

Partial Overview of Codes Affecting Mechanical Design

Mechanical Code

Plumbing Code

Fire Code

Wash. State Energy Code



Wash. State VIAQ Code

Washington State Ventilation & Indoor Air Quality Code (WSVIAQ)

Based on Ventilation Principles from *ASHRAE Standard 62*

Remember the definition of Air Conditioning:

In enclosed spaces, the combined treatment of the air to control, as specified, temperature, relative humidity, velocity of motion, and radiant heat energy level, with consideration of the need for removal of air-borne particles and contaminant gases.

Common Causes of Indoor Air Quality Complaints

■ Ventilation systems	48.3%
■ Inside contamination	17.7%
■ Outside contamination	10.3%
■ Poor humidity control	4.4%
■ Contamination from	3.4%
■ Hypersensitivity	3.0%
■ Cigarette smoking	2.0%
■ Other	10.9%

Factors Attributed to Ventilation

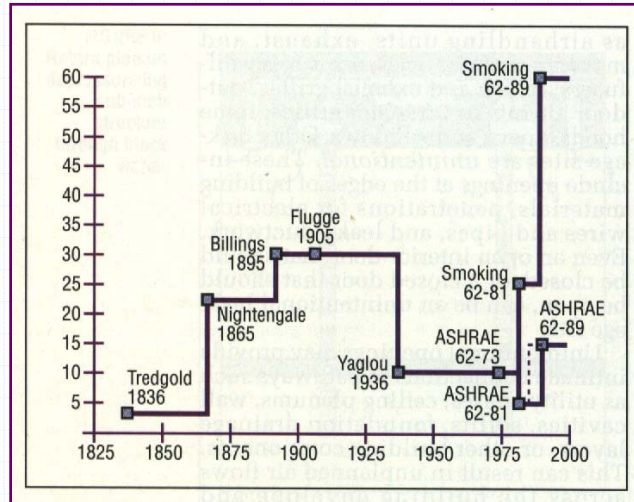
Maintenance factors

◆ Inadequate filtration	65%
◆ Malfunctioning drain pans/lines	60%
◆ Inadequate access to HVAC	60%
◆ Contaminated duct linings	45%
◆ Malfunctioning humidifiers	20%

Design Factors

◆ Inadequate outdoor air (OA)	75%
◆ Inadequate supply air to spaces	65%
◆ Inadequate return/exhaust air from space	70%

Historical Min. Ventilation Rates



Acceptable Outdoor Air

TABLE 1
National Primary Ambient-Air Quality Standards
for Outdoor Air as Set by the
U.S. Environmental Protection Agency (Ref 19)

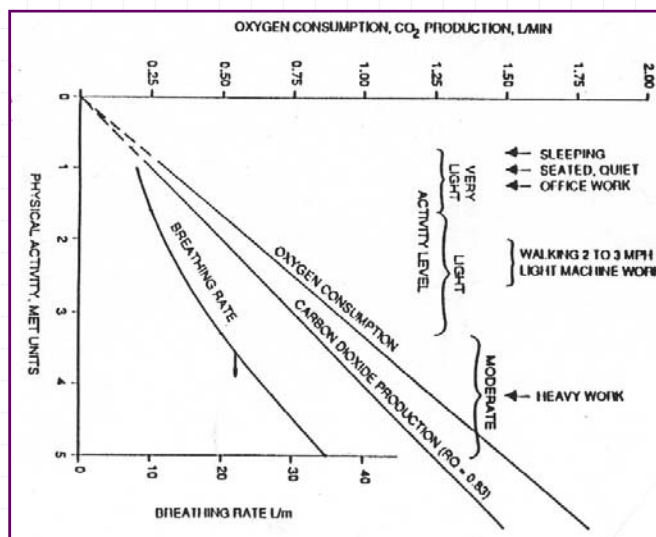
Contaminant	Long term			Short term		
	Concentration ug/m ³	Averaging ppm		Concentration ug/m ³	Averaging ppm	
Sulfur dioxide	80	0.03	1 year	365	0.14	24 hours
Total Particulate	75 ^a	—	1 year	260	—	24 hours
Carbon monoxide				40,000	35	1 hour
Carbon monoxide				10,000	9	8 hours
Oxidants (ozone)				235 ^b	0.12 ^b	1 hour
Nitrogen dioxide	100	0.055	1 year			
Lead	1.5	—	3 months ^c			

