



THE WARRIOR

U.S. Army Soldier Systems Center

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the future*

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Cover photo: Sgt. Raul Lopez, enlisted liaison with the Operational Forces Interface Group, portrays Future Warrior. (Warrior/Underhill)

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Gloves layer on warmth

By Curt Biberdorf
Editor

Trigger fingers, as well as the rest of the hands, will be ready to react wrapped under the Modular Glove System developed by the Special Operations Forces (SOF) Special Projects Team at the U.S. Army Soldier Systems Center in Natick, Mass.

The glove system brings a significant change for the SOF community in hand protection, according to Stephanie Castellani, project officer.

"It's new and never been done before," Castellani said. "It's a great improvement because they've never had anything baseline that all the (SOF branches) have agreed to, and (the system) lays the groundwork for future improvements with new materials and technology."

Most importantly, the gloves pass the "trigger test." "Function is first. They have to be able to manipulate their weapon systems," said Richard Elder, an equipment specialist with the SOF Special Projects Team. "Safety used to be the primary concern, but if he can't shoot, he'll toss it for something else."

Now special operators won't have to buy gloves on the commercial market to find a product that works for them.

Starting as a science initiative in 2001, the program transitioned to a fielding initiative in the past year, Elder said. In testing, special operators from different services wore the modular gloves while mountaineering, skiing and snowshoeing on a glacier in Alaska.

Eight companies submitted a glove system through the Small Business Innovative Research program, but the glove system from Outdoor Research in Seattle, Wash., was chosen in the final selection.

It's composed of a Nomex contact liner, intermediate wet/dry glove and extreme wet/dry glove with a removable insulation liner. Comfort ranges from minus 20 degrees to 45 degrees F depending on which individual glove or combination is worn. In all, there are five ways to dress with the glove system.

The Nomex contact liner was designed for the first layer. It's constructed of a Malden Mills Powerstretch fleece with Nomex and soft, flame-resistant Pittards leather lining the palm and fingers that provide a lightweight, flexible glove with an acceptable grip and abra-

sion resistance.

"This is good alone at temperatures above 40 degrees or when handling hot weapons," Castellani said. "For dexterity and tactility, everyone loved it."

The intermediate wet/dry glove worn with or without the Nomex contact liner protects from 10 degrees to 45 degrees F.

Except for the palm, the glove's shell is made with three types of Gore-Tex laminate materials for waterproofing and windproofing while providing moisture vapor transfer and abrasion resistance. AlpenGrip, a proprietary polymer material with a slightly rubbery feel, is used for the palm for complete waterproofing and high abrasion resistance while retaining flexibility. Attached inside the glove is a waterproof liner coated with brushed polyester to improve moisture wicking.

Even when the intermediate glove is worn over the contact liner, Castellani said tactility is still acceptable. Part of the credit goes to the shape of the glove with its curved fingers and tapered fingertips.

In colder climates, the extreme wet/dry glove protects from minus 20 degrees to 20 degrees F worn in combination with the Nomex contact liner or intermediate glove.

The same AlpenGrip palm with Cordura Gore-Tex

material for the shell, waterproof liner with brushed polyester coating and curved, "box-cut" fingers with an articulated thumb for dexterity are found in the extreme glove.

What's different is a lengthened top portion of the shell to protect the wrists and a removable Moonlite Pile insulating insert. Pocket heat-



Warrior/Biberdorf

The Modular Glove System is composed of (from left to right) a Nomex contact liner, intermediate wet/dry glove and extreme wet/dry glove.

ers can be placed into either the intermediate or extreme glove, according to Castellani, but the extreme glove insert has a pocket on top designed specifically for that purpose.

The extreme glove also uses hook and loop fasteners at the wrist and forearm for a snug fit.

"It's a bit bulkier, but you need the extra bulk for the extra warmth," she said. "It's been tested to minus 29 degrees F, so it exceeds the minus 20 requirement."

Fielding is scheduled for late summer beginning with the 10th Special Forces Group in Fort Carson, Colo. The glove system will be sold commercially, enabling conventional forces to purchase the item, according to Elder.

*Extra protection, stability
and comfort come at a 'loss'
with the Marine Corps...*

Lightweight Helmet

By Curt Biberdorf
Editor

It may not look much different from the current Personnel Armor System, Ground Troops (PASGT) helmet, but the new Marine Corps Lightweight Helmet is improved in almost every way.

Fielding of more than 200,000 of the lightweight helmets to Marines will start this summer, replacing the old "Kevlar" as it's commonly called, which has been around since the early 1980s.

