

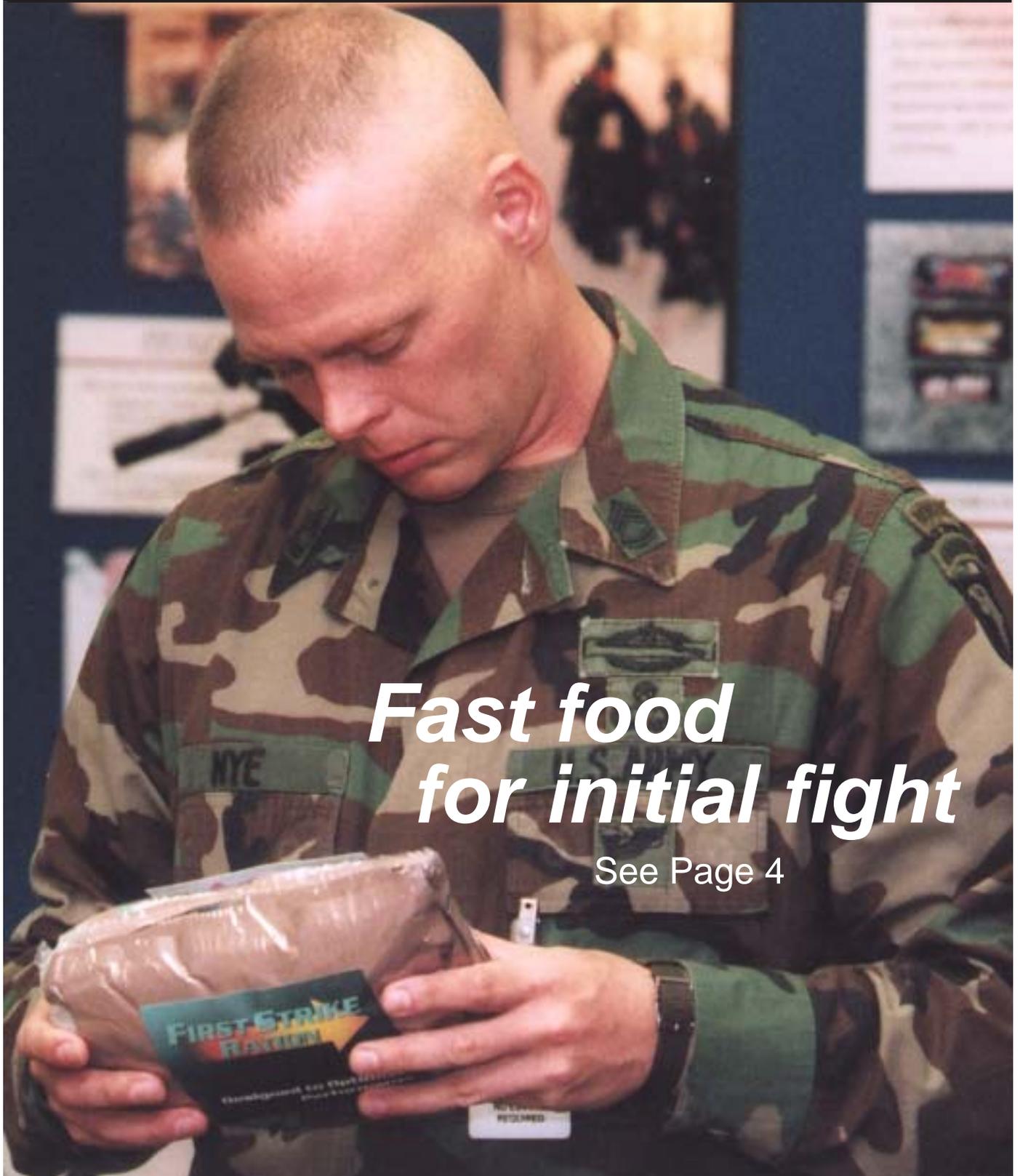


# THE WARRIOR

U.S. Army Soldier Systems Center

Natick, Massachusetts

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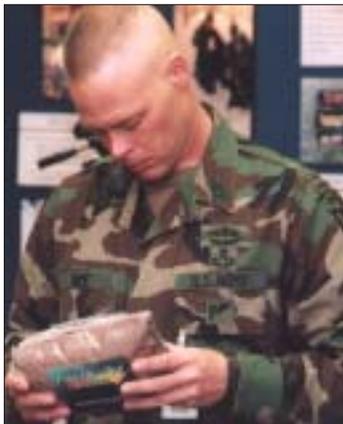
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Cover photo: Sgt. 1st Class Charles Nye looks at the content list of a First Strike Ration prototype. (Warrior/Underhill)

