

Table 1-T-100 : Cooling and Dehumidifying Heat Load Estimate Form

Job Name				
Address				
Space Used for				
Size _____ x _____ = Sq.Ft.x _____ = _____ Cu. Ft.				
Item	Area of quantity	Sun Gain or Temp. Diff.	Factor	Btu / Hour
SOLAR GAIN GLASS				
	Glass	Sq. Ft. x x		
	Glass	Sq. Ft. x x		
	Glass	Sq. Ft. x x		
	Glass	Sq. Ft. x x		
	Sky Light	Sq. Ft. x x		
SOLAR AND TRAINS GAIN – WALLS AND ROOF				
	Wall	Sq. Ft. x x		
	Wall	Sq. Ft. x x		
	Wall	Sq. Ft. x x		
	Wall	Sq. Ft. x x		
	Wall	Sq. Ft. x x		
	Roof Sun	Sq. Ft. x x		
	Roof Shaded	Sq. Ft. x x		
TRAIN GAIN EXCEPT WALLS AND ROOF				
	All Glass	Sq. Ft. x x		
	Partition	Sq. Ft. x x		
	Ceiling	Sq. Ft. x x		
	Floor	Sq. Ft. x x		
INFILTRATION AND OUTSIDE AIR				
	Infiltration	Cfm x X 1.08		
	Outside Air	Cfm x °F BF X 1.08		
INTERNAL HEAT				
	People	People		
	Power	H.P. / KW		
	Lights	x 1.08		
	Appliances Etc.	x		
ROOM SENSIBLE HEAT				
	Supply	Supply		
	Duct	Duct		
	Heat Gain%	Leak Loss %		
EFFECTIVE ROOM SENSIBLE HEAT				
ROOM LATENT HEAT				
	Infiltration	cfm x gr/b x 0.68		
	Outside Air	cfm x gr/b x BF x 0.68		
	People	People x		
	Steam	Lb / hr x 1080		
	Appliances, Etc.			
	Vapor Train			
	Room Latent Heat Sub Total			
	Supply Duct Leakage Loss	% + SAFETY FACTOR %		
EFFECTIVE ROOM LATENT HEAT				
EFFECTIVE ROOM TOTAL HEAT				
	Sensible :	Cfm x Of x (1-BF) x 1.08		
	Latent :	cfm x gr / lb x (1-BF) x 0.68		
	Grand Total Heat Sub Total			
	Return	Return		
	Duct	Duct H.P. % %		

Heat Gain%	Leak Loss			
TONS = GRAND TOTAL HEAT*				
Estimated for	Local Time	Peak Load	Local Time	
CONDITIONS	DB	WB	%RH	DP Gr/Lb
Outside				
Room				
Difference		x x x	x x x	xx
Selected Room Conditions		DB	WB	%RH
_____ People x $\frac{\text{VENTILATION}}{\text{INFILTRATION}}$ cfm Person _____				
_____ Sq. Ft. x _____ cfm / Sq. ft. = _____ cfm. Ventilation				
SWINGING				
REVOLVING DOORS – PEOPLE X CFM / PERSON = _____				
Open Doors _____ x _____ CRM / DOOR = _____				
Exhaust Fan				
Crack _____ Feet x _____ cfm / Ft = _____				
SENSIBLE HEAT FACTOR AND APPARATUS DEWPOINT				
$\frac{\text{Eff.room sens.Heat}}{\text{Eff.room total heat}} =$ _____ Sens Heat Factor (ESHF)				
Indicated adp _____ °F Selected adp. _____ °F				
(1 – BF) (Room Temp. ADP = _____ Dehumidified rise				
$\frac{\text{Room Sensible Heat}}{1.08 \times \text{Dehumidified rise}} =$ _____ Dehumidified cfm				
NOTES				

Psychrometric Formulae

**A. AIR MIXING EQUATIONS
(Outdoor and Return Air)**

$$t_m = \frac{(cfm_{oa} \times t_{oa}) + (cfm_{ra} \times t_{rm})}{cfm_{sa}} \dots \dots \quad (1)$$

$$h_m = \frac{(cfm_{oa} \times h_{oa}) + (cfm_{ra} \times h_{rm})}{cfm_{sa}} \quad (2)$$

$$W_m = \frac{(cfm_{oa} \times W_{oa}) + (cfm_{ra} \times h_{rm})}{cfm_{sa}} \quad (3)$$

