



FEMA

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. 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 mission includes:

- Conducting impartial, practitioner-relevant, and operationally oriented assessments and validations of emergency responder equipment;
- Providing information that enables decision makers and responders to better select, procure, use, and maintain emergency responder equipment.

Information provided by the SAVER Program will be shared nationally with the responder community, providing a life-saving and cost-saving asset to the U.S. Department of Homeland Security, as well as to federal, state, and local responders.

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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Hand-Held Lights

In order to provide emergency responders with information on currently available hand-held lights technologies, capabilities, and limitations, Science Applications International Corporation (SAIC) conducted a comparative assessment of hand-held lights for the SAVER Program in June 2007.

Detailed findings are provided in the Assessment Report on Hand-Held Lights, which is available by request at <https://saver.fema.gov>.

Background

Hand-held lights are commonly used by emergency responders to conduct search and rescue operations in darkened and/or nighttime environments. Hand-held lights enable responders to illuminate darkened areas so that targets can be identified and tasks can be performed correctly.

Assessment

Prior to the assessment, SAIC conducted a market survey in order to compile information on commercially available equipment. A focus group consisting of eight emergency response practitioners from various regions of the country met in April 2007 to identify equipment selection criteria for the assessment, determine evaluation criteria, and recommend assessment scenarios.

The focus group discussed a variety of hand-held light designs and configurations. It was noted that hand-held lights are available in a broad range of sizes and styles, from lightweight batons to heavier lights or lanterns. The focus group reached a consensus that the assessment should be narrowed to concentrate primarily on hand-held lights that have characteristics commonly needed for search and rescue operations, such as a heavier weight distribution, rechargeable batteries, and multiple position beams. Based on focus group recommendations and market survey research, the following hand-held lights were assessed as representative of the current marketplace of hand-held lights that meet the selection criteria:

- Bright Star Lighting Products Lighthawk™
- Streamlight® Fire Vulcan®
- Lightforce Enforcer
- Princeton Tec® Shockwave LED™.

Eight emergency response practitioners served as evaluators for the assessment. Each of the hand-held lights were used to replicate search and rescue activities (SAR) in two buildings designed for urban SAR and firefighting training. Evaluators conducted four rotations, and each rotation consisted of two stations: (1) a darkened maze and (2) a darkened building. In the darkened maze, evaluators were required to use their hand-held lights to locate strategically placed mannequin "victims," to prepare the mannequins for extrication by strapping them into an extrication device, and to complete other tasks such as shutting down numbered breakers on a circuit panel. In the darkened burn building, evaluators were required to use their hand-held lights to search the building, record the location of any non-viable victims,

and draw a diagram of each room and its contents. They encountered obstacles, such as confined spaces, obstructed passages, steep inclines, and stairwells. Each hand-held light was evaluated in the same manner, and the assessment conditions were controlled to make the evaluation of each light as similar as possible.

Assessment Results

Evaluators rated the lights based on the evaluation criteria established by the hand-held lights 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 light scored against each of the specific 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 hand-held light used during the assessment. The hand-held light models are listed by highest to lowest composite score. The full report includes a breakdown of evaluator comments by individual criterion.

Lighthawk

The LightHawk received the highest composite score of the assessed hand-held lights. Evaluators complimented the manufacturer on the brightness and quality of light produced by the Lighthawk. They noted that the rear-mounted light emitting diode (LED) marker lights enhance responder safety.

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.

Evaluators remarked that the Lighthawk housing appears sturdy and durable, and the lens appears very rugged. The built-in battery compartment is protected with a non-slip rubber bottom, which is also designed to absorb shock. The Lighthawk's adjustable head was favored by the evaluators. The vertical adjustment enables hands-free operation by placing the light on a flat surface and directing it at desired areas and/or objects. The battery power level indicator is easily seen and identifiable, and it allows the user an adequate amount of time before the battery is depleted. The battery charging indicator is conveniently located,

Table 1. Hand-Held Lights Assessment Results

Hand-Held Light	Composite Score	Affordability (10% Weighting)	Capability (30% Weighting)	Deployability (20% Weighting)	Maintainability (10% Weighting)	Usability (30% Weighting)
Lighthawk	69.4	58	61	71	68	81
Fire Vulcan	69.2	64	62	73	68	76
Enforcer	57.1	50	49	57	63	65
Shockwave LED	53.0	51	55	38	54	62

Note: Scores contained in the complete assessment report may be listed in a different numerical scale. For the purposes of the SAVER Summary, SAVER category scores are normalized and rounded to the nearest whole number.

LED = light-emitting diode

and the four colored LED light charging indicators are easily identifiable: amber (standby), red (charging), green (charge complete), and red blink (fault, see maintenance and troubleshooting). The Lighthawk also received the highest usability category score with the highest evaluator ratings in all eight usability criteria. It caused no undue strain during use, and its lamp head is proportional to the rest of the light. The size of the Lighthawk makes it ideal for use in confined spaces.

