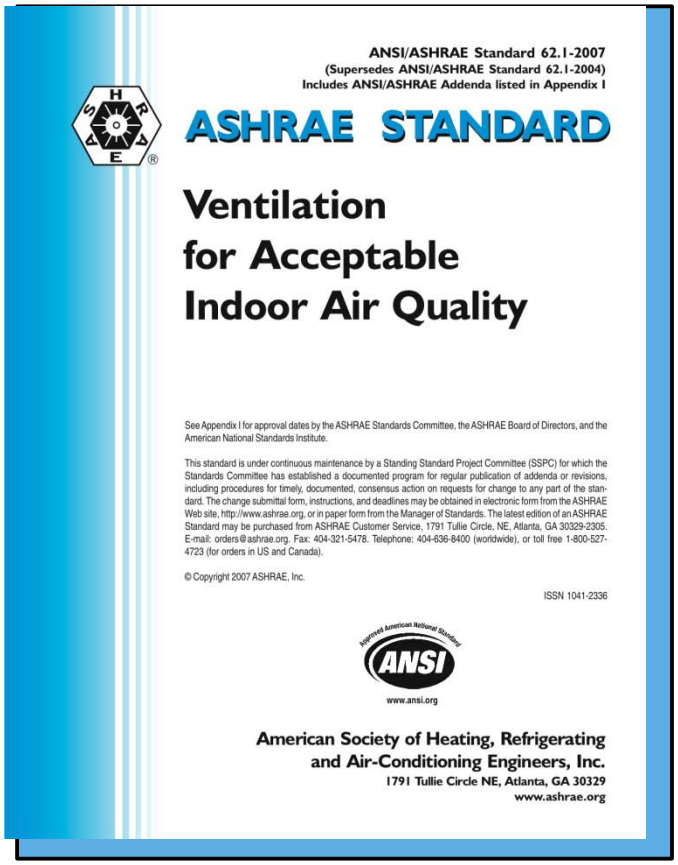
ASHRAE Standard 62.1-2010 Ventilation for Acceptable Indoor Air Quality