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# 'Power Fuel' energizes troops

By Curt Biberdorf  
Editor

Rapid yet sustained energy for warfighters could be a squeeze away with "Power Fuel," a quick energy booster gel in development at the Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass.

Power Fuel is part of Combat Feeding's Performance Enhancing Delivery System, a military food system that will deliver performance-enhancing natural food constituents to troops in the field.

Energy gels in the commercial market are popular with athletes during a workout or race who want easily absorbed and digested carbohydrate-based calories to replace expended glucose. Packaged in plastic pouches, the 1-ounce servings are sucked out on the move and out of hand. Troops engaged in high physical activity might also benefit from such a product, and food technologists are taking the gel formulation to another level.

"The more motivated ones are going to want to do anything to get a performance advantage," said Jack Briggs, a food technologist on the Performance Enhancement and Food Safety Team. "We tried to make a gel instead of a paste-like substance. Our gels have a gelatin-like structure."

They apparently have staying power as well, according to a study completed this year by the U.S. Army Research Institute of Environmental Medicine located here.

The study compared the responses of human research volunteers after consuming glucose water—the control product—a highly viscous glucose gel and Combat Feeding's finished gel product, all three equal in carbohydrate content.

The finished gel, which contains a mixture of glucose and maltodextrin—a com-

plex carbohydrate—along with fat and a trace of protein, showed significant improvement over the glucose water and high viscosity glucose, but Briggs said the most interesting part was its "bi-phasic" characteristic.

In other words, after reaching its apex or "glucose spike" and subsequently decreasing, the glucose levels in six of the 13 participants rebounded and slightly increased for a period of time as opposed to continuously decreasing to baseline levels or lower, which is typically the case.

"None of us can understand it. We've never seen it

before, but it appears you can get another boost of energy," Briggs said. "You're going to get a slower absorption of glucose initially but the release of glucose to the bloodstream will be sustained for a longer period of time. We feel very confident that modulating glucose uptake and release will



Graphic by Steve Smith

maintain energy levels and potentially improve warfighter performance in the field."

The next step is to conduct another study to further explore that characteristic of glucose modulation. What is learned may be applied to other military rations, he said.

Still, how it works won't matter if the gel is unsavory. Taste was evaluated in sensory panels with exercisers familiar with commercial gels and other consumers, and the Power Fuel had a good overall acceptance compared to the four commercial products on the market, according to Briggs.

Current flavors are mixed berry, apple cinnamon, cherry vanilla and mocha. The gel ingredients include juice concentrates—except for mocha—various carbohydrate types, unsaturated fats and gums. Caffeine was added to the mocha gel, and other performance-enhancing ingredients, such as tyrosine or glutamine, may fortify the gel at some point if they prove to be effective, Briggs said.

By comparison, some commercial gels are basically corn/rice syrup and flavoring, and they aren't required to have a minimum shelf life of three years at 80 degrees or six months at 100 degrees F. Packaged in a capped tube, Power Fuel's serving size of 3.4 ounces delivers from 240 calories to 320 calories, depending on the flavor, and is about three times the portion of commercial gels. They are also being tested in a pouch.

Briggs said a goal is to have Power Fuel become a commercially-available item to hold down purchase costs. If approved for the military, Power Fuel will be issued as part of the First Strike Ration, which is scheduled for fielding in 2007.



Warrior/Biberdorf

**An early test formulation of Power Fuel is poured from a tube. The high energy gel is also being tested in a pouch.**

# Strike one

## Upcoming ration sustains troops in early days of combat

By Curt Biberdorf  
Editor

Stripping is routine for ground troops lightening their field ration load they carry into battle. The new First Strike Ration (FSR) should minimize if not save them the task while bumping up the nutrition they need for peak performance.