Vulcan does not have a battery power level indicator, the battery charging indicator located on the charger is easily seen and identifiable: red means charging and green means charging is



Hand-Held Light in Darkened Maze

complete. The Fire Vulcan was easily placed in and removed from the charger while wearing gloves. It weighs 3.3 pounds and is easily carried and operated with only one gloved hand if worn with the quick-release strap. The strap's buckle is easy to disconnect and reattach, as necessary, and the carrying strap could be advantageous for search and rescue activities. During the assessment, the weight of the light was well distributed, and the handle was centered. Evaluators stated that the Fire Vulcan would be rather large for law enforcement operations, but it is a nice size for other responder disciplines. The Fire Vulcan also received the highest deployability category score. The battery was easily maintained and quickly recharged.

Disadvantages of the Fire Vulcan include that the stationary lamp head cannot be adjusted. Evaluators reported that the switch would be easier to operate while wearing gloves if it moved up and down rather

	<p> Pros</p> <ul style="list-style-type: none"> • Weight • Swivel head • Rubberized base • LED marker lights • Switch • Strap provided • Spare bulb • Replacement parts costs • Battery power level indicator • Battery charging indicator • Light penetration in smoke • Durability • Waterproof • Handle
	<p> Cons</p> <ul style="list-style-type: none"> • Small, difficult-to-read instructions • Minimal literature/instructions • No information on intrinsic safety • No information on operating temperature ranges • No steady LED mode • AC charger only • Charger mounting • Strap quality
Lighthawk	Composite Assessment Score: 69.4

While the advantages of the LightHawk were numerous, disadvantages expressed by the evaluators included small, difficult-to-read instructions and no information on operating temperature ranges.

Fire Vulcan

The Fire Vulcan received the second highest composite score, as well as the highest capability category rating. Manufacturer's literature indicated that a fully-charged battery will power the light up to 3 hours with steady halogen and LED, up to 6 hours with blinking halogen and LED, and up to 60 hours with blinking LED only. Evaluators reported that the light is sturdy and well built with a hard plastic body, rubberized rim around the bulb, and built-in battery compartment. According to manufacturer's literature, the Fire Vulcan is waterproof up to 100 feet, and is the only assessed light that floats. Although the Fire

	<p> Pros</p> <ul style="list-style-type: none"> • Quick-release strap • Light diffusion capabilities • LED marker lights • Cost • Rubberized lens cap area • IS information • Helpful literature/instructions • Wiring/mounting • AC/DC charger • Ease of placement • Submersible to 100 feet
	<p> Cons</p> <ul style="list-style-type: none"> • Directional light • Weight • Brightness • LED penetration in smoke environment • Ease of accidentally triggering switch • No swivel head • No battery power level indicator
Fire Vulcan	Composite Assessment Score: 69.2

than side to side. They accidentally turned off the Fire Vulcan several times during the assessment due to the location and style of the switch.

Enforcer

The Enforcer received the third highest composite score of the assessed lights. The manufacturer’s literature states that a fully-charged battery will power the Enforcer for 1 hour using the 30-watt bulb and for 30 hours using the LED lamp. The Enforcer was easily operated with and without gloves, and is the only assessed light that offers colored lenses (i.e., clip-on filter systems) as optional accessories.

The manufacturer’s literature does not provide specifications for the light output of the Enforcer, but the evaluators felt that the Enforcer was the brightest of the evaluated lights. However, they stated that the brightness of the light can be blinding and could possibly create safety issues for responders. Other disadvantages include that the plastic around the lens appeared brittle and easily breakable, and the handle and plastic clips for the battery area were noted as weak. In addition, the lens did not appear durable enough to withstand being dropped. The light’s beam width can be adjusted by rotating the lamp head, but the lamp head does not have marked settings or a stop to prevent the user from completely unscrewing the

	 Pros	<ul style="list-style-type: none"> • Storage/carrying case • Easy switch operation (with or without gloves) • Adjustable beam width • Brightness of the 30-watt bulb • Directional light • Battery consumption rate of LED lamp • Upright positioning • Car charger/adapter
	 Cons	<ul style="list-style-type: none"> • Elevated brightness was a safety concern • Large lamp head • Two-switch operation • No locking/stop mechanism • No carrying strap • No IS information • No battery power level indicator • Complicated charging system • Weight distribution • Initial cost • Replacement parts costs • Durability • Difficult battery removal • Poor literature/instructions
Enforcer		Composite Assessment Score: 57.1

lamp head while attempting to adjust the beam width. The Enforcer is water-resistant; however, the manufacturer does not recommend that the light be immersed in water. Evaluators stated that there were no battery power level indicators except on the car charger.

Shockwave LED

Although the Shockwave LED received the lowest composite score, it did have some advantages including its compact size, bright light, and alkaline batteries. The manufacturer indicates that the Shockwave LED has a light output of 170 lumens and that a fresh set of alkaline batteries can power the Shockwave LED for up to 20 hours. According to the manufacturer, the Shockwave LED is waterproof and can be submersed in water up to 100 meters. The light offers two beam width modes: focused wide and focused narrow. However, evaluators said that it is difficult to differentiate between the two modes.