6.1.3 Ventilation Requirements

Indoor air quality shall be considered acceptable if the required rates of acceptable outdoor air in Table 2 are provided for the occupied space

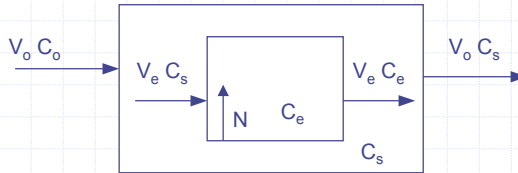
- ◆ Assumes contaminants produced are proportional to number of people in the space.
- ◆ CO₂ is used as an indicator of air quality.
- ◆ 1000 ppm CO₂ recommended to satisfy comfort (odor) criteria.
- ◆ Outside air quantities are based upon assumed occupant activity, densities, and presence of predictable contaminants are selected to control CO₂ concentrations

Carbon Dioxide Production



Appendix D

Rationale for OA based on CO₂



V_o = OA flow

V_e = breathing rate

N = CO₂ generation per person

C_e = CO₂ conc. In breath

C_s = CO₂ conc. In space

C_o = CO₂ conc. In OA

$$V_o = N / (C_s - C_o)$$

Rationale for 15 CFM/Person

$$V_o = N / (C_s - C_o)$$

$N = 0.30$ liters/min at 1.2 METS

$C_s = 1000$ ppm = $1000/1,000,000 = 0.001$

$C_o = 300$ ppm = $300/1,000,000 = 0.0003$

$$\begin{aligned} V_o &= \frac{0.30 \text{ liter/min}}{(0.001 - 0.0003) \times 60 \text{ sec/min}} \\ &= 7.14 \text{ liter/sec} \\ &= 15 \text{ cfm} \end{aligned}$$

Wash State VIAQ Code

- ◆ Basis of State VIAQ Code is Standard 62
- ◆ Section 304.1 Requirements
 - Natural Ventilation Requirements
 - ◆ Uniform Building Code
 - Mechanical Ventilation
 - ◆ Outdoor air quantities per Table 3-4
 - ◆ Occ Densities are greater of Table 3-4 or known.
 - ◆ Exception
 - Occupants assumed can be no less than 50% of Table 3-4
 - Density must be known
 - Density must be documented on the plans

International Building Code

Though IBC is widely adopted, many jurisdictions amend based on UBC – which reads:

occupancies customarily occupied by human beings shall be provided with natural ventilation by means of openable exterior openings with an area not less than 1/20th of the total floor area or shall be provided with a mechanically operated ventilation system.

Table 3-4

TABLE 3-4
OUTDOOR AIR REQUIREMENTS FOR VENTILATION¹
Occupancies not Subject to Sections 302 and 303

Application	Estimated Maximum ² Occupancy P/1000 ft ² or 100 m ²	Outdoor Air Requirements cfm/person
Dry Cleaners, Laundries³		
Commercial laundry	10	25
Commercial dry cleaner	30	30
Storage, pick up	30	35
Coin-operated laundries	20	15
Coin-operated dry cleaner	20	15
Dwelling Units in Buildings Greater Than Four Stories or Attached to I-Occupancy Facilities		
Bedrooms & living areas ^{2a}		15
Offices		
Office space ⁹	7	20
Reception area	60	15
Telecommunication centers and data entry areas	60	20
Conference rooms	50	20

Ventilation Exercise

◆ What is the ventilation requirement for the office space shown below?

