



# *Eye and Hearing* **Protection**

**SOLDIERS' SENSES ARE SAFEGUARDED BY NEW-GENERATION TECHNOLOGIES.**

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Even in the 21st century, the human senses of sight and hearing can mean the difference between another U.S. casualty statistic or an American soldier prevailing over the enemy in combat. Warfighters thus are indebted to industry innovators who have devised a broad array of advanced-technology systems to protect combatants' eyesight and hearing.

We examine the panoply of these vital systems, beginning with hearing protection.

## **HEARING PROTECTION**

Vendors are intensely involved in protecting soldiers from hearing loss. For example, TEA's biggest customer is SOCOM. "They have been using hearing protection regularly for 10 years," said Director of Business Development Steve Tucidowski. "But the products are starting to attract attention in the green Army, too."

The challenge is maintaining situational awareness with hearing protection. TEA does that electronically. Its battery-powered earmuff or in-ear devices compress sounds over 85 decibels, so soldiers can have face-to-face conversations even with weapons firing.

Hearing loss begins when soldiers are exposed to more than 85 decibels on average during an eight-hour period. Firing weapons can yield 140 to 160 decibels. And there can be constant noise over 105 decibels in helicopters or armored vehicles. TEA's high-threat headset reduces noise by 19 decibels, offering significant protection against sharp, instantaneous sound peaks.

TEA now makes a digital-ear system for in-ear protection, which maintains situational awareness and allows soldiers to communicate with better signals provided by digital techniques.

The other challenge is maintaining radio or other electronic communications. TEA's in-ear devices use bone-conduction microphones so that speech is transmitted up from the jawbone to the ear bones and out on radios or intercom.

Getting soldiers to use hearing protection can be challenging, due to discomfort, awkwardness or heat. Tucidowski argued TEA

equipment provides comfort and is not obtrusive while providing a high level of protection.

"The Invisio X5 provides one of the most comfortable fits," said Nick Lafferty, TEA director of marketing and training. "One of the biggest distinctions between our product and other [hearing protection] products is we use a patented bone conduction technology," Lafferty explained. "We also have patented the comfort providers that keep the bud in the ear," he continued. "We call that Soft Spring."

Aside from blocking unwanted and harmful loud noises, TEA hearing protection systems also are distinguished by permitting warfighters to hear sounds that are critical to situational awareness, Lafferty said.

"Another big thing is the situational awareness," he said, providing "combat situational awareness with pinpoint accuracy" to tell a warfighter such as a special operator precisely where enemy gunfire is originating.

For comfort, he added, "we offer a fully customized ear piece," the X6 custom-molded version of the ear bud that conforms to the precise shape of the warfighter's ear canal.

Bose emphasizes new technologies and a balanced approach to protecting headset wearers in noise-filled environments. Bose uses a combination of passive and active noise reduction to reduce damaging sound pressure at the ear. In active reduction, advanced electronic circuitry monitors sound at the ear, identifies unwanted noise and creates an out-of-phase signal to reduce noise.

Bose's latest military products include the TriPort Tactical Headset Series II. The Triport is primarily used in wheeled tactical vehicles, where soldiers experience noisy operations but critical communications must take place. Bose headsets are used in every branch of the U.S. armed services and by many foreign militaries. They are in M1A1 Abrams tanks, Strykers and mine resistant ambush protected vehicles.

In January 2011, Silynx Communications launched the 20-meter immersible Micro C4OPS tactical communication

headset with hearing protection and enhancement. The new model is a miniaturized and enhanced version of Silynx's C4OPS. "It's the only 20 mm immersible system on the market," stressed CEO Gil Limonchik.

The Micro C4OPS is modular and interchangeable with headset configurations including in-ear, covert, maritime and earmuff headsets. The basic configuration is two in-ear buds. For covert missions, the system can be concealed under a shirt with a wireless ear piece. The maritime headset allows soldiers to go down to 20 meters underwater while maintaining functioning communication.

"It has enhanced noise compression algorithms with active noise reduction," Limonchik explained. There is an automatic leak test that ensures ear buds are sealed correctly. "That is unique," he noted.

The Micro C4OPS can handle radio communication, data or GPS. It can change channels with voice prompts, selecting channels with pre-assigned frequencies. "It has an automatic whisper mode," Limonchik said.