The manufacturer states that the Shockwave LED is engineered to be impact-resistant, yet evaluators reported that the on/off switch broke when the light was accidentally dropped during the assessment. The light appeared to be too fragile for repeated emergency responder use, and the plastic housing did not absorb shock. The lamp head is stationary and does not offer the versatility of an adjustable head. Unlike most of the other assessed models, the light does not offer battery power level indicators or a battery charger/indicator.

	 Pros	<ul style="list-style-type: none"> • Bright light • Weight • Compact size • Wrist strap • Alkaline batteries • 20-hour battery life • Free LED replacement • Submersible to 100 feet
	 Cons	<ul style="list-style-type: none"> • Weak switch • No battery power level indicator • No IS information • Weight distribution • Poor literature/instructions • Minimal difference between beam width settings
Shockwave LED		Composite Assessment Score: 53.0

Conclusion

The purpose of this comparative assessment was to evaluate the effectiveness of hand-held lights used in emergency response applications, especially firefighting and USAR response. During the assessment, the evaluators followed scenario-driven exercises that included common tasks encountered by responders when using hand-held lights.

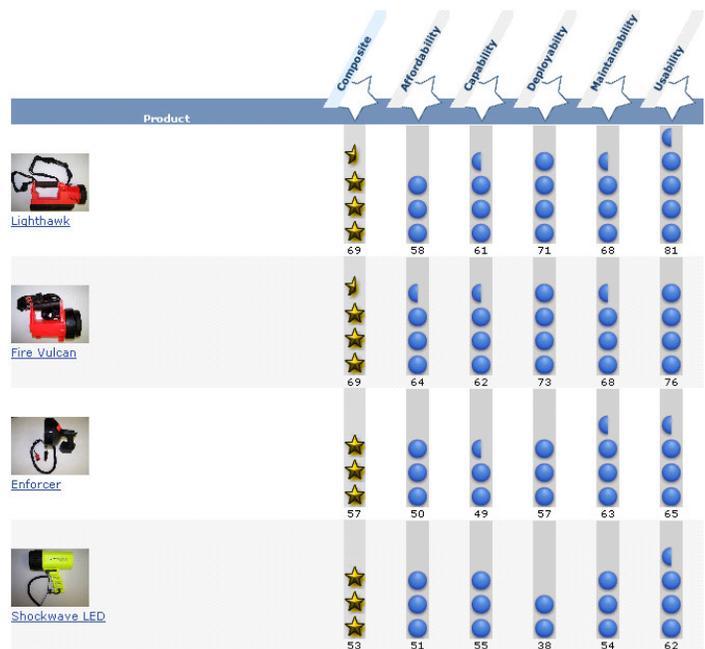
Evaluators were able to successfully complete the assessment tasks using each of the hand-held lights, but each of the hand-held lights performed differently. The Lighthawk and Fire Vulcan models received the highest scores in all five SAVER categories. Although the Lighthawk had a greater unit cost than the Fire Vulcan, its adjustable lamp head and easy-to-use switch were the key features that contributed to its slightly higher score.

An analysis of the evaluator comments and scores revealed the following common conclusions concerning the assessed hand-held lights:

- Evaluators preferred models with internal rechargeable batteries. However, local jurisdictions should consider the tactical operations in which they would use the hand-held light to determine whether recharging capabilities would be feasible and/or available.
- Hand-held lights with more rugged and durable construction were preferred.
- Models with carrying straps allow responders to operate freely while using the device.
- Evaluators expressed a preference for models with rear-mounted LED marker lights.
- Adjustable lamp heads added significant value to basic tasks.

All reports in this series, including the interactive QuickLook tool, are available on the SAVER website (<https://saver.fema.gov>).

QuickLook Snapshot



Note: The SAVER QuickLook, available on the SAVER website, allows users to select the SAVER categories that are most important to their department and view results according to their specific needs.

Table 2. SAVER Category and Criteria Scores

KEY						
		Lighthawk	Fire Vulcan	Enforcer	Shockwave	
Assessment Criteria	Affordability	Life expectancy				
		Battery type				
		Battery and replacement parts				
		Warranty				
		Accessories				
		Technical support				
		Maintenance				
	Capability	Light output				
		Durability				
		Multiple power sources				
		Environmental conditions				
		Multi-color light beam				
		Adjustable beam				
		Flotation				
		Battery power level indicator				
		Battery charging indicator				
	Deployability	Battery readiness				
		Quick-release charger				
		Portable/mountable charger				
		Ease of initial setup				

Table 2. SAVER Category and Criteria Scores (Continued)

		KEY				
		Least Favorable		Most Favorable		
						
		Lighthawk	Fire Vulcan	Enforcer	Shockwave	
Assessment Criteria (Continued)	Maintainability	Battery recharge time				
		Replacement parts				
		Battery replacement				
		Ease of repair				
		Bulb replacement				
		Ease of cleaning				
		Rechargeable battery shelf life				
	Usability	Ease of operation				
		Versatility				
		Switch function				
		Weight				
		Size				
		Weight distribution				
		Self-defense weapon				
		Heat output				