2J SUPPLY
HVAC DISTRIBUTORS

RHVAC Formulas & Conversions

1 gallon water = 8.346 lb (@ 68°F)	1 sq. ft. EDR = 240 BTU
$Q_S = m \times c \times \Delta t$	$Q_L = m \times hf$
1 pound = 7,000 grains	1 ton refrigeration = 12,000 BTU/Hr
1 boiler HP = 33,479 BTU/Hr	1 ton refrigeration = 3.515 kW
C° = 5/9 x (F° - 32°)	F° = 9/5 x (C° + 32°)

Pressure	***Electrical***
1 atmosphere = 14.696 psi	1 watt = 3.412 BTU/Hr
1 lb. = 27.72 in. w.c.	1 Btu/hr = 0.2931 watt
1 oz. = 1.73 in. w.c.	1 horsepower = 2545 BTU/Hr
psia = in. Hg/2.036	1 horsepower = 746 watts
in. Hg = psia x 2.036	Voltage = Amperage x Resistance
mm Hg = psia x 51.715	Watts = $(\text{Amperage})^2$ x Resistance
in. Hg vacuum = 29.921 - in. Hg	Watts = Voltage x Amperage
microns = 51,715 x psia	COP = EER x 0.293
1 ft (head) = 0.433 psi	EER = Output (BTU)/Input (Watts)

Nominal Airflow
Cooling = 400 CFM per ton
Heating = 12 CFM per 1000 BTU input
$CFM_{new} = CFM_{old} \times (RPM_{new}/RPM_{old})$
RPM = (120 x Hz) / Number of poles
BTU/Hr (sensible) = CFM x 1.08 x Temperature Rise
BTU/Hr (latent) = 0.68 x Q x Δg
Water quantity (gpm) required for heating & cooling = $q/500\Delta t_{water}$

Motor Efficiency =	$\dfrac{HP \times 746 \times 100\%}{KW\ Input \times 1000}$
Pump Efficiency % =	$\dfrac{GPM \times 8.3 \times Foot\ Head}{BHP \times 33{,}000}$

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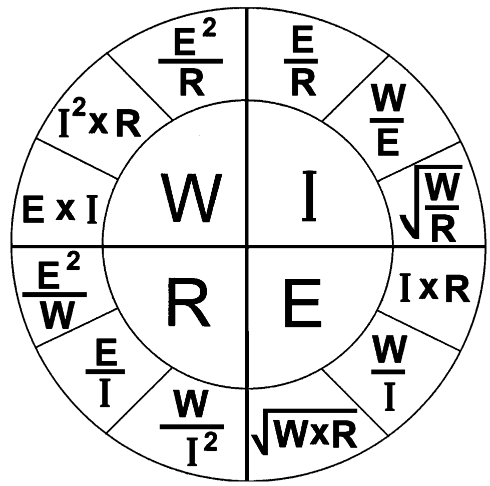
HVAC DISTRIBUTORS

RHVAC Formulas & Conversions

Ohm's Law for Direct Current - Single Phase Loads

W = Watts
I = Current (Amperes)
E = Electromotive Force (Volts)
R = Resistance (Ohms)

To obtain any value in the center circle, for direct or alternating current, perform the operation indicated in one segment of the adjacent outer circle



Air Coils

Q Sensible = 1.08 x CFM △ T = BTU/Hr
Q Latent = .068 x CFM x △ SH = BTU/Hr
Q Total = 4.5 x CFM x △ H = BTU/Hr

$$\text{Lb/Hr. Condensate} = \frac{4.5\ \text{CFM} \times \triangle\ \text{SH grains}}{7{,}000\ \text{grains/Lb}}$$

$$\text{SHR (Sensible Heat Ratio)}\quad \frac{\text{Q Sensible}}{\text{Q Total}}$$

Formulas - Belt Drives

Driven Pulley Diameter
(Motor Pulley Dia. x RPM) + Driven Pulley RPM
Driven Pulley RPM
(Motor RPM x Motor Pulley Dia.) + Driven Pulley Dia.
Motor Pulley Diameter
(Driven Pulley Dia. x RPM) + Motor RPM
Motor RPM
(Driven Pulley Dia. x RPM) + Motor Pulley Dia.

