# Smarter Solutions to Welder Heat Stress: Keeping Workers Comfortable, Safe and Productive

**SUMMARY:** With numerous studies pointing to heat's negative impact on performance, fabricators are naturally searching for technologies that offer a combination of convenience and results. Miller's CoolBand™ and CoolBelt™ are solutions that have been shown to reduce temperatures significantly with minimal extra weight or feeling cumbersome to the welder. At a price of $150 and $295, respectively, they also offer a quick return on investment through increased productivity and product quality.

There is no singular solution when it comes to heat stress prevention, and specialized apparel by itself may not be enough to keep workers functioning at their best. Every welding environment is different, and organizations typically employ a combination of measures that meet their needs. However, the welding helmet cooling devices now available on the market represent a big step forward in terms of convenience and effectiveness. Already used in a variety of demanding environments, they've proven to be highly effective as part of an overall plan to maintain the welder's well-being and performance.

## THE PROBLEM OF HEAT STRESS: THREATS TO WELDER SAFETY, COMFORT AND PRODUCTIVITY

For as long as welding has been used in metal fabrication, protecting workers from severe heat exposure has been a major concern. The welder's head and face are often within two feet of the welding arc, which can reach a staggering 6,500 degrees Fahrenheit. The base metal radiates much of that heat into the air, exposing the operator to sweltering temperatures. All the while, the welder is wearing a helmet and other protective gear – 10 pounds or more in total – that trap their natural body heat. While intense heat can certainly be irritating for the welder, the impact is more than an issue of comfort. There are significant safety, liability and productivity considerations as well.

When the outside temperature increases, the body tries to cool off by directing more blood just under the skin and by perspiring. When the body is no longer able to keep its temperature in check, a condition called heat stress sets in and the effects can be severe. Symptoms include irritability, weakness, shivering and disorientation. Prolonged exposure may result in heat stroke, which is characterized by chills, convulsions and a loss of consciousness.

In extreme cases, the health consequences can be dire. In a recent five-year period there were 3,442 worker fatalities linked to heat.[1] Older workers are particularly at risk. Of these heat-related deaths, nearly half were individuals over the age of 65. This should be of particular concern to employers who conduct welding services, as the average age of welders today is 54.[2]

Even in less severe circumstances where clear physical symptoms aren't evident, intense heat can affect the welder's ability to perform his or her work successfully. A growing body of research indicates that heat stress hinders one's ability to concentrate and perform tasks that require even a moderate level of skill. As a result, employees work at a slower pace and with less accuracy. Because welding is often used in applications where bond strength is critical, the significance of each error is magnified. Mistakes that go undetected can not only damage the company's reputation for reliability and quality, but can be a liability and cause danger if a critical weld is made with less accuracy. Even those that are caught can be costly to correct, and neither outcome is one today's companies can afford.

Naturally, manufacturers and fabricators have taken a number of measures over the years to combat heat exposure, such as installing air conditioning systems, using fans for spot cooling and controlling humidity with dehumidifiers. Companies have also mandated frequent water breaks to rehydrate employees, equipped welders with heat-reflective clothing and used cooling vests to lower the individual's core temperature. While these measures have been somewhat effective, each comes with certain limitations as well. For instance, it can sometimes take up to 24 hours for someone to fully rehydrate by consuming fluids, and repeated trips to get water can curb productivity and create production bottlenecks. Vests that expose the chest and back to cool water can lower body temperature, but are heavy, cumbersome to wear all day and can create productivity challenges of their own since refilling may be frequently required.

Two recent innovations in welder protection, Miller's exclusive CoolBand™ and CoolBelt™, address many of these shortcomings. The devices direct air over the welder's head and face, significantly reducing under-hood temperatures. What's more, the devices are comfortable and lightweight, so they can be worn all day without sacrificing performance.

## HOW DOES HEAT STRESS EFFECT PRODUCTIVITY?

Because of the prolonged exposure to heat experienced by welders, the risk of bodily harm is very real. When temperatures rise above 90 degrees, heat cramps and sunstroke are possible with lengthy physical activity; above 105 degrees, these conditions become probable.[3]

However, heat can have a detrimental effect on mental activity and motor skills, even before bodily symptoms are present. A number of studies over the years have addressed the impact of heat exposure on worker performance. The clear conclusion from this body of research is that employees become not only less productive, but also less accurate, when the air temperature around them is well above the comfort range.

A comprehensive review of existing research that was published in the journal Ergonomics noted a gradual deterioration of worker performance when exposed to hot environments. In cases where the research subjects were exposed to temperatures of 90 degrees or higher, the reduction in performance was as high as 15 percent when compared to normal conditions.[4] The authors identified a negative impact on perceptual and attention-oriented tasks, in particular, whenever the experimental temperature rose above 80 degrees.

In 2005, American and Finnish researchers published their own review of heat-related research and arrived at remarkably similar conclusions. The authors cited a consistent and proportional decline in productivity as a result of heat. On average, output dropped 2 percent for each degree above 77 degrees.[5] That means that a welder exposed to a 90 degree environment would be able to perform 26 percent less work.