Presented by

Roger Hedrick, LEED AP, BEMP

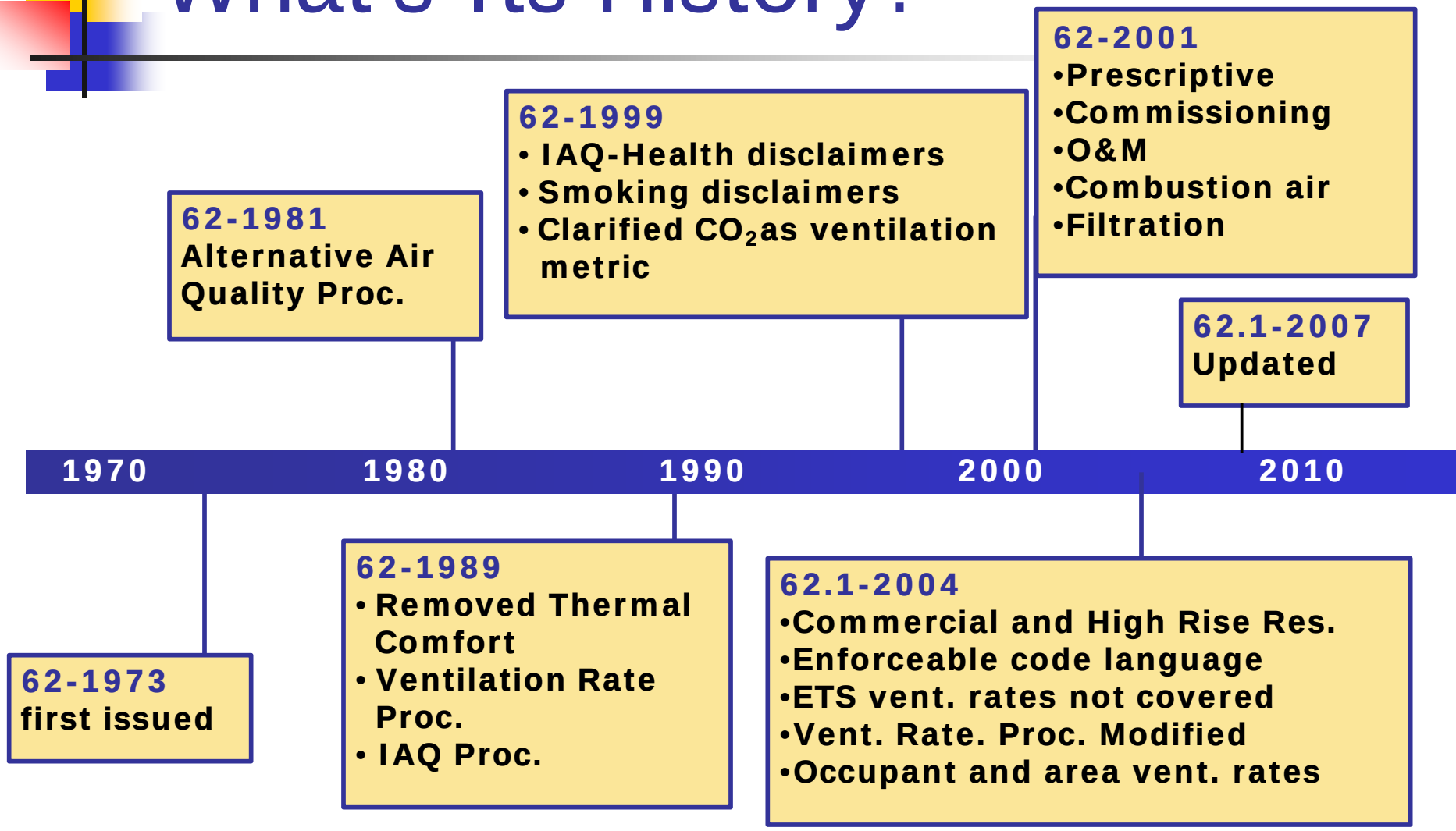
Chair, SSPC 62.1

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?