A project that began in 1999, the helmet is part of the redesign of all individual equipment for Marines, according to Jim Mackiewicz, Marine Corps Customer Team leader at the U.S. Army Soldier Systems Center in Natick, Mass. The team provides technical and contract support for Product Manager-Individual Combat Equipment (PM-ICE) at the Marine Corps Systems Command in Quantico, Va.

Helmet prototypes went through operational testing at Marine Corps Air Ground Combat Center at Twentynine Palms, Calif., in 2000 and 2002 during combined arms field exercises and were field-evaluated by Marines at Camp Lejeune, N.C.

"It was one of the highest rated pieces of equipment in the (Marine Corps Operational Test and Evaluation Activity)," Mackiewicz said, who was project officer for the helmet. "To get an 85-90 percent approval rating is almost unheard of."



Warrior/Underhill

A four-point retention strap makes the new helmet seven times more stable than the PASGT.

Testing lasted an extra year to work out glitches and allow time to compare the Army's new Modular Integrated Communication Helmet (MICH), he said.

"Both the lightweight helmet and the MICH were comfortable and higher rated than the PASGT, but the lightweight helmet was higher rated than the MICH," said Maj. Stuart Muladore, PM-ICE team leader. "As it boiled down, it was still the helmet of choice for us."

The helmet's shell is shaped like the PASGT, but new materials bring a 6 percent improvement in fragmentation protection as well as the abil-

ity to stop a direct hit from a 9mm round. Lab testing showed a 40 percent improvement in impact protection, which also means better durability. The manufacturer, Gentex Corp. in Carbondale, Penn., warrants the helmet for 15 years.

As the helmet's name suggests, the extra capability was designed with a corresponding weight reduction of about one-half pound. For comparison, a medium PASGT weighs 3.6 pounds vs. a medium lightweight helmet's 3.05 pounds.

"It's the same weight as the MICH but doesn't lose the area of coverage," Mackiewicz said. The



Warrior/Underhill

The soft black leather X-shaped nape pad is part of the retention system that is airborne-certified.



The inside of the chinstrap is lined with suede for improved comfort. Each helmet is delivered with an extra chinstrap and two headbands. (Warrior/Underhill)

MICH shell looks like a trimmed PASGT. “We could have made it as light as 2.8 pounds with a MICH-style cut. The MICH feels good but Marines said they didn’t feel as protected wearing it.”

Complaints have been voiced about the PASGT interfering with the Interceptor Body Armor, but the solution was more a matter of improving stability, not just reducing size, he said.

By incorporating a four-point retention strap, similar to the MICH, the lightweight helmet is seven times more stable than the PASGT so it won’t rock back and forth or fall off. Although most Marines won’t be jumping out of airplanes, it’s airborne-certified.

Comfort is improved with soft black leather for the X-shaped nape pad, headband and border around a new breathable nylon mesh suspension pad, and black suede-lined chinstrap. Two buckles on each side of the helmet provide tensioning and centering of the nylon retention webbing.

The PASGT helmet’s five sizes remain, but Marines can easily adjust headband circumference and height by one-half inch with the lightweight helmet’s hook and loop fabric fasteners for a better fit.



Warrior/Underhill

Major changes inside the lightweight helmet are a soft leather headband and a new breathable nylon mesh suspension pad with a leather border. Marines can adjust headband circumference and height by one-half inch fasteners for a better fit.

“One reason we didn’t go with a trimmed version is because you can have it sit too high,” he said.

Both adjustments help accommodate Marines when they’re wearing masks or hoods, or when any helmet-mounted displays or optics

are attached.

Heat stress is similar to the PASGT, according to Mackiewicz, and in anticipation of wear and tear, each helmet is delivered with a replacement kit containing an extra chinstrap and two headbands.



Future Warrior

Soldier uniform concept remains decades ahead of its time

*Story by Curt Biberdorf
Photos by Sarah Underhill*

Nothing works on Future Warrior, and that's the way it's supposed to be. The uniform ensemble, first assembled at the U.S. Army Soldier Systems Center in Natick, Mass., in 1999, was redesigned for 2003 to better depict technology decades from reality for soldiers.

While the Objective Force Warrior (OFW) soldier weapon platform prepares for fielding within the decade, Future Warrior is set apart as a mostly visionary tool for researchers, said Cheryl Stewardson, the integrated protection functional area

leader for the Natick Soldier Center's OFW program.

