



Cool The Force

Microclimatic Cooling Conference
14 Sep 2004



"The Nation's Laboratory for Advanced Automotive Technology"



Report Documentation Page

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Cool The Force

Objective: Identify near and long term solutions to mitigate Soldier heat stress in tactical vehicles

IPT Participants: TARDEC, PEO CS & CSS, ARL (HFE), TACOM (Safety Office), Natick Soldier Center (in coordination with PEO Soldier), USARIEM and PM Air Warrior

Focus: Cooling capability in vehicles (Order of priority)

HMMWV

HET, HEMTT, PLS, M939, FMTV

M35, M809





Cool The Force

HMMWV:

PM bought air conditioner system manufactured by Red Dot

Characterization of HMMWV with Red Dot A/C shows that supplemental cooling is required to provide increased comfort level in extreme heat and humid conditions (120 degrees F with solar load) while the soldier is performing long missions

Both short and long term solutions were investigated





Microclimate Cooling Requirements

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Cooling physiological requirements are dependent on:
Work Rate
Ambient Environment
Clothing Ensemble Characteristics

Estimates of Metabolic Heat Production of Various Activities
(For a 155 lb man)

WORK RATE	ACTIVITY	WATTS
Very Light (105 to 175 Watts)	Lying on ground	105
	Guard duty	137
	Driving truck	163
Light (175 to 325 Watts)	Walking on hard surface @ 2.25 mph with no load	210
	Walking on hard surface @ 2.25 mph with 44 lb load	255
	Walking on hard surface @ 2.25 mph with 66 lb load	292
Moderate (325 to 500 Watts)	Walking in loose sand @ 2.25 mph with no load	326
	Calisthenics	378
	Walking on hard surface @ 3.50 mph with 44 lb load	448
	Foxhole digging	475
Heavy (500+ Watts)	Walking on hard surface @ 3.50 mph with 66 lb load	507
	Walking on loose sand @ 3.50 mph with no load	642





Cooling Efficiencies

“Chest and back then legs are the most effective areas to cool.”

“Head cooling can improve comfort but has little effect on heat balance for persons performing physical work.”

“Head cooling alone can only remove ~20 watts of body heat and can result in headaches.”

Dr. Margaret Kolka
Information Paper Subj.:Microclimate and Head Cooling,
MCMR-EMT
Dtd. 20 Jun 2003
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Systems Selected for Evaluation



Liquid Vest System – Foster-Miller



Ice Based Liquid Vest System - Carlson



Air Vest System - TARDEC

Ice pack Vests - TARDEC



Solar Blankets - TARDEC





Temperatures

	Options	AC ON	Ambient inside vehicle	Temp Applied to Skin	Duration system can cool	Number of Soldiers Cooled
No MCG	Just Solar Load		145		X	
	With Solar Blankets		141		Indefinite	4
With MCG	Just Solar Load	X	98		Engine run time	4
	With Solar Blankets	X	91		Engine run time	4
	M1 Air Vest	X	100	< 83	Engine run time	4
	Liquid System	X	99	67	Engine run time	4
	Carlson Ice System	X	98	55 to AMB	3.3 hrs/full ice chest	2
	Gel Vests		145		1.5 hrs/complete set	1

All scenarios: Engine running, windows closed, 120 degree ambient outside, and solar load





Status

Supplemental evaluation of various systems completed

At decision brief to PM Tactical Vehicles on available options, the decision was made to provide 10 prototype systems of each air vest and liquid vest cooling systems for Soldier evaluation

Total of 20 cooling systems (10 of each air vest and liquid vest) shipped on 6 Aug 04





Air Vest Cooling System

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System Description: Utilizes the air from the Red Dot A/C. Tubing is connected to the air duct which allows air to flow through the M1 vest. 4 connections are provided. Quick release connectors are used.





Liquid Vest Cooling System

System Description: Utilizes the vehicle A/C to chill a fluid (water) that is pumped into a microclimate cooling garment. The system consists of a heat exchanger, flow control assembly and microclimate cooling garment. The flow control assembly has a pump, valve and manifold which distributes the fluid flow to 4 soldiers. Quick release connectors are used.





Program Path Forward

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Obtain Soldier feedback on systems

Develop performance requirements

Develop supplemental cooling program for all tactical vehicles

Support PM acquisition program





Questions?