B. COOLING LOAD EQUATIONS

$$ERSH = RSH + (BF) (OASH) + RSHS^* \quad (4)$$

$$ERLH = RLH + (BF) (OALH) + RLHS^* \quad (5)$$

$$ERTH = ERLH + ERSR \quad (6)$$

$$TSH = RSH + OASH + RSRS^* \quad (7)$$

$$TLH = RLH + OALH + RLRS^* \quad (8)$$

$$GTH = TSH + TLH + GTHS^* \quad (9)$$

$$RSH = 1.08 \times cfm_{sa} \times (t_{rm} - t_{sa}) \quad (10)$$

$$RLH = 0.68 \times cfm_{sa} \times (W_{rm} - W_{sa}) \quad (11)$$

$$RTH = 4.45 \times cfm_{sa} \times (h_{rm} - h_{sa}) \quad (12)$$

$$ERTH = RSH + RLH \quad (13)$$

$$OASH = 1.08 \times cfm_{oa} \times (t_{oa} - t_{rm}) \quad (14)$$

$$OALH = 0.68 \times cfm_{oa} \times (W_{oa} - W_{rm}) \quad (15)$$

$$OATH = 4.45 \times cfm_{oa} \times (h_{oa} - h_{rm}) \quad (16)$$

$$OATH = OASH + OALH \quad (17)$$

$$(BF)(OATH) = (BF) (OASH) + (BF) (OALH) \quad (18)$$

$$ERSH = 1.08 \times cfm_{da} \times (t_{rm} - t_{adp}) (1-BF) \quad (19)$$

$$ERLH = 0.68 \times cfm_{da} \times (W_{rm} - W_{adp}) (1-BF) \quad (20)$$

$$ERTH = 4.45 \times cfm_{da} \times (h_{rm} - h_{adp}) (1-BF) \quad (21)$$

$$TSH = 1.08 \times cfm_{da} \times (t_{edp} - t_{idp})^{**} \quad (22)$$

$$TLH = 0.68 \times cfm_{da} \times (W_{ea} - W_{ia})^{**} \quad (23)$$

$$GTH = 4.45 \times cfm_{da} \times (h_{ea} - h_{ia})^{**} \quad (24)$$

C. SENSIBLE HEAT FACTOR EQUATIONS

$$RSHF = \frac{RSH}{RSH+RLH} = \frac{RSH}{RTH} \quad (25)$$

$$ESHF = \frac{ERSH}{RSH+ERLH} = \frac{ERSH}{ERTH} \quad (26)$$

$$GSHF = \frac{TSH}{TSH+TLH} = \frac{TSH}{GTH} \quad (27)$$

D. BYPASS FACTOR EQUATIONS

$$BF = \frac{t_{ldb} - t_{adp}}{t_{edb} - t_{adp}} : (1 - BF) = \frac{t_{edb} - t_{ldb}}{t_{edb} - t_{adp}} \quad (28)$$

$$BF = \frac{W_{ia} - W_{adp}}{W_{ea} - W_{adp}} : (1 - BF) = \frac{W_{ea} - W_{ia}}{W_{ea} - W_{adp}} \quad (29)$$

$$BF = \frac{h_{ia} - h_{adp}}{h_{ea} - h_{adp}} : (1 - BF) = \frac{h_{ea} - h_{ia}}{h_{ea} - h_{adp}} \quad (30)$$

E. TEMPERATURE EQUATIONS AT APPARATUS

$$t_{edb}^{**} = \frac{(cfm_{oa} \times t_{oa}) + (cfm_{ra} \times t_{rm})}{cfm_{sa}} \quad (31)$$

$$t_{ldb} = t_{adp} + BF t_{edb} = t_{adp} \quad (32)$$

t_{edb}^{**} and t_{lwb} correspond to the calculated values of h_{ea} and h_{ia} on the psychrometric chart.

$$h_{ea}^{**} = \frac{(cfm_{oa} \times h_{oa}) + (cfm_{ra} \times h_{rm})}{cfm_{sa}} \quad (33)$$

$$h_{ldb} = h_{adp} + BF (h_{ea} - h_{adp}) \quad (34)$$

F. TEMPERATURE EQUATIONS FOR SUPPLY AIR

$$t_{sa} = t_{rm} - \frac{RSH}{1.08 (cfm_{sa})} \quad (35)$$

Psychrometric Formulae (Contd...)