Future Warrior was reintroduced at the May 22 opening of the Institute for Soldier Nanotechnologies, a new partnership between the Army and Massachusetts Institute of Technology (MIT).

"We wanted to showcase now the concepts they're working on for the future," she said. "Seeing (concepts) on a human form helps us see how (technologies) might be used and their limitations."

During the past three years, scientists and engineers have experi-

mented with concepts to determine their feasibility with OFW, Stewardson said. What's out of bounds for OFW ended up on Future Warrior.

Looking menacing in an all-black, custom-fit uniform from head to toe, Future Warrior is portrayed by Sgt. Raul Lopez, liaison sergeant with the Operational Forces Interface Group.

Replacing the modified motorcycle helmet used in the previous Future Warrior concept, the custom-designed helmet Lopez wears is leaner and incorporates several features representing upcoming tech-

nology. A blue-tinted visor signifies agile eye protection against tunable lasers, while inside a new projection display technology based off the Joint Strike Fighter helmet is now more accurately shown.

“We have sensors now for thermal and image intensification, but making them small enough, fusing the images and projecting them onto the visor—that’s the leap,” Stewardson said.

Openings at the top of the helmet fit in with the idea of a 3-D audio and visual sensor suite. They restore natural hearing lost in an encapsulated space and enhance long-range hearing. Cameras enhance vision from the sides and behind. A smaller halo on the helmet represents a tracking system for friendly and enemy forces. By reshaping the helmet, Future Warrior has an expanded field of view.

Protection against chemical and biological agents is more realistic with a respirator tube that attaches to the back of the helmet and connects to a low-profile air purifier that forces cool air into the helmet for comfort and visor defogging.

“It was envisioned to come down very sleek into the body, but we couldn’t find a material to do it in the short time we had to put this concept prototype together,” Stewardson said.

Another major change in the uniform is the addition of protruding, interconnecting black pieces of plastic on the legs that represent a lower-body exoskeleton. It will connect through the boots up to the waist and enable the wearer the ability to carry up to 200 pounds.

Above the waist, MIT’s research on nanomuscles for advanced arm and torso strength may be linked to the exoskeleton to give Future Warrior potentially superhuman ability to move or carry. A flexible display on the forearm of Future Warrior glows when switched on and draws attention to the simulated touch screen keypad for information input and output for tasks such as navigation, physiological status monitoring and command communication. The display is connected into a compact computer worn on an armored belt around the waist.

Continued on next page





Attached to the arm is a slim box representative of the remote control unit for any system that might be used, such as a robotic mule or unmanned aerial vehicle.

Found near the top of the torso front and back are what look like quarter-sized buttons built into the fabric depicting a nanostructure sensor array to detect weapons of mass destruction, friendly or enemy lasers, or even weather.

“(The sensors) could trigger a response in the uniform to open or close the fibers depending on temperature or precipitation,” Stewardson said.

Black was chosen as the color to clue observers that it’s the future, she said, although the aim is for a uniform that’s invisible.

Speaking of stealth, much of the futuristic capability can’t be shown at least in part because of nanotechnology.

Along the black stretch fabric are custom-fitted plastics and foams that take the place of liquid body armor that will instantly solidify when struck. “All the parts are much harder than we wanted. We haven’t figured out how to portray (liquid armor),” Stewardson said.

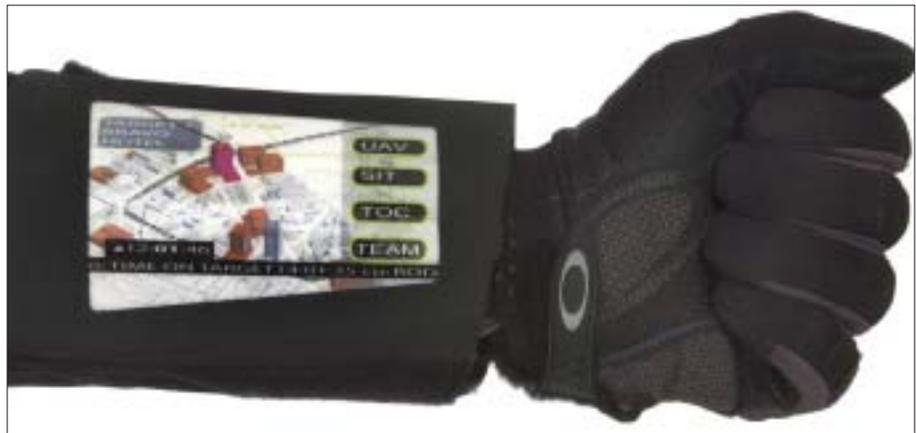
Through nanotechnology, multifunctional materials will be able to transport power and data. The materials will also be able to fend off chemical and biological agent attacks, self-decontaminate and become waterproof.

