Homeland Security
Science and Technology

Summary

U.S. Department of Homeland Security
SAVER
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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High-Visibility Vests

In order to provide emergency responders with information on currently available high-visibility vest technologies, capabilities, and limitations, Science Applications International Corporation (SAIC) conducted a comparative assessment of high-visibility vests for the SAVER Program in March 2008. Detailed findings are provided in the Assessment Report on High-Visibility Vests*, which is available by request at https://www.rkb.us/saver.*

Background

High-visibility vests are personal protective equipment (PPE) used to illuminate and identify emergency responders. These vests aid in the prevention of accidents and avoidable deaths by allowing responders to be recognized at farther distances. They also enable responders to be seen at different locations (e.g., side of the road) during varying weather conditions and times of day.

Assessment

Prior to the assessment, SAIC conducted a market survey to investigate currently available high-visibility vests. Then, a focus group consisting of eight emergency responder personnel from various regions of the country met in November 2007 to identify equipment selection criteria, determine evaluation criteria, and recommend assessment scenarios.

The focus group was presented with manufacturer information on available high-visibility vests for possible assessment. Participants agreed that it would be beneficial to assess comparable Class 2 high-visibility vests. They discussed factors affecting the SAVER Program's equipment selection process and recommended high-visibility vest characteristics to be considered for the upcoming assessment. Features discussed included breakaway designs, various colors, fastening methods, and user-friendly attachments. Based on the focus group recommendations and market survey research, five high-visibility vests were assessed:

- GloWear™ Hi-Gloss Chevron
- Beacon Wear™ Premium High-Visibility Safety Vest With Power Pack
- GloWear Standard Breakaway
- Incident Command Visi-Cool Mesh Vest
- OccuLux® Deluxe Flame Retardant.

Eight emergency response subject matter experts (SME) were selected to serve as assessment evaluators. Each high-visibility vest was evaluated during simulated emergency response operations under daylight and nighttime conditions. There were five rotations conducted during the day, and evaluators were assigned a specific high-visibility vest for each rotation. An additional rotation was conducted to assess the vests reflective capabilities at night. There were four assessment stations within each rotation, with the

exception of the night rotation. The visibility station was the only station used during the night rotation.

The activities performed in this assessment were consistent with activities that could be performed by emergency responders during a major hurricane. Each high-visibility vest was evaluated in the same manner, and operational conditions were controlled to make the evaluation of each vest as similar as possible. Following each rotation, evaluators completed a worksheet to capture their insights on that particular high-visibility vest. These comments have been included in the full assessment report.

Assessment Results

Evaluators rated the vests based on the evaluation criteria established by the high-visibility vests focus group. Each criterion was prioritized within the five SAVER categories (affordability, capability, deployability, maintainability, and usability) 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 high-visibility vest scored within the specific evaluation criteria assigned to the SAVER Program categories, see table 2 (on page 7).

The following sections provide a brief summary of evaluator comments and feedback on each high-visibility vest used during the assessment. The sections present the vests from the highest to the 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.

Chevron

The Chevron vest received the highest composite score and the highest scores in the affordability and deployability categories. Although the vest does not offer adjustment capabilities, it is available in an assortment of sizes. Its mesh material does not restrict movement and appears durable enough to withstand multiple stresses. The Chevron is reasonably priced and includes a limited lifetime warranty.

Table 1. High-Visibility Vests Assessment Results[1]

High-Visibility Vest	Composite Score	Affordability (15% Weighting)	Capability (30% Weighting)	Deployability (10% Weighting)	Maintainability (5% Weighting)	Usability (40% Weighting)
Chevron	**74**	77	66	78	76	78
Beacon Wear	**74**	58	73	76	76	80
Breakaway	**70**	74	64	75	78	71
Visi-Cool	**70**	71	67	68	76	71
OccuLux	**68**	64	66	72	76	69

Note:

[1] 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.

