ASHRAE Standard 62.1-2010
Ventilation for Acceptable Indoor Air Quality

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Chair, SSPC 62.1
ASHRAE Standard 62.1
Overview

- General comments
- General requirements
- Ventilation requirements
- Construction and O/M requirements
- Energy Efficiency Options
- Possible Coming Changes
- Questions
ASHRAE Standard 62.1

What's Its History?

62-2001
• Prescriptive
• Commissioning
• O&M
• Combustion air
• Filtration

62-1999
• IAQ-Health disclaimers
• Smoking disclaimers
• Clarified CO₂ as ventilation metric

62-1989
• Removed Thermal Comfort
• Ventilation Rate Proc.
• IAQ Proc.

62-1981
Alternative Air Quality Proc.

62-1981
First issued

62-1973

62.1-2004
• Commercial and High Rise Res.
• Enforceable code language
• ETS vent. rates not covered
• Vent. Rate. Proc. Modified
• Occupant and area vent. rates

62.1-2007
Updated
1. Purpose

1.1 Specify minimum ventilation rates and other measures intended to provide IAQ that is acceptable to human occupants and that minimizes adverse health effects

1.2 Intended for regulatory application to new buildings and additions

1.3 Guide the improvement of IAQ in existing buildings
2. Scope

- 2.1 All spaces intended for human occupancy excluding low-rise residential (62.2)

- 2.2 Defines requirements for ventilation, air-cleaning design, commissioning, installation and O&M

- 2.3 Additional requirements and other standards may apply (labs, healthcare, industrial, etc.)

- 2.4 May be applied to both new and existing buildings, not intended to be used retroactively

- 2.5 Does not prescribe specific ventilation rates for smoking spaces
2. Scope

- 2.6 Ventilation requirements based on chemical, physical, & biological contaminants

- 2.7 Consideration or control of thermal comfort is not included

- 2.8 In addition to ventilation, the standard contains requirements related to certain sources
2. Scope

2.9 Acceptable IAQ may not be achieved in all buildings meeting these requirements because of:

- Diversity of sources and contaminants
- Air temperature, humidity, noise, lighting, and psychological/social factors
- Varied susceptibility in the occupants
- Introduction of outdoor contaminants
3. Definitions

- 36 Terms Defined
- Two of Particular Significance
  - Acceptable Indoor Air Quality
  - Occupiable Space
General Requirements

4. Outdoor Air Quality

- 4.1 Regional Air Quality
  - Must determine NAAQS attainment status
    www.epa.gov
  - Air cleaning is required in some cases in non-attainment areas

- 4.2 Local Air Quality
  - Conduct observational site survey to identify local sources of air contaminants
General Requirements

4. Outdoor Air Quality

4.3 Documentation

- Regional air quality compliance status
- Local survey information
- Conclusions regarding acceptability of outdoor air quality
General Requirements

5. Systems and Equipment

5.1 Ventilation Air Distribution

- Must provide means to adjust the system
- Minimum ventilation air must be provided to each terminal unit in ceiling/floor plenum systems
General Requirements

5. Systems and Equipment

5.2 Exhaust Duct Location

- Operate exhaust ducts with harmful contaminants at negative pressure

5.3 Ventilation System Controls

- Control to assure proper ventilation under any operating condition

5.4 Airstream Surfaces

- Use materials that have documented resistance to microbial growth and erosion
General Requirements

5. Systems and Equipment

5.5 Outdoor Air Intakes

- Separate OA intake from outdoor contaminant sources
- Must comply with default minimum separation distances in Table 5-1. Examples:
  - Loading dock  25 ft
  - Dumpster  15 ft
  - Surface below intake  1 ft
  - Cooling tower exhaust  25 ft
- Must limit moisture penetration (using hood, proper velocity, etc.) or manage water that penetrates
- Prevent moisture intrusion into equipment mounted outdoors
- Must use bird screens and prevent bird nesting
General Requirements

5. Systems and Equipment

5.6 Local Capture of Contaminants

- Discharge air from non-combustion equipment that captures contaminants shall be exhausted to the outdoors

5.7 Combustion Air

- Follow manufacturer’s instructions to provide sufficient combustion air and exhaust air for indoor fuel-fired appliances

