December 1, 2011

The Honorable Hilda L. Solis
Secretary
U.S. Department of Labor
200 Constitution Ave. NW
Washington, DC 20210

Wage and Hour Division
U.S. Department of Labor
Room S-3502
200 Constitution Ave. NW
Washington, DC 20210

[submitted electronically at www.regulations.gov]

Re: Child Labor Regulations, Orders and Statements of Interpretation;
Child Labor Violations — Civil Money Penalties. RIN 1235-AA06

Dear Secretary Solis:

Public Citizen, a consumer and health advocacy group representing more than 225,000 members and supporters nationwide, submits the following comments in response to the Department of Labor’s (DOL) Wage and Hour Division notice of proposed rulemaking (RIN 1235-AA06), entitled “Child Labor Regulations, Orders and Statements of Interpretation; Child Labor Violations—Civil Money Penalties,” 76 Fed. Reg. 54836 (Sept. 2, 2011). Specifically, our comments are directed to Part V.M. of the notice, which discusses the possibility of a new Agricultural Hazardous Occupations Order concerning “Employment in Agriculture Under Adverse Circumstances,” 76 Fed. Reg. at 54865. In summary, we are requesting that DOL institute the following protections against extreme heat exposure for all child farmworkers under the age of 16:

- A prohibition on any work, or duration of work, that places child workers at risk for excessive and dangerous heat exposure, enforced through the implementation of
an adequately protective heat stress threshold, which will set a maximum level of heat stress to which a child worker can be safely exposed;
- Mandatory rest breaks every hour on particularly hot days to prevent heat exhaustion;
- Drinking water and shade provisions;
- Adequate training of employees and their supervisors on appropriate heat stress management;
- Adequate and constant supervision of minor employees by adult employees;
- Accurate record-keeping of injuries and training activities; and
- A Heat Illness Prevention Plan and Emergency Response Plan to prevent and treat, respectively, heat-related injury.

I. Background

Public Citizen believes that child labor should be abolished. Permitting children under the age of 16 to work for meager pay — often for 12 or more hours continuously, in dangerous conditions — harks back to the early days of the Industrial Revolution, when children toiled in perilous factory jobs for slave wages, a chapter in American history most thought was long gone. Sadly, however, the practice is alive and well on industrial farm establishments across the country.

During the New Deal era, Congress enacted the Fair Labor Standards Act (FLSA), which included a ban on almost all work for children less than 14 years of age. However, an exemption was granted to agricultural establishments. The exemption, originally intended to allow children to work on small, local farms for family or neighbors, has long been conveniently used by large industrial “farms” to exploit cheap child labor. Children as young as 12 years of age, many of them vulnerable undocumented immigrants, routinely work alongside their parents, picking grapes and tomatoes, often under sweltering heat.

A recent report by Human Rights Watch documents the atrocious conditions under which many children are forced to work.¹ Child laborers interviewed by the organization reported 12-hour workdays six or seven days a week for minimal pay. The report also noted that the U.S. government spent over $26 million in 2009 to eliminate exploitative child labor around the world, while allowing it to flourish here at home.

Reserving our objections to this regressive practice, we believe that, at the very least, if permitted, agricultural child labor must be restricted only to the safest workplaces and tasks. Unfortunately, this is far from the reality on the vast majority of farms and agriculture-related work, where children routinely work on some of the most hazardous
tasks. This past summer, two 17-year-old boys in Oklahoma were hospitalized in critical condition after their legs were crushed in the auger of a commercial grain elevator. The event coincided with the fatal electrocution of two 14-year-old girls on a Monsanto corn farm in Illinois.

We commend DOL on its belated willingness to enact humane protections for child workers and urge the agency to consider in its deliberations the serious effects of extreme heat on children. According to data from the Bureau of Labor Statistics (BLS), over the past 20 years, at least 1,672 teenage workers (or 93 per year — and almost certainly more) have been seriously injured from excessive heat exposure, an entirely preventable hazard.

On Sept. 1, 2011, Public Citizen filed a petition with the Occupational Safety and Health Administration (OSHA) calling for a federal standard protecting all workers from extreme heat exposure, which has killed at least 523 workers and seriously injured 43,454 over the past 20 years. Despite this toll, and repeated recommendations for a standard by the National Institute for Occupational Safety and Health (NIOSH) and OSHA’s own advisory committee, OSHA has to-date refused to enact a standard that would, according to NIOSH, “prevent or greatly reduce the risk of adverse health effects to exposed workers.”