Still a development project of the Department of Defense Combat Feeding Directorate at the U.S. Army Soldier Systems Center in Natick, Mass., the FSR is a single package, high-energy, no-utensils-required ration that would be substituted for three packages of the venerable Meals, Ready-to-Eat (MRE) for forward-deployed troops in the first 72 hours of combat.

“About seven years ago, we said there has to be a better way to assess what items are being fieldstripped, ensure that these items contain the right nutrition level and

condense the cube,” said Betty Davis, Performance Enhancement and Food Safety Team leader and project officer for the FSR.

Three MREs totaling 3,600 calories were being shaved to 2,200-2,500 calories after soldiers had tossed out unwanted contents. Each FSR hits the target with about 2,300 calories.

The FSR is close to half the weight and volume of the MRE, which fits into the Army’s goal of becoming lighter, leaner and more mobile as it transitions to the Objective Force. The FSR also cuts down packaging waste.

When the first concept was created two years ago, it was composed of breakfast, lunch, dinner and snack pack, but Davis said the downfall was that each pouch opened the path for fieldstripping.

“Probably when the final version is in the field, soldiers will want to strip it because it’s human nature,

but in field tests, it has never been stripped,” Davis said. “We have a great prototype FSR, but it’s definitely going to be changing.”

The latest prototype has proven so popular in evaluation that the U.S. Army Special Operations Support Command requested as many of the rations as the Combat Feeding employees could make in their Food Engineering Lab for shipment to Rangers deployed in support of Operation Iraqi Freedom.

Every food was selected for its ability to be eaten out-of-hand for troops on the move. From lessons learned from early concepts, the FSR has evolved into a single shrink-wrapped bag packed with a combination of familiar and new ration components.

It currently contains two shelf-stable pocket sandwiches but will soon contain three based on feedback, two flavors of miniature HooAH! nutritious booster bars, two



Warrior/Underhill

Contents of a prototype First Strike Ration consist of shelf-stable pocket sandwiches, a HooAH! nutritious booster bar, Zapplesauce, sticks of beef jerky, crackers, peanut butter, a dairy bar, ERGO beverage mixes, an accessory packet and package of dried fruit.



Warrior/Underhill

**1<sup>st</sup> Sgt. Stephen Carnahan, Sgt. 1<sup>st</sup> Class Charles Nye and 1<sup>st</sup> Sgt. Rudy Romero show how they fieldstrip Meals, Ready-to-Eat at Combat Feeding's ration display room during a visit of the Soldier Systems Center Sept. 5, 2002. The soldiers, with 1<sup>st</sup> Battalion, 187th Infantry from Fort Campbell, Ky., fought in Operation Anaconda in Afghanistan and shared their insights on soldier items with the work force.**

servings of Energy Rich, Glucose Optimized (ERGO) beverage mix, a dairy bar, crackers or bread, cheese spread, two sticks of beef jerky, a package of dried fruit, a modified version of applesauce named "Zapplesauce," a Ziploc bag, and an accessory packet missing the tiny bottle of Tabasco sauce but including an extra wet napkin.

Barbecue chicken and barbecue beef are two varieties of pocket sandwiches now available, and Davis said that more varieties will be added as they are developed. The sandwiches are approved for the MRE and offer for the first time tidy sandwiches that don't require refrigeration.

The dairy bar, likely to be renamed "dessert" bar, is available in chocolate, peanut butter, mocha, banana nut, vanilla nut, vanilla and strawberry flavors. The extruded bar, without a home since it was created about a decade ago, has the consistency of fudge and provides milk protein.

"We took it off the shelf, revisited it and made it cheaper to produce," Davis said. "A number of people here are excited about it, and it could find its way into other rations, including the MRE."

Zapplesauce is one of the best-liked components, according to Davis. The product is made with extra maltodextrin, a complex car-



Warrior/Underhill

**MRE packages are shown in the fieldstripped size.**

bohydrate, for sustained energy release.