- Products of combustion from vented appliances shall be vented directly outdoors
General Requirements

5. Systems and Equipment

5.8 Particulate Matter Removal

- Use a filter rated at MERV 6 (or greater) upstream of cooling coils and other wet-surface devices in supply stream
General Requirements
5. Systems and Equipment

5.9 Dehumidification Systems

- Must be able to limit indoor RH to 65% or less at design dew point condition
  - Exception to RH limit - where occupancy requirements or processes dictate higher RH conditions
- Intake airflow must be greater than relief/exhaust during cooling (to minimize moist air infiltration)
At 75°F, 65% RH gives a 13°F "safety margin" before condensation.
5.10 Drain Pans

- Assure drainage without flooding or carryover
- Slope: 0.125” (1/8”) per foot toward outlet
- Drain: located at lowest point, with sufficient diameter prevent overflow
- Drain seal: Shall include P-trap or other seal for negatively pressurized drain pans to prevent ingestion of air while allowing complete drainage (fan on or off)
- Pan size: length at least 1/2 coil height or as necessary to limit carryover
General Requirements
5. Systems and Equipment

5.11 Finned Tube Coils and Heat Exchangers

- Provide drain pan beneath all dehumidifying cooling coil assemblies and all condensate producing heat exchangers

- Select to limit coil pressure drop to 0.75 in.wc.@ 500 fpm face velocity

  - Exception- higher pressure drop can be accommodated by providing access on both sides and providing clear and complete instructions for maintenance
General Requirements
5. Systems and Equipment

5.12 Humidifiers and Water Spray Systems

- Use potable water (or better)
- No downstream devices within absorption distance
  - Exception- devices or obstructions provided with appropriate drain pan
General Requirements
5. Systems and Equipment

5.13 Access for Inspection, Cleaning and Maintenance.

- Install equipment with sufficient working space for access and maintenance
- Provide access doors, panels or other means to allow convenient and unobstructed access for maintenance of the HVAC system
5. Systems and Equipment

5.14 Building Envelope and Interior Surfaces

- Weather barrier to prevent water penetration into envelope
- Vapor retarder or other means to prevent condensation on cold surfaces within envelope
- Seal all exterior seams, joints, penetrations to limit infiltration
- Insulate pipes and ducts expected to have surface temperature below surrounding dew point
General Requirements
5. Systems and Equipment

- 5.15 Buildings with Attached Parking Garages.
  
  Limit infiltration of vehicular exhaust:
  
  - Maintain garage pressure at or below adjacent occupied space
  
  - Or, use a vestibule
  
  - Or, otherwise design to minimize air migration from garage to occupied space
General Requirements
5. Systems and Equipment

5.16 Air Classification and Recirculation.

Designate expected air quality classification for all return transfer or exhaust air (refer to table 5.2, 6.1 and 6.4 for examples of air classes):

- Class 1: Low contaminant concentration
- Class 2: Moderate concentration
- Class 3: Significant concentration
- Class 4: Highly objectionable or potentially harmful concentration
General Requirements
5. Systems and Equipment

- Recirculation limitations
  - Class 1 to anywhere
  - Class 2 to self, similar Class 2 or Class 3 or Class 4
  - Class 3 to self
  - Class 4 to outdoors
5. Systems and Equipment

- Re-designation of air class

  - Air Cleaning- may allow re-designation of the air to a cleaner classification.

  - Transfer- a mixture of air with different classes shall be re-designated with the highest class of classification among the air classes mixed.

  - Energy Recover- energy recovery from class 2 (exhaust) airstreams must have no more than 10% leakage into a class 1 airstream.
General Requirements
5. Systems and Equipment

5.17 Requirements for buildings containing ETS areas and ETS-Free areas.

- Note - Does not purport to achieve acceptable IAQ in ETS areas.
- Spaces must be classified as ETS or ETS-Free
- ETS-Free areas shall be at a positive pressure in relation to ETS areas
General Requirements

5. Systems and Equipment

- 5.17 (continued)
  - ETS-Free areas must be kept separate by means of solid walls, floors, ceilings and doors with automatic closers.
  - Recirculation or transfer from ETS to ETS-Free is prohibited
  - ETS areas must be exhausted to prevent recirculation to ETS-Free areas
Ventilation Requirements

6. Procedures

6.1 General- Three different procedures are available to determine the outdoor airflow rates for mechanical ventilation systems.

