Climate by Design INTERNATIONAL

# Dew Point Reference

| Dew Point (°F) | Dew Point (°C) | Humidity Ratio (Gr/Lb) | Vapor Pressure (In. Hg) |
|---|---|---|---|
| 80 | 26.7 | 156.4 | 1.033 |
| 79 | 26.1 | 151.1 | 1.000 |
| 78 | 25.6 | 146.1 | 0.967 |
| 77 | 25 | 141.2 | 0.936 |
| 76 | 24.4 | 136.4 | 0.905 |
| 75 | 23.9 | 131.8 | 0.876 |
| 74 | 23.3 | 127.3 | 0.847 |
| 73 | 22.8 | 123.0 | 0.819 |
| 72 | 22.2 | 118.8 | 0.792 |
| 71 | 21.7 | 114.7 | 0.765 |
| 70 | 21.1 | 110.8 | 0.740 |
| 69 | 20.6 | 107.0 | 0.715 |
| 68 | 20 | 103.3 | 0.691 |
| 67 | 19.4 | 99.7 | 0.667 |
| 66 | 18.9 | 96.2 | 0.645 |
| 65 | 18.3 | 92.9 | 0.622 |
| 64 | 17.8 | 89.6 | 0.601 |
| 63 | 17.2 | 86.5 | 0.580 |
| 62 | 16.7 | 83.4 | 0.560 |
| 61 | 16.7 | 80.5 | 0.541 |
| 60 | 15.6 | 77.6 | 0.522 |
| 59 | 15 | 74.8 | 0.504 |
| 58 | 14.4 | 72.2 | 0.486 |
| 57 | 13.9 | 69.6 | 0.469 |
| 56 | 13.3 | 67.1 | 0.452 |
| 55 | 12.8 | 64.6 | 0.436 |
| 54 | 12.2 | 62.3 | 0.420 |
| 53 | 11.7 | 60.0 | 0.405 |
| 52 | 11.1 | 57.8 | 0.391 |
| 51 | 10.6 | 55.7 | 0.376 |
| 50 | 10 | 53.6 | 0.363 |
| 49 | 9.4 | 51.6 | 0.349 |
| 48 | 8.9 | 49.7 | 0.337 |
| 47 | 8.3 | 47.9 | 0.324 |
| 46 | 7.8 | 46.1 | 0.312 |
| 45 | 7.2 | 44.3 | 0.300 |
| 44 | 6.7 | 42.7 | 0.289 |
| 43 | 6.1 | 41.0 | 0.278 |
| 42 | 5.6 | 39.5 | 0.268 |
| 41 | 5 | 38.0 | 0.258 |
| 40 | 4.4 | 36.5 | 0.248 |
| 39 | 3.9 | 35.1 | 0.238 |
| 38 | 3.3 | 33.7 | 0.229 |
| 37 | 2.8 | 32.4 | 0.220 |
| 36 | 2.2 | 31.2 | 0.212 |
| 35 | 1.7 | 29.9 | 0.204 |
| 34 | 1.1 | 28.8 | 0.196 |