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

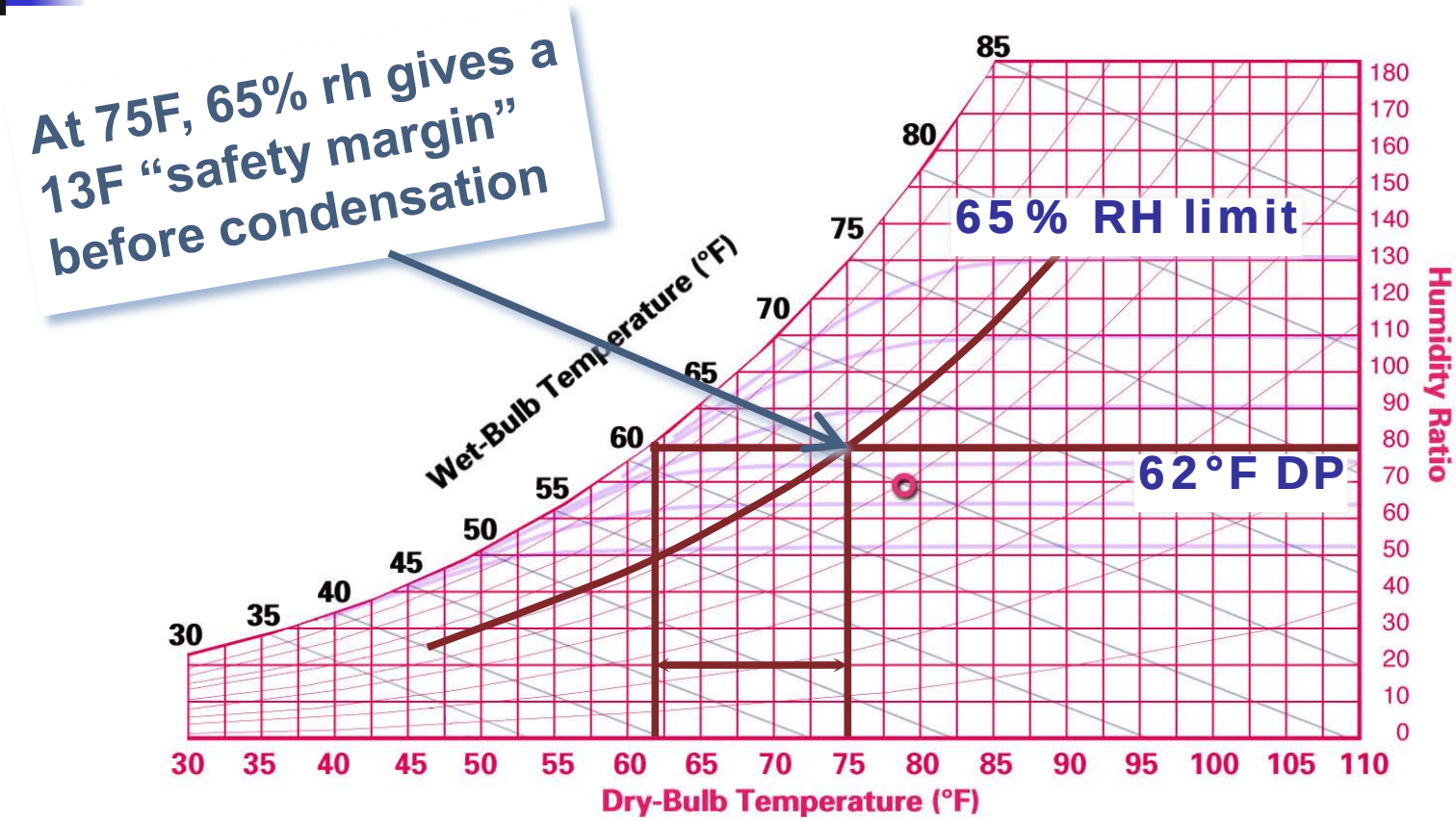
General Requirements
5. Systems and Equipment

- 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)

