



# Using Thermal Cooling to Fight Heat Stress in the Construction Industry



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## Introduction

Due to the taxing nature of construction workers' work, they are 13 times more likely to die from a heat-related illness in the United States (Acharya, P. et al., 2018). Therefore, the purpose of this research was to test different cooling garments on their effectiveness in preventing heat exhaustion in construction workers. The researcher collected physiological responses such as the skin temperature (TSK), internal core temperature (THY), sweat rate (SWA), temperature sensation, and comfort perceptions when wearing the cooling garments. A number of factors, contribute to heat exhaustion like the demanding nature of construction labor, humid conditions, and lengthy workdays (Acharya, P. et al., 2018). The majority of US Occupational Safety and Health Administration (OSHA) regulations pertaining to personal protective equipment (PPE) in the construction sector (OSHA 29 CFR 1926) deal with physical item safety risks as opposed to heat stress and thermal comfort. Thermal comfort clothing could be a potential preventive intervention against heat stress in construction workers (Guo, Y. et al., 2019).

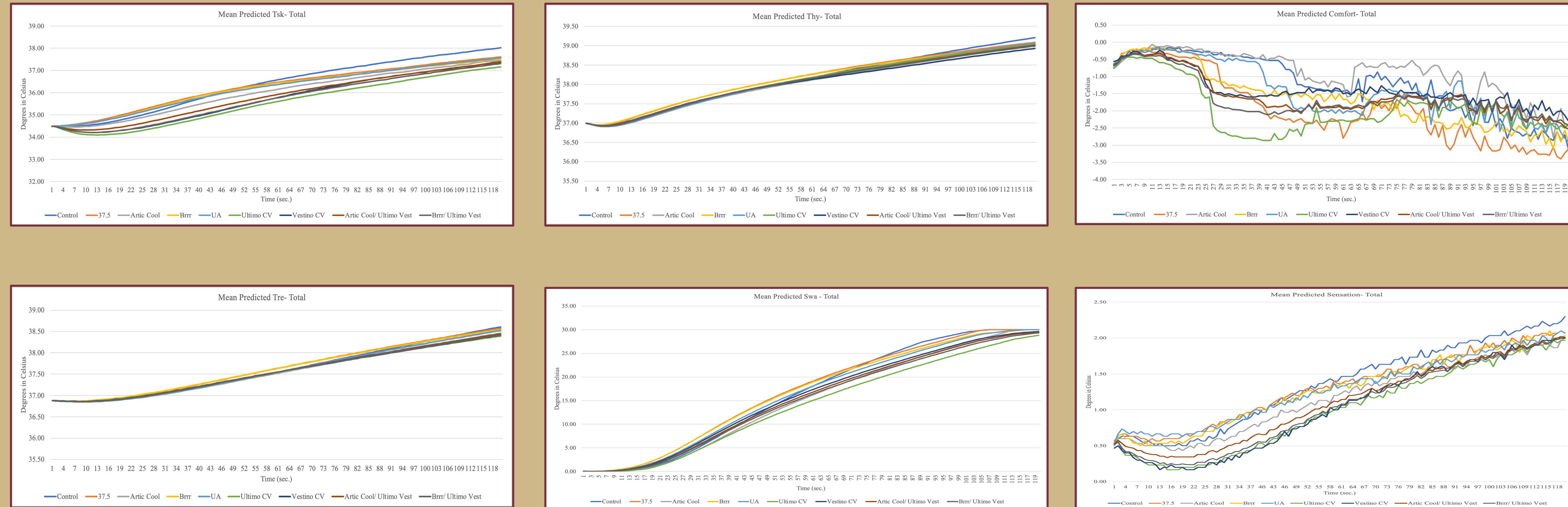
## Materials

Garment Sample	Fiber Content
SHIRT1	Modal 47.5%/Polyester 47.5%/Spandex 5%
SHIRT2	Body: Polyester 94%/Spandex 6% Mesh: Polyester 88%/Spandex 12%
SHIRT3	Polyester 82%/Spandex 18%
SHIRT4	Nylon 90%/Elastane 10%
VEST1	Outer: Polyester 100% Liner: Nylon/Polyester Straps: Elastic/Polyester belt/Neoprene/Spandex
VEST2	Outer: Polyester 100% Liner: Nylon/Polyester Straps: Elastic/Polyester belt/Neoprene/Spandex

## Methods

- A sweating thermal manikin was used to replicate the physiological responses a construction worker would have to their garments.
- Each item of clothing was tested in a controlled chamber at 33°C, 65% humidity, and 0.4 m/s wind speed. This mimicked outdoor working conditions in warm weather.
- The clothes were tested for one hour and there were three repetitions of each ensemble.

## Results



## Images



Control Configuration



ANDI, sweating thermal manikin

## Discussion & Conclusion

After collecting and reviewing the analysis of the three cooling shirts and the two cooling vests, the tests indicate that there was a significant decrease in skin temperature (TSK) and sweat rate (SWA) for both vests and for SHIRT2. There was a negligible difference in internal core temperature (THY) amongst the different garments which makes sense considering the environmental conditions. SHIRT2 was found to be the most comfortable shirt for construction work. The findings support the use of cooling technologies in construction work PPE and apparel as they are more comfortable and can decrease skin temperature and sweat rates

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## References

- Acharya, P., Boggess, B., & Zhang, K. (2018). Assessing Heat Stress and Health among Construction Workers in a Changing Climate: A Review. *International Journal of Environmental Research and Public Health*, 15(2), 247. <https://doi.org/10.3390/ijerph15020247>
- The global cooling fabrics market size is estimated to be USD 2.0 billion in 2020 and is expected to reach USD 2.6 billion by 2025, at a CAGR of 6.0% from 2020 to 2025 (2020, Nov 09). *NASDAQ OMX's News Release Distribution Channel* <https://www.proquest.com/wire-feeds/global-cooling-fabrics-market-size-is-estimated/docview/2458494622/se-2>
- Xiang, J., Bi, P., Pisaniello, D., & Hansen, A. (2014b). Health Impacts of workplace heat exposure: An Epidemiological review. *Industrial Health*, 52(2), 91–101. <https://doi.org/10.2486/indhealth.2012-0145>