Maltodextrin is also the key ingredient in ERGO, which tastes similar to a sports drink. It's intended to increase endurance by conserving glycogen, which is energy stored in the liver and muscles. The ERGO drinks packs will have a "fill-to" line so users easily know how much water to pour in.

Straws were desired but are not feasible, so other options, a spout fitment for example, are being investigated for easier drinking and may be available as technology changes, Davis said.

HooAH!, which is similar to commercial performance bars, comes in chocolate, peanut butter, apple-cinnamon, raspberry and cranberry flavors. HooAH! may be fortified with tyrosine or extra caffeine for performance enhancement depending on testing results with the U.S. Army Research Institute of Environmental Medicine.

Other possibilities for the FSR include breakfast-type pocket sandwiches, a protein drink or bar, high-performance energy gel and caffeinated sticks of gum.

The FSR has a shelf life of two years instead of three years at 80 degrees F because the rations don't have to be pre-positioned. They have to stay warmer than 20 degrees F to avoid freezing, and the warfighter will have to resort to another source to heat the food because no heater pack is included.

Davis said she expects the FSR to be ready for fielding by 2007.

# Joint drop

*Project explores precision aerial delivery for lightweight loads*

**By Curt Biberdorf**  
Editor

With precision airdrop, the Air Force and Army plan to eventually safely deliver anything from sensors to armored vehicles in weights ranging from 200-42,000 pounds to friendly ground forces with accuracy similar to Joint Direct Attack Munitions, commonly called “smart bombs,” that strike enemy targets.

The next step in making that a reality is the Joint Precision Airdrop System (JPADS), a proposed Advanced Concept Technology Demonstration (ACTD) beginning in 2004 and managed at the U.S. Army Soldier Systems Center in Natick, Mass.

JPADS is intended to resupply troops anytime and anywhere within 24 hours, where 24 hours is worst case from United States to anywhere in the world. Aircraft survivability will increase because cargo will be delivered within 100 meters of the ground target from altitudes of 25,000 feet and at an offset distance of up to 12 miles.

The ACTD will focus on payloads of 10,000 pounds—the lightweight



Warrior/Underhill

**A C-17 prepares to drop an unguided or “dumb” load of cargo.**

category—with a usable payload of no less than 8,000 pounds, that would resupply troops with food, water, ammunition and even fuel, according to Richard Benney, technical manager for JPADS and Airdrop Technology Team leader at Natick.

Cost is the driving factor for JPADS because the capability exists now but at more than five times the price users are willing to pay, Benney said. The goal is to drop the

price to \$3-6 per cargo pound, and even at that price he said it’s an expensive alternative to current standard low-altitude airdrop systems.

“It won’t replace the ground logistics, but it gets you the extra capability, especially if you’re cut off from an ambush and need resupply, or for locations that trucks can’t reach,” Benney said. “It won’t drop a Humvee. The next (weight) level will do that. A lot of the technology from this program applies to all weight classes.”

Even with advanced technology, he added that “smart” systems won’t allow flight crews to drop supplies anywhere and expect a precise landing. Rather, it widens the window of opportunity to make it easier.

JPADS combines the Army’s Precision and Extended Glide Airdrop System (PEGASYS) program with the Air Force’s Precision Airdrop System (PADS) program to meet joint requirements for precision airdrop.

PEGASYS is the name of a family of precision airdrop systems, consisting of extra light, light, medium and heavy payload categories. It consists of a canopy decelerator and airborne guidance unit, including a Global Positioning System, along with the appropriate pallet platform.

PADS is an on-board computer



Warrior/Underhill

**A loadmaster moves a Humvee onto a C-17 before an unguided airdrop. The JPADS will first focus on precision airdrop of supplies and equipment in a lighter weight category.**



Courtesy photo

**A parafoil is one of the three candidate decelerator systems for JPADS.**

system predicting release points for ballistic or “dumb” parachute systems for high altitude airdrops. It uses mission-planning and weather forecasting software, and can receive en-route mission changes and weather updates via satellite links.

The joint system will be able to send a signal from the aircraft to the receiver of cargo pallets carried aboard a C-130 or C-17, each pallet potentially directed to different drop zones.