Gas Pressure Conversions

IN. w.c. =	Oz
1	.58
1.73	1
3.5	2
10.5	6.1
27.71	16

Watts of Heat
1 Watt = 3.413 BTUs
BTUs = Watts x 3.143

Determining Belt Length

$$L = \frac{D + d}{2} \times Pi + 2x$$

Where:
L = Length of belt
D = Diameter of large pulley
d = Diameter of small pulley
x = Center to center distance
Pi = 3.1416

Approximate Heat Values (BTUs)

Fuel Oil, Gallon

#1	#2	#3
135,800	139,400	141,800

Gas, Cu. Ft

Natural	Propane
1150/950	2550

Gas, Gallon

Propane	Butane
91,500	102,600

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HVAC DISTRIBUTORS

RHVAC Formulas & Conversions

Conversions Between I-P and SI Units

Airflow
cfm = L/s x 2.119
L/s = cfm x .4719

Area
sq ft = m^2 x 10.76
m^2 = sq ft x 0.0929

Weight
lb = kg x 2.205
kg = lb x 0.4536

Length
in. = cm x 0.3937
cm = in. x 2.54

Static Pressure
in. (water @ 60°F) = Pa x 0.004019
Pa = in. (water @ 60°F) x 248.8

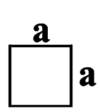
Conversion Factors from ASHRAE Handbook of Fundamentals

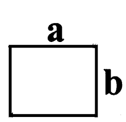
Suggested Temperatures to Operate Coolers / Refrigerators

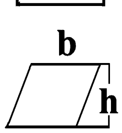
Product	Approx Cooler Temp
Cheese, Eggs, Butter	Serving Cooler, 50° to 60° Storage Cooler, 31° to 36°
Poultry & Meats (Fresh)	Cooler, 34° to 38° Cases, 38° to 42°
Poultry & Meats (Frozen)	-5° to +5°
Meats (Fresh) Firm for Cutting	28° to 32°
Vegetables, Fruits	35° to 45°
Cream & Milk	Can Water Cooling, 36° to 38° Cooler Storage, 36° to 40°
Beer Storage	36° to 45°
Fur Storage	Shock Temp, 10° to 15° Max Temperature, 38°
Ice Cream	Hardening, -20° Storing, -5° to -10°

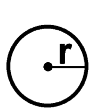
Areas, Volumes & Surface Areas

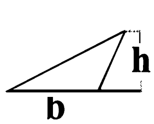
Areas

Square = aa


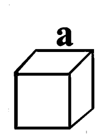
Rectangle = ab


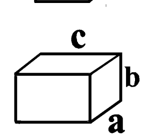
Parallelogram = bh


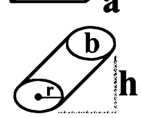
Circle = *pi* r^2


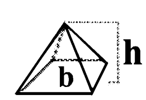
Triangle = (½) bh


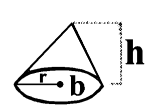
Volumes

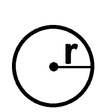
Cube = a^3


Rectangular Prism = abc


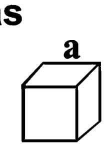
Cylinder = bh = *pi* r^2 h


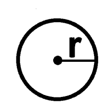
Pyramid = (1/3) bh


Cone = (1/3) bh
= 1/3 *pi* r^2 h


Sphere = (4/3) *pi* r^3


Surface Areas

Cube = $6a^2$


Sphere = 4 *pi* r^2


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RHVAC Formulas & Conversions

Superheat Charging Table

SUPERHEAT = Suction Line Temperature - Saturated Suction Temperature

Cond Enter DB TEMP	-----------------------------Entering Evaporator Air Temperature Web Bulb (WB)--------------------------------													
	50°F	**52°F**	**54°F**	**56°F**	**58°F**	**60°F**	**62°F**	**64°F**	**66°F**	**68°F**	**70°F**	**72°F**	**74°F**	**76°F**
55°F	9°	12°	14°	17°	20°	23°	26°	29°	32°	35°	37°	40°	42°	45°
60°F	7°	10°	12°	15°	18°	21°	24°	27°	30°	33°	35°	38°	40°	43°
65°F	--	6°	10°	13°	16°	19°	21°	24°	27°	30°	33°	36°	38°	41°
70°F	--	--	7°	10°	13°	16°	19°	21°	24°	27°	30°	33°	36°	39°
75°F	--	--	--	6°	9°	12°	15°	18°	21°	24°	28°	31°	34°	37°
80°F	--	--	--	--	5°	8°	12°	15°	18°	21°	25°	28°	31°	35°
85°F	--	--	--	--	--	--	8°	11°	15°	19°	22°	26°	30°	33°
90°F	--	--	--	--	--	--	5°	9°	13°	16°	20°	24°	27°	31°
95°F	--	--	--	--	--	--	--	6°	10°	14°	18°	22°	25°	29°
100°F	--	--	--	--	--	--	--	--	8°	12°	15°	20°	23°	27°
105°F	--	--	--	--	--	--	--	--	5°	9°	13°	17°	22°	26°
110°F	--	--	--	--	--	--	--	--	--	6°	11°	15°	20°	25°
115°F	--	--	--	--	--	--	--	--	--	--	9°	14°	18°	23°

