THE WARRIOR

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Vapor chamber

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Cover photo: Paul, an animatronic manikin, cycles through some motions in the Man In Simulant Test chamber. (Warrior/Biberdorf)

THE WARRIOR
U.S. Army Soldier Systems Center

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System fits male sailors

By Curt Biberdorf
Editor

Classic or athletic, the Navy Clothing and Textile Research Facility (NCTRF) has developed a men's sizing system for uniforms that will give sailors a much improved appearance and fit.

Female sailors were first for the NCTRF, an installation partner at the U.S. Army Soldier Systems Center (Natick), regarding changes to uniform sizes. An anthropometric study of females in the late 1980s resulted in a new sizing system for female sailors that incorporated the three body types and lengths and size standards used by the apparel industry at that time.

The Army, Air Force and Coast Guard subsequently adopted the women's sizing system, and the intent behind the changes for men is the same.

"It reduces alterations and improves appearance," said Sirvart Mellian, program manager for Anthropology and Sizing at the NCTRF. "(The sailors) are as excited as we are about it."

The proposed changes classify the Navy's coats, shirts and pants as classic and athletic body types. A chest measurement at least 6 inches greater than the waist measurement define the athletic upper-body type, and a hip measurement at least 6 inches greater than the waist define the athletic lower-body type. The classic body type has a less than 6-inch difference between those critical measurements.

Mellian said Navy Exchange stores and the NCTRF were receiving comments from dissatisfied customers about poor-fitting uniforms and high alteration costs.

"They were telling us we had a fit problem with our uniforms," she said. "In the military you're restricted as to where you can buy your uniforms. You can't shop at various stores to find the line of clothing that is designed for your body type and looks good on you, so it's important that we have uniforms that have the appropriate sizing to satisfy the demographics of our population."

Mixing a "combination of art and science," Mellian, who also helped develop the women's sizing system, wanted to develop a system based on Navy anthropometric data. She collected 38 clothing-related anthropometric dimensions from a sample of 1,338 sailors that demographically represented the Navy by age, race and rank.

"What's unique is that while we collected our anthropometric data, we also had each sailor try on 17 current Navy uniform items to identify specific size and fit problems. We evaluated the size and fit, and collected their input regarding the problems they were experiencing with their uniforms," Mellian said. "Combining the anthropometric, size, and fit data, and information collected during the survey, we hope to get as close to satisfying our user-population as possible."

Besides identifying the two body types, the new sizing system solved problems observed during uniform size and fit evaluation, developed same-size standards for each garment type to eliminate confusion of uniform size, and established an idea of fit for each garment type. It also standardized seam allowances of each garment type.

Courtesy photo

A sharper fitting uniform off the rack is the main benefit of the Navy men's sizing system.

By having their critical body dimensions measured, sailors can identify their correct body type and size, and then mix and match body types and sizes to find the best fit.

With such a wide variety of body shapes, minor alterations may still be necessary, according to Mellian.

In spring 2000, NCTRF completed an evaluation at Naval Air Station Whidbey Island and Naval Training Center Great Lakes that verified the patterns for the athletic and classic body types. Final verification occurred in February 2002 at Naval Station Norfolk.

Mellian said she eagerly anticipates implementation of the new sizing system by the Navy and other military services.

Stressing heat

Monitor calculates risk for safety, maximum production

By Curt Biberdorf
Editor

Knowing when to stop working and start drinking has its payoffs.

Monitoring the environment to advise troops on work/rest cycles and water consumption to prevent heat casualties has been accomplished with some variation of the Wet Bulb and Globe Temperature (WBGT) device since 1956. Now a hand-sized monitor developed at the U.S. Army Research Institute of Environmental Medicine (USARIEM), an installation partner at the U.S. Army Soldier Systems Center (Natick), has transformed heat risk assessment.

"In many cases, the WBGT is fine. Its sensors respond to most of the environmental parameters, but from a biophysical view, it's quite limited," said William Matthew, a biophysicist at USARIEM and principal investigator of the Miniature Heat Stress Monitor. "The WBGT-based guidelines use one chart based on a significant number of assumptions about environment, clothing and activity, so the potential for error is quite high. You'd have to have a telephone book of tables to cover all the variables."

Heat stress creates discomfort and inefficiency. Injuries and deaths caused by heat exhaustion or heat stroke are a regular occurrence in the military and civilian population.

"You see heat casualties, and you see them when you wouldn't think they would be there intuitively," Matthew said. "Heat casualties are less of a problem if you have the right measurements and then bring that information into a rational predictive model."

