



**Homeland  
Security**

Science and Technology

# Summary

U.S. Department of Homeland Security



System Assessment and Validation for Emergency Responders

The U.S. Department of Homeland Security (DHS) established the System Assessment and Validation for Emergency Responders (SAVER) Program to assist emergency responders making procurement decisions.

Located within the Science and Technology Directorate (S&T) of DHS, the SAVER Program conducts objective operational tests on commercial equipment and systems and provides those results along with other relevant equipment information to the emergency response community in an operationally useful form. SAVER provides information on equipment that falls within the categories listed in the DHS Authorized Equipment List (AEL).

The SAVER Program is supported by a network of technical agents who perform assessment and validation activities. Further, SAVER focuses primarily on two main questions for the emergency responder community: "What equipment is available?" and "How does it perform?"

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## Eye Protection (Tactical Goggles)

*In order to provide emergency responders with information on currently available eye protection technologies, capabilities, and limitations, Science Applications International Corporation (SAIC) conducted a comparative assessment of tactical goggles in April 2008. Detailed findings are provided in the Assessment Report on Eye Protection (Tactical Goggles), which is available by request at <https://www.rkb.us/saver>.*

### Background

Emergency responders use eye protection to prevent injury during operations, such as vehicle extraction, crowd control operations, and responses to natural disasters. Eye protection comes in various types depending upon the threat that is to be reduced. Tactical goggles are one form of protective eyewear that encloses or protects the eye area in order to prevent particulates, infectious fluids, or chemicals from striking the eyes.

### Assessment

Prior to the assessment, SAIC conducted a market survey to investigate currently available eye protection. The primary objective of the market survey was to provide an overview of available equipment to emergency responders. A focus group consisting of eight emergency response personnel from different jurisdictions met in December 2007, to identify equipment selection criteria for the assessment, determine assessment criteria, and recommend assessment scenarios.

The focus group discussed comfort, anti-fogging capabilities, durability, and the level of protection that responder eyewear should possess. The group concurred that an assessment on tactical goggles that meet American National Standards Institute (ANSI) Z87.1 standards used by firefighters, medical personnel, and law enforcement would produce the most beneficial information to the responder community. Based on focus group recommendations (including whether or not the goggles met these selection criteria) and market survey research, the following tactical goggles were assessed:

- Eye Safety Systems (ESS) Advancer V-12
- ESS Profile Turbofan
- Wiley® X SG-1
- Wiley X Spear
- Bouton 450 Fire Goggles.

Eight emergency response practitioners served as assessment evaluators. Each set of tactical goggles was used in simulated law enforcement, firefighting, and search and rescue scenarios. Evaluators conducted five rotations, and each rotation consisted of six stations: (1) vehicle rescue, (2) sealing an activated sprinkler head, (3) woodland search, (4) train search/rescue, (5) door entry, and (6) maze/burn building.



**Station 1: Vehicle rescue**

The assessment environment and activities performed were replicable should there be a need to repeat an identical or similar assessment in the future. The activities performed in this

assessment were consistent with operational objectives that exist in emergency response situations.

### Assessment Results

Evaluators rated the tactical goggles based on the evaluation criteria established by the eye protection focus group. Each criterion was prioritized within the five SAVER categories and assigned a weighting factor based on a 100-point scale. The SAVER category and composite scores are shown in table 1. Higher scores indicate better performance. To view how each set of goggles scored against each of the evaluation criteria assigned to the SAVER Program Categories, see table 2.

The following paragraphs provide a brief summary of the evaluator comments and feedback on each tactical goggles set used during the assessment. The tactical goggle models are listed by highest to lowest composite scores. The full report includes a more thorough review of evaluator comments by category and individual criterion.

### SAVER Program Category Definitions

**Affordability:** This category groups criteria related to life-cycle costs of a piece of equipment or system.

**Capability:** This category groups criteria related to the power, capacity, or features available for a piece of equipment or system to perform or assist the responder in performing one or more responder-relevant tasks.

**Deployability:** This category groups criteria related to the movement, installation, or implementation of a piece of equipment or system by responders at the site of its intended use.

**Maintainability:** This category groups criteria related to the maintenance and restoration of a piece of equipment or system to operational conditions by responders.

