. Atlanta: American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.~~

**Add reference 16. [A new reference should have been added by Addendum 62L.]**

<sup>16</sup> SMACNA. 2001. *HVAC Systems – Testing, Adjusting and Balancing Manual*, 3rd ed. Sheet Metal and Air-Conditioning Contractors National Association Inc., Chantilly, VA.

**Delete Appendix F: Rationale for Lag or Lead Time for Transient Occupancy.**

**Retitle Appendix D and modify it as indicated below:**

**(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.)**

## APPENDIX D

### PROCEDURE FOR USE OF CLEANED RECIRCULATED AIR

#### ACCEPTABLE MASS BALANCE EQUATIONS FOR USE WITH INDOOR AIR QUALITY PROCEDURE

The amount of outdoor air specified in Table 2 may be reduced by recirculating air from which offending contaminants have been removed or converted to less objectionable forms. Formaldehyde, for example, may be oxidized to water

and carbon dioxide. The amount of outdoor air required depends on the contaminant generation in the space, the contaminant concentrations in the indoor and the outdoor air, the filter location, the filter efficiency for the contaminant in question, the ventilation effectiveness, the supply air circulation rate, and the fraction recirculated.

When applying the Indoor Air Quality Procedure from Section 6.2, mass balance analysis may be employed to determine outdoor air ventilation requirements to control indoor contaminant levels. The equations in Table D-1 are acceptable for performing such mass balance analysis in single-zone systems.

**Quantities**

- $A, B$  = filter location
- $V$  = volumetric flow
- $C$  = contaminant concentration
- $E_e$  = ~~Efficiency or~~ air change effectiveness
- $E_f$  = filter efficiency
- $F_r$  = flow reduction factor
- $N$  = contaminant generation rate
- $R$  = recirculation flow factor

**Subscripts**

- $f$  = filter
- $O$  = outdoor
- $r$  = return
- $s$  = supply space
- $v$  = ventilation

Figure D-1 shows a representative system. A filter may be located in the recirculated airstream (location A) or in the supply (mixed) airstream (location B). ~~The ventilation effectiveness will depend on the location of the supply outlet, the return inlet, and the design and performance of the supply diffuser. Figure D-1 is a schematic of a typical system with the supply outlet and the return inlet in the ceiling. It is possible for some supply air to flow directly from the supply to the return, by passing the occupied zone of the room. This reduces the effectiveness of the ventilation supplied to the space (see Appendix E).~~

All of the exhaust is shown in Figure D-1 as being taken from the return airstream. Many systems will have part or all of the exhaust taken directly from the space. If the exhaust air is taken from the ceiling area, it will be subject to the same loss of ventilating efficiency as if it were taken from the return air flow. See Appendix E for its effect on ventilating efficiency,  $E_r$ . The exhaust air flow,  $V_e$ , is then equal to all of the exhaust air flow regardless of whether it is taken from the return air or from the room. Then:

$$V_e = V_o \tag{D-1}$$

Let  $V'_{e_r}$  be the portion of air exhausted from the return duct, and  $V''_e$  be the portion exhausted directly from the room. Then:

$$V_e = V'_{e_r} + V''_e \tag{D-2}$$

and

$$V_r = V_s - V''_e \tag{D-3}$$

The material balance at the supply outlet is:

$$V_s = V_o + RV_r = (V'_e + V''_e) + RV_r \tag{D-4}$$

$$RV_r = V_s - (V'_e + V''_e) \tag{D-5}$$

$RV_r$  is the recirculated air and  $V_r$  is the return air. Therefore:

$$R = [V_s - (V'_e + V''_e)] / V_r \tag{D-6}$$

Variable-air-volume (VAV) systems reduce the circulation rate when the thermal load is satisfied. This is accounted for by a flow reduction factor  $F_r$ . ~~The supply air temperature is normally held constant in a VAV system. Constant volume systems require a variable supply air temperature. VAV systems also may have a constant or proportional outdoor air flow rate.~~

A mass balance for the contaminant may be written to determine the required outdoor airflow or the space contaminant concentration at steady-state conditions for each of the system arrangements. The various permutations for the air-handling and distribution systems are described in Table D-1. There are ~~seven~~ eight variations. The mass balance equations for computing the required outdoor airflow and the space contaminant concentration at steady-state conditions for each system are presented in Table D-1.

If the allowable space contamination is specified, the equations in Table D-1 may be solved for the outdoor airflow rate  $V_o$ . When the outdoor air flow rate is specified, the equations may be solved for the resulting contaminant concentration as shown in Table D-1.

~~Filters are effective for removing particles. They are less effective or ineffective in removing gases and vapors. Therefore, when designing a filtration system, consideration must be given to contaminants that are poorly filtered or not filtered at all. The ventilating rate may only be reduced until some contaminant reaches its maximum acceptable limit.~~

While the calculation methods in this appendix are based on single-zone systems and steady-state analysis, calculation methods exist that account for multizone and transient effects. <sup>D-1</sup>

**REFERENCES**

D-1 Dols, W.S., and G.N. Walton. 2002. CONTAMW 2.0 User Manual. National Institute of Standards and Technology, NISTIR 6921.

