

WHO

SYSCOM: ONR

Sponsoring Program:

Transition Target: Cooling Garments for Navy Shipyard Welders

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Other Transition Opportunities: Cooling garments for other Navy personnel who wear personal protective equipment (PPE) including shipyard painters

Notes: This shows the reduction in core body temperature of a sweating thermal manikin at the National Personal Protective Technology Laboratory (NPPTL) while wearing a full welding ensemble and engaging in simulated strenuous physical activity (metabolic rate = 5 METS). Without TDA's cooling garment (the red "control line"), the user would have suffered severe heat exhaustion within 1 hour (core body temperature exceeding 104 F). With TDA's cooling garment, core body temperature was significantly reduced and the wearer never reached a core body temperature of 104 F, even after 90 minutes in a hot and humid environment, while wearing heavy personal protective equipment, and exercising strenuously.

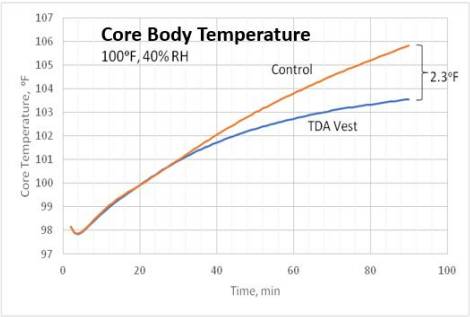


Image courtesy of TDA Research Inc (2020)

WHAT

Operational Need and Improvement: Shipyard welders frequently work in hot and humid environments. Worse still the welding torches produce additional heat, and the metal plates need to be preheated to over 150 degrees Fahrenheit, radiating heat onto the workers. These welders must wear personal protective equipment (PPE) which severely restricts sweat evaporation, one of the body's most effective methods for rejecting heat. These shipyard welders must take frequent breaks to avoid heat exhaustion. TDA is developing a cooling shirt that is worn beneath the PPE and drastically improves sweat evaporation efficiency to keep these workers cool.

Specifications Required: Any cooling garment that will be adopted in an industrial setting such as a US naval shipyard needs to be comfortable, lightweight, long lasting, and durable. It cannot overcool the wearer (leading to discomfort) and it must not be tethered or restrict the wearer's motion in any way. It needs to be effective over a wide range of relevant temperatures and relative humidities that welders might work in, and it needs to be fire resistant or protected by the welder's PPE.

Technology Developed: TDA has developed a battery powered cooling garment that pulls ambient air into the PPE and blows it through small channels built into the garment. The small channels drastically improve seat evaporation efficiency, even on hot and humid days. Unlike shirts that rely on phase change materials (PCMs), TDA's cooling garment is lightweight, long lasting, has a high cooling capacity, and the battery can be quickly swapped out so that the shirt can continue working indefinitely.

Warfighter Value: There are a huge range of scenarios where warfighters are subjected to extremely hot conditions and they are at risk of heat related illness. This possibility is particularly acute when they are wearing personal protective equipment (PPE) which prevents sweat evaporation, one of the body's most effective methods for heat rejection. PPE might include explosive ordnance disposal (EOD) suits, welding gear, shipyard painting disposal coveralls, body armor, etc. TDA's cooling garment is a lightweight, comfortable, durable, and mobile garment can protect these warfighters, even while they are wearing their PPE, and only requires a battery, which are readily available on the front lines.

WHEN

Contract Number: N00014-19-9-0015

Ending on: Oct 18, 2022

Milestone	Risk Level	Measure of Success	Ending TRL	Date
In depth calculations	Low	finalized calculations	3	4th QTR FY19
Swatch testing on sweating hot plate	Medium	Successfully demonstrate cooling improvement from small air channels	4	1st QTR FY20
Cooling garment testing on sweating manikin	Medium	Demonstrate effective cooling for full garment using a sweating thermal manikin	6	2nd QTR FY20
Produce 12 cooling garments for the Navy	Medium	Produce garments and get positive feedback from Navy	6	1st QTR FY23

HOW

Projected Business Model: TDA's cooling garment keeps the wearer cool and comfortable, even in hot and humid environments and when worn under heavy personal protective equipment (PPE). TDA is starting with the Navy Shipyard welder market, but we will also branch out to the civilian welding market and other civilian workers wearing PPE in hot environments. TDA is working with a local, Berry Compliant garment manufacturer to scale up production for small scale demonstrations and to supply our cooling garments to DoD customers.

Company Objectives: TDA's cooling garment fills a vital need for the armed forces, protecting personnel in hot environments (especially those wearing personal protective equipment). TDA's cooling garment is light weight, durable, comfortable, and uses very little consumables. We are currently developing it for naval shipyard welders, but based on talks with other DoD personnel, there appears to be considerable interest in this technology to protect all sorts of workers including shipyard painters, EOD personnel, and anyone else at risk of heat related injury. TDA's goal is to expand our garment manufacturing capabilities so that we can supply cooling garments to the DoD as demand increases. We are interested in licensing our garments to PPE suppliers to expand our potential markets. Expanding into the civilian market will help TDA supply cooling garments to the DoD at lower cost per unit due to economies of scale.

Potential Commercial Applications: TDA's cooling garment has enormous potential commercial applications. The first is expanding into the civilian market for workers in hot environments, especially those wearing PPE. Civilian shipyard welders are just as susceptible to heat related injury as naval welders. In fact, welders in general and other outdoor workers, such as construction workers, will also significantly benefit from TDA's cooling garments. TDA is also interested in breaking into the "athleisure", cooling people who are biking, climbing, running, or hiking in hot or humid climates. TDA's cooling garment will make these activities more enjoyable by increasing wearer comfort and safety.
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