| Dew Point (°F) | Dew Point (°C) | Humidity Ratio (Gr/Lb) | Vapor Pressure (In. Hg) |
|---|---|---|---|
| 33 | 0.6 | 27.6 | 0.188 |
| 32 | 0.0 | 26.5 | 0.180 |
| 31 | -0.6 | 25.3 | 0.172 |
| 30 | -1.1 | 24.2 | 0.165 |
| 29 | -1.7 | 23.1 | 0.157 |
| 28 | -2.2 | 22.0 | 0.150 |
| 27 | -2.8 | 21.0 | 0.143 |
| 26 | -3.3 | 20.1 | 0.137 |
| 25 | -3.9 | 19.1 | 0.130 |
| 24 | -4.4 | 18.3 | 0.124 |
| 23 | -5.0 | 17.4 | 0.119 |
| 22 | -5.5 | 16.6 | 0.113 |
| 21 | -6.1 | 15.8 | 0.108 |
| 20 | -6.7 | 15.1 | 0.103 |
| 19 | -7.2 | 14.4 | 0.098 |
| 18 | -7.8 | 13.7 | 0.093 |
| 17 | -8.3 | 13.0 | 0.089 |
| 16 | -8.9 | 12.4 | 0.085 |
| 15 | -9.4 | 11.8 | 0.081 |
| 14 | -10.0 | 11.2 | 0.077 |
| 13 | -10.6 | 10.7 | 0.073 |
| 12 | -11.1 | 10.2 | 0.070 |
| 11 | -11.7 | 9.7 | 0.066 |
| 10 | -12.2 | 9.2 | 0.063 |
| 9 | -12.8 | 8.8 | 0.060 |
| 8 | -13.3 | 8.3 | 0.057 |
| 7 | -13.9 | 7.9 | 0.054 |
| 6 | -14.4 | 7.5 | 0.051 |
| 5 | -15.0 | 7.1 | 0.049 |
| 4 | -15.6 | 6.8 | 0.046 |
| 3 | -16.1 | 6.4 | 0.044 |
| 2 | -16.7 | 6.1 | 0.042 |
| 1 | -17.2 | 5.8 | 0.040 |
| 0 | -17.8 | 5.5 | 0.038 |
| -1 | -18.3 | 5.2 | 0.036 |
| -2 | -18.9 | 5.0 | 0.034 |
| -3 | -19.4 | 4.7 | 0.032 |
| -4 | -20.0 | 4.5 | 0.030 |
| -5 | -20.6 | 4.2 | 0.029 |
| -6 | -21.1 | 4.0 | 0.027 |
| -7 | -21.7 | 3.8 | 0.026 |
| -8 | -22.2 | 3.6 | 0.025 |
| -9 | -22.8 | 3.4 | 0.023 |
| -10 | -23.3 | 3.2 | 0.022 |
| -11 | -23.9 | 3.1 | 0.021 |
| -12 | -24.4 | 2.9 | 0.020 |
| -13 | -25.0 | 2.7 | 0.019 |

| Dew Point (°F) | Dew Point (°C) | Humidity Ratio (Gr/Lb) | Vapor Pressure (In. Hg) |
|---|---|---|---|
| -14 | -25.6 | 2.6 | 0.018 |
| -15 | -26.1 | 2.4 | 0.017 |
| -16 | -26.7 | 2.3 | 0.016 |
| -17 | -27.2 | 2.2 | 0.015 |
| -18 | -27.8 | 2.1 | 0.014 |
| -19 | -28.3 | 1.9 | 0.013 |
| -20 | -28.9 | 1.8 | 0.013 |
| -21 | -29.4 | 1.7 | 0.012 |
| -22 | -30.0 | 1.6 | 0.011 |
| -23 | -30.6 | 1.5 | 0.011 |
| -24 | -31.1 | 1.5 | 0.010 |
| -25 | -31.7 | 1.4 | 0.009 |
| -26 | -32.2 | 1.3 | 0.009 |
| -27 | -32.8 | 1.2 | 0.008 |
| -28 | -33.3 | 1.2 | 0.008 |
| -29 | -33.9 | 1.1 | 0.007 |
| -30 | -34.4 | 1.0 | 0.007 |
| -31 | -35.0 | 1.0 | 0.007 |
| -32 | -35.6 | 0.9 | 0.006 |
| -33 | -36.1 | 0.9 | 0.006 |
| -34 | -36.7 | 0.8 | 0.006 |
| -35 | -37.2 | 0.8 | 0.005 |
| -36 | -37.8 | 0.7 | 0.005 |
| -37 | -38.3 | 0.7 | 0.005 |
| -38 | -38.9 | 0.6 | 0.004 |
| -39 | -39.4 | 0.6 | 0.004 |
| -40 | -40.0 | 0.6 | 0.004 |
| -41 | -40.6 | 0.5 | 0.004 |
| -42 | -41.1 | 0.5 | 0.003 |
| -43 | -41.7 | 0.5 | 0.003 |
| -44 | -42.2 | 0.4 | 0.003 |
| -45 | -42.8 | 0.4 | 0.003 |
| -46 | -43.3 | 0.4 | 0.003 |
| -47 | -49.9 | 0.4 | 0.002 |
| -48 | -44.4 | 0.3 | 0.002 |
| -49 | -45.0 | 0.3 | 0.002 |
| -50 | -45.6 | 0.3 | 0.002 |
| -51 | -46.1 | 0.3 | 0.002 |
| -52 | -46.7 | 0.3 | 0.002 |
| -53 | -47.2 | 0.2 | 0.002 |
| -54 | -47.8 | 0.2 | 0.002 |
| -55 | -48.3 | 0.2 | 0.001 |
| -56 | -48.9 | 0.2 | 0.001 |
| -57 | -49.4 | 0.2 | 0.001 |
| -58 | -50.0 | 0.2 | 0.001 |
| -59 | -50.6 | 0.2 | 0.001 |
| -60 | -51.1 | 0.1 | 0.001 |

# Humidity Control Design Logic

**Dehumidification Capacity**
What is the dehumidification capacity of the supply air? Said another way; how much moisture can a known amount of air with a known humidity ratio remove from the conditioned space every hour?

