DESIGN OPERATIVE TEMPERATURE AND HUMIDITY

$$T_{operative} = T_{db}$$

without :

clothing adjustment

radiation adjustemnt

activity adjustement

draft adjustment

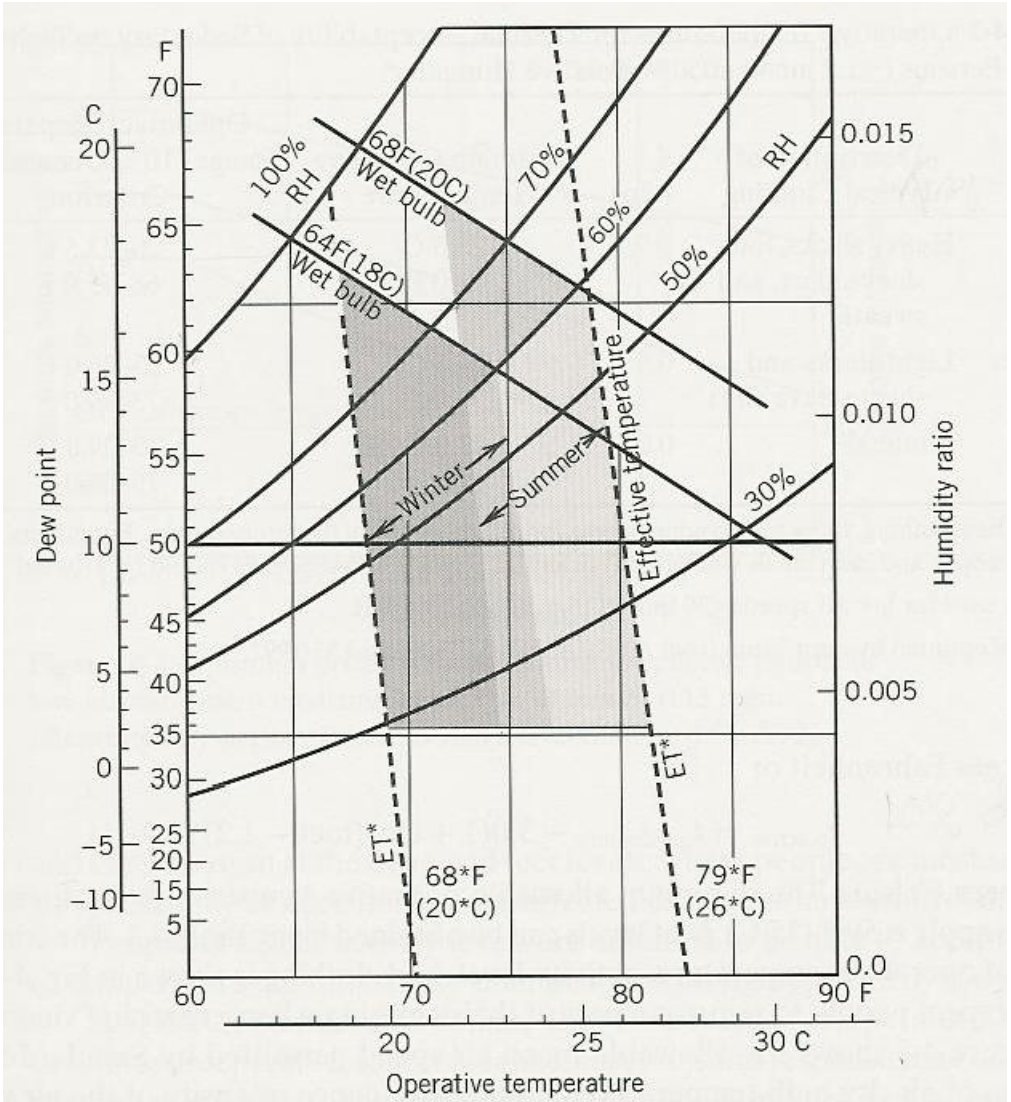


Figure 4-2 Acceptable ranges of operative temperature and humidity for people in typical summer and winter clothing during light and primarily sedentary activity (<1.2 met). (Reprinted by permission from ASHRAE Standard 55-1992)

RADIATION

$$T_{mrt}^4 = T_g^4 + C\overline{V}^{.5}\left(T_g - T_{air}\right) \quad (4-1)$$

T_{mrt} = Mean Radiant Temperature

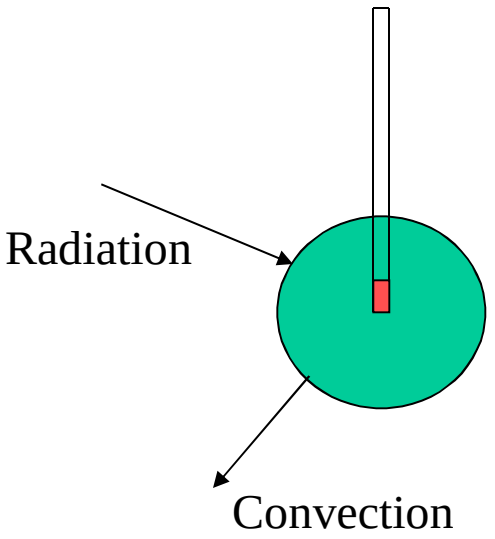
T_g = Globe Temperature

T_{air} = ambient ai rtemperature

$\overline{V}$ = air velocity, fpm, m/sec

$C = .103 \times 10^9$ English

$C = .247 \times 10^9$ Metric



T_O = Operative Temperature

$$T_O = \frac{T_{mrt} + T_{air}}{2}$$

CLOTHING AND ACTIVITY

$$T_{operative,active}{}^{O}C = T_{operative,passive} - 3.01(1+clo)(met-1.2)$$

$$T_{operative,active}{}^{O}F = T_{operative,passive} - 5.4(1+clo)(met-1.2)$$

$clo = .05$ to 1.0

$met = 1.2$ (passive) to $3.$

CONTAMINANT CONTROL

CO_2 Mass Balance

$$\text{mass } CO_2 \text{ in} + \text{mass } CO_2 \text{ generated} = \text{mass } CO_2 \text{ leaving}$$