WBGT devices measure air temperature, humidity with a wet "bulb" that needs to stay moistened with water to simulate evaporation of sweat, and radiant or solar heat with a six-inch-diameter black globe. They connect to a processor to calculate an integrated WBGT index reading. Army and Marine units currently look up a table to specify how many minutes troops should work and how many liters of water they should drink per hour based on three levels of physical exertion and the measured WBGT heat index category.

Warrior/Biberdorf

William Matthew, a biophysicist at USARIEM, sets up a tripod for the Miniature Heat Stress Monitor.

At the core of the miniature monitor is USARIEM's heat strain prediction model software, which is integrated into the suite of environmental sensors. The model is a compilation of data collected during the past 25 years that predicts the amount of heat strain young, healthy male soldiers will experience depending on their work rate, environment and clothing.

"It's a systematic way to look at body heat balance," Matthew said. "Heat flow through clothing, for example, is calculated from four variables of heat and vapor transfer measured in the laboratory on thermal copper manikins."

Powered by four AA alkaline batteries, the square-shaped monitor weighs 13 ounces and is housed in an injection-molded plastic case. The back opens up to rotate the sensor module into position and replace batteries. The field-replaceable sensor module measures air temperature, radiant heat with a gumball-sized black globe and humidity through a solid-state sensor. It has two extra sensors not found on the WBGT—wind speed, accurate even at low speeds, and atmospheric pres-

Warrior/Biberdorf

The Wet Bulb and Globe Temperature device (left) uses larger components to take the same measurements as the miniature monitor.

sure to adjust to various altitudes.

A five-button keypad is located next to a text and graphics-capable LCD display complete with a backlight for use at night. When switched on, the monitor automatically shows the present time, date and remaining battery power.

Programmed with a heat strain model, the user selects from a menu of clothing items and enters the work/task category choosing from rest, very light, light, moderate or heavy work. Then the monitor asks if the group is acclimated to the heat. After two minutes of processing, the monitor displays hourly water drinking requirements, optimal work/rest cycle limits, maximum safe time for continuous work and environmental data used to make those determinations.

WBGT readings are retained for a point of reference, but the monitor takes away the need for pages of printed tables for clothing and acclimatization. It can be set on default so the same information won't have to be repeatedly entered. Matthew said it would take the average user about 30 minutes to learn how to operate it.

With several other operating modes, its ability doesn't stop with a straightforward conditions report.

The user can set the current date and time, and select metric or English units for the displayed parameters in the system setup. The data log setup allows the user to select a start time, log time interval and duration that can provide operational test documentation or survey data for heat stress conditions during a 24-hour period. In data log review, the user can view all logged data, including predictive model outputs.

"This is the first time you can take a device with you in a tank, helicopter cockpit, shelter or outside where you can make these measurements and document the working conditions," Matthew said.

On the bottom of the monitor's case, a threaded mount securely attaches to a tripod for unattended data collection. A port on the lower left-hand side of the case plugs into a computer to download logged data for an alternative display or to import a spreadsheet for analysis. The same port enables program updates, calibration and diagnostics in the monitor's service mode.

Southwest Research Institute in San Antonio, Texas, engineered the item and built the first prototype monitor in 1998. USARIEM's Cooperative Research and Development Agreement partner, OCC-Consult Limited in Perth, Australia, has adopted it for use at a major copper mine. Up to 50 monitors help with the occupational safety and health program by determining whether the mine's cooling should increase or even if the workers should quit for the day.

"That's the beauty of it—it's adaptable to a wide range of user-specific models. Australia is using custom software that meets their particular needs," he said.

The monitor's measurement of ambient environment could be used for a variety of human factors engineering and development projects. Other potential applications are in foundries, offshore oil operations, agriculture, archeological digs and certain sports settings. For the military, commanders want to know the maximum work/rest situation, particularly for troops wearing chemical biological protective gear, according to Matthew.

The 6th Ranger Training Battalion evaluated it with good reviews, but "there's no strong Army proponent for fielding it right now," he said.

Warrior/Biberdorf

Powered by four AA alkaline batteries, the monitor weighs 13 ounces and is housed in an injection-molded plastic case.

Warrior/Biberdorf

The sensor module is field-replaceable. It rotates out from the case and measures air temperature, radiant heat with a gumball-sized black globe and humidity through a solid-state sensor.

