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 ^{0}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 SINSIBLE 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 0f 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 Sun 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 $\frac{\textbf{VENTILATION}}{INFILTRATION}$ $cfm\ Person$ _____

______ 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

$\frac{Eff.room\ sens.Heat}{Eff.room\ total\ heat}$ = _____ Sens Heat Factor (ESHF)

Indicated adp ___________ ^{0}F Selected adp. _______ ^{0}F

(1 – BF) (Room Temp. ADP = _____ Dehumidified rise

$\frac{Room\ Sensible\ Heat}{1.08\ x\ Dehumidified\ rise}$ = _______ Dehumidified cfm

NOTES

Psychrometric Formulae

A. AIR MIXING EQUATIONS (Outdoor and Return Air)

$$t_m = \frac{(cfm_{0a} \times t_{oa}) + (cfm_{ra} \times t_{rm})}{cfm_{0a}} \; .\;.\;.\;. \quad (1)$$

$$h_m = \frac{(cfm_{0a} \times h_{oa}) + (cfm_{ra} \times h_{rm})}{cfm_{sa}} \quad (2)$$

$$W_m = \frac{(cfm_{0a} \times W_{oa}) + (cfm_{ra} \times h_{rm})}{cfm_{sa}} \quad (3)$$

B. COOLING LOAD EQUATIONS

ERSH	=	RSH + (BF) (OASH) + RSHS*	(4)
ERLH	=	RLH + (BF) (OALH) + RLHS*	(5)
ERTH	=	ERLH + ERSH	(6)
TSH	=	RSH + OASH + RSHS*	(7)
TLH	=	RLH + OALH + RLHS*	(8)
GTH	=	TSH + TLH + GTHS*	(9)
RSH	=	1.08 x cfm_{sa} x (t_{rm} – t_{sa})	(10)
RLH	=	0.68 x crm_{sa} x (W_{rm} – W_{sa})	(11)
RTH	=	4.45 x crm_{sa} x (h_{rm} – h_{as})	(12)
RTH	=	RSH + RLH	(13)
OASH	=	1.08 x cfm_{oa} x (t_{oa} – t_{rm})	(14)
OALH	=	0.68 x cfm_{oa} x (W_{oa} – W_{rm})	(15)
OATH	=	4.45 x cfm_{oa} x (h_{oa} – h_{rm})	(16)
OATH	=	OASH + OALH	(17)
(BF)(OATH)	=	(BF) (OASH) + (BF) (OALH)	(18)
ERSH	=	1.08 x cfm_{da} ‡x (t_{rm} – t_{adp}) (1-BF)	(19)
ERLH	=	0.68 x cfm_{da} ‡x (W_{rm} – W_{adp}) (1-BF)	(20)
ERTH	=	4.45 x cfm_{da} ‡x (h_{rm} – h_{adp}) (1-BF)	(21)
TSH	=	1.08 x cfm_{da} ‡x (t_{edp} – t_{idp})**	(22)
TLH	=	0.68 x cfm_{da} ‡x (W_{ea} – W_{la})**	(23)
GTH	=	4.45 x x cfm_{da} ‡x (h_{ea} – h_{la})**	(24)

C. SENSIBLE HEAT FACTOR EQUATIONS

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

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

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

D. BYPASS FACTOR EQUATIONS

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

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

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

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_{la} on the psychrometric chart.

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

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

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 x $\frac{60}{13.5}$

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, Wm 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 coutdoor 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	Fahrenhelt 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 supliment
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_{ba}	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_{iwb}	leaving wet-club 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_{la}	leaving air moisture content
W_{m}	mixture of outdoor and return air moisture content
W_{oa}	outdoor air moisture content
W_{rm}	room moisture content
W_{sa}	supply air moisture content