Another Silynx innovation is the C4OPS Hybrid Headset, designed for loud and clear communications in extreme noise environments such as helicopters. A quick-disconnect on the collar clip allows connection of a noise-canceling boom microphone. This microphone can be easily removed with automatic switchover to the in-ear microphone. Another version mounts the boom microphone on a headband worn alone or under a helmet.

Silynx has released C4Grip, a two-meter immersible smart forward grip for assault rifles. A standard KM2 flashlight head can mount in front of the C4Grip, reducing weight by eliminating the need for a weapon-mounted flashlight and reducing cable clutter. The C4Grip wirelessly controls tactical radios and activates flashlight and laser aiming devices. "You control all of these without taking your hands off the weapon," Limonchik explained.

The basic C4OPS system has been adopted by U.S. special operations forces, top NATO forces, the FBI and by Army, Navy and Air Force units. Limonchik emphasized that Silynx equipment has been adopted at command levels, not sporadically by small units.

Brian Burns, who leads business development government programs at Nacre, described the company's QuietPro family as in-ear digital hearing systems that protect against the entire spectrum of impulse and continuous noise while enabling tactical communications on handheld radios or vehicle intercoms, giving users complete enhanced situational awareness. "It is automatic and adaptive," Burns said. "There is no need to turn it on to check on background noise. It can raise ambient sounds up to five times to enhance situational awareness," he said.

With patented digital signal-processing, QuietPro checks for tight seal of foam ear-tips so hearing is protected and in-ear microphones can communicate clearly on radios. Digital technology samples for dangerous noise 16,000 times per second and processes sound in less than one millisecond, providing superb protection and avoiding delays when talking face to face. Faster processing catches high-frequency impulse noises, for example from explosions, before they do damage. "We are faster than anyone else," Burns emphasized.

Low-frequency continuous noise is also dangerous, resonating through bone and flesh. QuietPro uses digital adaptive active noise reduction with compensating white noise waves for this threat.

Nacre's new QuietPro QP400 for the military has additional features, adapts to a wide range of communications and can

maintain simultaneous connections with up to four personal or mounted radios.

The QuietPro family has been approved for the Army's Tactical Communication and Protection System. Some 45,000 QuietPros have been sold to the Marines and 60,000 have been sold worldwide.

Threat4 CEO Patrick Armstrong said protecting hearing while preserving fighting capability presents tough problems. "You can issue ear plugs, but soldiers won't wear them, because they need to hear the environment," Armstrong said. Traditional radio headsets give audio reception, but do not allow for face-to-face communication and give no clue to direction of sounds. In-ear buds give better hearing protection but still do not localize sounds. "Hearing protection is easy, and using the radio is easy. It is harder to preserve natural hearing," he observed.

Threat4 hired an audiologist from the hearing-aid industry to develop algorithms that reproduce the human ear through digital signals. "We merged hearing-aid technology with hearing protection," he continued. "It is unique because it returns almost-human ear performance even though the soldier is fully protected."

Threat4's new x-62000 in-ear digital headset with boom microphone is certified for 32dB to 39dB noise protection, yet yields true 360-degree situational awareness and sound localization. It works out of the box and requires no programming of software. All electronics are mounted in the headset, so it requires no separate control box. It draws parasitic power from radios.

X-62000's digital technology avoids nausea that afflicts many soldiers using older noise-reduction technologies. It handles the entire human spectrum of sound frequencies. The National Tactical Officers Association rated the x-62000 4.8 out of a possible 5.

Armstrong said that the new-generation device is also the most affordable of comparable equipment, adding, "We are the best and the cheapest."

Lieutenant Colonel Jose Capo-Aponte, research optometrist and chief, visual sciences branch of U.S. Army Aeromedical Research Laboratory (USAARL), said eye protection is widely used in the services now. "The major problem is that the eye protection, no matter how good, is always behind the threat," he cautioned. "The threat just keeps getting worse."

Battlefield ocular traumas are now about 13 percent of non-lethal battlefield injuries and this portion is increasing, even though eye protection is worn 95 percent of the time outside the wire. Partly, this high percentage reflects better armor and medical care for other injuries. But Capo-Aponte argued that eye protection must continue to improve.