Near MIST

Chamber tests chemical protective ensembles for leakage

By Curt Biberdorf
Editor

Paul moves obediently to computer-controlled commands in his stainless-steel-enclosed home like a student in a self-defense or aerobic dance class.

Dressed for an attack with a simulated weapon of mass destruction, the animatronic manikin is trying out the new two-person Man In Simulant Test (MIST) chamber built at the U.S. Army Soldier Systems Center (Natick).

The MIST chamber, one of a handful designed for chemical simulant vapor testing, is intended to quickly and efficiently test complete prototype military chemical and biological agent protective ensembles for leakage with assistance from the manikin and human research volunteers.

Scientists and engineers at Natick will be able to save time and expense of sending their protective clothing to other chambers when a small on-site facility is all that's needed.

"This gives us a compact car instead of an 18-wheeler," said Walter Zukas, chemical engineer on the Chemical Technology Team. "It's the perfect preliminary test chamber. You can tell right away if the prototypes are going to work."

The range of ensembles spans from protective gear worn on the battlefield to the fully-encapsulated suits worn by first responders at a chemical spill. Because they're not seamless outfits, it's possible for vaporous contamination to enter through places such as zippers or where the trousers meet the overboots, which is why testing is necessary.

The chamber is divided into four rooms composed of insulated stainless steel walls similar to those found in industrial refrigerators and freezers. Snug door seals along with caulking and metal tape contain the simulated contaminant in the chamber.

Entry and exit is through the control room, which leads to the test pad recovery room, another room to decontaminate clothing, and finally the 9-foot by 10-foot test chamber. Connected outside the chamber is a unit that circulates temperature and humidity-controlled air inside the chamber. Each supporting room has a carbon trap filter to prevent contamination from the chamber during and after testing. The vapor from each test is fully recovered into the filters.

Thumb-sized detector Tenax patches are first placed strategically according to the garment on the manikin or human volunteers before donning the protective ensemble and proceeding through the series of motions.

Paul was developed by Creative Engineering, Inc. in Orlando, Fla., and the animatronic manikin is one of a few of its kind. It has a repertoire of moves that's meant to test

Warrior/Biberdorf

The MIST chamber's animatronic manikin tests prototype chemical protective ensembles to the limit.

Warrior/Biberdorf

Axel Rodriguez, chemical engineer, brings the animatronic manikin to life from the control room. A standard test lasts two hours.

the ensemble's closures and interfaces to the limit.

"(Paul) is programmed for 20 motions, but it can be changed," said Axel Rodriguez, chemical engineer on the Chemical Technology Team. "We're working to figure out a series of realistic sequences. They also will change depending on the garments."

Human research testing may include activities with a stationary bicycle, treadmill, rowing machine and climbing machine, which are all good for stretching the garment to the point where it could leak, said Elizabeth Klemperer, chemist on the Chemical Technology Team and planner of the two-person MIST.

From the control room, one computer manages the animatronic manikin while another operates the carbon filter machines in the test chamber, records data and dispenses oil of wintergreen droplets from a syringe onto a heated plate that evaporate to create a simulated chemical gas environment.

"(Oil of wintergreen) is a really good representative of a wide variety of chemical agents because they tend to be high boiling liquids. It's relatively non-toxic and easy to detect," Zukas said. "We use a fraction of the amount of oil used at other facilities."

Circulating air picks up the vapors, and plastic tubes inside the chamber bring air samples to a detector to check for even distribution. Vapor concentration is regulated by feedback to the carbon scrubber actuated by a signal from infrared detectors.

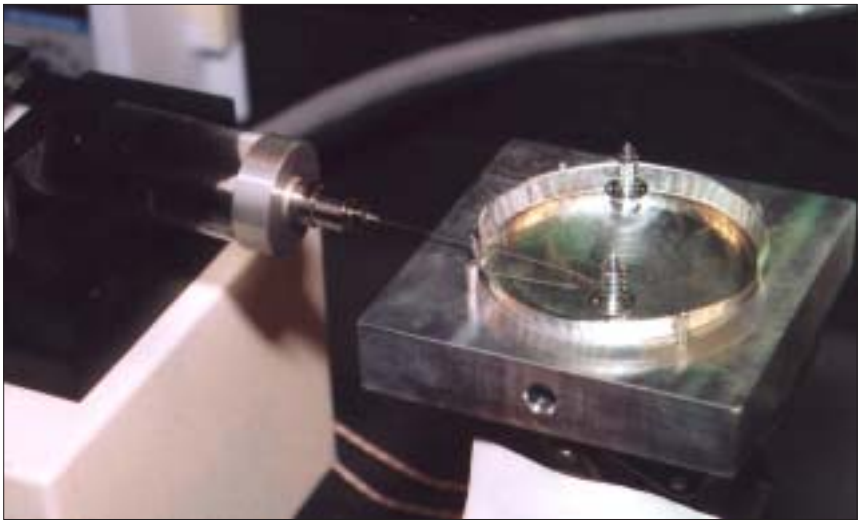
After a standard test period of two hours with constant chemical vapor exposure, the chamber is cleaned with filtered air heated to 150 degrees F to bring the chemical level to zero. The patches are then removed, capped in a bottle and analyzed in a laboratory at Natick.