Pros	Cons
• Best visibility during daytime • Comfortable material • Good ventilation • Good length • Reasonable price • Lifetime warranty	• No radio strap • Least preferred during nighttime operations

Chevron — **Composite Assessment Score: 74**

Chevron can be easily donned and doffed without assistance, and other operational equipment (e.g., helmets, duty rigs, and goggles) does not interfere with donning. In addition, the vest can be worn with PPE without diminishing visibility. Although the vest covers the user's duty belt, it allows sufficient access to the belt and the low-cut v-neck allows access to the user's uniform, which may hold additional equipment.

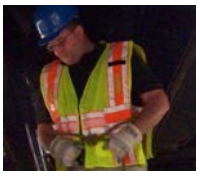
The Chevron vest color and reflective pattern were clearly visible from all angles at 100, 250, and 300 yards during daylight conditions. It remained visible during adverse weather conditions at all three distances, and it was also visible when contrasted with various backgrounds. Evaluators agreed that the Chevron appeared to have the greatest visibility of all the assessed vests during the daylight portion of the assessment.

Evaluators noted some disadvantages to the Chevron vest. It was the least preferred vest during the nighttime rotation; it provided minimal visibility at 100 yards during nighttime conditions, and its visibility gradually declined at greater distances. The reflective Chevron design provided increased visibility at 100 yards; however, reflectivity was limited at 250 and 300 yards. Finally, the Chevron does not include clips or loops to support communications equipment, and its interior pocket may be better suited for storing lightweight items.

Beacon Wear

The Beacon Wear vest received the highest scores in the capability and usability categories. It is available in a large range of sizes, and its adjustable straps enhance contour and fit. The vest material appears durable; it withstood numerous stresses throughout the assessment. This vest includes a storage bag and a 1-year warranty.

This vest can be easily donned, and multiple layers of clothing or PPE do not prohibit donning or degrade



Pros	Cons
• Best visibility during nighttime • Carrying case • Illumination devices • Sturdy strap • 1-year warranty • Adjustment capabilities for width and length • Good ventilation • Includes interior pocket • Professional appearance • Communications strap	• Cost • Essential accessories sold separately • Reduced visibility under adverse weather conditions

Beacon Wear — **Composite Assessment Score: 74**

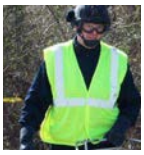
visibility. The vest design allows easy access to the user's duty belt, and the zipper provides accessible entry in the front of the vest. In addition, the vest includes an interior pocket, microphone strap, and six illuminating glow lights. No assistance is required when removing the vest.

The Beacon Wear was clearly visible from all angles during daytime operations at 100 and 250 yards, but was more difficult to distinguish at 300 yards. Evaluators noted a good contrast between the orange stripe and yellow background material; however, the reflective tape was visible only at the 100-yard distance during daylight conditions. The vest was distinctly visible at the first two distances during adverse weather conditions, but visibility was diminished at 300 yards. It performed very well at 100, 250, and 300 yards during nighttime conditions when using the battery-operated active lighting system.

Breakaway

The Breakaway vest received the highest score in the maintainability category. The vest is available in multiple sizes and the breakaway feature held up well during the assessment. Evaluators agreed that this vest is reasonably priced, and no additional accessories are required. The vest includes a limited lifetime warranty.

The Breakaway can be easily donned and worn over PPE without degrading the quality of the vest. The length of the vest allows users access to their duty belts, and the v-neck design allows easy access to equipment stored in pockets or on front panels of uniform shirts. This vest was clearly distinguishable



Pros

- Good length
- Breakaway feature
- Cost reflects quality
- Lifetime warranty
- Reasonably priced

Cons

- Quality of material
- Not adjustable
- No pockets, clips or attachments for equipment
- Background material not visible during nighttime operations

Breakaway — **Composite Assessment Score: 70**

at 100 yards during daylight and adverse weather conditions, and the vertical and horizontal stripes produced good reflectivity when light was directly focused on the vest.

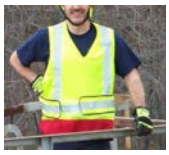
There were some disadvantages to the Breakaway vest. The background material was not visible during nighttime operations and visibility was extremely limited for this vest during adverse weather conditions presented during the night rotation. Also, the Breakaway does not offer adjustment capabilities and the background material does not appear durable. Evaluators stated the vest does not provide pockets, clips, or other attachments for equipment; therefore, a larger size may be required to accommodate additional equipment worn underneath the vest.