As OSHA has done essentially nothing to protect workers from this hazard for nearly 40 years, we are hopeful that DOL’s Wage and Hour Division will take the lead in ensuring that minimal safeguards are implemented to prevent further needless injuries in child and adolescent workers. We believe that the recommendations included in these comments are critical in ensuring that any rules managing heat stress in child workers are sufficiently protective.

II. Heat stress, agriculture, and child labor: scope of the problem and current federal enforcement

A. Agricultural workers have, by far, the highest rate of heat-related deaths

Any physical activity causes an increase in the generation of metabolic heat, which, in the presence of hot or humid conditions, can quickly overcome the body’s ability to cope with the heat load, leading to heat stroke if preventive measures are not promptly taken. Physically demanding labor, mainly in hot outdoor environments, is what characterizes a large proportion of farm labor in the U.S.
For this reason, agricultural workers are the most vulnerable to suffering severe adverse effects from extreme heat stress. In 2008, the Centers for Disease Control and Prevention (CDC) issued a *Morbidity and Mortality Weekly Report* (MMWR) documenting the extent of heat-related deaths in U.S. crop workers over the previous 14 years (1992-2006). Of a total of 423 total worker deaths from excessive heat exposure, crop workers accounted for 68, or 16%, of all deaths. Crop workers suffered much higher rates of death than did other workers, with 0.39 deaths per 100,000 workers, over 19 times the national rate. Most concerning, the majority of the deaths were in workers aged 20-54, not a population usually at high risk for heat-related deaths.

As Table 1 shows, workers in farming, fishing, and forestry occupations accounted for more than 1 in 5 deaths resulting from environmental heat exposure, with agricultural workers comprising the vast majority of these deaths. Consistent with the CDC report, this death rate is over 26 times that of the general worker population. Construction workers have also suffered high rates of heat-related deaths, at 4.5 times the national rate.

**Table 1. Heat-related deaths in agricultural workers, 1992-2009**

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Heat-relatedDeaths</th>
<th>Incidence (2000-2009) per million full-time workers</th>
<th>relative to national rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming, Fishing, &amp; Forestry</td>
<td>110 (21%)</td>
<td>7.30</td>
<td>26x</td>
</tr>
<tr>
<td>Construction &amp; Extraction</td>
<td>112 (21%)</td>
<td>1.22</td>
<td>4.5x</td>
</tr>
<tr>
<td>Total for all occupations</td>
<td>523</td>
<td>0.27</td>
<td>1x</td>
</tr>
</tbody>
</table>


**B. Child and adolescent workers are at even higher risk for heat-related illness**

Child laborers may be particularly vulnerable to the effects of extreme heat exposure due to their unique biological characteristics, a slower rate of acclimatization to high heat levels, and a possibly reduced awareness of when to take a break in response to
heat symptoms. In a study by the CDC, of all age groups, children aged 15-19 were found to have the highest incidence of nonfatal heat-related illness due to sports or other physical activities, at 10.1 per 100,000 persons, or five times the national rate. Children 10-14 years old had a rate of heat-related illness over twice the national average (5.2 per 100,000).

Multiple studies have shown that children do not respond to heat stress as efficiently as adults due to their different biological makeup. In response to these studies, in 2000, the American Academy of Pediatrics (AAP) released a policy statement summarizing its review of the evidence. In the statement, the AAP concluded that children and adolescents cannot adapt to extreme temperatures as well as adults when exposed to high climatic heat stress, for three principal reasons (taken verbatim from report):

1. Children have a greater surface area-to-body mass ratio than adults, which causes a greater heat gain from the environment on a hot day and a greater heat loss to the environment on a cold day.
2. Children produce more metabolic heat per mass unit than adults during physical activities that include walking or running.
3. Sweating capacity is considerably lower in children than in adults, which reduces the ability of children to dissipate body heat by evaporation.

These biological limitations are compounded by the fact that children may be less likely to respond to subjective symptoms of heat stress as rapidly as adults, particularly if they do not have the understanding or appreciation of the serious consequences of excessive heat exposure. In addition, as the AAP report pointed out, children take longer to acclimatize to high heat levels and therefore are unable to cope as well as adults with sudden increases in temperature, such as those seen during a heat wave.