General Requirements
5.9 Dehumidification Systems



General Requirements
5. Systems and Equipment

- 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

General Requirements
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

General Requirements
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

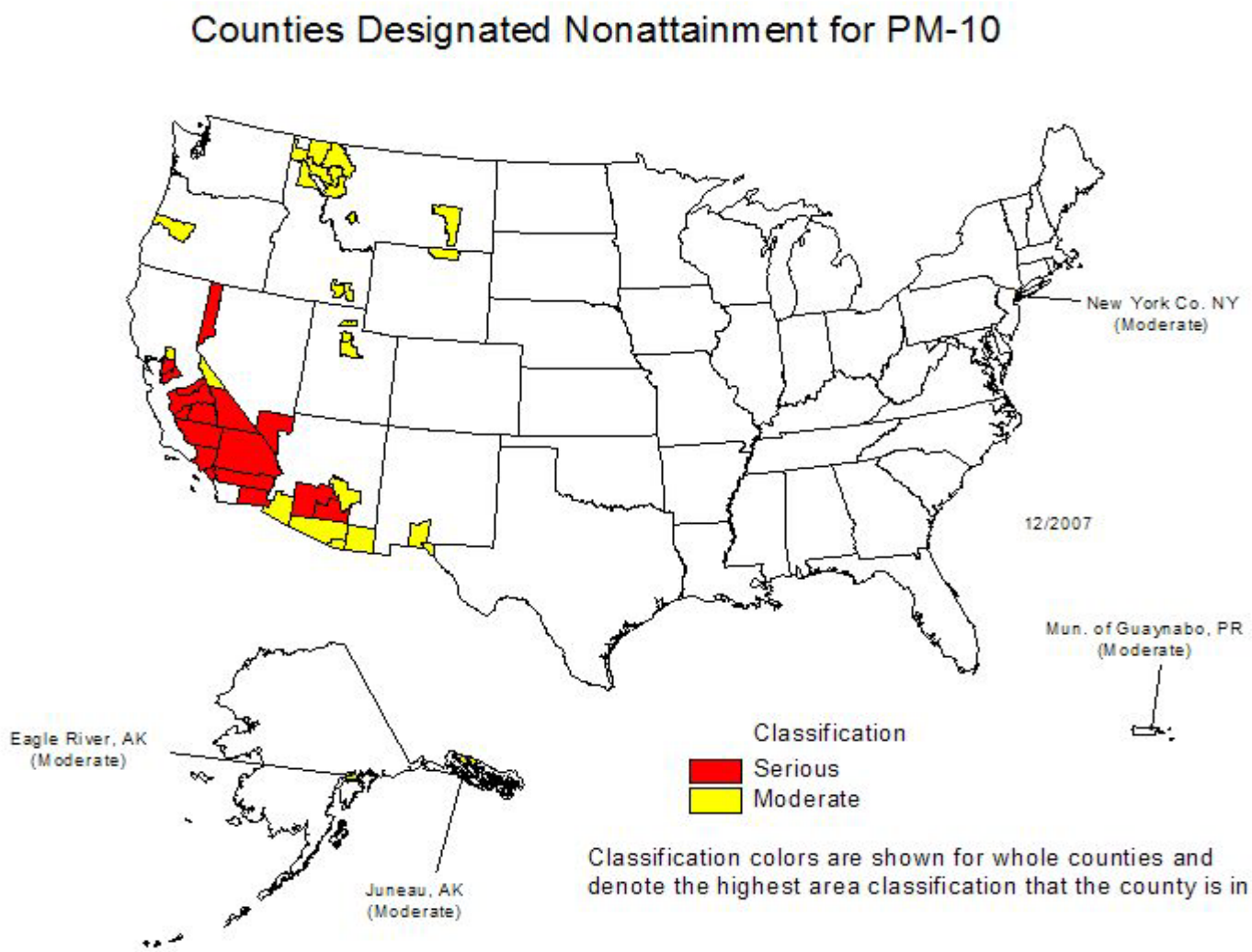
Ventilation Requirements 6. Procedures

- 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

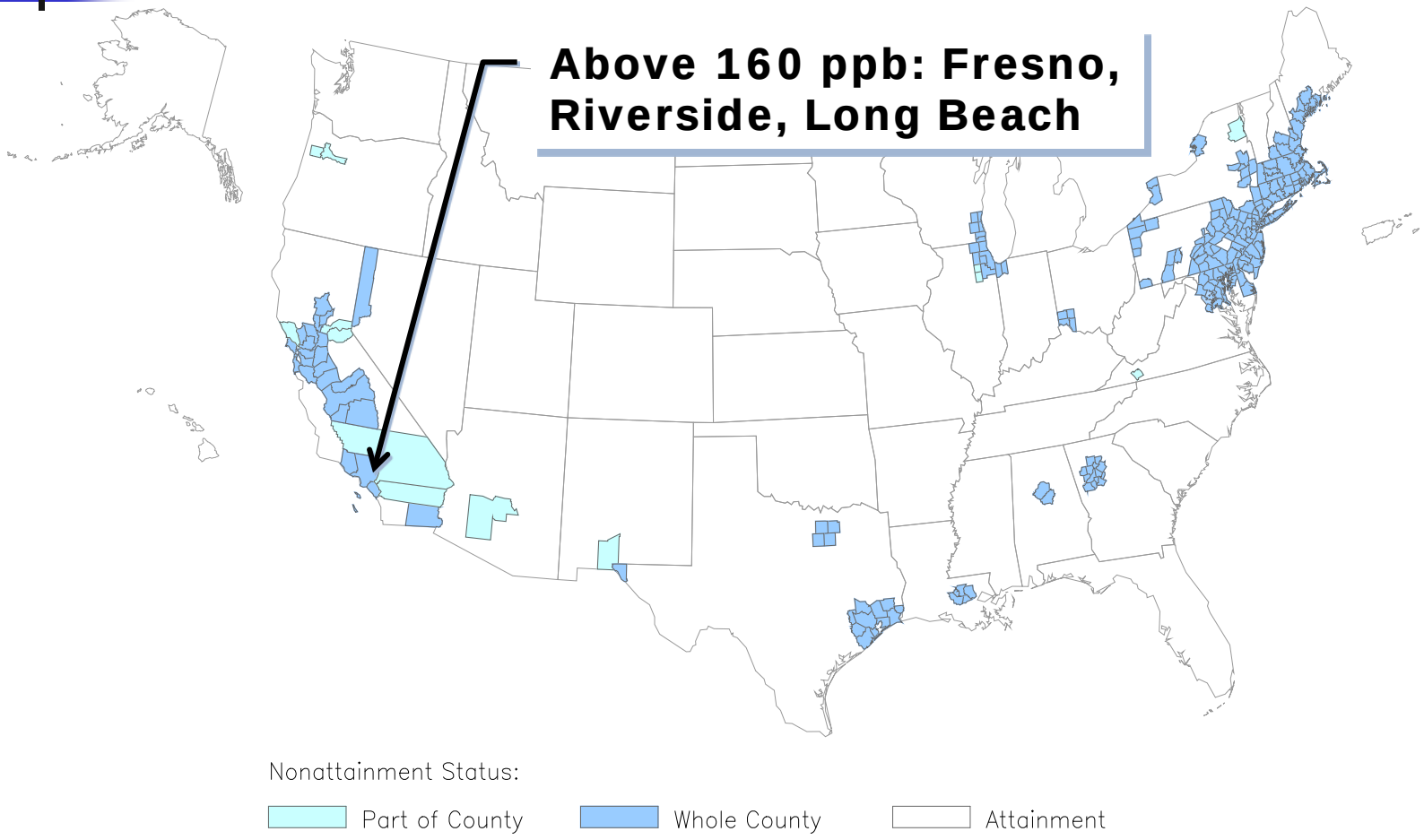
Ventilation Requirements
6.2 Ventilation Rate Procedure

- 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



Ventilation requirements
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:

$$Vbz = Rp*Pz + Ra*Az$$

TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE

(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate R_p	Area Outdoor Air Rate R_a	Notes	Default Values		Air Class
				Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)	
	cfm/person	cfm/ft^2		#/1000 ft^2	cfm/person	
Office Buildings						
Office space	5	0.06		5	17	1
Reception areas	5	0.06		30	7	1

GENERAL NOTES FOR TABLE 6-1

- 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

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

Prescribes both per-person and per-area rates

Ventilation Rate Procedure
Minimum Ventilation Rates

Comparison of breathing-zone OA flow

Occupancy category (default density/1000 ft²)		Std 62-2001 Vbz cfm	Std 62-2001 Effective cfm / p	Std 62.1-2010 Vbz cfm	Std 62.1-2010 Effective cfm / p
Office	(5p)	**100**	**20.0**	**85**	**17.0**
Classroom (ages 5-8)	(25p)	**375**	**15.0**	**370**	**15.0**
Lecture classroom	(65p)	**975**	**15.0**	**550**	**8.5**
Retail sales	(15p)	**300**	**20.0**	**233**	**16.0**
Auditorium	(150p)	**2250**	**15.0**	**810**	**5.4**

