**AIHA App Equations**

**Heat Stress Equations**

**Wet Bulb Globe Temperature – indoor and outdoor**



WBGT= ‘Degrees F’ Temperature

t= ‘Degrees F’ Temperature

**OSHA PERMISSIBLE HEAT EXPOSURE THRESHOLD LIMIT VALUE TABLE**

|  |  |  |
| --- | --- | --- |
| ------------- Work Load\* ------------ | | |
| **Work/rest regimen** | **Light** | **Moderate** | **Heavy** |
| Continuous work | 30.0°C (86°F) | 26.7°C (80°F) | 25.0°C (77°F) |
| 75% Work, 25% rest, each hour | 30.6°C (87°F) | 28.0°C (82°F) | 25.9°C (78°F) |
| 50% Work, 50% rest, each hour | 31.4°C (89°F) | 29.4°C (85°F) | 27.9°C (82°F) |
| 25% Work, 75% rest, each hour | 32.2°C (90°F) | 31.1°C (88°F) | 30.0°C (86°F) |
| \*Values are in °C and °F, WBGT. | | | |

**Noise Equations**

**Adding sound pressure levels from different sources**



SPL= ‘dBA’ decibels

SPLi= ‘dBA’ decibels

**OSHA equation for Allowable Exposure Time equation, using the OSHA 5 dB doubling rate with a TWA of 90 dBA.**

8

T = ----------------

2 SPL - 905

T= ‘Hours’

SPL= ‘dBA’ decibles

**Equation for computing the time allowed before an 8-hour TWA of 85 dBA is reached. This equation assumes a 3 dB doubling rate:**

T= ‘minutes’ amount of time minutes to reach 85 dBA

L= ‘dBA” Decibles

**Inverse square law**



I= ‘m/R’, Intensity

D= ‘feet’, Distance

**Converting percent dose to TWA**



TWA = ‘dBA’ Time Weighted Average

D= ‘%’ Dose

**Exposure Equations**

**Silica exposure calculations**

**These are actually two separate equations.**



PEL= mg/m3

% qrtz= % quartz

%crist= % cristobalite

%trd= % tridymite

**TLV of mixtures**



TLVmix = ‘#’ ends up being a whole number since the ppm units cancel each out in the equation

C= ‘ppm’ parts per million

TLV = ‘ppm’ parts per million

**Calculating TWAs**

TWA= CaTa + CbTb +…CnTn  
 Ta + Tb + …Tn

TWA= ‘ppm’ parts per million

C= ‘ppm’ parts per million

T= ‘minutes’

The time T in the denominator should always add up to 8 hours. In many cases, the concentration can be spread over few minutes or hours; they should be converted into hours and should add up as 8 hours.

**Ventilation Equations**

**Oxygen Deficiency Calculation**

Computing oxygen level in a room after a cryogen spill assumes instantaneous evaporation and equal mixing

This is a 2 part calculation that first requires computing the volume that is displaced by the cryogen spill and then subtracting that volume from the room volume

Variables:

Volume of cryogen spilled – liters

Density of inert gas – g/cm3

MW of gas for 1 mole– grams

Volume of room – ft3

1. Compute volume of displaced air from cryogen spill (ft3)

Volume of displace air (ft3) = (liters of cryogen)\*(103 cm/liter)\*(density of inert gas)\*(1 mole/MW of gas)\*(24.25 liters/mole)\*(1 ft3/28.31 liters)

1. Oxygen level in room (% oxygen)=

= (20.9%)\*(room volume - volume of displaced air)\*(volume of displaced oxygen)

Room volume

Note: in the numerator the volume of displaced air is subtracted from the volume of the room

**Room air changes per hour**



N= ‘#” a number

Q= ‘cfm’ cubic feet per minute

V= ‘ft3’ cubic feet

**Pressures**

TP = VP + SP

TP= ‘#’ Total Pressure

VP = ‘#’ Velocity Pressure

SP = ‘#’ Static Pressure

VP is always positive and SP can be positive or negative

**Changes in temperature and pressure for sample pump**

Generally, sampling should be conducted at approximately the same temperature and pressure as calibration, in which case no correction for temperature and pressure is required and the sample volume reported to the laboratory is the volume actually measured.  Where sampling is conducted at a substantially different temperature or pressure than calibration, an adjustment to the measured flow rate may be required to obtain the actual air volume sampled.   The flow rate adjustment is based on the following equation