Since the publication of the 2000 AAP position statement, more recent studies have demonstrated that, when compared to adults of similar fitness and when workloads are adapted to the children’s decreased physical capacity, the adverse effects of heat stress on children are similar to the effects on adults. An updated AAP statement issued in 2011 reflected this new evidence, stating that children are not at a higher risk for heat stress when conditions are strictly controlled, such as in experimental settings or closely supervised athletic environments.

It should be immediately evident, however, that these newer findings are irrelevant to the real world of industrial agriculture. The studies referred to in the AAP’s 2011 policy statement were conducted on children in controlled settings, where hydration was
vigorously maintained and workloads were adjusted to the children’s decreased physical capacities. This latter point is crucial when translating this research into everyday life on a commercial farm. Children, particularly adolescents, are almost always responsible for maintaining workloads similar to those of adults, thereby incurring a higher heat load under the same conditions. It is quite unlikely that employers calculate each child’s physical capacity and adjust the workload accordingly.

Therefore, child workers are invariably at a higher risk for heat-related illness at agricultural worksites. At a minimum, therefore, children should be entitled to the same evidence-based protections indicated for adult workers (and outlined below in our Section III recommendations) and should be entirely prohibited from working on days with particularly high heat loads.

C. Underreporting of dangerous conditions by farmworkers

The existing data almost certainly underestimate the prevalence of agricultural heat-related injuries in children for several reasons. As is the case with all workers (see below), most agricultural workers with heat-related illness short of severe exhaustion are likely to self-treat, do not report illness, and do not (or are not able to) take time off to recuperate. Additionally, in agriculture, signs of heat stress — rash, sweating, headache, and fatigue — can be confused with similar symptoms encountered with exposure to pesticides, thus leading to misclassification of the exposure and further underreporting.

Accurate injury reporting is also hindered by unique features of the agricultural work environment, including a largely migrant workforce, a seasonal work cycle, workers’ poor English skills, and economic and social factors that prevent workers from speaking out about workplace conditions. The majority of farmworkers are poor, can ill afford to stop working to treat or recover from injuries, often fear losing their jobs if they take time off, lack awareness of employment rights, and may perceive that reporting injuries would be construed by employers as complaints and thus result in reprisal. Most farmworkers are immigrants, with many lacking proper work permits and fearful of deportation if they raise concerns about, or request the most basic protections from, heat stress. Children are all the more likely to under-report injuries for these reasons, feeling a need to “work through” heat-related symptoms to support their parents and families, and lacking awareness as to the significance of these symptoms in the first place.

D. Minimal OSHA enforcement under the General Duty Clause
Despite the epidemic of heat-related injuries and deaths, OSHA has done almost nothing to protect farmworkers from the consequences of working under extreme heat conditions. Over the past 40 years, the agency has conducted just 12 inspections of agricultural worksites that have resulted in a heat-related citation. Nine inspections were reactive in nature, initiated only in response to the death of a farmworker. Despite the serious nature of the violations, employers responsible for the dangerous work conditions were fined an average of only $3,171 per violation, less than half the maximum allowable fine ($7,000) for serious violations.\(^{24}\)

E. Field Sanitation Standard: important but no substitute for a heat standard

In addition to the General Duty Clause (under-) utilized by OSHA, the Wage and Hour Division currently has the authority to enforce the Field Sanitation Standard (29 C.F.R. 1928.110), a rule adopted in 1987 that requires agricultural employers to provide adequate sanitation facilities and potable water for all employees working in the fields. However, the standard is vague and requires only the provision of drinking water that is “readily accessible” and in “sufficient amounts,” and mandates only that employers encourage workers to “drink water frequently and especially on hot days.”\(^{25}\) In subsequent interpretations, OSHA cited heat stress and heat exhaustion as “primary hazards addressed by the standard,”\(^{26}\) yet the agency did not attempt to expand upon the standard or make it more specific. Ultimately, although the general idea was a good one, the language — like that of the General Duty Clause — is vague and leaves up to the employer what constitutes “accessible” and “sufficient” quantities of drinking water.