**Usability:** This category groups criteria related to the quality of the responders' experience with the operational employment of a piece of equipment or system. This includes the relative ease of use, efficiency, and overall satisfaction of the responders with the equipment or system.

### Advancer V-12

The Advancer V-12 goggles tied for the highest composite score and received the highest evaluator rating in the usability category. The goggles are compatible for use across various disciplines and are available with clear, prescription, and smoke-colored interchangeable lenses. These goggles are described by their manufacturer as compatible with night vision systems. They provide 100 percent Ultraviolet A (UVA)/Ultraviolet B (UVB) protection, are ANSI Z87.1-2003 compliant, and have been U.S.

**Table 1. Eye Protection (Tactical Goggles) Assessment Results<sup>1</sup>**

Tactical Goggles	Composite Score	Affordability (20% Weighting)	Capability (35% Weighting)	Deployability (10% Weighting)	Maintainability (10% Weighting)	Usability (25% Weighting)
Advancer V-12	77	72	81	72	73	81
Profile Turbofan	77	66	82	77	76	80
SG-1	75	73	83	76	66	68
Spears	70	66	76	74	58	69
450 Fire	61	57	71	68	57	51

Note:

<sup>1</sup> Scores contained in the assessment report may be displayed differently. For the purposes of the SAVER Summary, all SAVER category scores are normalized using a 100-point scale and rounded to the nearest whole number.

	 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Carrying case (firefighters)</li> <li>• Adjustable strap</li> <li>• Ventilation</li> <li>• Compatibility with helmets</li> <li>• Secure fit</li> <li>• Night vision compatibility</li> <li>• Good value for price</li> <li>• Prescription lenses compatibility</li> <li>• Scratch resistance</li> <li>• Ballistic protection</li> <li>• Speed sleeve</li> </ul>
	 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Lens change out</li> <li>• Carrying case clip</li> <li>• Carrying case size</li> <li>• Foam inserts (e.g., water leakage)</li> </ul>
<b>Advancer V-12</b>		<b>Composite Assessment Score: 77</b>

military .22 caliber impact tested. The Advancer V-12 goggles are compatible with many helmets used by emergency responders and they work particularly well with helmets used by fire service personnel.

The frame design of the goggles allows for a secure and snug fit. The goggles can be easily adjusted to prevent movement while performing tasks, and the head strap can be easily adjusted. The Advancer V-12 lenses have a scratch-resistant coating, and during the woodland search scenario, tree limbs did not damage the lenses.

The carrying case for these tactical goggles can be easily attached to structural fire fighting personal protective equipment (PPE) for transport. The size and construction of the carrying case is sufficient when transporting but cumbersome when stored in a pocket or while performing tasks. Evaluators reported that the quality of the Advancer V-12 goggles justifies its cost. The Advancer V-12 includes a 1-year limited warranty, and repair components are readily available through vendor supply channels.

The Advancer V-12 lenses are coated to prevent fogging and the goggles have an adjustable ventilation system designed to increase the flow of air. Some fogging was experienced during assessment operations; however, the field of view was not obstructed or diminished by fog or condensation. Evaluators suggested that the built-in adjustable vents remain closed until ventilation is needed, this may provide additional protection from dust and debris.

Disadvantages include that while the frame design is secure, it may become uncomfortable after extended

wear due to the tight fit around the eye socket area. The cloth protective sleeve was a hindrance while adjusting the goggles. The lenses and frame seem sturdy but the small clip and strap do not appear durable enough to withstand long-term use. Evaluators also noted that the lenses were initially difficult to change. Users would require some additional practice to become proficient in performing the task.

Some of the evaluators noted that the goggles may be considered too expensive for their individual jurisdictions.

### Profile Turbofan

The Profile Turbofan tactical goggles tied for the highest composite score and received the highest evaluator ratings in the maintainability and deployability categories. The goggles are designed to protect against flying debris and should adequately protect against splash hazards as long as there is not heavy saturation. These goggles have clear and tinted lenses that can be used for indoor and outdoor operations by various response disciplines. Prescription corrective lenses are available for purchase. The goggles are ANSI Z87.1-2003 compliant, .22 caliber ballistic rated, and provide 100 percent UVA/UVB protection. The manufacturer states that the Profile Turbofan is compatible with night vision systems. These goggles have a built-in, battery-powered, fan system that prevents fogging during use and are dual thermal to perform effectively in extreme cold temperatures.