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Trouble Shooting - System Characteristics With An Expansion Valve

Problem	Liq Pressure	Suct Pressure	Super Heat	Sub-Cool	Discharge Sup	Comp Amps
Dirty Condenser Coil	H	H	N	L	N	N
Refrigerant Overcharge	H	H	N	H	N	N
Non-Condensable	H	L	N	L	N	N
Restricted Liquid Line	L	L	H	L	H	L
Restricted Condenser Coil	L	L	H	L	L	L
Refrigerant Undercharge	L	L	H	L	H	L
Oversized Indoor TXV	L	H	L	L	L	N
Undersized Indoor TXV	H	L	H	H	H	L
Restricted Indoor Coil	L	L	H	H	H	L
Broken Compressor Valve	L	H	H	L	L	L
Low Air Flow	L	L	N	H	L	N
Dirty Evaporator Coil	L	L	N	H	L	N
Inefficient Compressor	L	L	H	L	L	H

Trouble Shooting - System Characteristics With A Fixed Restrictor

Problem	Liq Pressure	Suct Pressure	Super Heat	Sub-Cool	Discharge Sup	Comp Amps
Dirty Condenser Coil	H	H	L	L	H	H
Refrigerant Overcharge	H	H	L	H	L	H
Non-Condensable	H	L	L	L	H	H
Restricted Liquid Line	L	L	H	H	H	L
Restricted Condenser Coil	L	L	H	L	L	L
Refrigerant Undercharge	L	L	H	L	H	L
Oversized Indoor Restrictor	L	H	L	L	L	N
Undersized Indoor Restrictor	H	L	H	H	H	L
Restricted Indoor Coil	L	L	H	H	H	L
Broken Compressor Valve	L	H	H	L	L	L
Low Air Flow	L	L	L	H	L	N
Dirty Evaporator Coil	L	L	L	H	L	N
Inefficient Compressor	L	L	H	L	L	H

L - LOW ***N- NORMAL*** ***H - HIGH***

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Residential Duct Sizing Guide - Rectangular & Round Duct

Air Volume CFM	4" Duct Height	6" Duct Height	8" Duct Height	10" Duct Height	12" Duct Height	Equivalent Round Duct	Air Volume CFM
50	6" x 4"					5"	50
75	6" x 4"					6"	75
100	8" x 4"	6" x 6"				6"	100
125	10" x 4"	6" x 6"				7"	125
150	10" x 4"	8" x 6"				7"	150
175	12" x 4"	8" x 6"				8"	175
200	14" x 4"	8" x 6"				8"	200
225	16" x 4"	10" x 6"				8"	225
250	16" x 4"	10" x 6"				9"	250
275		12" x 6"	8" x 8"			9"	275
300		12" x 6"	8" x 8"			9"	300
400		14" x 6"	10" x 8"			10"	400
500		18" x 6"	12" x 8"	10" x 10"		11"	500
600		20" x 6"	14" x 8"	12" x 10"		12"	600
700		24" x 6"	16" x 8"	12" x 10"		12"	700
800		26" x 6"	18" x 8"	14" x 10"	12" x 12"	13"	800
900		30" x 6"	20" x 8"	16" x 10"	12" x 12"	14"	900
1000			22" x 8"	16" x 10"	14" x 12"	14"	1000
1100			24" x 8"	18" x 10"	16" x 12"	15"	1100
1200			26" x 8"	20" x 10"	16" x 12"	15"	1200
1300			28" x 8"	20" x 10"	18" x 12"	16"	1300
1400			30" x 8"	22" x 10"	18" x 12"	16"	1400
1500				24" x 10"	20" x 12"	16"	1500
1600				24" x 10"	20" x 12"	17"	1600
1700				26" x 10"	22" x 12"	17"	1700
1800				28" x 10"	22" x 12"	18"	1800
1900				30" x 10"	22" x 12"	18"	1900
2000					24" x 12"	18"	2000

NOTE: The above duct sizes are based on a fraction drop of .10 inches per 100 feet of lineal duct. The "Equal-Friction" method of duct sizing should be adequate for normal residential furnace heating & air conditioning applications. Larger air volumes or higher static pressures should be dealt with on an individual job basis