Current issues are protecting eyes from both primary blasts and secondary, tertiary and quaternary blast effects such as energized debris and shrapnel, flash burns and other blunt and penetrating traumas.

One need is new materials that can provide stronger resistance to shattering without disrupting vision. This requires optimal transparency and elimination of distortion and prismatic effects even when the material is shaped to increase protection. "Wrap-around shapes using current materials tend to create distortion or prismatic effects that hinder visual performance," Capo-Aponte noted.

Another challenge is developing lenses that can rapidly change between dark-tinted to clear. "By rapid, we mean a change in the lens optical density in just a second or so," Capo-Aponte said.

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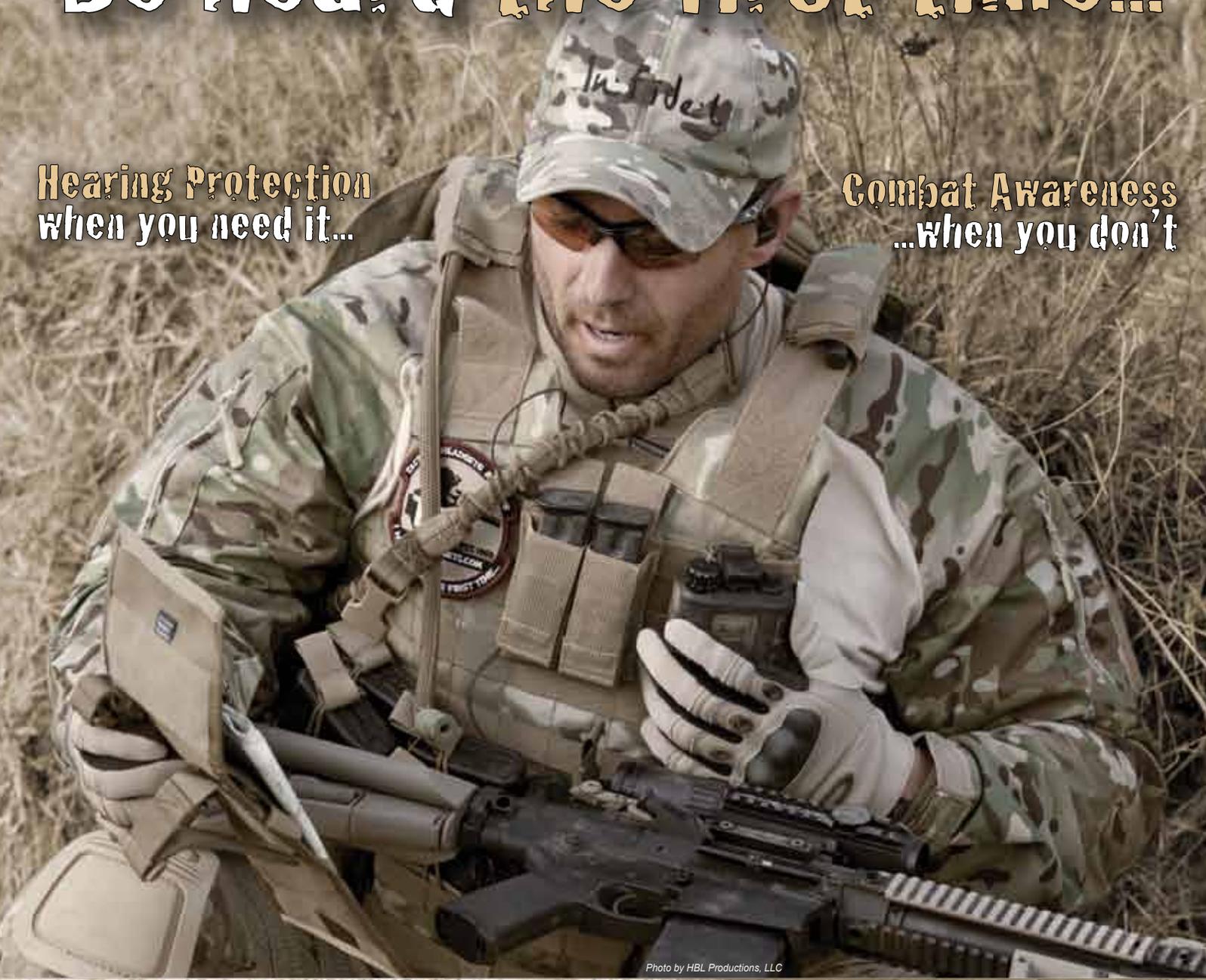


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Current materials and technology do not provide a rapid change in optical density, from sunglasses to completely transparent and back again. "They are slow and the dynamic range is narrow," he observed.