Customer support is available to assist with replacement parts and other issues. The goggles must

	 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Speed sleeve (storage)</li> <li>• Ventilation</li> <li>• Lens change out</li> <li>• Replacement parts</li> <li>• Night vision compatibility</li> <li>• Fog resistance</li> </ul>
	 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Speed sleeve (during use)</li> <li>• Battery compartment</li> <li>• Incompatibility with rescue helmet</li> <li>• Incompatibility with ballistic helmet</li> <li>• Strap adjustment</li> <li>• Fan system</li> <li>• Price</li> </ul>
<b>Profile Turbofan</b>		<b>Composite Assessment Score: 77</b>

be returned to the manufacturer to determine if the manufacturer will replace the product when it is broken. The Profile Turbofan provides adequate fog resistance so that the user's view is not obstructed or degraded. Evaluators did not experience any fogging issues during the assessment rotations.

The Profile Turbofan lenses, strap, and frame seem durable enough to withstand prolonged use by responders in the field and the goggles have a scratch-resistant coating to protect the lenses, effectively filter sunlight, and provide optical clarity. Evaluators did not experience any vision distortion or issues with glare during use. They reported that the horizontal view is clear, but visibility is limited when viewing downward as the lower edge of the field of vision becomes distorted.

There are some adjustability issues with the Profile Turbofan. The goggles had to be readjusted several times due to the pressure applied to their cheekbones during wear, and the design would not allow the goggles to fit well or adjust securely to smaller faces. The foam insert around the face provides a comfortable fit, but may become hot or cause discomfort during use. The battery pack may become uncomfortable to the wearer due to its size, weight, and location.



**Station 5: Door Entry**

The initial price of the Profile Turbofan goggles is expensive and may be too expensive to be purchased by small jurisdictions. In addition, the lenses are the only repairable component of the

goggles. Not enough data were available to conduct a cost-benefit analysis pertaining to repairing or replacing the goggles.

The Profile Turbofan can be easily carried when in the case, but the battery pack makes it difficult to carry the goggles without the case. The carrying case can be easily attached to gear while not being worn. Although the carrying case provides adequate space for the goggles, it is hard to fit the goggles and the extra lenses into the case.

### SG-1

The SG-1 tactical goggles received the second highest composite score and scored highest in the affordability and capability categories. The goggles are compatible

with fire, rescue, and law enforcement helmets and are designed to protect the user from dust and other flying projectiles. They provide 100 percent UVA/UVB protection; are heat-resistant, ANSI Z87.1-2003 compliant, and U.S.-MIL-PRF 31013 ballistic impact safe; and are compatible with night vision systems. Evaluators also stated that the goggles are aesthetically pleasing with all responder gear.



**Station 2: Sealing an activated sprinkler head**

The SG-1 goggles are supplied with clear and tinted lenses, and corrective lenses are available from the manufacturer. The goggles' low profile provides a snug fit and the straps can be easily adjusted, which minimizes discomfort to the eye area. The SG-1 carrying case is great for storage and provides sufficient room for the goggles and extra lenses.

Repair components for the SG-1 are readily available through the manufacturer. An address, phone number, and Web site address are available for customer support, and customer service information is provided on the package of the product.

When the goggles were dry, field of view and peripheral vision were adequate. The lenses are

 <b>Pros</b>	 <ul style="list-style-type: none"> <li>• Strap adjustment</li> <li>• Size/profile</li> <li>• Weight</li> <li>• Lens changeout</li> <li>• Helmet compatibility</li> <li>• Ease of movement</li> <li>• Maintains position on face</li> <li>• Comfort/fit</li> <li>• Good value for price</li> <li>• Replacement parts</li> <li>• 1-year warranty</li> <li>• High level of ballistic protection</li> <li>• Corrective lenses available</li> <li>• Night vision compatibility</li> </ul>
	 <b>Cons</b> <ul style="list-style-type: none"> <li>• Fogging</li> <li>• Condensation</li> <li>• Tightness around eyes</li> <li>• Pressure around eye sockets</li> <li>• Carrying case clip</li> <li>• Release button</li> <li>• Strap incompatibility with helmet</li> </ul>
<b>SG-1</b>	<b>Composite Assessment Score: 75</b>