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:

$$V_{oz} = V_{bz}/E_z$$

- 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:

$$V_{ot} = V_{oz}$$

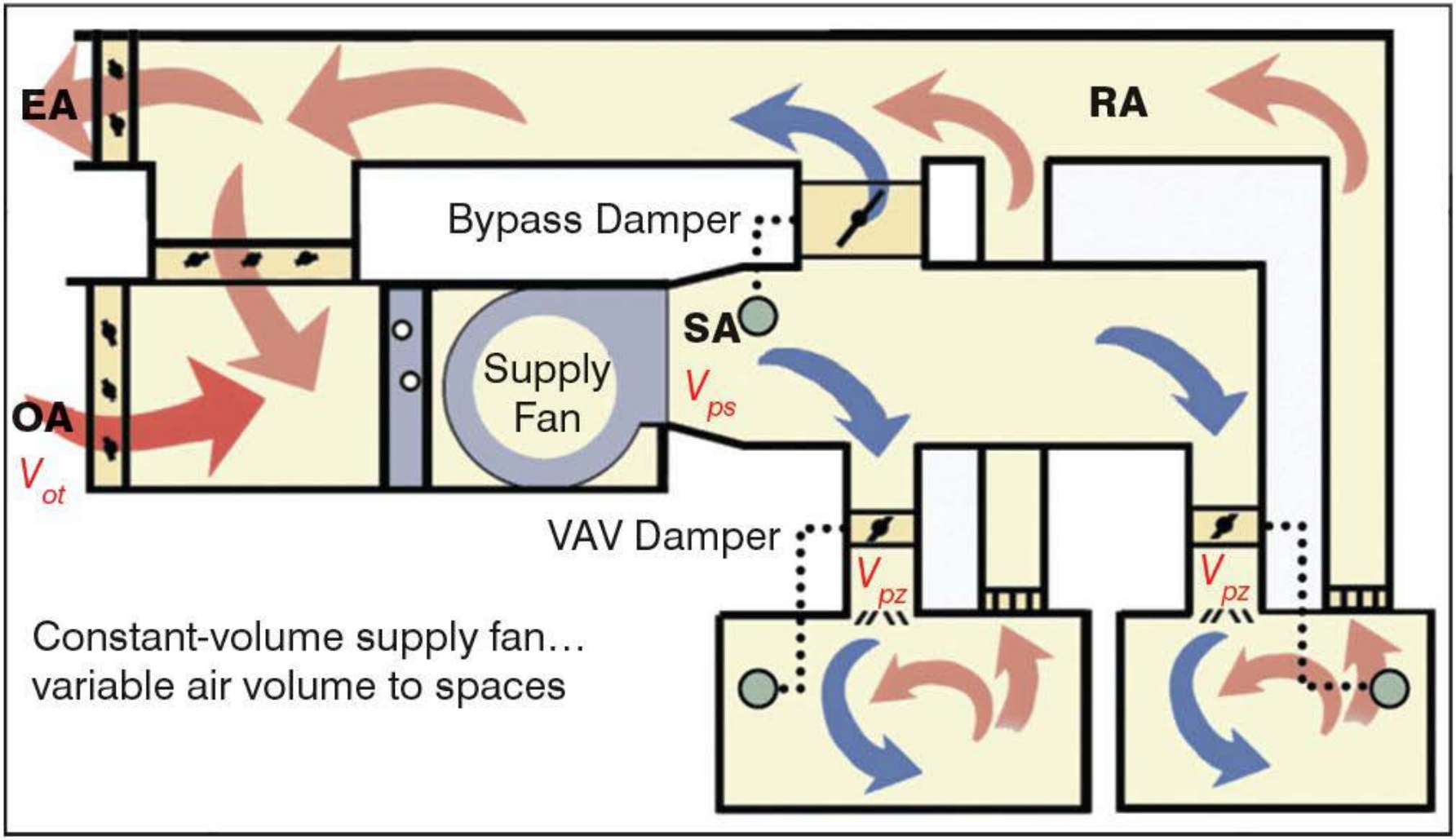
- 6.2.4 100% Outdoor Air Systems. Find system-level outdoor air intake flow:

$$V_{ot} = \Sigma V_{oz}$$

Ventilation Requirements
6.2 Ventilation Rate Procedure

- 6.2.5 Multiple-Zone Recirculating Systems. Use prescribed equations to find outdoor air intake flow (*Vot*):

$$V_{ot} = \frac{1}{E_v} \times \left[D \sum_{allzones} R_p P_z + \sum_{allzones} R_a A_z \right]$$