- Ventilation Rate Procedure- Prescribes rates & procedures based on typical space contaminant sources & source strengths
Ventilation Requirements

6. Procedures

- IAQ Procedure - Requires calculation of rates based on analysis of contaminate sources, concentrations and perceived air quality targets

- Natural Ventilation Rate Procedure - Prescribes design criteria for ventilation air to be provided through openings to the outdoors
6.2 Ventilation Rate Procedure

6.2.1 Outdoor Air Treatment. If outdoor air is judged to be unacceptable per Section 4.1 assessment:

- MERV 6 filter in PM10 non-attainment regions
- MERV 11 filter in PM2.5 non-attainment regions
- 40% efficient ozone filter in some ozone non-attainment regions
- Other - document assumptions
Air Data: PM$_{10}$
Air Data: Ozone

Above 160 ppb: Fresno, Riverside, Long Beach
6.2 Ventilation Rate Procedure

6.2.2 Zone Calculations.

Use Table 6.1 rates (both cfm/person and cfm/sf) to find breathing zone outdoor airflow:

\[ V_{bz} = R_p \times P_z + R_a \times A_z \]
<table>
<thead>
<tr>
<th>Occupancy Category</th>
<th>People Outdoor Air Rate $R_p$</th>
<th>Area Outdoor Air Rate $R_a$</th>
<th>Default Values</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>cfm/person</td>
<td>cfm/ft²</td>
<td>Occupant Density (see Note 4)</td>
<td>Combined Outdoor Air Rate (see Note 5)</td>
</tr>
<tr>
<td>Office Buildings</td>
<td></td>
<td></td>
<td>#/1000 ft²</td>
<td>cfm/person</td>
</tr>
<tr>
<td>Office space</td>
<td>5</td>
<td>0.06</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Reception areas</td>
<td>5</td>
<td>0.06</td>
<td>30</td>
<td>7</td>
</tr>
</tbody>
</table>
1 Related requirements: The rates in this table are based on all other applicable requirements of this standard being met.

2 Smoking: This table applies to no-smoking areas...

4 Default occupant density: The default occupant density shall be used when actual occupant density is not known.
Ventilation Rate Procedure
Minimum Ventilation Rates

- Table 6-1: Minimum breathing-zone rates for 78 categories

<table>
<thead>
<tr>
<th>Occupancy category</th>
<th>Std 62-2001 Rp cfm/p</th>
<th>Std 62-2001 Ra cfm/ft²</th>
<th>Std 62.1-2010 Rp cfm/p</th>
<th>Std 62.1-2010 Ra cfm/ft²</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>20</td>
<td>0.0</td>
<td>5.0</td>
<td>0.06</td>
</tr>
<tr>
<td>Classroom (ages 5-8)</td>
<td>15</td>
<td>0.0</td>
<td>10.0</td>
<td>0.12</td>
</tr>
<tr>
<td>Lecture classroom</td>
<td>15</td>
<td>0.0</td>
<td>7.5</td>
<td>0.06</td>
</tr>
<tr>
<td>Retail sales</td>
<td>0</td>
<td>0.3</td>
<td>7.5</td>
<td>0.12</td>
</tr>
<tr>
<td>Auditorium</td>
<td>15</td>
<td>0.0</td>
<td>5.0</td>
<td>0.06</td>
</tr>
</tbody>
</table>

*Prescribes both per-person and per-area rates*
## Ventilation Rate Procedure

### Minimum Ventilation Rates

#### Comparison of breathing-zone OA flow

<table>
<thead>
<tr>
<th>Occupancy category</th>
<th>(default density/1000 ft²)</th>
<th>Vbz cfm</th>
<th>Effective cfm/p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>(5p)</td>
<td>100</td>
<td>20.0</td>
</tr>
<tr>
<td>Classroom (ages 5-8)</td>
<td>(25p)</td>
<td>375</td>
<td>15.0</td>
</tr>
<tr>
<td>Lecture classroom</td>
<td>(65p)</td>
<td>975</td>
<td>15.0</td>
</tr>
<tr>
<td>Retail sales</td>
<td>(15p)</td>
<td>300</td>
<td>20.0</td>
</tr>
<tr>
<td>Auditorium</td>
<td>(150p)</td>
<td>2250</td>
<td>15.0</td>
</tr>
</tbody>
</table>