In 1992, OSHA claimed in a fact sheet that the Field Sanitation Standard, along with similar state standards, would “reduce heat-related injuries among those covered by more than 90 percent.”\(^{27}\) Not surprisingly, given that the standard only addresses heat-related illness through a single and vaguely worded provision for drinking water, this prediction proved a gross overestimate of the standard’s impact. According to the CDC, the incidence of heat-related deaths in agricultural workers has actually increased, tripling from 0.2 deaths per 100,000 workers to 0.6 per 100,000 workers since the implementation of the standard over 20 years ago.\(^{28}\)

III. Summary of requests to DOL for consideration in its proposed rulemaking

Given the entirely preventable nature of heat-related illness and death, the DOL must urgently act to protect child and adolescent workers (defined as all those under the age of 16), who are among the most vulnerable to suffering these effects. We therefore ask that DOL institute the following protections for young workers, in accordance with the
requests listed in our 2011 petition to OSHA. Child laborers must be prohibited from working when temperatures exceed the dangerous thresholds outlined below. We reiterate that there is no way that children can continue to be allowed to work at heat levels above these thresholds without endangering their health. DOL has summarized its request for comments on the proposed rule in three central questions (paraphrased below):

- How could DOL best protect young workers from heat-related illnesses and injuries?
- What should be the temperature triggers for such requirements?
- What mechanisms could DOL use to measure field temperatures (e.g., using heat index charts or the Wet-Bulb Globe Temperature [WGBT] index) or to enforce a heat provision (e.g., using medical documentation of heat-related illness)?

Below, we provide answers to these questions based on the best available evidence on heat illness prevention, taken from NIOSH, the American Conference of Governmental Industrial Hygienists (ACGIH), and the U.S. military. We also include other requirements we believe are critical to ensure maximal compliance with the proposed rule. Detailed explanations of each of the provisions are provided in our OSHA petition for a heat standard,29 submitted along with these comments in the docket.

It should be noted that these recommendations were originally developed for adults, as we are not aware of any official or unofficial heat stress recommendations targeted specifically to child and adolescent workers. Therefore, given children’s increased vulnerability to heat-related illness, the recommendations presented below should be interpreted as minimal protections. Consultation by DOL with pediatric heat stress experts is warranted, as necessary, to further refine the provisions to reflect children’s unique biological characteristics.

A. Heat stress threshold

Arguably the most important component to the proposed DOL protections is the development of a heat stress threshold that would serve as a trigger, requiring employers to take immediate action to prevent the onset of heat injury. Such a threshold, based on the WBGT, has already been developed and refined by both NIOSH and ACGIH, and a similar exposure limit is already in use by the Navy.30

Employers can easily measure the WBGT on a daily basis using a specialized thermometer that can be bought online for as little as $150. These thermometers
incorporate ambient temperature, humidity, wind, and the effect of direct sunlight and report a single value that the employer can then compare (taking into account each employee’s workload) with values on a mandated heat stress threshold.

A commonly accepted WBGT threshold, and one referred to in OSHA’s *Technical Manual*, is based on the ACGIH Threshold Limit Value (TLV) and Action Limit curves (Appendix, Figure 1). These thresholds apply to acclimatized and unacclimatized workers, respectively, and were originally developed decades ago to require employers to take specific engineering and work-practice controls necessary to keep core body temperature below 38.0 C (100.4 F) for most workers (below 38.5 C for acclimatized, healthy workers with no risk factors for heat illness), factoring in the effects of environmental heat, metabolic heat, acclimatization, and clothing (see Appendix for WBGT calculation and Tables 4 and 5 for additional factors in calculating WBGT and metabolic heat).

Due to the acute nature of heat injury and the substantial variation in heat levels throughout a typical work day, the heat stress threshold must not be an 8-hour time-weighted average (TWA). Were heat levels to be averaged over the course of an 8-hour day (as is commonly done with more chronic chemical exposures), dangerous variations in temperature would be missed, exposing workers to immediate harm, even with a low 8-hour TWA. For this reason, we urge DOL to use OSHA’s suggested protocol, detailed in its *Technical Manual* on heat stress, to average WBGT values every hour for continuous exposures, and every two hours for intermittent exposures.

DOL must develop criteria to distinguish between acclimatized and unacclimatized workers, in a manner consistent with current NIOSH, ACGIH, or military guidelines, for the purpose of determining differential heat stress thresholds applied to each type of worker. Unacclimatized workers should be gradually introduced to conditions of high heat stress through a rigorous acclimatization protocol (typically over 10-14 days). During heat waves (defined as days when the National Weather Service has declared heat advisories or warnings; days with maximum temperatures above 95 F; or days when the daily maximum temperature exceeds 90 F and is 9 F higher than the previous day), previously acclimatized workers should be reclassified as unacclimatized and an appropriate heat stress threshold recalculated accordingly.