Zukas said the Navy, U.S. Army Research Institute of Environmental Medicine and National Protection Center at Natick have expressed interest in the facility.

"It really could be used to test any equipment, including commercial items we're interested in using. It's like a climatic chambers but for a chemical environment, and without the rain and high wind," Zukas said.

Warrior/Biberdorf

Next to the chamber is a room to decontaminate clothing used in testing.



Warrior/Biberdorf

Oil of wintergreen dispensed from a syringe onto a hot plate creates a simulated chemical gas environment inside the chamber.

Clammed cover

Maintenance shelter thrives since Gulf War inception

By Curt Biberdorf
Editor

Commonly called "clamshells," the Large Area Maintenance Shelters (LAMS) have seen varied and increasing action—including support of Operation Enduring Freedom—since its procurement for Operation Desert Shield and Desert Storm.

The shelter was originally developed and has been managed since 1992 by the 21st Century Fabric Structures Group at the U.S. Army Soldier Systems Center (Natick) to cover maintenance crews working on Army helicopters and armored vehicles.

"They needed shelter quick to get them out of the sand," said Robert Abbruzzese, an equipment specialist and LAMS cell leader, recalling the product's beginning. "The idea is to have a simple, quick-to-erect shelter. It's been a huge success for Natick and (Army Materiel Command). It's the shelter of choice for the aviation community right now."

The LAMS are semi-mobile, modular platform systems that can deploy to support force projection and staging base operations anywhere around the world in 72 hours. Free of vertical support beams, they allow unobstructed movement inside a weatherproof shelter.

Clamshell Buildings in Ventura, Calif., manufactures the aviation LAMS while the vehicle LAMS are made by Canvas Specialty in Los Angeles. Of the two, the aviation LAMS are used more often since the Army has not been in a tank war since Desert Storm, said Abbruzzese.

The aircraft shelter consists of 10 bays or modules while the vehicle shelter uses four bays assembled from extruded, interchangeable aluminum beams and covered by sections of polyester vinyl. At each end is a full-width, full-height clamshell-type door for drive-through access. They have a pre-assembled wiring harness for electricity, overhead lights, two fans for ventilation and can function in blackout conditions. Vehicle LAMS are 10 feet narrower and also have two sidewall doors.

Setup with material-handling equipment, such as forklifts, is optional although commonly used, Abbruzzese said. The LAMS are regularly erected with the help of a technical assistance team from Natick. Setup takes a crew of 10 anywhere from five to 12 days, and they can be placed on almost any open area, but a smooth concrete or asphalt surface is sought after.

Courtesy photo

Extruded, interchangeable aluminum beams form the Large Area Maintenance Shelter frame.

Courtesy photo

The Large Area Maintenance Shelter is called a clamshell because of the way the doors open and close.

Improvements through the years include an electric-powered winch instead of a hand crank to raise and lower the clamshell doors, a more durable covering that lasts up to seven years and redesigned crating that's enabled the Army to reduce the number of ISO shipping containers from eight to two.

Not type-classified, a total of 69 shelters are in the Army war reserve today, according to Abbruzzese. Bringing them together was a large task for the Structures Group because many LAMS components were in disarray after Desert Storm. Pieces were left behind or returned to a U.S. base that was closed under a round of Base Realignment and Closure, further scattering the components.

Since Desert Storm, the LAMS have been or currently are being used for peacekeeping, training and humanitarian missions in the Balkans, Hungary, Italy and Puerto Rico. They were deployed to Honduras for Hurricane Mitch relief support and to Jackson, Tenn., when the Tennessee Army National Guard needed temporary shelter while fixing a tornado-destroyed hangar.

