

## Heat Stress Evaluation Based on WBGT

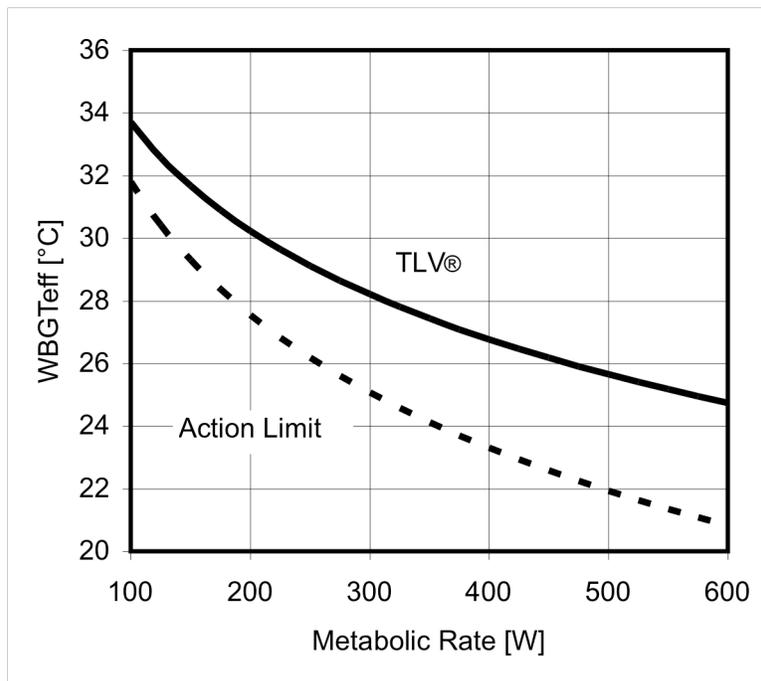
The ACGIH® Threshold Limits Value® (TLV®) for Heat Stress and Strain (2006) exposure evaluation is based on a task analysis that considers environmental conditions reflected in the wet bulb globe temperature (WBGT) index, the work demands (metabolic rate) and the clothing requirements. The effective WBGT ( $WBGT_{eff}$ ) is the sum of the measured WBGT and the clothing adjustment factor.

The first step is to identify the various locations and activities that are performed in a one to two hour period. Each distinct pair of location and activity is noted, and the Single Task Heat Stress Data form (page 2) is completed for each of these tasks. Two blank locations for clothing ensembles and clothing adjustment factors (CAF) are provided on the form for user specific ensembles.

The individual task data are then entered onto the Multi-Task Heat Stress Analysis form (page 3). The effective WBGT is computed and then the time-weighted average of the metabolic rate and effective WBGT are computed.

The level of heat stress is found from the following figure by locating the point where TWA-metabolic rate and TWA- $WBGT_{eff}$  meet.

ACGIH® TLV® for Heat Stress and Strain -- WBGT Limits



Note: The actual TLV® chart labels the y-axis as WBGT while this figure uses  $WBGT_{eff}$ . There is no difference except to emphasize that the WBGT value used is adjusted for clothing.

### Single Task Heat Stress Data

Task Number of	Task Description			
<b>Clothing</b>  Check an Ensemble and Enter Clothing Adjustment Factor.  Space provided for two other ensembles.	<i>Ensemble</i>	°F	°C	Clothing Adjustment Factor
	<input type="checkbox"/> Work Clothes / Cloth Coveralls	0	0	
	<input type="checkbox"/> Double Layer Cloth	5	3	
	<input type="checkbox"/> SMS Polypropylene Coveralls	1	0.5	
	<input type="checkbox"/> Polyolefin Coveralls	2	1	
	<input type="checkbox"/> Limited-Use Vapor-Barrier	20	11	
	<input type="checkbox"/>			°F / °C
<input type="checkbox"/>				
<b>Work Demands</b>  Choose a characteristic category and enter rate. Intermediate values are acceptable.  Values based on average person.	Category	Rate		Metabolic Rate [W]
	Rest / Sedentary	115		
	Light Sustainable with ease for 8 h	180		
	Moderate Sustainable for 8 h w/ nominal breaks	300		A better alternative is to use the component estimate method.
	Heavy Breaks required at least every hour †	415		
	Very Heavy Frequent breaks required †	520		
	† When averaged over an hour, heavy and very heavy work with breaks are usually moderate.			
<b>Task Time</b>		Time [min]		
<b>Thermal Environment</b>  °F / °C Enter individual values or WBGT from instrument. Circle units.	$T_{db}$		WBGT Equations	WBGT
	$T_{nwb}$		Inside or Shade $0.7 T_{nwb} + 0.3 T_g$	
	$T_g$		In Direct Sun $0.7T_{nwb}+0.2T_g+0.1T_{db}$	°F / °C

### Multi-Task Heat Stress Analysis

Use Single Task Heat Stress Data forms to supply data to this analysis.

Task	Brief Description	CAF [ °F / °C ]	Metabolic Rate [W]	Time [min]	WBGT [ °F / °C ]	WBGT <sub>eff</sub> WBGT + CAF	Time x Met Rate	Time x WBGT <sub>eff</sub>
1								
2								
3								
4								
5								
6								
<b>Total</b>		Sum the following columns: Time, Time x Met Rate, Time x Eff WBGT						
<b>Time-Weighted Average (TWA)</b>		Divide Total of Time x Met Rate by Total Time and Enter under M. Divide Total of Time x WBGT <sub>eff</sub> by Total Time and Enter under WBGT <sub>eff</sub> . This pair of values are used to locate the conditions on the TLV chart.					M	WBGT <sub>eff</sub>