Visi-Cool

The Visi-Cool vest is available in several different sizes and its hook and loop strap provides adjustment capabilities. Evaluators agreed the Visi-Cool appears durable enough to withstand continual use under normal circumstances and that the vest is also affordable. Identification logos can be purchased separately as optional accessories.

This vest is longer than the other assessed vests, but it easily separated from either side to provide access to responder equipment. It provides a loop attachment to accommodate a radio or microphone, and its colored panels can assist during incident command situations. The vest can be easily doffed, and no assistance is required.

There were mixed responses regarding the visibility of the Visi-Cool during daylight conditions. Four of the evaluators stated the vest was clearly visible from all angles and easily identifiable at 100 yards, and the other four evaluators reported difficulty in distinguishing the vest at this distance. The Visi-Cool was highly visible under nighttime conditions at 100, 250, and 300 yards as long as there was direct lighting. The vertical and horizontal reflective tape on the vest provided good visibility, but the colored panel was not distinguishable during the nighttime rotation.



Pros

- Adjustment capabilities
- Colored band for identification
- Good ventilation
- Affordable

Cons

- Difficult over-the-head donning/doffing
- No pockets
- No warranty information
- Reduced nighttime visibility

Visi-Cool — **Composite Assessment Score: 70**

Disadvantages to this vest include diminished visibility at 250 and 300 yards. The colored panel was less distinct at increased distances and precipitation muted the brightness of the vest. Also, the poncho-style configuration of the Visi-Cool was difficult to don while wearing PPE such as helmets, creating potential delay in deploying the vest during emergency situations. It does not include pockets, and access to the user's front uniform pockets/equipment is restricted. Finally, no warranty information was found on this vest.

OccuLux

The OccuLux vest appears durable and can withstand continuous stresses and use. The manufacturer stipulates that the OccuLux has the same storage requirements as the other assessed high-visibility vests and includes a limited lifetime warranty. The vest is available in sizes small to 6XL.

This vest was easily donned while wearing multiple layers of clothing. PPE and other operational equipment do not prohibit donning and it offers an outside pocket for equipment storage. Evaluators reported that it was visible from all angles at 100 and 250 yards during daytime operations. This vest's vertical and horizontal reflective stripes allowed it to be identifiable under adverse weather conditions, and visibility of the vest was significantly improved when light was focused directly on it. As a result, evaluators agreed that the OccuLux appeared to be the brightest vest at 250 and 300 yards.

There were some disadvantages to the OccuLux vest. It was not very visible during the nighttime rotation at 100, 250, or 300 yards. Evaluators agreed that the color of the vest was not as conspicuous as the other

 	Pros	• Includes exterior pocket • Durable fabric • Professional appearance • Lifetime warranty
	Cons	• Too long (covers equipment) • Adjustment capabilities • Poor ventilation • No communication strap • Access restrictions due to front closure • Cost
OccuLux	**Composite Assessment Score: 68**	

vests, and the gray reflective tape blended in with the vest color. The brightness of the OccuLux color was slightly diminished under adverse weather conditions, and the gray color of the reflective tape seemed more subdued. The vest does not offer adjustment capabilities to enhance contour and fit, and it is more expensive than the other assessed vests. Also, the vest covers the user's duty belt and interferes with equipment access, and the high-cut neckline restricts access to equipment stored under the vest. Finally, evaluators noted that the vest does not include attachments for storing radios, cell phones, or other communications equipment.