designed with a Foil™ coating to prevent scratching and fogging; however, evaluators noted slight fogging, which resulted in obscured vision. The vents allow air movement within the goggles, but the small size of the vents impedes the amount of airflow and does not adequately prevent fogging. Because the vents may also allow water to enter the goggles, they may not provide adequate protection against splash hazards.

The protective case is slightly bulky but can be carried in the user’s pocket when not in use, and responders can also attach the carrying case to their duty gear for transporting.

Evaluators expressed a concern with the durability of the SG-1 goggles. The frame does not appear to be durable, and a clip on the arm broke when the evaluators were disconnecting the arm from the frame to install the strap assembly. The clip attachment design may not be conducive to prolonged use by emergency responders.

### **Spear**

The Spear tactical goggles received the third highest composite score. They are designed with ballistic lenses to protect the wearer from particles such as dust and flying debris, and also protect against small amounts of liquids and chemicals. The goggles provide 100 percent UVA/UVB protection, are ANSI Z87.1-2003–compliant, and are compatible with night vision systems. Evaluators stated that the goggles are designed with interchangeable clear and tinted lenses, which are designed with a T-shell and Foil coating to prevent fogging and scratching. Prescription lenses are available but must be fabricated by an optometrist. The Spear goggles are compatible with most firefighter and search and rescue helmets

but do not work well with ballistic helmets. The goggles would work well for general fire and rescue duties, but they may interfere with specialized law enforcement gear (e.g., scopes, cameras). The Spear carrying case features easy-to-use hook and pile latches for removing or storing the goggles. Repair components for the Spear goggles are available through the manufacturer, and a 1-year warranty is available for the goggles. The initial purchase price of the goggles also includes additional accessories. Adequate customer service information (i.e., phone number and Web site address) for the Spear goggles is available.

The frame, strap, and lenses appear durable enough to withstand long-term use by emergency responders. Evaluators described the splash protection as adequate; however, they noted that the foam rubber seal did not prevent water from getting inside the goggles, which caused fogging and distorted their vision. Under normal conditions, the built-in vents provided adequate fog resistance, while performing strenuous activities by allowing air movement within the goggles.

Evaluators expressed concerns regarding the fit, comfort, and visibility of these goggles. They stated that the lenses have too high of a profile and interfere with the front brim of a ballistic helmet. The goggles did not fit their faces securely and slid up on their noses during assessment tasks. In addition, the goggles become uncomfortable on the nose, forehead, and cheekbones after extended wear. Peripheral vision was poor, and the vertical field of vision was slightly limited. The protective speed sleeve was difficult to use and a hindrance during assessment tasks. The goggles are expensive and may preclude some smaller jurisdictions from purchasing this item.

### **450 Fire**

The 450 Fire tactical goggles received the lowest composite score. These goggles are used primarily by firefighters, and are non-vented and are designed to protect against gases, smoke, fluids, flying particles, and debris. The goggles are ANSI Z87.1-2003 and National Fire Protection Association (NFPA) 1971–compliant, provide 100 percent Ultraviolet (UV) protection, and feature .75-inch ballistic grade lenses. The manufacturer claims the 450 Fire goggles can withstand the NFPA, 500°F, 5-minute test and will not melt or retain flame. The lenses are coated with anti-fogging material and minimal fogging was reported during the rotations. The manufacturer

	 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Strap</li> <li>• Lens changeout</li> <li>• Anti-fogging</li> <li>• Peripheral field of vision</li> <li>• Replacement parts</li> <li>• Prescription lenses compatibility</li> <li>• Speed sleeve (storage)</li> </ul>
	 <b>Cons</b>	<ul style="list-style-type: none"> <li>• Water leakage</li> <li>• Vertical field of vision</li> <li>• Incompatibility with ballistic helmet</li> <li>• Comfort issues</li> <li>• No user guide</li> <li>• Speed sleeve (during use)</li> </ul>
<b>Spear</b>	<b>Composite Assessment Score: 70</b>	