**Std 62-2001**

<table>
<thead>
<tr>
<th>Occupancy category</th>
<th>(default density/1000 ft²)</th>
<th>Vbz cfm</th>
<th>Effective cfm/p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Office</td>
<td>(5p)</td>
<td>85</td>
<td>17.0</td>
</tr>
<tr>
<td>Classroom (ages 5-8)</td>
<td>(25p)</td>
<td>370</td>
<td>15.0</td>
</tr>
<tr>
<td>Lecture classroom</td>
<td>(65p)</td>
<td>550</td>
<td>8.5</td>
</tr>
<tr>
<td>Retail sales</td>
<td>(15p)</td>
<td>233</td>
<td>16.0</td>
</tr>
<tr>
<td>Auditorium</td>
<td>(150p)</td>
<td>810</td>
<td>5.4</td>
</tr>
</tbody>
</table>

**Std 62.1-2010**

*Most OA flow rates go down a little ... some, a lot!*
Zone Outdoor Airflow

- Use Table 6.2 defaults to find zone air distribution effectiveness, \( Ez \)

- Find zone outdoor airflow for each zone:

\[
V_{oz} = \frac{V_{bz}}{Ez}
\]

- \( Ez \) can range from 0.5 to 1.2

- \( Ez=0.8 \) with certain common heating designs. This is 25% more OA.
Ventilation Requirements

6.2 Ventilation Rate Procedure

6.2.3 Single-Zone Systems. Find system-level outdoor air intake flow:

\[ V_{ot} = V_{oz} \]

6.2.4 100\% Outdoor Air Systems. Find system-level outdoor air intake flow:

\[ V_{ot} = \sum V_{oz} \]
6.2.5 Multiple-Zone Recirculating Systems. Use prescribed equations to find outdoor air intake flow ($V_{ot}$):

$$V_{ot} = \frac{1}{E_v} \times \left[ D \sum_{allzones} R_p P_z + \sum_{allzones} R_a A_z \right]$$
Constant-volume supply fan... variable air volume to spaces
Spreadsheets

- There is a spreadsheet supplied with the Users manual that aids in calculating Vot, the air required at the outdoor air intake.
6.2.6 Design for Varying Operating Conditions.

- Must provide required ventilation rates whenever occupied
- May (optional) base design calculations on averages over three time-constants:
  \[ T = 3 \frac{v}{V_{bz}} \] (IP units)
  - Average zone population \((P_z)\) when population varies
  - Average breathing zone outdoor airflow \((V_{bz})\) when primary airflow varies
  - Average outdoor air intake flow \((V_{ot})\) when intake flow varies
6.2 Ventilation Rate Procedure

6.2.7 Dynamic Reset

- May (optional) reset intake (Vot) or zone minimum airflow based on variations in estimated occupancy, efficiency, or actual intake airflow.
Ventilation Requirements

6.3 IAQ Procedure

- Performance-based design approach
- Designed to maintain the concentrations of specific contaminants and
- Achieve the design target level of perceived indoor air quality acceptability
Ventilation Requirements

6.3 IAQ Procedure (cont)

- Allows contaminant removal through air cleaning in addition to ventilation
- Allows tailoring ventilation rate to specifics of the space
- May allow ventilation rates to be reduced below levels prescribed by the Ventilation Rate Procedure.
- IAQ Procedure requirements are being made more specific
Ventilation Requirements

6.3 IAQ Procedure

- Designing for compliance using the IAQ Procedure requires four steps:
  - Identify contaminants of concern, along with sources and emission rates
  - Specify target concentration and exposure time
  - Specify target perceived air quality in terms of percent satisfied
  - Follow an acceptable design procedure to find required airflow values.
Ventilation requirements  
6.3.4 IAQ Procedure

- Rate is larger of that determined by
  - Mass balance analysis, AND
  - Subjective Evaluation, OR
  - Design approaches that have proved successful in similar buildings

- Can combine VRP and IAQP
Ventilation Requirements
6.3.4.1 IAQ Procedure (cont)