**B. Reimbursed, mandatory rest breaks**

Young workers must be given periodic rest breaks every hour (in the shade for outdoor environments) to ensure that total heat stress over a given hour is not in excess of the ACGIH threshold curves (Appendix, Figure 1 and Table 2). These rest breaks must be
staggered over the course of an hour to minimize risks incurred from continuous labor under extreme-heat conditions. In addition, all workers requesting a break due to discomfort or overt heat-related symptoms must be granted a break of no less than five minutes or the time needed for the worker to fully recover, whichever is longer.

The U.S. army has developed rigorous work-rest cycles and hydration protocols corresponding to work intensity and WBGT categories. These protocols (Appendix, Table 3) could easily be posted at all worksites and followed by the employer as a guide for when to institute a rest break.

In implementing this provision, the Wage and Hour Division must consider the practice of piece-rate payments. Many crop workers are paid by the “piece,” that is, by the number of fruits or vegetables harvested and not by the amount of time worked. Therefore, these workers may be inclined to skip even required rest breaks or water breaks in order to maximize their earnings. It is clear that this may prove to be a dangerous dilemma for this group of workers most at risk for heat-related illness, who may continue to work despite warning symptoms of heat illness in order to get more pay. Therefore, these rest breaks must be reimbursed in such a way as to prevent these workers from having to choose between their safety and their livelihood. The burden to protect worker safety and health should always fall on the employer, and this is no exception.

C. Drinking water

The current provision under the Field Sanitation Standard mandating drinking water for farmworkers is vague and insufficient to prevent heat stress, especially in children and adolescents, who may be more prone to dehydration. Therefore, young workers must be given access to quantities of cool, potable water sufficient to maintain adequate levels of hydration. At least one quart of water per worker per hour must be made available, and young workers must be given the opportunity and encouraged to drink at least 150-200 milliliters of potable water every 15-20 minutes, or an amount appropriate for age and weight. The water must be cool (10-15 C), palatable, and provided in individual (not communal) serving cups. DOL should explicitly state that employers will be held responsible should children fail to adequately hydrate themselves.

D. Shade

Employers must provide outdoor workers access to sufficient areas of shade, both during rest breaks and upon request, with enough coverage to comfortably accommodate all child and adolescent workers at one time.
E. Adequate and constant supervision of minor employees

All youth employees should be supervised by adults at all times and not permitted to work alone, particularly on hot days.

F. Employee and supervisor training

All employers must be required to provide initial training to new employees and supervisors and at least annual training thereafter on 1) employee rights under the new heat rules, 2) the hazards of heat stress, 3) the warning signs and symptoms of heat-related illness, and 4) available measures to treat heat illness. For workers not fluent in English, all training sessions should be administered in the worker’s first language. All employees and supervisors should then be formally assessed for understanding of these training sessions, through an oral and written (if the worker is literate) evaluation, in the worker’s first language, that will be kept by the employer and furnished to OSHA upon request. In addition to the above schedule, these trainings should also be required before any major change in ambient temperature or humidity conditions, such as before a heat wave as defined by the National Weather Service (see section A).

G. Emergency response

In the case of a heat-related illness, the employer must take immediate action to remove from exposure to heat an employee showing or reporting signs of heat illness and immediately obtain the necessary assistance and consultation from a certified first-aid responder or medical professional. Employers should have a plan (included as part of the Heat Illness Prevention Plan, see section H) for providing on-site first aid to workers with possible symptoms of heat-related illness.

H. Record-keeping requirements

All businesses must keep adequate records and furnish upon request to DOL:

- A written Heat Illness Prevention Plan. This will be a detailed plan outlining how the employer will comply with all requirements of the new heat rules, with specific measures taken to prevent heat-related illness, including policies regarding using protective clothing and equipment, scheduling work times, adjusting work pace during heat waves to reduce risk of heat illness, and implementing an Emergency Response Plan as outlined in the provision above (section G). The Heat Illness Prevention Plan will also include a detailed listing of all training sessions and
evaluations given to employees and supervisors as required in the “Employee and Supervisor Training” (section F) provision above; and
- A record of all worker injuries due to heat, consistent with OSHA reporting requirements for serious injuries. DOL should mandate a separate line on the Form 300 Log of Injury for the recording of all such heat-related injuries.