	 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Price</li> <li>• Field of vision</li> <li>• Compatibility with fire helmet</li> <li>• Operating/storage temperatures</li> </ul>
	 <b>Cons</b>	<ul style="list-style-type: none"> <li>• No warranty</li> <li>• Strap/strap adjustment</li> <li>• Fit</li> <li>• Incompatibility with military and law enforcement helmet</li> <li>• No instruction manual</li> </ul>
<b>450 Fire</b>	<b>Composite Assessment Score: 61</b>	

complete the assessment tasks with the five tactical goggles, but each set performed differently.

An analysis of the evaluator comments and scores revealed these common observations concerning the assessed tactical goggles:

- Tactical goggles with easily adjustable straps provide additional comfort and allow users to adjust the goggles, as necessary, without having to remove them.
- A high value was placed on goggles that provide a comfortable fit. Improper fit can create unwanted tightness or pressure on the user’s nose bridge or eye sockets. It can also create discomfort while wearing goggles for extended amounts of time.
- Easily interchangeable lenses are preferred. Responders typically change lenses during response operations, so it is crucial that minimal time is spent changing out the lenses.
- Good optical clarity is critical. It is imperative that responders have clear peripheral vision, as well as minimal distortions or glare, while wearing tactical goggles.
- Compatibility with various types of PPE is preferred. Eye protection compatibility with head gear is essential to ensure comfort and fit.

provides a phone number, fax number, Web site address, and physical address for customer support. Evaluators stated that the goggles are affordable, but additional accessories are not available. They also noted that because the 450 Fire goggles are inexpensive, it would be more cost-effective to replace the goggles rather than to attempt to repair them.

The frame, strap, and lenses of the goggles appear to be made out of durable materials and should withstand long-term use. The goggles are effective with firefighting helmets, but are not compatible with most ballistic helmets.

The shape of the frame provides a snug fit, but the goggles placed pressure on the bridge of the nose and cheekbones during the assessment. The face piece is uncomfortable and irritated evaluators’ faces, leaving marks after the goggles were removed. In addition, the strap is difficult to adjust; evaluators had to remove the goggles to readjust the strap.

The 450 Fire goggles work well in darkened buildings, but interchangeable lenses are not provided for transition to outdoor operations. These goggles leaked when they encountered water during the sprinkler station and may not sufficiently protect against some splash hazards. The goggles provided an unobstructed view when dry, but the view was distorted when the goggles became wet or condensation occurred.

The manufacturer does not provide any warranty information.

## Conclusion

The purpose of this comparative assessment was to evaluate the effectiveness of selected tactical goggles used in various situations. The assessment was based on a scenario-driven exercise, which included common response tasks requiring the use of tactical goggles. Evaluators were able to successfully

## QuickLook Snapshot<sup>2</sup>



Notes:

<sup>2</sup> The SAVER QuickLook, available on the SAVER Web site, allows users to select the SAVER categories that are most important to their department and view results according to their specific needs.

<sup>3</sup> Scores contained in the assessment report may be displayed differently. For purposes of the QuickLook, all SAVER category scores are normalized using a 100-point scale.

All reports in this series as well as reports on other technologies are available by request at <https://www.rkb.us/saver>.

**Table 2. SAVER Category and Criteria Scores**

<b>KEY</b>						
Least Favorable		Most Favorable				
						
		<b>Advancer V-12</b>	<b>Profile Turbofan</b>	<b>SG-1</b>	<b>Spear</b>	<b>450 Fire</b>
<b>Assessment Criteria</b>						
<b>Affordability</b>						
Initial expenditure						
Repair vs. replace						
Warranty						
Accessories						
<b>Capability</b>						
Protection						
Fog resistance						
Durability						
Multiple applications						
Design						
Lens versatility						
<b>Deployability</b>						
Ease of employment						
Ease of transport						
<b>Maintainability</b>						
Cleaning requirements						
Decontamination						
Customer service						
Repairs						
Storage requirements						
<b>Usability</b>						
Fog resistance						
User friendliness						
Field of vision						
Appearance						
Equipment compatibility						