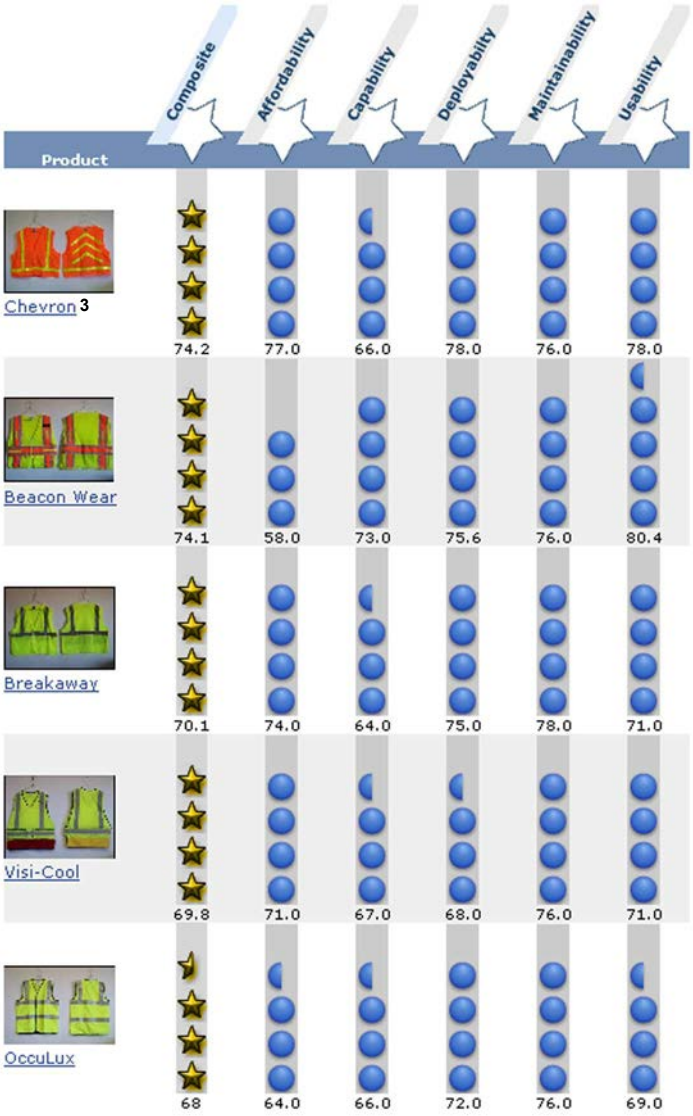
Conclusion

Although evaluator comments and equipment scores indicated that the four assessed high-visibility vests would increase visibility of responders during operations, it was agreed that some of the vests would be more effective than others. The vests used in this assessment helped achieve the overall goal of comparatively assessing high-visibility vests that can be used by emergency responders. The assessment was based on a scenario-driven exercise that included common response tasks necessitating the use of high-visibility vests. An analysis of evaluator comments and scores revealed these common observations concerning the assessed high-visibility vests:

- Evaluators expressed a strong preference for vests designed to permit maximum visibility of the wearer through the use of contrasting colors or illumination devices.
- Evaluators placed a significant value on high-visibility vests with attachment capabilities such as clips, straps, loops, and pockets.
- Evaluators preferred high-visibility vests that allowed them easy access to their equipment.
- Evaluators placed a high value on vests made of pliable materials.
- Evaluators expressed a strong preference for high-visibility vests that offer adjustment capabilities.
- Evaluators preferred lightweight vests that provide adequate ventilation while being worn.

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

QuickLook Snapshot[2]



Notes:

[2] 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.

[3] 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.

Table 2. SAVER Category and Criteria Scores

KEY Least Favorable → Most Favorable					
○ ◔ ◑ ◕ ●	Chevron	Beacon Wear	Breakaway	Visi-Cool	OccuLux
Assessment Criteria					
Affordability					
Initial cost	●	●	●	●	●
Replacement cost	●	◕	●	●	◕
Capability					
Characteristics	●	●	●	●	●
Equipment compatibility	◕	●	◕	◕	◕
Options/features	◑	◕	◑	◑	◑
Aesthetics	◕	◕	◕	●	◕
Deployability					
Ease of donning	●	●	●	●	●
Doffing/storage	●	●	●	●	●
Maintainability					
Routing cleaning	●	●	●	●	●
Repair	◕	◕	●	◕	◕
Decontamination	◕	◑	◕	◕	◕
Warranty	●	●	●	◑	◕
Usability					
Visibility	●	●	●	●	●
Performance	●	●	●	◕	◕
Ease of movement	●	●	●	●	●
Comfort	●	●	◕	●	◕
Durability	◕	◕	◑	◑	◕