

CONVERSIONS, USEFUL FORMULAS AND OTHER COOL STUFF:

Evaporative Cooling (Direct) Effectiveness:

$$E = \frac{T_{edb} - T_{ldb}}{T_{edb} - T_{ewb}} \times 100$$

T_{edb} = Temperature Entering Media, Dry Bulb °F
 T_{ldb} = Temperature Leaving Media, Dry Bulb °F
 T_{ewb} = Temperature Entering Media, Wet Bulb °F

EC Water Evaporation Rate Estimate:

$$\text{Gallons per minute} = \frac{V \times (T_{edb} - T_{ldb})}{500,000}$$

V = Air Volume in cubic feet per minute (cfm)

Air Volume Requirement to meet Heat Load:

$$\text{Air Volume, V} = \frac{\text{THLS}}{1.08 \times \text{EF} \times (T_{sdb} - T_{ldb})}$$

THLS = Total Heat Load of Space (Sensible Only), btu/h

EF = Elevation Factor: EF = 1.00 at sea level

EF = 0.91 at 2500ft elevation EF = 0.83 at 5000ft elevation

T_{sdb} = Temperature Indoor Space Design Dry Bulb (78°F)

Evaporative Cooling "Rule of Thumb" Air Volume Requirement:

$$\text{Air Volume, V} = \text{Ls} \times \text{Ws} \times \text{Hs} \times (\text{ACs} / 60)$$

Ls = Length of Space to be cooled, ft

Ws = Width of Space to be cooled, ft

Hs = Height of Space to be cooled, ft

ACs = Air changes of space per hour (typ. 15 to 20)

Metric Conversions

1 inch = 25.4 mm = 2.54 cm	1 foot = 0.305 m = 30.5 cm
1 yard = 0.914 m = 91.4 cm	1 m = 3.281 ft = 1.094 yards
1 ounce = 28.35 grams	1 lb = 454 grams = 0.454 kg
1 kilogram = 2.205 pounds	
1 cu inch = 16.39 cu cm	1 cu foot = 0.028 cu meters
1 cu ft = 28.32 liters = 7.48 gal	1 cu yard = 0.765 cu meters
1 gallon = 3.785 liters	1 liter = 0.264 gallons
1 gal water = 8.337 lbs = 3.79 kg	°Fahrenheit - 32 x 0.555 = °Celsius
1 ft/min (fpm) = 0.0051 m/sec	1 gal/min (gpm) = 0.063 liters/sec
1 cu ft/min (cfm) = 0.00047 cu m/sec	
1 lb/sq.in. (psi) = 2.307 ft water	1 psi = 2.036 inches of mercury

Volume: [L(in) x W(in) x H(in)] / 1728 = Cubic feet

Power: BHP x 0.7457 = kW

Velocity of water in Pipe (fps) = [GPM x 0.41] / d(in)²

Air velocity (fps) in duct = Rectangular Duct: (cfm x 144) / (W x H)
Round Duct: (cfm) / (d² x 0.00545)

Capacity (AC Tonnage): 12,000 Btu/hr = 1 ton of Cooling

Misc: 1 pound = 7,000 grains

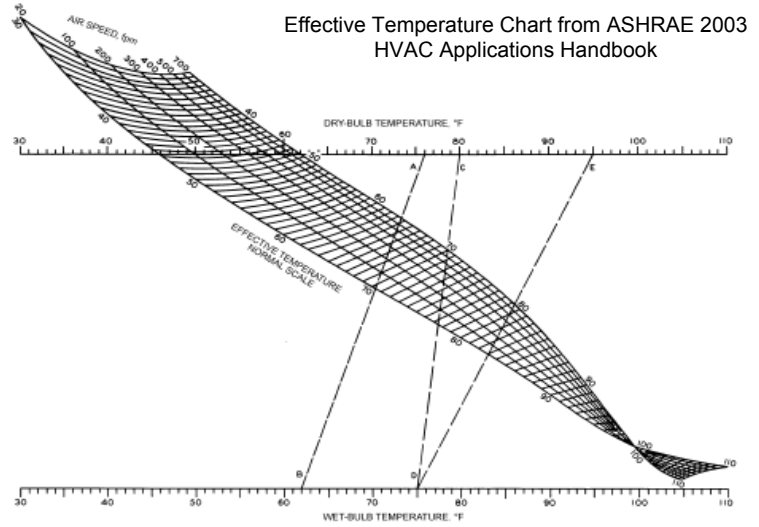
Water Conversions:

Gallons in sump = L x W x H x 0.0043 (Dimensions in Inches)

Weight (lbs) of sump = L x W x H x 0.0361 (Dimensions in Inches)

1 gallon of water = 8.337 pounds 1 cubic foot = 7.48 gallons

Specific gravity water = 1.0 1 ft water = 0.433 PSI 1 PSI = 2.309 ft water



Effective Temperature Examples:

* Feeling the Air Flow makes a BIG DIFFERENCE *

Outside Air Temp	Supply Temp	Air Velocity	Effective Temp
100°F / 70°F	78°F	700 fpm	67°F
		200 fpm	73°F
95°F / 60°F	70°F	700 fpm	62°F
		200 fpm	68°F

Much like when you were a kid running through the sprinkler, the evaporation effect makes you cool but when the wind starts to blow it can get down right COLD!

Location	ASHRAE 1% Cooling Design Conditions		Evaporative Cooling Supply Air Temperatures			
	DryBulb °F	WetBulb °F	6" media °F	8" media °F	12" media °F	18" media °F
Albuquerque, NM	93	60	69.9	66.6	63.3	61.0
Boise, ID	94	63	72.3	69.2	66.1	63.9
Denver, CO	93	59	69.2	65.8	62.4	60.0
Detroit, MI	87	72	76.5	75.0	73.5	72.5
El Paso, TX	98	64	74.2	70.8	67.4	65.0
Las Vegas, NV	106	66	78.0	74.0	70.0	67.2
Los Angeles, CA	81	64	69.1	67.4	65.7	64.5
Oklahoma City, OK	96	74	80.6	78.4	76.2	74.7
Phoenix, AZ	108	70	81.4	77.6	73.8	71.1
Pittsburg, PN	86	70	74.8	73.2	71.6	70.5
Sacramento, CA	97	69	77.4	74.6	71.8	69.8
Salt Lake City, UT	94	62	71.6	68.4	65.2	63.0
San Antonio, TX	97	74	80.9	78.6	76.3	74.7

Temperatures do not include fan/motor heat gain/nominal efficiency at air velocity 450-500fpm

HydrEVAP Evaporative PreCoolers for AC Air-Cooled Condensers

Typical Performance Calculation (6" Media):

Example: Ambient Air Temp: 95°Fdb, 60°Fwb, 12%rh ► PreCooler Supply Air Temp to Air-Cooled Condenser: 70°Fdb

	at 95F	at 70F	HydrEVAP Effect	at 105F	at 76F	HydrEVAP Effect	at 115F	at 82F	HydrEVAP Effect
Capacity (tonnage)	232.6	274.4	18% Increase	214.8	264.4	23% Increase	187.6	246.4	31% Increase
KW Input (kW)	282.5	230.2	19% Reduction	308.1	241.1	22% Reduction	316.8	253.4	25% Reduction
EER Rating	9.5	13.3	40% Increase	8.0	12.4	55% Increase	6.8	11.5	69% Increase

Assume typical 250 ton Standard Efficiency AC System. Based on Manufacturer's published data for air-cooled condensers



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