Product Manager-Comanche in Fort Rucker, Ala., is requesting the shelters while their hangars are being renovated.

The most memorable use of the LAMS was at Rocky Mountain Arsenal in Denver, Colo., according to Abbruzzese. The technical assistance team assembled two shelters together over a scrap pile to assist with the removal of sarin-gas-filled bomblets in December 2000. The shelter was equipped with a specially designed air filtration system to provide containment and treatment of air inside.

"That was probably our biggest, highest-profile use of the shelters for a non-war mission," he said.

Demand continues to be intense for LAMS, and his group is looking to assemble more of them from parts stored at Sierra Army Depot in Herlong, Calif., as stocked supplies diminish.

"We're getting tons of requests," he said. "Obviously, they like it. Until the (Wide Span Air Beam Shelter) comes on line, it's the only thing out there."

Courtesy photo

Each LAMS module is covered by sections of polyester vinyl. Complete setup takes five to 12 days for a crew of 10.

Courtesy photo

The LAMS was designed to cover maintenance crews working on Army helicopters and armored vehicles.

Locked out

Field hospitals gain chemical, biological protection

By Curt Biberdorf
Editor

Army field hospitals will acquire the ability to ward off the ill effects from a nuclear, biological or chemical attack when the Chemically Protected Deployable Medical Systems (CP DEPMEDS) are fielded.

Sent to a threat area, the protective kit will be assembled with the conventional hospital. The result will be a functional barrier against harmful warfare agents or fallout that allows the hospital to treat casualties without the use of protective gear or causing further harm.

"These hospitals are very large and difficult to move in a short amount of time. If attacked, you have to be able to protect the patients and staff for at least a 72-hour mission," said David Haley, CP DEPMEDS manager on the Survivable Shelters Team at the U.S. Army Soldier Systems Center (Natick). "There may be no opportunity to move the patients to another hospital."

A series of TEMPER tents and ISO containers linked together with passageways offer nearly 32,000 square feet of treatment space. Up to 140 staff members can treat as many as 236 patients for three days in a clean, climate-controlled atmosphere.

The M-28 Simplified Collective Protection Equipment, a major component of the CP DEPMEDS, consists of chemical-resistant liners, litter and ambulatory tunnel airlocks, protective entrances, blowers and filters integrated into the hospital. To prevent contaminated air from entering the protected shelter, a generator-powered environmental control unit along with the M-28 blowers and filters create a steady overpressure by drawing in outside air, filtering it, and then blowing it into the shelters.

An audible and visible alarm located at the end of each tent activates if the pressure drops too low.

Warrior/Underhill

Patients are decontaminated before entering the facility. They stay in the airlock for one minute to purge any remaining contaminants before inprocessing.

Warrior/Underhill

Soldiers at Fort Carson, Colo., inprocess a mock patient during the CP DEPMEDS first operational test in 1997.

The environmental control unit also warms or cools the air to a comfortable temperature.

Other features added to the hospital are chemical and biological agent resistant gaskets for the ISO containers, a 20,000 gallon protected water distribution system that delivers 6,500 gallons of potable water per day, two chemical and biological- protected 12-person latrines, and waste management facilities. Another airlock chamber enables the staff to receive a pallet's worth of supplies.

"It's somewhat transparent from

Warrior/Underhill

Up to 140 staff members can treat as many as 236 patients for three days in a clean, climate-controlled atmosphere. The CP DEPMEDS configuration is noticeable when in nuclear biological chemical mode.

Warrior/Underhill

Passageways with chemical-resistant liners connect the series of TEMPER tents and ISO containers to form the field hospital.

Warrior/Underhill

An audible and visible alarm located at the end of each tent activates if the pressure drops too low. Enough pressure is necessary to prevent contaminated air from entering the protected shelter.

inside. It's just when you go to the NBC mode that you notice that the hospital is different," Haley said.

At the entrance is where the hospital appears modified. Tunnel airlocks for patients look like plastic tubes sticking out of a clear tent. Patients are decontaminated before entering the facility and stay in the airlock for one minute to purge any remaining contaminants before inprocessing.

The first operational test was held in August 1997 at Fort Carson, Colo. More than 400 soldiers successfully performed simulated medical operations while encapsulated in the facility for three days, Haley said. A second operational test and evaluation was held at Fort Devens, Mass., in August 1998.

After the CP DEPMEDS are approved for fielding, five systems will be pre-positioned around the world and the remaining seven will be stored in the Army war reserve at Pine Bluff Arsenal, Ark.