“The mission planning software will be able to communicate with any airdrop system,” Benney said. “The pilot or navigator, possibly via a SATCOM link from anywhere in the world, will be able to tell each individual load where to go. They could be spread out or bunched together or both depending on what’s needed.”

To get similar accuracy now, cargo needs to be released at 1,500 feet or lower, and even then, only the first pallet will land close to the intended target because the aircraft generally crosses a 3-mile drop zone to deploy all the payloads it’s carrying. That allows enough time and distance to take hits from shoulder-launched missiles or anti-aircraft artillery, according to Benney.

Candidate decelerator systems for JPADS have been downselected from eight to three: a low-cost parafoil, hybrid single surface parachute and “strong screamer.”

The parafoil uses low-cost para-



Warrior/Underhill

**Standard round parachutes are now used for unguided airdrop. Round parachutes may still be used in a precision airdrop system under the JPADS Advanced Concept Technology Demonstration.**

chute construction techniques similar to round parachute designs while offering greater capability and reliability. The hybrid is a new design built with a lower-cost, high-performance, zero-porosity fabric used in the hot air balloon industry. The screamer starts with a ram-air drogue parachute deployed at high

altitude and then opens standard Army inventory round parachutes at lower altitudes.

The program expects to ultimately downselect to just one of these decelerators as it prepares to meet the needs of the Objective Force of just-in-time resupply to locations anywhere around the world.



**Earl Battle, a clothing designer, stitches an upper body portion of a prototype Future Warrior uniform.**



**A button is stitched by machine onto a piece of cloth.**

# Dressed right

## Facility designs, makes prototypes of clothing items for warfighters

*Story by Curt Biberdorf  
Photos by Sarah Underhill*

Although they're called clothing designers, the eight-member staff of the Design and Prototype Facility at the U.S. Army Soldier Systems Center in Natick, Mass., mixes science into the artistry of not just vests, coats, shirts and trousers, but any textile-related military item worn or carried by warfighters.

From helmet covers to socks, they design it all, yet their work is rarely about fashion and primarily a matter of function.

"What we do is more innovative engineering," said Heather Cumming-Rowell, senior clothing designer. "We often have to figure out how to work with experimental fabrics with the goal to provide improved protection, mobility, comfort and fit. We're looking to give warfighters the capability they need

in the field."

Furthermore, the designers need to ensure their design integrates with the rest of the warfighter's existing battle ensemble.

Working for a variety of military customers, the facility makes new designs and less frequently modifies an existing design with improved features.

Scattered around the work space, hanging dress forms display a wide scope of projects the designers have created, including the Air Warrior microclimate cooling garment, a protective body armor set used by combat engineers to clear mines, the Marine Corps utility uniform in the new camouflage pattern, and a reversible Battle Dress Uniform (BDU) constructed with desert camouflage on one side and woodland on the other.

"This particular uniform went through several design generations, and each generation was a learning experience," Cumming-Rowell said about the two-sided uniform. "It uses a single-ply of fabric, and the original version had pass-through pockets with offset flaps. It was a challenge, but we did it."

The design process begins with a hand-drawn or computer-drawn sketch so the customer can visual-



**Diane Kessinger, a clothing designer, uses an ultrasonic cutter.**



**Lynne Hennessey, a clothing designer, measures a microclimate cooling vest draped on a dress form.**

ize the final item. Upon approval, the design is entered into a Computer Aided Design (CAD) system that enables electronic storage and modification of the pattern.

“There are times when you really need to decipher every design detail to visualize what the customer is actually looking for in a prototype,” said Rachel Rizoli, a clothing designer. “Once the pattern is digitized, you never have to repeat the complete process. Say someone doesn’t like the location of a button or the angle of a pocket. A designer can change this in the CAD system.”

The facility’s Gerber CAD is compatible with many other CAD systems, and the designers can send electronic files of finished designs to manufacturers to reduce the turnaround of initial samples from weeks to days, according to Rizoli.

Each design drawn into the CAD system is in the master size and then graded to accommodate larger and smaller sizes.

