

## Good Air to Breathe

Written by Randolph Fillmore



**Masks that allow the wearer better vision, easier breathing and less of that claustrophobic feeling of heavier, bulkier suits of the past are making their way to the operators.**

The post September 11 world in which threats from chemical, biological radioactive and nuclear agents (CBRN) are more likely has seen manufacturers of protective gear for both the warfighter and civilian first-responders double their efforts to provide top-quality equipment with enhanced protection features and better wearability.

Even prior to September 11, the emphasis in protection was developing in terms of TICs (toxic industrial chemicals) and TIMs (toxic industrial materials). The National Institute for Occupational Safety and Health (NIOSH) developed a list of the 10 worst CBRN agents and developed standards for CBRN respirators bridging military and industrial standards, of which there is now considerable overlap. In 1999, NIOSH established the National Personal Protective Technology Laboratory (NPPTL) to test CBRN protective gear headed for the civilian market. Increasingly, CBRN protective gear headed for either the U.S. military or civilian markets are tested to the same standards.

Over the last decade and following the Gulf War, masks, respirators and filters, protective suits and escape hoods have been constantly upgraded as many military and first-responder users seek not only greater protection and comfort for the wearer, but also aim at improving mission success.

### **M50's Debut**

Off the drawing board and through all its testing hoops, the new and improved Joint Service General Purpose Mask (JSGPM M50) makes its entry into the field this spring, replacing the Air Force and Navy MCU-2A/P and the M40 used by the Army and Marine Corps. The M50 has been in development and testing for more than five years.

Promising 150 percent more protection, 300 percent more chemical resistance, a 36 percent weight reduction and just over 35 percent better stats in inhalation and exhalation resistance, the JSGPM can make a difference for troops, said Corey Grove, a chemical engineer at the Edgewood Chemical and Biological Center (ECBC) in Edgewood, Md. Grove was intimately involved with the new JSGPM.

"To meet requirements, we are working from the top down," said Grove, a veteran research and development scientist with 22 years of experience. "The joint requirements office tells us what the warfighter of the future will need 10 or 20 years from now."

The M50 is made by Avon. Avon project manager John Bevans said that they received the contract in March, 2000, and that the M50 is a good example of how the DoD and industry have been working together.

"The first two years we focused on evaluating various technologies affecting all elements of the JSGPM, including filtration, optics, materials and overall design," explained Bevans. "From this we produced about 1,000 pieces that were subjected to testing and evaluation. Our success today is highly attributable to the open communication between our company and the government."

While the new JSGPM is stepping out this spring, designers are already at work on the mask's next evolution. In addition to being more protective against chemical, biological, radiation and nuclear threats, the new JSGPM, as well as commercially produced masks, seeks better integration with protective qualities increasingly more compatible with mission completion requirements as much as personal safety.

"We spend a lot of time on system integration," said Grove. "Soldiers really don't want any material between them and the outside world and the mask has historically been the 'odd man out' because it is usually worn for a shorter amount of time and in the past demonstrated low priority for integration."

According to Grove, the new and better-integrated JSGPM has enhanced compatibility for wider field-of-vision for rifle sighting and firing. ECBC testing concluded that the new mask improved night vision goggle compatibility by 18 percent, overlapping field-of-view by 144 percent, Bradley sighting compatibility by 27 percent and rifle firing by 30 percent.

Filter design is a great factor in the mask being compatible with other equipment, noted Grove. The M50 was designed with twin canisters to help lower breathing resistance while improving filtration to cope with increasing demands. "It provides better balance and a larger filtration surface that a single canister cannot," said Grove.

The dual canister also provides for better rifle sighting, whether the rifleman is left or right handed. The next generation of breathers and filters may remove the breather and filter from the face altogether. However, moving it elsewhere presents its own set of problems since the soldier's body carries so much equipment already. An option might be to move it elsewhere on the helmet, into a position that may also allow the filtration system area to be expanded.

A new emphasis is on designing filters to screen out a plethora of potentially deadly chemical and biological agents while enhancing wearability for both troops and first responders. Those standards were consumer-driven as users sought better protection.