CFM → Supply Grains/Lb → Space Grains/Lb

$$\frac{\text{Grains}}{\text{Hr}} = 4.5 \times \text{CFM} \times \Delta\ \text{Gr/Lb}$$

**Required Supply Air Humidity Ratio**
If the supply air flow rate and the indoor humidity ratio are fixed, how dry does the supply air have to be in order to remove a known internal moisture load?

CFM → Supply Grains/Lb → Space Gr/Lb Moisture Load Gr/Hr

$$\frac{\Delta\ \text{Grains}}{\text{Lb}} = \frac{\text{Gr/Hr}}{4.5 \times \text{CFM}}$$

**Required Supply Air Flow Rate**
If the supply air flow humidity ratio and the indoor humidity ratio are both fixed, how much supply air is needed to remove a known internal moisture load?

CFM → Supply Grains/Lb → Space Grains/Lb Moisture Load Gr/Hr

$$\text{CFM} = \frac{\text{Gr/Hr}}{4.5 \times \Delta\ \text{Gr/Lb}}$$

**Mixed-air humidity Ratio**
When two air flows with different humidity ratios are blended, what will be the humidity ratio of the resulting mixture?

CFM 1 Gr/Lb1 → CFM3 Gr/Lb3 ← CFM 2 Gr/Lb2

$$\text{Gr/Lb3} = \frac{(\text{CFM1} \times \text{Gr/Lb1}) + (\text{CFM2} \times \text{Gr/Lb2})}{\text{CFM3}}$$

Conversion: 7000 Grains = 1 Pound

**Dehumidified Air vs. Bypass Air**
A dehumidifier might need to dry only part of the supply air rather than its entire volume. How much of the supply air should be dried by the dehumidifier in order to bring the entire supply air flow to the required humidity ratio?

CFM 1 Gr/Lb 1 → D/H → CFM3 Gr/Lb2 → CFM1 Gr/Lb3 → CFM3; Gr/Lb 1 → D/H

$$\text{CFM3} = \frac{(\text{CFM1} \times \text{Gr/Lb1}) - (\text{CFM1} \times \text{Gr/Lb3})}{\text{Gr/Lb1} - \text{Gr/Lb2}}$$

**Sensible Heat BTUH**
When there is temperature difference absorbed or transmitted that is not accompanied with a change of state how many BTUs are being used?

CFM T1 → Sensible Heat → T2

$$\text{BTUH} = 1.08 \times \text{CFM} \times \Delta\ \text{T}$$

BTUH = BTU/Hour

**Latent Heat BTUH**
When there is a temperature difference which is released or absorbed by a substance during a change of state ( i.e solid, liquid, gas ) how many BTUs are being used?

CFM Gr/Lb 1 → Latent Heat → Gr/Lb2

$$\text{BTUH} = .68 \times \text{CFM} \times \Delta\ \text{Gr/Lb}$$

**Total Heat**
How does one calculate the total amount of heat being used in a system?

CFM h1 → Sensible + Latent Heat → h2

$$\text{BTUH} = 4.5 \times \text{CFM} \times \Delta\ \text{h}$$

h = Enthalpy (Btu/Lb)

**Air Change Rate (per hour) – ACH**
What CFM is needed in a space to exchange the air at a specified rate (per hour)?

CFM → HR → CFM

$$\text{CFM} = \frac{\text{Space Volume (FT\^ 3)}}{\text{Air Changes per Hour (ACH)}}$$

**Vapor Pressure Differential**
What is the pressure differential due to the vapor of moisture in the air?

$P_{high}$ → $\Delta P_{vapor}$ → $P_{low}$

$$\Delta P_{vapor\ (in\ Hg)} = P_{high} - P_{low}$$

Conversion: 1 in. Hg = 13.609 in W.C.

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