Over the years, body shapes have changed, and designers have taken that factor into account by acquiring new “central-sized” dress forms for measuring or draping. The Army-specific dress forms were created as a result of the research on body shapes compiled in the Army’s anthropometric database, said Steven

Paquette, anthropology coordinator in the Science and Technology Directorate.

Once patterns are entered electronically, a mechanical cutter precisely slices pieces of fabric for assembly or can cut out oaktag patterns for designers, customers and contractors. Ballistic materials are still cut by hand with a circular power knife.

“Before the mechanical cutter, we cut all prototypes to be fabricated by hand,” Cumming-Rowell said, noting the time and fabric sav-

ings with the machine.

Once the pieces are cut, Rizoli compared the construction process to an engineering project. “It’s as if you’re building a bridge, connecting a series of parts that lead up to the final result.”

For example, the standard BDU consists of a coat and trousers with 53 fabric pieces and four different sewing stitches. Chemical-biological protective clothing designs are tricky because of the emphasis on minimizing or sealing seams for leakproofing. The Chemical Protective Undergarment project incorporated a knitted design to aid in eliminating seams.

The facility owns a collection of machines to help designers make rapid prototypes.

Sewing machines complete various tasks, fusing machines create stiffness, an ultrasonic cutter slices fabric without fraying edges, and pneumatic machines set plastic and metal snaps, grommets and eyelets. Seam-sealing machines and heavy-duty presses are also available.

“Even while sewing the pieces together, designers can find ways to make an improvement better,” Rizoli said.

The facility typically constructs 10-18 prototype copies for initial fit and wear tests, according to Cumming-Rowell.

The design team participates in first article inspections and field fit tests to develop patterns for use in technical data packages supporting large-scale procurement.



**Christine Reffel, senior CAD engineer, digitizes a paper pattern into the computer. Digitized patterns are easier and faster to modify.**

# Paint, repellent united

By Karen Michael-Fleming  
Contributing Writer

The diseases insects carry—malaria, dengue and leishmaniasis, to name a few—are real health threats in the field, which is why soldiers are issued insect repellent. They're also issued camouflage face paint because they're expected to be able to hide in plain sight—without giving away their position by swatting at insects.

Yet, until recently, soldiers who needed to use repellent and camouflage face paint at the same time ran into sticky situations.

"If you applied the repellent first and then the face paint, the paint hindered the repellent's effectiveness. If soldiers reversed the order of application, the repellent made a gooey, smelly mess ... and soldiers weren't using it," said Col Raj. Gupta, a medical entomologist who's worked on fixing the face paint and repellent

problem since 1989.

The idea to unite the two was a soldier-driven initiative, said William Robertson, a combat developer with the U.S. Army Medical Department Center and School in San Antonio, Texas. Through the Soldier Enhancement Program, which allows troops to weigh in on anything they wear, use or carry, soldiers told the Army they needed the two products to be combined.

"Soldiers, in some cases, weren't using the Army-available products but were attempting to purchase their own products from the civilian world," to resolve the problem, Robertson said. "Soldiers should not have to spend their own money to do their job."

Offering a solution to the problem, Gupta and other researchers at the now-closed Letterman Army Institute of Research and the Walter Reed Army Institute of Research (WRAIR) blended camouflage face

paint with a controlled-released formulation of deet, the repellent issued to soldiers since 1990.

"We were only successful because of very vibrant and active basic research that established the physical parameters and theoretical framework that led to the development of these products," Gupta said. "The knowledge we gained from active basic science research essentially cut in half the time to create prototype candidates."

## Shadow color

The two new camouflage face paint compacts—the brown one has deet, the green one doesn't—have five colors for soldiers to use when they hide in plain sight. With the new compacts, warfighters will have all the colors they need for a deployment anywhere in the world. The plastic compacts contain 20 applications of green, loam (a dark, greenish brown) and sand and 10 applications of white and black, a new color for the military.

"When we talked to soldiers, we found that they really wanted the black color to produce shadow effects and to match their BDU (battle dress uniform) colors," said Scott Doughty, a biomedical engineer and product manager for the face paint for the U.S. Army Medical Materiel Development Activity.