I. Scope

In order for the proposed protections to ensure the safety of all young agricultural workers, it is critical that they apply:

- Year-round, given the variation in climate in different regions of the country;  
- To all outdoor and indoor agricultural workplaces, regardless of ambient temperature, as other critical factors (e.g., humidity, clothing, and hydration levels) may cause heat-related illness at lower temperatures; and
- To all employees, without exemptions for duration of time worked per hour, as this will already be considered when calculating the heat stress threshold recommended in these comments.

We thank you for the opportunity to comment on the proposed child labor rules, and urge you to take these points into consideration.

Sincerely,

Sammy Almashat, MD, MPH
Researcher
Public Citizen’s Health Research Group

Sidney Wolfe, MD
Director
Public Citizen’s Health Research Group
Appendix

Figure 1. Heat stress threshold developed by the ACGIH, representing maximum heat burdens for workers under various levels of metabolic and environmental heat (taken as is from ACGIH 2011 TLVs and BEIs booklet)\textsuperscript{39}

\* WBGT\textsubscript{eff} is the measured WBGT plus the Clothing Adjustment Factor. See Table 5.
\*\* “TLV” refers to threshold for acclimatized workers; “Action Limit” refers to unacclimatized workers.

CALCULATING THE WET-BULB GLOBE TEMPERATURE (WBGT)

For outdoor workplaces (with direct sun exposure): \( \text{WBGT}_\text{out} = 0.7 \ T_{\text{nwb}} + 0.2 \ T_g + 0.1 \ T_{\text{db}} \)

For indoor workplaces (without sun exposure): \( \text{WBGT}_\text{in} = 0.7 \ T_{\text{nwb}} + 0.3 \ T_g \)

\([T_{\text{nwb}} = \text{natural wet-bulb temperature}; \ T_g = \text{globe temperature}; \ T_{\text{db}} = \text{dry-bulb (air) temperature}]\)

The natural wet-bulb temperature \((T_{\text{nwb}})\) accounts for humidity, which at high levels inhibits a person’s ability to sweat, thus weakening this most critical cooling mechanism. The globe temperature \((T_g)\) represents the ambient air temperature but considers the effects of direct sunlight and air movement, while the dry-bulb temperature \((T_{\text{db}})\) is used in outdoor situations only and represents the outside air temperature shielded from direct sunlight.
Table 2. Screening criteria for TLV and Action Limit for heat stress exposure (taken from ACGIH, 2011)\textsuperscript{40}

This table from ACGIH incorporates all four factors (environmental heat, metabolic heat, work duration per hour, and acclimatization) into an easy-to-read table that sets certain temperature threshold limits to alert employers to an increased risk of heat-related health effects.

<table>
<thead>
<tr>
<th>Allocation of Work in a Cycle of Work and Recovery</th>
<th>TLV\textsuperscript{a} (WBGT values in °C)</th>
<th>Action Limit (WBGT values in °C)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>31.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Moderate</td>
<td>29.0</td>
<td>27.5</td>
</tr>
<tr>
<td>Heavy</td>
<td>29.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Very Heavy</td>
<td>30.0</td>
<td>29.0</td>
</tr>
<tr>
<td>75 to 100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50 to 75%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25 to 50%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0 to 25%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 3. U.S. Army work/rest guidelines including WBGT heat categories\textsuperscript{41}

![Work/Rest and Water Consumption Table](image-url)
Table 4. Clothing-adjustment factors for some clothing ensembles* (taken from ACGIH 2011 TLVs and BEIs)\textsuperscript{42}

<table>
<thead>
<tr>
<th>Clothing Type</th>
<th>Addition to WBGT [$^\circ$C]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Work clothes (long sleeve shirt and pants)</td>
<td>0</td>
</tr>
<tr>
<td>Cloth (woven material) coveralls</td>
<td>0</td>
</tr>
<tr>
<td>Double-layer woven clothing</td>
<td>3</td>
</tr>
<tr>
<td>SMS polypropylene coveralls</td>
<td>0.5</td>
</tr>
<tr>
<td>Polyolefin coveralls</td>
<td>1</td>
</tr>
<tr>
<td>Limited-use vapor-barrier coveralls</td>
<td>11</td>
</tr>
</tbody>
</table>

*These values must not be used for completely encapsulating suits, often called Level A. Clothing Adjustment Factors cannot be added for multiple layers. The coveralls assume that only modesty clothing is worn underneath, not a second layer of clothing.
Table 5. Estimating energy cost of work (work-rate) by task analysis (obtained from NIOSH)\textsuperscript{43}

A standard measurement tool was proposed in 1986 by NIOSH, incorporating body position, type of work, and basal metabolism to determine the person's total energy expenditure, or work rate, per hour. This can be used to determine the metabolic heat in calculating the total heat load on a worker (see Figure 1, ACGIH threshold curves).