                 Qcorrected        =    ‘L/min’ the flow rate to be used for calculating the volume

                Qindicated         =     ‘L/min’ the flow rate indicated on the rotameter

                                Pc            =     ‘kPa’ pressure during calibration

                                Ps            =     ‘kPa’ pressure of air during sampling

                                Tc            =     ‘Kelvin’ Absolute temperature during calibration

                                Ts            =     ‘Kelvin’ Absolute temperature during sampling

\*remember that degrees Kelvin are calculated by degrees Celcius +273 and degrees Rankin are calculated by degrees Fahrenheit + 460.

**Velocity**

V = 4005 √VP

V = ‘ft/min’ velocity of air

VP – ‘W.C.’ Water Column velocity pressure,(assuming STP for equation)

**Hood Static Pressure**

|SPh| = *V Pd* + *he*

SPh= ‘in. wc’ value of hood static pressure

*V Pd*  = ‘in. wc’ velocity pressure in duct

*he* = ‘in. wc’ hood entry loss

**Dilution Ventilation Based on Room Air Changes**

G

C = ------ (1 – e –N t/60 ) x 106

Q

The actual units are listed after the comma at the end of each of these parameters.

*C* = concentration at time *t*, ppm

*G* = rate of generation of contaminant, ft3/min

*Q’ =* effective rate of ventilation, ft3/min

*e* = natural logarithm, 2.71828…

*t* = time elapsed, hours

*N* = number of air changes per hour

60 = conversion from minutes to hours

**Dilution to Control Evaporation**

*(403)(SG)(ER)(K)(10 6)*

*Q = -----------------------------------*

*(MW)(C)*

*The actual units are listed after the comma at the end of each of these parameters.*

*Q* = volumetric flow required to limit concentration, ft3/min

403 = constant for units used

*SG* = specific gravity, nondimensional

*ER* = evaporation rate, pints/min

*K* = ventilation (dilution) safety factor, nondimensional

106 = unit conversion (ppm to volume percent)

*MW* = molecular weight, g

*C* = contaminant concentration in air, ppm

**Fan Laws**

*FSP* = *SP out* - *SP in* - *V P in*

*The actual units are listed after the comma at the end of each of these parameters.*

*FSP* = fan static pressure; this can also be shown as SPfan, in. wc

*SP out* = static pressure out; measured on the outlet side of the fan, in. wc

*SP in* = static pressure in; measured on the inlet side of the fan, in. wc

*V P in* = velocity pressure on the inlet side of the fan, in. wc

**Fan Total Pressure**

*FTP* = *TP out* - *TP in*

*The actual units are listed after the comma at the end of each of these parameters.*

*FTP* = fan total pressure, in. wc

*TP out* = total pressure measured at the outlet, in. wc

*TP in* = total pressure measured at the inlet, in. wc

**Fan Laws**

Size2 RPM2

Q2 = Q1 (--------) 3 (---------)

Size1 RPM1

*The actual units are listed after the comma at the end of each of these parameters.*

*Q2* = volumetric flow rate for condition 2, ft3/min

*Q1* = volumetric flow rate for condition 1, ft3/min

Size2= fan diameter for condition 2, inches

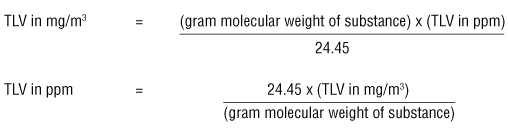
Size1= fan diameter for condition 1, inches

RPM2= fan speed for condition 2, rpm

RPM1= fan speed for condition 1, rpm

**Conversions Equations**

**Converting mg/m3 to ppm**



TLV= ‘mg/m3’ or ‘ppm’ depending on which formula you use to calc the Threshold Limit Value

mg/m3= ‘mg/m3’ milligrams per cubic meter

ppm= ‘ppm’ parts per million

**Converting diameter to area**



These are two separate equations that the person could use.

Result will be inches squared

d= ‘inches’ diameter

r= ‘inches’ radius