Since 1996, Doughty and a team from Fort Sam Houston, Texas; Fort Benning, Ga.; Fort Belvoir, Va.; and U.S. Army Soldier Systems Center in Natick, Mass., have helped guide the two products through advanced development by working with the manufacturer, the Food and Drug Administration (because face paint is considered a cosmetic) and the Environmental Protection Agency (because it controls products that contain deet).

Developing both the deet and non-deet versions was a "happy coincidence," for researchers, Gupta said. "When we started looking at adding deet to the face paint, the 'Big Army' took notice and said that creating a better face paint that has



File photo

**A Marine applies camouflage face paint from a compact. A new brown compact with deet and new green compact without the insect repellent have five colors, including for the first time black paint.**

thermal protection was something they planned to do, so they turned over developing the non-deet product to the team as well.”

Textile technologist Anabela Dugas has tested the two formulations for their visual and near-infrared protection at Natick since 1998. Just as she does with all military camouflage items, she used a color spectrometer to determine each paint’s reflectant properties, ensuring the readings were within acceptable minimum and maximum ranges for visual protection as well as for defeating night vision goggles.

### Reflective appeal

Once the paint color passed that test, soldiers smeared on the paint and headed for the camouflage evaluation facility that has arctic, woodland, urban and desert scenes. There, researchers donned night vision goggles to confirm if the spectrometer’s readings were accurate.

“What you see through night vision goggles is light, so the sand properties should be the same as the sand face paint so you blend in to the sand background,” she said. The numbers the spectrometer gives for minimum and maximum levels are required specifications for documentation, Dugas said, but seeing through night vision goggles really is believing.

Because the product ultimately belongs to soldiers, researchers took it to the field to see if soldiers liked it. Gupta brought the product to an infantry company in Panama in 1996 for its first study. He knew he was headed toward a successful product, he said, when the soldiers kept the prototypes.

Later studies conducted in 1999 by WRAIR researchers Lt. Col. Mustapha Debboun and Col. Dan Strikman in Thailand, and by Debboun in Korea in 2001 let seven additional infantry companies test the face paint.

Doughty and the development team focused on packaging issues, like the size and weight of the compact, easy-opening clasps and mirror. The mirror couldn’t be glass because it needs to withstand the rigors of field life, but it couldn’t be plastic because deet is a solvent and

will dissolve most plastic over time. In the end, stainless steel was the reflector of choice.

“The interesting comment from Korea (trials) is soldiers love the mirror for shaving,” Doughty said. “Once they finished with the paint in the compact, they probably broke the hinge and kept the mirror.”

Though the product has cleared most hurdles, the development team still has work to do, starting with educating soldiers. Because of the team’s work, new specifications are being finalized for any face paint the Defense Logistics Agency may procure in the future.

Doughty noted that soldiers who purchase commercial products, like the paint bow hunters use, aren’t getting the safeguards the new face paint offers, with or without deet.

“Natick Soldier Center has tested all of these,” Doughty said, pointing to his collection of off-the-shelf camouflage face paint compacts, “and they absolutely do not come close to meeting the military specifications for concealment. We need to let soldiers know that though these products are out there, they don’t offer the protection they need.”

The team is also taking on the widely used camouflage face paint sticks to get them up to the same standard as the compacts. In contrast to the 184,000 compacts purchased last year through the supply system, Army units bought almost 300,000 of the sticks.

The problem with the sticks, Dugas said, is they offer only visual protection from the naked eye, not from night vision devices. Doughty said the dispenser, which is rolled aluminum and can cut less-than-svelte fingers and easily dislodges its cap, also stands improvement.

Future product improvements include face paint that offers concealment from thermal imagers so heat radiating from the face and hands can’t be detected against their background.

“When we come up with thermal-defeating paint, we will have to see if it interferes with the deet and if the time-released repellent interferes with the thermal,” Doughty said. “That will be the next challenge for researchers.”

*Editor’s Note: Karen Michael-Fleming is a reporter with the Fort Detrick Standard newspaper.*



File photo

**A soldier smears on the widely used camouflage face paint stick. The sticks are not yet to the same standards of the compacts.**