

temperature was accepted as the *winter comfort line* or *optimum effective temperature*. These tests were made in 1923 in rooms with wall surface temperatures approximately the same as the room dry-bulb temperature. For walls of large area having unusually low surface temperatures, how-

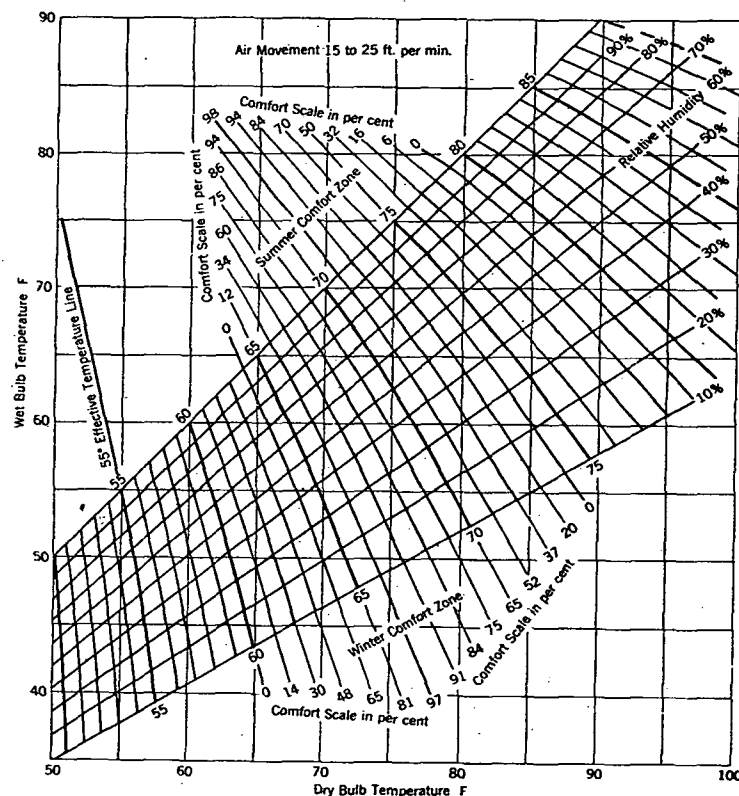


FIG. 3. SEASONAL VARIATION IN THE COMFORT ZONE^{a-b}

^aDetermination of the Comfort Zone, by F. C. Houghten and C. P. Yaglou (A.S.H.V.E. TRANSACTIONS Vol. 29, 1923).

^bThe Summer Comfort Zone; *Climate and Clothing*, by C. P. Yaglou and Philip Drinker (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).

ever, a somewhat higher range of effective temperature is required to compensate for the increased loss of heat from the body by radiation. Although Fig. 2 shows the comfort zone as extending from 0 per cent relative humidity to 100 per cent relative humidity, it is probable that the limits should be 30 per cent and 70 per cent since extreme humidities are not conducive to comfort. Furthermore, 30 per cent to 70 per cent is the approximate range used in the experiments at the A.S.H.V.E. Laboratory.

The *summer comfort zone* for men and women in the United States

wearing customary warm weather clothing ranges from about 67 deg to 75 deg ET, based on studies made at the Harvard School of Public Health. The probable optimum effective temperature is 71 deg. These effective temperatures average about 4 deg higher than those found in winter when customary winter clothing was worn. Fig. 3 shows the summer and winter comfort zones superimposed upon the effective temperature chart designed at the A.S.H.V.E. Laboratory¹⁰. Young men as a general rule prefer conditions in the cool region of the comfort zone, and women and older people in the warm region of the comfort zone.

Crowding the experimental chamber lowered the optimum effective temperature from 70.8 deg when the gross floor area per occupant was 44 sq ft and the air space 380 cu ft to 69.4 deg when the floor area was reduced to 14 sq ft and the air space to 120 cu ft per occupant.

Comfort Chart Examples

Example 2. Given dry-bulb and wet-bulb temperatures of 75 and 68 F, respectively. First, what is the effective temperature? Second, is this condition warmer or cooler than 80 F dry-bulb and 60 F wet-bulb?

Solution. The first condition is given by the intersection of the 75 F dry-bulb line and the 68 F wet-bulb line (Fig. 2). The effective temperature of 72.1 deg is given by the numerical value of the effective temperature line passing through this point and indicated by the scale along the saturation curve. The second condition is given by the intersection of 80 F dry-bulb and 60 F wet-bulb and is 71.8 deg ET. It is therefore 0.3 deg ET cooler than the first condition.

Example 3. Given 76 F dry-bulb and 61 F wet-bulb, how many degrees difference between this condition and the winter comfort line or 66 deg ET?

Solution. The effective temperature for this condition is given by the intersection of the 76-F dry-bulb and 61-F wet-bulb lines and is 70 deg ET, which is 4 deg ET warmer than the comfort line.

Example 4. Given the dry and wet-bulb temperatures in a room 76 and 54 F, respectively. What air velocity will be necessary to make this condition more comfortable, that is, 66 deg ET?

Solution. From Fig. 1 it will be seen that this condition has an effective temperature of 68.0 deg in still air, while an air velocity of 200 fpm gives an effective temperature of 65.7 deg. A velocity of about 160 fpm will give the desired result.

Example 5. Given a condition having dry and wet-bulb temperatures of 90 F and 85 F, respectively. How much cooler will this condition feel if air at a velocity of 300 fpm is supplied instead of still air?

Solution. This condition in still air has an effective temperature of 86.6 deg (Fig. 1) while if the air has a velocity of 300 fpm it will have an effective temperature of 83.8 deg. Cooling of 2.8 deg ET will be produced by the 300-fpm air velocity.

Adaptation to Seasonal Weather

The variation in the comfort zone (Fig. 3) from winter to summer is probably due partly to adaptation to seasonal weather and partly to differences in the clothing worn in the two seasons.

The optimum effective temperature was found to follow the average monthly outdoor temperature more closely than the prevailing outdoor temperature. It remained at approximately the same value in July, August and September, and although the average monthly temperature did not vary much, the prevailing outdoor temperature ranged from 70 F

¹⁰The Summer Comfort Zone; *Climate and Clothing*, by C. P. Yaglou and Philip Drinker (A.S.H.V.E. TRANSACTIONS, Vol. 35, 1929).