G. AIR QUANTITY EQUATIONS

$$cfm_{da} = \frac{ERSH}{1.08 \times (1-BF) (t_{rm} - t_{adp})} \quad (36)$$

$$cfm_{da} = \frac{ERLH}{0.68 \times (1-BF) (W_{rm} - W_{adp})} \quad (37)$$

$$cfm_{da} = \frac{ERTH}{4.45 \times (1-BF) (h_{rm} - h_{adp})} \quad (38)$$

$$cfm_{da} \ddagger = \frac{TSH}{1.08 \times (t_{edp} - t_{ldp})} \quad (39)$$

$$cfm_{da} \ddagger = \frac{TLH}{0.68 \times (W_{ea} - W_{la})} \quad (40)$$

$$cfm_{da} \ddagger = \frac{GTH}{4.45 \times (h_{ea} - h_{la})} \quad (41)$$

$$cfm_{sa} = \frac{RSH}{1.08 \times (t_{rm} - t_{sa})} \quad (42)$$

$$cfm_{sa} = \frac{RLH}{0.68 \times (W_{rm} - W_{sa})} \quad (43)$$

$$cfm_{da} = \frac{RTH}{4.45 \times (h_{rm} - h_{sa})} \quad (44)$$

$$cfm_{ba} = cfm_{sa} - cfm_{da} \quad (44)$$

Note : cfm_{da} will be less than cfm_{sa} only when air is physically bypassed around the conditioning apparatus.

$$cfm_{sa} = cfm_{oa} - cfm_{ra} \quad (45)$$

$$1.08 = 0.244 \times \frac{60}{13.5}$$

Where 0.244 = Specific heat of moist air at 70 F db and 50% rh, Btu / (deg F) (lb dry air).

60 = min./hr

13.5 = specific volume of moist air at 70 F db and 50% rh

$$0.68 = \frac{60}{13.5} \times \frac{1076}{7000}$$

Where 60 = min./hr

13.5 = Specific volume of moist air at 70 F db and 50% rh

1076 = average heat removal required to condense one pound of water vapor from the room air.

7000 = grains per pound

$$4.45 = \frac{60}{13.5}$$

Where 60 = min./hr

13.5 = Specific volume of moist air at 70 F db and 50% rh

* RSHS, RLHS and GTHS are supplementary loads due to duct heat gain, duct leakage loss, fan and pump horsepower gains, etc. To simplify the various examples, these supplementary loads have not been used in the calculations. However, in actual practice, these supplementary loads should be used where appropriate.

‡When no air is to be physically bypassed around the conditioning apparatus, $cfm_{da} = cfm_{sa}$

** When t_m , W_m and h_m are equal to the entering conditions at the cooling apparatus, they may be substituted for t_{edp} , W_{ea} and h_{ea} respectively.

ABBREVIATIONS

Adp	apparatus dewpoint
BF	bypass factor
(BF) (OALH)	bypassed outdoor air latent heat
(BF) (OASH)	bypassed outdoor air sensible heat
But/hr	British thermal units per hour
Cfm	cubic feet per minute
db	dry-bulb
dp	dewpoint
ERLH	effective room latent heat
ERSH	effective room sensible heat
ERTH	effective room total heat
ESHF	effective sensible heat factor
F	Fahrenheit degrees
tpm	feet per minute
gpm	gallons per minute
gr/lb	grains per pound
GSHF	grand sensible heat factor
GTHS	grand total heat supplement
OALH	Outdoor air latent heat
OASH	Outdoor air sensible heat
OATH	Outdoor air total heat
rh	relative humidity
RLH	room latent heat
RLHS	room latent heat supplement
RSH	room sensible heat
RSHF	room sensible heat factor
RSHS	room sensible heat supplement
RTH	room total heat
Sat EH	saturation efficiency of spray
SHF	sensible heat factor
TLH	total latent heat
RSH	total sensible heat
w b	wet bulb

SYMBOLS

cfm_{ba}	bypassed air quantity around apparatus
cfm_{da}	dehumidified air quantity
crm_{ba}	outdoor air quantity
cfm_{ra}	return air quantity
cfm_{sa}	supply air quantity
h	specific enthalpy
h_{adp}	apparatus dewpoint enthalpy
h_{es}	effective surface temperature enthalpy
h_{ea}	entering air enthalpy
h_{ia}	leaving air enthalpy
h_m	mixture of outdoor and return air enthalpy
h_{oa}	outdoor air enthalpy
h_{ra}	room air enthalpy
h_{sa}	supply air enthalpy
t	temperature
t_{adp}	apparatus dewpoint temperature
t_{edb}	entering dry-bulb temperature
t_{es}	effective surface temperature
t_{ew}	entering water temperature
t_{ewb}	entering wet-bulb temperature
t_{ldb}	leaving dry-bulb temperature
t_{lwb}	leaving wet-bulb temperature
t_m	mixture of outdoor and return air dry-bulb temperature
t_{oa}	outdoor air dry-bulb temperature
t_{im}	room dry-bulb temperature
t_{sa}	supply air dry-bulb temperature
W	moisture content or specific humidity
W_{adp}	apparatus dewpoint moisture content
W_{ea}	entering air moisture content
W_{es}	effective surface temperature moisture content
W_{ia}	leaving air moisture content
W_m	mixture of outdoor and return air moisture content
W_{oa}	outdoor air moisture content
W_r	room moisture content
W_{sa}	supply air moisture content