“I believe nanotechnology is going to give us much more than we can even envision today. This is just a sampling,” Stewardson said.

In many ways, the revised Future Warrior is the same. A microturbine will provide power for items such as the microclimate conditioning system for heating and cooling. The weapon remains a fire-and-forget system using soft-launch seeking missiles. A transdermal nutrient delivery system provides the nourishment to get through a battle. He’s still going to be a moving target for researchers, shedding workable technology for the next greatest thing.

“There’s always going to be a Future Warrior,” Stewardson said. “In the soldier business, you can never rest on your laurels. Somebody is always out there to beat you.”

A flexible display worn on the forearm depicts a touch screen keypad for information input and output. The display is one of many changes to better show the visionary technology of the Future Warrior uniform.



Objective Force Warrior contract awarded

Future Warrior will be stuck in the future, but Objective Force Warrior is moving along to become a reality with the June 12 announcement of the Lead Technology Integrator for the Objective Force Warrior Advanced Technology Demonstration (OFW ATD) program.

Eagle Enterprise Inc., a division of General Dynamics of Westminster, Md., will execute Phase II (preliminary and detailed design) and Phase III (demonstration build, training and demonstration) of the OFW ATD program, managed by the Natick Soldier Center (NSC) at the U.S. Army Soldier Systems Center in Natick, Mass.

OFW is the Army's flagship soldier science and technology program focused on providing the future soldier and small team with combat overmatch and skip-a-generation capabilities intended to improve soldier survivability, enable greater combat lethality and provide networked communications between soldiers and other combat platforms such as the Future Combat Systems and Comanche helicopter.

"As the government lead for this program, I am very pleased with and appreciative of the partnering and support this program has received from the Army's S&T community," said Philip Brandler, NSC director.

The NSC is the home for the development of the technology for nearly everything the soldier wears, carries, consumes and uses for shelter.

"Transformation of the soldier is fundamental to the Army's transformation to the Objective Force," said Assistant Secretary of the Army for Acquisition, Logistics and Technology Claude M. Bolton Jr. "This program will be instrumental in achieving that vision."

Eagle Enterprise Inc. will receive \$100 million for

the 25-month Phase II. The cost of the 15-month Phase III will be negotiated with Eagle Enterprise Inc. during Phase II. This program continues efforts begun last year to conceptualize, design and demonstrate a revolutionary soldier "system of systems," a concept that will be demonstrated in 2006.

"Army transformation is all about networking soldiers with weapon systems, vehicles, and aircraft to create a joint, integrated fighting force with overwhelming and devastating power," said Lt.

Gen. John Riggs, director, Objective Force Task Force. "OFW forms the heart of the soldier-centric Objective Force."

The Objective Force is the Army's future full-spectrum force: organized, manned, equipped and trained to be more strategically responsive, deployable, agile, versatile, lethal, survivable and sustainable across the entire spectrum of military operations.

The tenets of the Objective Force are to enable the Army to see first, understand first, act first and finish decisively from major theater war through peacekeeping missions and homeland security.

Enabled through a seamless network, the OFW soldiers will have unprecedented battlefield knowledge, standoff precision lethality, ballistic survivability and mobility capabilities available today only in "platform-based" forces but without burdensome weight.

The goal is to reduce a soldier's physical load by 50 percent, down to less than 50 pounds.

The OFW systems architecture will provide full integration into the Future Combat Systems unit of action, establishing the OFW soldier as the centerpiece of these formations.

Editor's Note: Information was taken from a Department of the Army news release.



Automatic tracking

Combat Feeding joins radio frequency supply revolution

By Curt Biberdorf
Editor

Information never before obtained about supplies and equipment will be available to the military through the next generation of Radio Frequency Identification (RFID) technology known as Auto-ID.

The Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass., has joined nearly 100 companies and five international research universities as sponsors of the Auto-ID Center at the Massachusetts Institute of Technology (MIT), founded in 1999.

The center is developing technology based on non-proprietary, global standards that will create an affordable solution for the Defense Department and commercial industry worldwide. Combat Feeding calls

this initiative “Global Asset Visibility.”

