American Standard®
HEATING & AIR CONDITIONING

Basic Air Conditioning Formulas

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TO DETERMINE	EXPRESSED AS	COOLING	HEATING and/or HUMIDIFYING
Total Airflow	CFM_T	1. $CFM_T = \frac{N_T\ V}{60\ min./hr.}$	1. $CFM_T = \frac{N_T\ V}{60\ min./hr.}$
Infiltration or Ventilation	CFM_o	2. $CFM_o = \frac{N_o\ V}{60\ min./hr.}$	2. $CFM_o = \frac{N_o\ V}{60\ min./hr.}$
Number of Air Changes Per Hour – Total	N_T	3. $N_T = \frac{CFM_T\ (60\ min./hr.)}{V}$	3. $N_T = \frac{CFM_T\ (60\ min./hr.)}{V}$
Number of Air Changes Per Hour – Outdoor Air	N_o	4. $N_o = \frac{CFM_o\ (60\ min./hr.)}{V}$	4. $N_o = \frac{CFM_o\ (60\ min./hr.)}{V}$
Total Heat (H_T)	Btuh	5. $H_T = CFM_T \times 4.5 \times (h_1 - h_2)$ = Btuh	6. $H_T = CFM_T \times 4.5 \times (h_2 - h_1)$ = Btuh
Sensible Heat (H_S)	Btuh	7. $H_S = CFM_T \times 1.08 \times (T_1 - T_2)$ = Btuh	8. $H_S = CFM_T \times 1.08 \times (T_2 - T_1)$ = Btuh
Latent Heat (H_L)	Btuh	9. $H_L = CFM_T \times .68 \times (W_1 - W_2)$ = Btuh	10. $H_L = CFM_T \times .68 \times (W_2 - W_1)$ = Btuh
Entering Air Temperature (T_1) (Mixed Air)	°F. D.B.	11. $T_1 = t_1 + \frac{CFM_o}{CFM_T} \times (t_2 - t_1)$ = °F.D.B. ① ① If duct heat gain is a factor, add to T_1: $\frac{\text{Duct Heat Gain (Btuh)}}{CFM_T \times 1.08}$	12. $T_1 = t_1 - \frac{CFM_o}{CFM_T} \times (t_1 - t_2)$ = °F.D.B. ② ② If duct heat loss is a factor, subtract from T_1: $\frac{\text{Duct Heat Loss (Btuh)}}{CFM_T \times 1.08}$
Leaving Air D.B. Temperature (T_2)	°F. D.B.	13. $T_2 = T_1 - \frac{H_S}{CFM_T \times 1.08}$ = °F.D.B.	14. $T_2 = T_1 + \frac{H_S}{CFM_T \times 1.08}$ = °F.D.B.
Required Airflow	CFM_T	15. $CFM_T = \frac{H_S\ (total)}{1.08 \times (T_1 - T_2)}$ = CFM OR $CFM_T = \frac{H_S\ (internal)③}{1.08 \times (t_1 - T_2)}$ = CFM ③ Sensible load of outside air not included	16. $CFM_T = \frac{H_S}{1.08 \times (T_2 - T_1)}$ = CFM
Enthalpy – Leaving Air (h_2)	Btu/lb. dry air	17. $h_2 = h_1 - \frac{H_T}{CFM_T \times 4.5}$ = Btu/lb. dry air	18. $h_2 = h_1 + \frac{H_T}{CFM_T \times 4.5}$ = Btu/lb. dry air
Leaving Air W.B. Temperature	°F.W.B.	19. Refer to Enthalpy Table and read W.B. temperature corresponding to enthalpy of leaving air (h_2) (see #17).	20. Refer to Enthalpy Table and read W.B. temperature corresponding to enthalpy of leaving air (h_2) (see #18).
Heat Required to Evaporate Water Vapor Added to Ventilation Air	Btuh	21. $H_L = CFM_o \times .68\ (W_3 - W_o)$ = Btuh	22. $H_L = CFM_o \times .68\ (W_3 - W_o)$ = Btuh
Humidification Requirements	Lbs. water/hr.	23. $\left(\text{Make up Moisture}\right) = \frac{\text{Excess Latent Capacity of System} \times \text{\% Run Time}}{1060\ Btu/lb.}$ = lbs./hr. (Industrial Process Work)	24. $\left(\text{Make up Moisture}\right) = \frac{H_L\ \text{loss Btuh (see \#22)}}{1060\ Btu/lb.}$ = lbs./hr.

LEGEND

CFM_T	=	Total airflow cubic feet/min.	
CFM_o	=	Outdoor air cubic feet/min.	
N_T	=	Total air changes per hour	
N_o	=	Outdoor air, air changes per hour	
V	=	Volume of space cubic feet	
H_T	=	Total heat Btuh	
H_S	=	Sensible heat Btuh	
H_L	=	Latent heat Btuh	
* h_1	=	Enthalpy or total heat of entering air	Btu/lb.
* h_2	=	Enthalpy or total heat of leaving air	Btu/lb.
T_1	=	Temperature of entering air	
T_2	=	Temperature of leaving air	
T_{adp}	=	Apparatus dewpoint	°F.D.B.
t_1	=	Indoor design temperature	°F.D.B.
t_2	=	Outdoor design temperature	°F.D.B.
W_1	=	Grains of water/lb. of dry air at entering condition	Grains/lb.
W_2	=	Grains of water/lb. of dry air at leaving condition	Grains/lb.
W_3	=	Grains of water/lb. of dry air at indoor design conditions	Grains/lb.
W_o	=	Grains of water/lb. of dry air at outdoor design conditions	Grains/lb.

DERIVATION OF AIR CONSTANTS

The air constants below apply specifically to standard air which is defined as dry air at 70°F and 14.7 P.S.I.A. (29.92 in. mercury column). They can, however, be used in most cooling calculations unless extremely precise results are desired.

4.5 (To convert CFM to lbs./hr.)

$4.5 = \frac{60\ min./hr.}{13.33}$ or $60 \times .075$

Where 13.33 is the specific volume of standard air (cu.ft./lb.) and .075 is the density (lbs./cu.ft.)

$1.08 = \frac{.24 \times 60}{13.33}$ or $.24 \times 4.5$

.24 BTU = specific heat of standard air (BTU/LB/°F)

$.68 = \frac{60}{13.33} \times \frac{1060}{7000}$ or $4.5 \times \frac{1060}{7000}$

Where: 1060 = Average Latent Heat of water vapor (BTU/LB.).
7000 = Grains per lb.

* See Enthalpy of air (Total Heat Content of Air) Table for exact values.

For complete equipment / combination selections, installation instructions and warranty information, please refer to Product Data/Ratings and/or Installers Guides and Limited Warranty Handbooks.

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