<table>
<thead>
<tr>
<th>A. Body position and movement</th>
<th>kcal/min*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sitting</td>
<td>0.3</td>
</tr>
<tr>
<td>Standing</td>
<td>0.6</td>
</tr>
<tr>
<td>Walking</td>
<td>2.0-3.0</td>
</tr>
<tr>
<td>Walking uphill</td>
<td>add 0.8 per meter rise</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Type of work</th>
<th>Average kcal/min</th>
<th>Range kcal/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hand work</td>
<td></td>
<td></td>
</tr>
<tr>
<td>light</td>
<td>0.4</td>
<td>0.2-1.2</td>
</tr>
<tr>
<td>heavy</td>
<td>0.9</td>
<td></td>
</tr>
<tr>
<td>Work one arm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>light</td>
<td>1.0</td>
<td>0.7-2.5</td>
</tr>
<tr>
<td>heavy</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Work both arms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>light</td>
<td>1.5</td>
<td>1.0-3.5</td>
</tr>
<tr>
<td>heavy</td>
<td>2.5</td>
<td></td>
</tr>
<tr>
<td>Work whole body</td>
<td></td>
<td></td>
</tr>
<tr>
<td>light</td>
<td>3.5</td>
<td>2.5-9.0</td>
</tr>
<tr>
<td>moderate</td>
<td>5.0</td>
<td></td>
</tr>
<tr>
<td>heavy</td>
<td>7.0</td>
<td></td>
</tr>
<tr>
<td>very heavy</td>
<td>9.0</td>
<td></td>
</tr>
</tbody>
</table>

| C. Basal metabolism | 1.0 |

<table>
<thead>
<tr>
<th>D. Sample calculation**</th>
<th>Average kcal/min</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assembling work with heavy hand tools</td>
<td></td>
</tr>
<tr>
<td>1. Standing</td>
<td>0.6</td>
</tr>
<tr>
<td>2. Two-arm work</td>
<td>3.5</td>
</tr>
<tr>
<td>3. Basal metabolism</td>
<td>1.0</td>
</tr>
<tr>
<td>Total</td>
<td>5.1 kcal/min</td>
</tr>
</tbody>
</table>

\textsuperscript{*} For standard worker of 70 kg body weight (154 lbs.) and 1.8 m\textsuperscript{2} body surface (19.4 ft\textsuperscript{2}).

\textsuperscript{**} Example of measuring metabolic heat production of a worker when performing initial screening.

Adapted from References 2, 108, 111, 112.


Data on “Fatal occupational injuries to workers exposed to environmental heat due to the effects of heat and light, by industry and occupation,” containing a breakdown of worker deaths by individual occupation was obtained via email from the Bureau of Labor Statistics (BLS) Office of Safety, Health, and Working Conditions on August 17, 2011. Between 2003-2009, of 45 deaths in the Farming, Fishing, and Forestry occupations, agricultural workers accounted for 40 deaths.


Astrand PO. Experimental Studies of Physical Working Capacity in Relation to Sex and Age. Copenhagen, Denmark: Munksgaard; 1952.


Public Citizen Comments to the Department of Labor, Dec. 1, 2011


37 According to the Institute of Medicine, daily water requirements are slightly less for children aged 4-8 (1.7 liters), 9-13 (2.4 liters), and 14-18 (3.3 liters), compared with most adults (3.7 liters). However, these are approximations and do not factor in weight or activity level on that particular day. Recommendations from the Institute of Medicine. Dietary Reference Intakes: Electrolytes and Water. Accessed on November 30, 2011. 
http://www.iom.edu/Global/News%20Announcements/~/media/442A08B899F44DF9AAD083D86164C75B.ashx


42 American Conference of Governmental Industrial Hygienists (ACGIH). 2011 Threshold Limit Values (TLVs) and Biological Exposure Indices (BEIs). Heat Stress and Heat Strain, Table 1, p. 214. ISBN: 978-1-60760-28-8.