$$Q_t C_e + N = Q_t C_S$$

Q_t = air flow entering and leaving thes pace, $ft^3/min, m^3/min$

C_S = space contaminant concentration,

$$ft^3_{\text{contaminant}}/ft^3_{\text{air}}, m^3_{\text{contaminant}}/m^3_{\text{air}}$$

C_e = entering air concentration, Table 4-4, p105

N = contaminant generation, ft^3/time, m^3/time

Ventilation Requirements, Fig 4-2, p103

Local Building Codes - air changes/hour (ACH)

4-16

$$Q_t C_e + N = Q_t C_S$$

$$1000\frac{\text{ft}^3\text{air}}{\text{min}} \times \left(\frac{200\ \text{parts}\ CO_2}{1{,}000{,}000}\right) + .25\frac{\text{ft}^3\ CO_2}{\text{min}} = 1000\frac{\text{ft}^3\text{air}}{\text{min}} \times C_S$$

$$.2 + .25 = 1000 \times C_S$$

$$C_S = .00045$$

$$C_S = 450\ \text{parts}\ CO_2/1000000\ \text{parts air}$$

$$C_S = 450\ \text{volumes of}\ CO_2/1000000\ \text{volumes of air}$$

$$.472\ \text{m}^3/\text{sec}\left(\frac{200}{1000000}\right) + .000118\ \text{m}^3/\text{sec} = .472\ \text{m}^3/\text{sec} \times C_e$$

$$.0000944 + .000118 = .472\frac{\text{m}^3}{\text{sec}} \times C_e$$

$$C_e = .00045$$

$$C_e = 450\ \text{ppm}$$

Table 4-3 Engineering Data—High-Performance Dry-Media Filters (Corresponds to Efficience Data of Fig. 4-8)

Standard Size Rated Capacity[a]	Meter: Inch:	0.3 × 0.6 × 0.2 12 × 24 × 8		0.3 × 0.6 × 0.3 12 × 24 × 12		0.6 × 0.6 × 0.2 24 × 24 × 8		0.6 × 0.6 × 0.3 24 × 24 × 12		Pressure Loss Inches of Water	Pa
		ft^3/min	m^3/s	ft^3/min	m^3/s	ft^3/min	m^3/s	ft^3/min	m^3/s		
Media Type	M-2[b]	900	0.42	1025	0.48	1725	0.81	2000	0.94	0.15	37.4
	M-15	900	0.42	1025	0.48	1725	0.81	2000	0.94	0.35	87.2
	M-100	650	0.30	875	0.41	1325	0.62	1700	0.80	0.40	100.0
	M-200	450	0.21	630	0.29	920	0.43	1200	0.56	0.40	100.0
Effective filtering area (all media types):		14.5 ft^2	1.35 m^2	20.8 ft^2	1.93 m^2	29.0 ft^2	2.69 m^2	41.7 ft^2	3.87 m^2		

[a]Filters may be operated from 50 to 120 percent of the rated capacities with corresponding changes in pressure drop.
[b]The M-2 is available in 2-in. thickness and standard sizes with a nominal rating of 0.28 in. wg at 500 fpm face velocity.

$$\Delta p = \Delta p_{\substack{\text{reference} \\ \text{(table)}}} \times \left(\frac{Q}{Q_{\substack{\text{reference} \\ \text{(table)}}}} \right)^2$$

HEPA

High Efficiency Particle Air Filter

99.9%, .3 microns

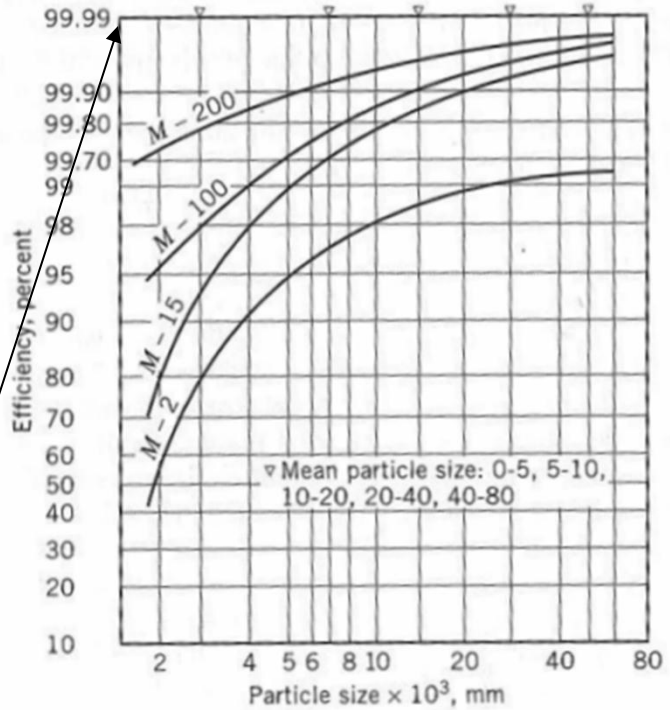


Figure 4-8 Gravimetric efficiency of high-performance dry-media filters.