EA
RA
Bypass Damper
SA
V_{ps}
Supply Fan
OA
V_{ot}
VAV Damper
V_{pz}
V_{pz}
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.

Ventilation Requirements
6.2 Ventilation Rate Procedure

- 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:

    $T = 3 \nu / Vbz$ (IP units)

    - Average zone population (Pz) when population varies
    - Average breathing zone outdoor airflow (Vbz) when primary airflow varies
    - Average outdoor air intake flow (Vot) when intake flow varies

Ventilation Requirements
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

Ventilation Requirements
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:
  - Kitchenettes 0.30 cfm/ft2
  - Public toilet 50 cfm/unit (typ)
  - Art classroom 0.70 cfm/ft2

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

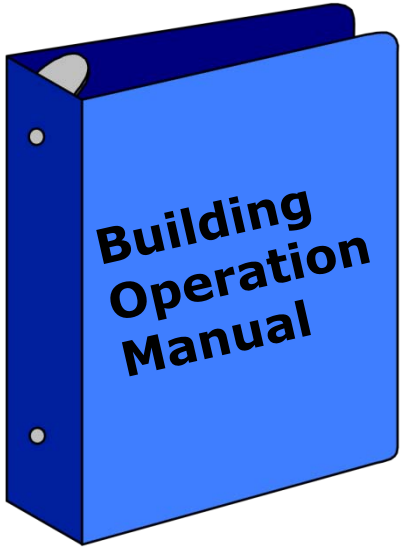
- Air Duct System Construction shall be in accordance with the SMACNA duct construction standards and NFPA standards governing installation of HVAC systems
- 7.2 System Start-Up- Defines the testing or inspecting for cleanliness, functional operation and balancing of the HVAC system

Construction Requirements
7. Construction/Start-Up

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

Operating Requirements
8. Operation & Maintenance

- 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

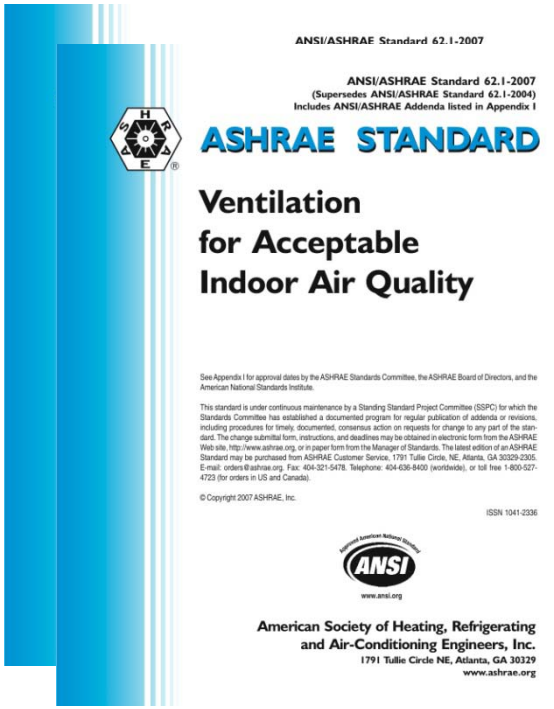
- IAQ Procedure
  - Most appropriate for multiple similar buildings
  - Known contaminants that can be cleaned
  - Designer/Owner must accept liability
  - Not LEED!

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?

Roger Hedrick
rhedrick@archenergy.com
303 459 7481