**2% – the amount workers' output decreases for each degree above 77 degrees**

The effect of this phenomenon from a business perspective is substantial. If the production of a single welder is valued at $75,000 a year, even a 5 percent drop in productivity means that company is seeing a $3,750 reduction in revenue. Of course, the effect is multiplied for each welder the business employs.

Evidence suggests that working in intense heat for several hours a day can also affect the employee's quality of work. One early, and very influential study[6] evaluated the performance of workers who were subjected to different room conditions. At 80 degrees, the workers made five errors per hour and 19 errors after three hours. When the temperature was raised to 90 degrees, the workers made nine mistakes per hour and 27 after three hours. At 95 degrees, the workers made 60 mistakes per hour and 138 after three hours. Overall, the study concluded that a similarly hot environment will produce a proportional amount of errors regardless of task.

Inversely, it can be calculated that by cooling the worker 15 degrees, they will make approximately 90% fewer errors.

Increased errors can have a substantial financial impact on a business with welders. To give a hypothetical example, if a crew working at 95 degrees makes 100 errors in a week, and the cost of correcting each mistake is $20, the cost of those errors is $2,000 during that stretch. If you could reduce welders' temperature to 80 degrees, the number of heat-related errors could be reduced to 10, for a total cost of $200. That translates to a total savings of $1,800 per week. Even if the number of errors were reduced by just 50 percent, the company saves $1,000 each and every week.

**DETERMINE YOUR POTENTIAL SAVINGS BY LOWERING WELDERS' TEMPERATURES 15 DEGREES**

**[(number of heat related errors at 95 degrees) x (cost of fixing errors)] x 0.90 = Total Potential Savings of Reducing Heat Related Errors**

More recent studies have supported this relationship. In one 2007 experiment, utility workers were asked to set up a mock power line in both indoor and outdoor environments. Subjects who performed the work in hot outdoor weather (between 90 and 100 degrees) without any cooling gear made 78 percent more errors than those who did the same tasks inside.

Another consideration when it comes to productivity for the entire business is the role that proper risk management plays. Laws protect workers from occupational injuries associated with exposure to high temperatures over a prolonged period of time. Adopting technologies as part of an integrated heat management plan may help control time and resources spent dealing with legal liabilities associated with heat related injuries. Each company's situation is different and they should make their own assessments in consultation with legal advisors.

## WHAT STEPS CAN YOU TAKE?

Given the health risks and detriment to performance associated with lengthy heat exposure, manufacturers are looking for cost-effective ways to keep their welders cool. Taking breaks and consuming liquids throughout the day can certainly be part of the solution, although rehydrating the body can result in lost productivity. The preferred approach is one that keeps the employee comfortable and operating at peak performance without sacrificing total output. A significant downside of cooling vests that some welders use is their size and weight, which can make the worker uncomfortable and actually increase fatigue.

Miller's CoolBand and CoolBelt take a different approach to these workplace challenges. Both pieces of equipment utilize the same basic concept – providing constant airflow over the welder's head and face. The lightweight CoolBand, which mounts under the welder's helmet, comes with a built-in fan that draws outside air and directs it over their head and face through strategically placed vents. The main difference with the CoolBelt is the location of the fan, which is secured on the worker's lower back. Air flows upward through a piece of tubing that fits into the welder's helmet; it's then disbursed through the vents. The CoolBand can make the temperature up to 8 degrees cooler under the hood, whereas the CoolBelt can reduce the temperature as much as 17 degrees.

The devices offer several key advantages over other equipment currently on the market. For instance, both are significantly lighter than a cooling vest, thereby enhancing stamina throughout the workday. Additionally, neither the CoolBand nor the CoolBelt obstructs the worker's range of motion, allowing him or her to perform efficiently. William Fries, a welder with Xtreme Fabrication in Kentucky, summed up the CoolBand's impact when working on an outdoor project in 90 degrees heat: "The fact that you have some air movement across your face makes all the difference in being able to get the job done."[7]

[1]Centers for Disease Control & The Bureau of Labor Statistics

[2]U.S. Department of Labor

[3]National Oceanic and Atmospheric Association. http://www.weather.gov/os/brochures/heat_wave.shtml

[4]Pilcher, J.J., Nadler, E. and Busch, C., 2002, Effects of hot and cold temperature exposure on performance: a meta-analytic review. Ergonomics, 45, 682-698.

[5]Seppanen, O., Fisk, W.J. and Faulkner, D., 2003, Cost benefit and analysis of the night-time ventilative cooling in office building. Lawrence Berkeley National Laboratory.

[6]Mackworth, N.H., 1946, Effects of heat on wireless telegraphy operators hearing and recording Morse messages. British Journal of Industrial Medicine, 3, 143-158.

[7]Quote from William J. Fries IV of Xtreme Fabrication LLC.