- Mass balance analysis equations are provided in Appendix D
- Equations are limited to the steady-state analysis of a single zone
- Not specified by the Standard, but use simulation software for multiple zone systems
Ventilation Requirements

6.3 IAQ Procedure

- May be used:
  - To take credit for low-emitting materials
  - To take credit for air cleaning
  - To achieve specific target concentrations of one or more contaminants
  - To achieve specific levels of perceived IAQ (percent satisfied)

- Does not apply for ETS … no acceptable concentration to reference
Ventilation Requirements

6.4 Natural Ventilation

- Requires occupant controllable openings to outdoors
- Minimum size of openings based on floor area to be ventilated
- Requires mechanical ventilation system be installed – VRP or IAQP
6.4 Natural Ventilation

- Floor area that can be naturally ventilated based on multiple of ceiling height

- Multiplier based on opening configuration
  - One-sided – 2h
  - Two-sided – 5h
  - Corner – 5h along line
## Ventilation Requirements

6.5 Exhaust Ventilation

- Must provide exhaust for some space types.

- Rates prescribed in Table 6.4. For instance:
  
<table>
<thead>
<tr>
<th>Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kitchenettes</td>
<td>0.30 cfm/ft²</td>
</tr>
<tr>
<td>Public toilet</td>
<td>50 cfm/unit</td>
</tr>
<tr>
<td>Art classroom</td>
<td>0.70 cfm/ft²</td>
</tr>
</tbody>
</table>
Construction Requirements

7. Construction/Start-Up

- 7.1 Construction Phase
  - Don’t operate air handlers without filters
  - Protect building materials
  - Protect occupied areas
  - Limit migration of construction contamination into occupied space
Construction Requirements

7. Construction/Start-Up

- Air Duct System Construction shall be in accordance with the SMACNA duct construction standards and NFPA standards governing installation of HVAC systems.

- 7.2 System Start-Up- Defines the testing or inspecting for cleanliness, functional operation and balancing of the HVAC system.
Construction Requirements

7. Construction/Start-Up

- Documents shall be provided to Owner including:
  - Balancing report,
  - As-built construction drawings, and
  - Design criteria with assumptions
8.2 Operations and Maintenance Manual.

- Develop a building operations and maintenance manual which shall include a maintenance schedule with frequencies of tasks.

- O&M manual shall be provided to Owner of the building.
Operating Requirements

8. Operation & Maintenance

- **8.3 Ventilation System Operation** - Operate in accordance with Building O&M Manual and Section 6 when spaces are expected to be occupied.

- **8.4 Ventilation System Maintenance** - Maintain in accordance with Building O&M Manual or as required by Section 8.
Saving Energy

- Careful design
  - Maximize effectiveness and efficiency
  - Vary operation as conditions change
  - Use time averaging when appropriate
Saving Energy

- **DOAS**
  - Separates ventilation from temperature control
  - Allows optimizing ventilation

- **Natural ventilation**
  - Must control mechanical system properly!
Saving Energy

- **IAQ Procedure**
  - Most appropriate for multiple similar buildings
  - Known contaminants that can be cleaned
  - Designer/Owner must accept liability
  - Not LEED!
SSPC 62.1

- Standard is under continuous maintenance
- Anyone can propose a change to the standard
- Notice of proposed changes appears in ASHRAE Standards Action
- Anyone can comment on proposed changes
- Anyone can request an interpretation
ASHRAE Standard 62.1-2010
& Related Activities…

- Std 62.1-2010 is the current version
- IMC & UMC adopted equations and ventilation rates
- Several educational courses are available from ASHRAE
ASHRAE 62.1 Resources

- User’s Manual for 62.1-2010
- IMC & UMC Code adoption
- ALI Short Course and Professional Development Course
- eLearning course
- IAQ Design Guideline is published
- Next publication – ASHRAE 62.1-2013
ASHRAE 62.1 Future Changes

- Complete ventilation shutoff when zero occupancy
- More specifics for multizone DCV
- More refinement for space types
  - Better integration for VRP and Exhaust
  - More space types?
ASHRAE 62.1 Future Changes

- IAQP
  - More design guidance
  - More rigor
  - Code/LEED acceptance?
- General improvements
- Code integration
Questions?

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