Another issue is that eyewear shape must interface effectively with equipment and protect eyes without affecting the protection of other combat systems, particularly hearing-protection devices.

USAARL is evaluating effects of blasts on ocular structures and current military eyewear. It is also developing ophthalmic standards to optimize design and compatibility of eyewear with other protective systems to guide developers of protective equipment.

Heavyglare offers many brands and styles of shatter-resistant eye protection gear to the military, and provides stronger prescriptions than some laboratories, Heavyglare CEO Grant Lambert said. Safety and protection for warfighters are paramount. Whichever eyewear gear is chosen, "normally it has a polycarbonate shatter-resistant lens in it, and it will [meet] the different military and OSHA safety standards for shatter-resistance," Lambert said in an interview.

Heavyglare distinguishes itself in its prescription capabilities, he added. "We are able to do the prescriptions, and we're able to do them at much greater powers than you're able to get at a standard lab," Lambert said. "If someone is carrying a weapon, it's pretty important for them to be able to see what they're shooting at," he noted.

The company is able to provide eyewear for large numbers of warfighters, fast. "We've had some good success in making prescription eyewear for the military," Lambert recalled. "We've done it for quite a few years. We were contacted by the 82nd Airborne, and they needed 4,000 pairs of prescription goggles. We had supplied them with that. They needed that in 30 days, so we supplied them with some clear [and] smoked lenses for them in the Wiley X [goggle model] SG-1s."

Heavyglare offers an immense array of protective eyewear from many manufacturers, affording a wide choice to warfighters. While some are tried-and-true favorites, others are newer offerings.

"Numa Point is a new product that just came to market a couple of years ago," he related. "I'm going to be putting that on our GSA schedule as well." And there are other new offerings. "One of the newest products that we've just started selling is an eyewear line called Body Specs, and we've just added them to our GSA schedule—the GSA schedule to sell directly to the military, state, federal and local governments as well," Lambert reported.

Heavyglare eyewear is designed for the realities that warfighters face in theater. "Some of the more popular ones have a foam insert that you can snap in and out of the product, to help with dirt and debris that you'll get with desert conditions," he observed. "A lot of them will come with a safety strap to keep them on your head, and a carrying case so when you're not wearing them, they'll be protected and not get scratched up when they're not in use."

The eyewear that the company offers is popular throughout the military services, Lambert said. "We do sell to all branches of the government, the Marine Corps, the Coast Guard, they all do purchase from us," he continued. "We also carry a product called Revision, which is a newer product as well, which offers some of the same properties as the Wiley X or Body Specs products, with milspec standards and safety standards."

The eye gear that Heavyglare offers is available to military units through the General Services Administration. "Contracts go for five years, so we're in our second year of a GSA contract," he explained.

ESS makes authorized protective eyewear for soldiers. Communications Specialist Ari Drougas noted these include the Crossbow eye-shield, an interchangeable one-lens shield system, and the Profile Night Vision Goggle. "We were the first company with a low-profile NVG that fits in the helmet," he said. The Crossbow was the most widely used model in the Army in 2011 and the only eye-shield used by Marines. It is fitted with anti-microbial foam.

ESS has added military sunglasses that provide the same impact protection as the Crossbow. "Soldiers can use sunglasses when not in combat because they look better but provide the same level of protection," Drougas said.

The military sets specifications for both eye-shields and goggles, the most important of which are impact standards. "They specify a projectile and speed, and we must prove the lens will not be compromised," Drougas said. There are also optical standards to ensure clarity and freedom from distortion. After these two requirements are met, services seek comfort and the ability to integrate with other gear soldiers must wear.

Drougas argued that Crossbow is the only true anti-fog spectacle. "Others used mixed solutions," he said. "We spray inside for fog and outside for scratch protection." The highest level of anti-fog protection is provided by goggles with fans, which ESS provides in its Turbofan series. But these models tend to be used by elite forces, not rank-and-file soldiers.