“The global supply chain is a bigger network than most people realize,” said Kathy Evangelos, executive assistant to the Combat Feeding director. “Auto-ID will automate the global supply chain.”

UPC to EPC

The Universal Product Code (UPC), a bar code of lines and numbers now used to identify objects, has existed since the 1970s for logistics management, but the technology is limited.

During Operation Desert Storm, the military did not know what was in 25,000 of the 40,000 containers sent overseas, she said. Containers today can be tracked with RFID

tags, and they have greatly improved the situation for operations Enduring Freedom and Iraqi Freedom. Still, Auto-ID offers more.

“We’re starting to see tags with microchips in all kinds of products,” Evangelos said. “Industry sees RFID as a replacement for the bar code, and Auto-ID takes it a step further.”

The technology is based on the Electronic Product Code (EPC), a 96-bit code capable of identifying more than 80 thousand trillion, trillion unique items. An electronic tag containing an EPC on a microchip wirelessly stores and transmits data to a reader. The EPC code serves as an address directing users to an Internet site where managed levels of information on the item are found.



(Above) A portable reader determines the ability to read Type 3 tags on pallets already loaded into a container during preliminary testing at Defense Distribution Depot San Joaquin. (Top right) Type 1 case tags are read while simulating loading and unloading through an entrance and exit portal. (Bottom right) A flatbed truck drives past a reader scanning Type 3 pallet and container tags. Courtesy photos





Courtesy photo

Type 1 Electronic Product Code tags are affixed along the edge of individual cases of Meals, Ready-to-Eat.

Information retrieval is possible using the Object Naming Service, which associates the EPC with an item. It points to a server that uses the Physical Mark-Up Language to distribute and represent related information, such as shipping instructions, inspection schedules, location, expiration dates or even technical manuals. Savant software technology manages the flow of data and provides an interface to legacy systems.

Sensing trouble

Auto-ID will provide real-time visibility. Accurate automated inventories will eliminate the need for manual counts, according to Evangelos, which ultimately reduces the supply chain footprint and associated costs.

Furthermore, EPC tags will allow automatic manifests to be written to containers, and sensor integration will provide the capability to monitor the status of an item, pallet or container by detecting variables such as temperature, vibration, rough handling, or chemical or biological contamination that could affect product quality.

“Initially we want to track rations, but imagine what it can do for vaccines and other medical supplies and other temperature sensitive items,” Evangelos said.

She said one possibility with the technology is reading a temperature profile from a container or pallet tag that translates complicated data using a shelf-life model, developed by MIT for Combat Feeding. The model will allow food inspectors to determine the condition of Meals, Ready-to-Eat or Unitized Group Rations using a simple, easy-to-understand color-coded system—green for “issue”, yellow for “limited inspection” and red for “100 percent inspection.”

Corporations plan to track down to the item level, such as packages of disposable razor blades or bottles of laundry detergent, but Combat Feeding is interested in tracking at the case, pallet and container level, she said.

Case level or Type 1 passive tags come in various shapes and sizes and cost anywhere from 20 cents to \$1. Eventually, these tags will cost less than 5 cents. Pallet and container or Type 3 battery tags today cost as much as \$150.

“The tags we are testing currently cost around \$17 and eventually, revolutionary technology advancements using tiny NanoBlocks will bring the cost down to \$1 to make widespread use affordable,” Evangelos said.

Combat Feeding is conducting DoD’s first technology demonstra-



Courtesy photo

A Type 3 temperature and manifest tag is attached to a pallet of rations.

tion of Auto-ID at the Defense Distribution Depot San Joaquin this fall with Alien Technology, Inc., OatSystems, Defense Logistics Agency and Oak Ridge National Labs.

The demonstration will simulate rations being tracked from an assembler or depot to general and direct support supply points in a field setting with distribution to individual units. Preliminary testing and a shakedown were conducted in the spring, and follow-up testing is ongoing in preparation for the fall demonstration.

Beans and beyond

Goals for the demonstration are automatic, real-time tracking and visibility at the supply points; automatic inventories to units issued; capturing historical product temperature data; and automatic tracking and updates of container inventories.

Results and lessons learned from the demonstration will help set the framework for a proposed Defense Logistics Agency Advanced Concept Technology Demonstration (ACTD) in 2005. Additionally, EPC technology is proposed as an expansion of a current RFID ACTD being conducted by the Navy, according to Evangelos.

Although combat rations are the demonstration product, any military item, including ammunition and spare parts for vehicles, can be tracked under the program to help warfighters ultimately get what they need when they need it.