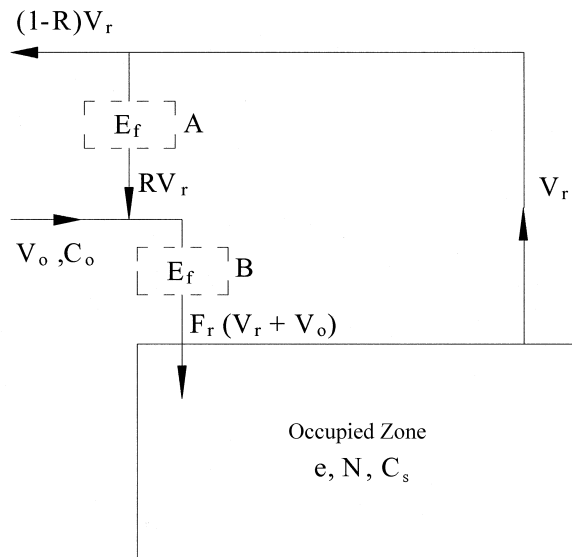
*Revise Table D-1 in Appendix D by deleting the first column in the existing table and revising it as indicated below:*

**TABLE D-1**  
**Required Outdoor Airflow or Space Contaminant Concentration with Recirculation and Filtration**

Required Recirculation Rate				Required Outdoor Airflow	Space Contaminant Concentration	Required Recirculation Rate
Filter Location	Flow	Temperature	Outdoor Airflow			
None	VAV	Constant	100%	$V_o = \frac{N}{eF_r(C_s - C_o)}$	$C_s = C_o + \frac{N}{eF_r V_o}$	Not applicable
A	Constant	Variable	Constant	$V_o = \frac{N - eRV_r E_f C_s}{e(C_s - C_o)}$	$C_s = \frac{N + eV_o C_o}{e(V_o + RV_r E_f)}$	$\frac{RV_r}{eE_f C_s} = \frac{N + eV_o(C_o - C_s)}{eE_f C_s}$
A	VAV	Constant	Constant	$V_o = \frac{N - eF_r RV_r E_f C_s}{e(C_s - C_o)}$	$C_s = \frac{N + eV_o C_o}{e(V_o + F_r RV_r E_f)}$	$\frac{RV_r}{eF_r E_f C_s} = \frac{N + eV_o(C_o - C_s)}{eF_r E_f C_s}$
A	VAV	Constant	Proportional*	$V_o = \frac{N - eF_r RV_r E_f C_s}{eF_r(C_s - C_o)}$	$C_s = \frac{N + eF_r V_o C_o}{F_r e(V_o + RV_r E_f)}$	$\frac{RV_r}{eF_r E_f C_s} = \frac{N + eF_r V_o(C_o - C_s)}{eF_r E_f C_s}$
B	Constant	Variable	Constant	$V_o = \frac{N - eRV_r E_f C_s}{e[C_s - (1 - E_f)C_o]}$	$C_s = \frac{N + eV_o(1 - E_f)C_o}{e(V_o + RV_r E_f)}$	$\frac{RV_r}{eE_f C_s} = \frac{N + eV_o[(1 - E_f)C_o - C_s]}{eE_f C_s}$
B	VAV		100%	$V_o = \frac{N}{eF_r[C_s - (1 - E_f)C_o]}$	$C_s = \frac{N + eF_r V_o(1 - E_f)C_o}{eF_r V_o}$	
B	VAV	Constant	Constant	$V_o = \frac{N - eF_r RV_r E_f C_s}{e[C_s - (1 - E_f)C_o]}$	$C_s = \frac{N + eV_o(1 - E_f)C_o}{e(V_o + F_r RV_r E_f)}$	$\frac{RV_r}{eF_r E_f C_s} = \frac{N + eV_o[(1 - E_f)C_o - C_s]}{eF_r E_f C_s}$
B	VAV	Constant	Proportional*	$V_o = \frac{N - eF_r RV_r E_f C_s}{eF_r[C_s - (1 - E_f)C_o]}$	$C_s = \frac{N + eF_r V_o(1 - E_f)C_o}{eF_r(V_o + RV_r E_f)}$	$\frac{RV_r}{eF_r E_f C_s} = \frac{N + eF_r V_o[(1 - E_f)C_o - C_s]}{eF_r E_f C_s}$

\* Proportional indicates that the outdoor airflow varies with the supply airflow, such that the outdoor airflow is equal to the design value times the flow reduction factor  $F_r$ .

Replace the current Figure D-1 in Appendix D with the following figure:



**Figure D-1 Recirculation and filtration Ventilation System Schematic**

## **POLICY STATEMENT DEFINING ASHRAE'S CONCERN FOR THE ENVIRONMENTAL IMPACT OF ITS ACTIVITIES**

ASHRAE is concerned with the impact of its members' activities on both the indoor and outdoor environment. ASHRAE's members will strive to minimize any possible deleterious effect on the indoor and outdoor environment of the systems and components in their responsibility while maximizing the beneficial effects these systems provide, consistent with accepted standards and the practical state of the art.

ASHRAE's short-range goal is to ensure that the systems and components within its scope do not impact the indoor and outdoor environment to a greater extent than specified by the standards and guidelines as established by itself and other responsible bodies.

As an ongoing goal, ASHRAE will, through its Standards Committee and extensive technical committee structure, continue to generate up-to-date standards and guidelines where appropriate and adopt, recommend, and promote those new and revised standards developed by other responsible organizations.

Through its *Handbook*, appropriate chapters will contain up-to-date standards and design considerations as the material is systematically revised.

ASHRAE will take the lead with respect to dissemination of environmental information of its primary interest and will seek out and disseminate information from other responsible organizations that is pertinent, as guides to updating standards and guidelines.

The effects of the design and selection of equipment and systems will be considered within the scope of the system's intended use and expected misuse. The disposal of hazardous materials, if any, will also be considered.

ASHRAE's primary concern for environmental impact will be at the site where equipment within ASHRAE's scope operates. However, energy source selection and the possible environmental impact due to the energy source and energy transportation will be considered where possible. Recommendations concerning energy source selection should be made by its members.