Drougas sees soldiers moving toward spectacles and away from goggles. Although goggles afford more protection around the edges of eyes, they are uncomfortable and may interfere with peripheral vision.

ESS has developed a new frame for the Crossbow designed to fit with hearing protection and communication equipment. "It is virtually undetectable with a padded seal," Drougas noted. The aim is to eliminate pain or headaches when eye and hearing protection are worn together.

Revision Military's entire line of military eye protection is designed to protect and perform on the battlefield, stressed Dan Packard, senior vice president sales for Revision Military.

"The Sawfly Spectacle is ideal for everyday wear and designed to be extremely comfortable for long hours in the field," Packard said. "It features ultra-thin, adjustable arms for optimal use with hearing protection and communications equipment. Over-molded temples and a soft-grip nose-pad ensure comfort and a stay-put fit."

Sawfly exceeds U.S. military ballistic impact requirements for spectacles. "Precision manufactured interchangeable lenses ensure distortion-free vision, full side-impact protection and anti-fog performance," Packard said. "Anti-scratch lenses resist a wide range of chemicals. Lean, extendable arms guarantee comfort, while thinness ensures hearing protection and headsets work as designed."

Revision's Desert Locust Goggle provides additional protection against hazards such as sunlight, wind, dust and flying debris. "The Desert Locust provides the widest field-of-view in its class along with high performance anti-fog protection," Packard said. "Its no-foam frame gasket ensures a comfortable fit and maintains a hygienic, easy-to-clean facial seal."

Desert Locust also exceeds ballistic impact requirements for goggles and ensures distortion-free vision. A low profile ensures compatibility with helmet, binoculars and NVGs, while full-frame ventilation and coated lenses prevent fogging. Its pliable frame seals comfortably to the soldier's face.

"Both systems provide excellent interoperability with NVGs, weapons optics and thermal-imaging equipment," Packard noted. "They are both on the U.S. Army Authorized Protective Eyewear List and made 100 percent in the United States."

The Sawfly Spectacle and Desert Locust Goggle also block harmful ultraviolet rays. "Importantly, each system can be outfitted with laser protective lenses to protect against a broad range of battlefield threats," Packard said.

Revision has a new Exoshield Extreme Low-profile Eyewear System, a single lens system that seals close to the face for excellent interoperability with NVGs, optics and thermal imaging. Packard said it is ideal for high-speed mobility, dynamic environments and a broad spectrum of operational needs.

Also new is Revision's Batlskin Modular Head Protection System, which protects against ballistic, blast and blunt-force trauma. "The Batlskin System comprises an all-new ballistic helmet shell, trauma liner, front mount, retention system, mandible guard and visor," Packard said. "It uniquely addresses the soldier's need for a single, integrated head protection system that's scalable and adaptable." Batlskin enables soldiers to transform helmets from a standard shell in low-threat environments to a helmet and visor configuration for peacekeeping or a complete helmet, visor and mandible guard system for full-scale combat.

ArmorSource makes helmets for all levels of protection, from the lowest to the highest, according to President Yoav Kapah. It has also made face and eye protection for bomb-disposal units. Depending on the level of protection, this explosive shield adds three to five pounds to helmet weight.

The company has been working with Eye Tactical to provide lightweight protection for eyes and faces against fragmentation and ballistic penetration, integrated with helmets. "This will give the full face protection," Kapah emphasized.

The composite Lightweight Level IIIA Mask Protection has a 3.4 mm high optical lens. A ballistic pad snaps onto the mask frame for protection, while the assembly weighs only 1.4 to 1.6 pounds. "We have worked hard to reduce weight because weight on the head is much harder to carry than the same weight on the body," Kapah said.

The mask fits small, medium, large and extra-large Kevlar helmets. An NVG mount mask is pre-notched to accommodate standard NVG mounts. It was developed for combat gunners or other mounted soldiers to offer additional protection against fragmentation and secondary debris caused by IEDs.

"It's a great breakthrough," Kapah emphasized. The new model is being supplied to NATO forces and to the U.S. State Department, and Kapah seeks to supply the U.S. Army as well. ★

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