### **Breathers and Filters**

Because all CBRN respirator filters continue to rely on activated charcoal to either absorb agents or employ attached compounds to neutralize or react with dangerous toxins, most advancements in respirators come with improved wearability, reduction of the physiological burden, and extending the time respirators can be used.

Ken Bobetich, Mine Safety Appliances Company's product group manager for air purifying filters, says that MSA's new contract with the U.S. Air Force for the Firehawk SCBA (self-contained breathing apparatus) brings the Air Force a new level of protection and performance. When the user does not want to depend on the air-purifying device, at the flip of a switch, the respirator changes from an air filtering system to a powered respirator.

Bobetich said that MSA, the first company to receive CBRN approval for a SCBA respirator, talked with and listened to users and responded to their needs for a number of scenarios in their latest Firehawk design phase. Those included situations where the first-responder could use the purifying respirator while getting to a site and then, rather than change to another respirator, throw a switch to a powered respirator and use that air during the time spent in the most hazardous area.

"Changes in design have come from listening to users' specifications," explained Bobetich. "We make changes and then take the device back to the users for their input."

Global Secure Safety Corporation's new FR3 powered air purifying respirator has new features over its now replaced FR2. According to the company's vice president for development, Jack Sawicki, the FR3 is a NIOSH-approved, powered air purifying CBRN hooded respirator that runs off of six D-cell alkaline batteries, an improvement over using rechargeable batteries that might take a long time to recharge. It has three canisters that meet both DoD and civilian requirements.

"It's a lightweight, comfortable one-size-fits-all system," explained Sawicki. "It was designed for law enforcement, HAZAMT teams, fire departments and industrial users."

The FR3, said Sawicki, has a unique hood design that uses ratchet headgear to maintain the hood's shape during long-term storage. "It ensures that the equipment is always ready and in good working condition," he said.

The company also sells the CF60 that is not a full hood and uses a HEPA filter for less dangerous situations.

Non-powered respirators continue to be in high demand. MSA also makes the Advantage 1000 gas mask, developed for the military with a dual-mount canister allowing weapon sighting from either shoulder, and the Advantage 1000 full-face respirator with a wrap-around flexible lens and a speaking diaphragm for short-range communication.

Another of Avon's non-powered respirators is the FM-12, available in three sizes, says Bevans, and has been designed to provide less inhalation resistance and reduced CO<sub>2</sub> retention to minimize the physiological burden on the wearer. Twin canister mountings allow the filter to be fitted on either the left or right side of the face piece. Eyepieces are recessed and can be tinted. Included is a high-flow drinking system that can be connected via tubes to a standard military canteen through a special cap. The FM-12 also includes an amplifying speech module. Avon has also introduced the C50, a civilian version of the JSGPM that incorporates most all of the features found in the JSGPM including its unique polyurethane lens.

### **Protective Suits**

Besides respiratory protection, full protection from exposure to CBRN agents requires encapsulating suits, gloves, boots and hoods.

Remploy, a United Kingdom company that has been making protective gear for 30 years, supplies protective suits to every police department in the U.K. and their new top-of-the-line suit, the CR1, will be available in the U.S. starting in April, 2006. According to George Speary, Remploy's director in the U.S., the company's R&D people listen to the needs of warfighters and first-responders and used their input to assess new materials. For example, their already available Mark IV CBRN Frontliner, a hooded trouser combination manufactured for over 15 years and originally designed and endorsed by the U.K.'s Ministry of Defence. To be both protective on the outside and wick away perspiration from the inside layer, it is comprised of three layers.

"The first layer is made of thousands of wax pellets that melt when they heat up and become impermeable, the middle layer stops the nasties, and the inner layer is activated reinforced carbon that is laminated to protect but also allows perspiration to migrate," said Speary, who added that W.L. Gore (Goretex) and DuPont furnish much of the materials they use to make their ensembles. "Our goal is to lessen the physiological burden and strain."

Finally, Avon produces the EH20 escape hood, designed to be immediately accessible in a CBRN environment. "It's compact," said Bevens. "It can fit in a pocket or a desk drawer, it opens in less than thirty seconds and provides at least 20 minutes of protection." ♦

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