



# 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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## Alternating Current Detectors

*In order to provide emergency responders with information on currently available alternating current detector (AC Detector) technologies, capabilities, and limitations, the Center for Domestic Preparedness (CDP) conducted a comparative assessment of AC Detectors for the SAVER Program in February 2008. Detailed findings are provided in the Assessment Report on Alternating Current Detectors, which is available by request at <https://www.rkb.us/saver>.*

## Background

AC Detectors are used by fire, police, and ambulance crews responding to vehicular accidents, during search and rescue operations in urban and rural settings, and by clean up crews working on downed trees after wind and ice storms. AC Detectors provide warning of exposed high voltage AC from a safe distance using early audible and/or visual warning of the presence of AC voltages without the need to contact the surface which carries the dangerous AC potential.

## Assessment

Prior to the assessment, the CDP conducted a market survey to investigate available AC/direct current (DC) Detectors. A focus group consisting of students from various regions of the country met in December 2007 to develop evaluation criteria for the assessment, and to recommend deployment situations and scenario activities to be used in standard assessment plan development. All participants held a variety of hazardous material (HAZMAT) and fire service backgrounds.

The focus group recommended that the assessment focus on non-contact AC Detectors. The assessed models were selected based on the selection criteria established by the focus group and are representative of available technologies that meet those criteria. Based on focus group recommendations and market survey research, the following AC Detectors were assessed as representative of the current marketplace:

- Amprobe® Test Tools Tic Tracer 300HV (Tic Tracer 300HV)
- HotStick USA, Inc. AC HotStick (AC HotStick)
- Salisbury Safety Products AC Audio/Visual Voltage Detector Kit #4769 (Salisbury 4769)
- Storm King Mountain™ V-Watch™ Fire (V-Watch Fire)
- Will-Burt International TAC Stick® (TAC Stick).

The assessment was conducted using a combination of fire service and rescue activities recommended by the AC/DC Detectors focus group. Eight emergency responders with strong fire service backgrounds served as assessment evaluators. Each AC Detector was evaluated in the same manner, and operational conditions were controlled to make the evaluation of each detector as similar as possible. Detailed comments were captured by the data

collectors during the assessment activities, and these comments have been included in the full assessment report.

## Assessment Results

Evaluators rated the AC Detectors based on the weighted evaluation criteria established by the AC Detectors 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 light scored against each of the evaluation criteria assigned to the SAVER Program categories, see table 2.

The following paragraphs provide a brief summary of evaluator comments and feedback on each AC Detector used during the assessment. The AC Detector models are listed by highest to lowest scores. The full report includes a breakdown of evaluator comments by individual criterion.

### AC HotStick

The AC HotStick received the highest composite score, as well as the highest scores in all five of the SAVER categories. The AC HotStick is a modified version of the TAC Stick and is marketed by HotStick USA, Inc. Because of the similarities in the two devices, the evaluator teams used these models simultaneously in order to allow the evaluators to compare them side by side. This detector received slightly higher scores than the TAC Stick in the capability, usability, and maintainability categories.

### 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.


The AC HotStick received high capability scores largely due to its detection distance and sensitivity. It performed well with all of the voltage sources used in the assessment and detected the high voltage AC sources (distribution lines greater than 2,400 volts [V]) at a distance of approximately 50 feet. This detector detected the medium voltage sources (440 to 24,000 V ground transformers and service lines) from safe distances. It was noted that the detection distance for medium voltage sources varied based on the amount of shielding of the voltage source. The AC HotStick

Table 1. AC Detectors Assessment Results<sup>1</sup>

AC Detector	Composite Score	Affordability (10% Weighting)	Capability (30% Weighting)	Deployability (20% Weighting)	Maintainability (10% Weighting)	Usability (30% Weighting)
AC HotStick	82	56	85	83	73	83
TAC Stick®	79	56	83	83	71	79
V-Watch™ Fire	65	48	59	76	47	75
Salisbury 4769	63	44	66	65	47	68
Tic Tracer 300HV	59	50	55	63	49	68

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>• Included training DVD</li> <li>• Repair cost estimates in manual</li> <li>• Field of detection</li> <li>• Ability to pinpoint sources</li> <li>• Padded pouch</li> <li>• Carrying lanyard</li> <li>• Waterproof</li> <li>• Long battery life</li> <li>• Easy to clean</li> <li>• Insulated</li> <li>• Beeps only when alarming</li> </ul>
	<b>Cons</b> <ul style="list-style-type: none"> <li>• Size of instruction book</li> <li>• Alarm volume</li> <li>• Easy to muffle speaker</li> <li>• Difficult battery replacement</li> </ul>
<b>AC HotStick</b>	<b>Composite Assessment Score: 82</b>

detected low voltage sources (110 to 277 V wiring and 110 V and 220 V outlets) approximately 12 inches from the source.

The AC HotStick received high usability scores due to its easy operation, intuitive design, and user-friendly controls. One usability advantage over the TAC Stick was the instructional digital versatile disc (DVD) provided with the AC HotStick. The DVD demonstrated the operation of the detector using real-life scenarios.

This detector received a high deployability score because of the reported long battery life of 1 year with typical intermittent use, or 300 hours of continuous use. The detector is lightweight with a grooved rubber handle and did not cause hand strain during assessment activities. The AC HotStick's contrasting color assisted in avoiding contact with potentially energized sources, required little or no setup prior to use, and was ready for operation in less than 1 minute.

Evaluators noted several AC HotStick disadvantages. For instance, the location of the speaker at the bottom of the detector caused the evaluators to muffle it when in use. In addition, the batteries were difficult to replace, and detector settings were easy to inadvertently change while placing the detector in its protective pouch.




**AC HotStick and Tac Stick low AC Detection**  
Photo courtesy of CDP

## TAC Stick®

The TAC Stick received the second highest composite score and tied with the AC HotStick in the affordability and deployability categories. Like the AC HotStick, the TAC Stick detector received a high deployability score because of the reported long battery life of 1 year with intermittent use, or 300 hours of continuous use. The TAC Stick is lightweight and did not cause hand strain during assessment activities. In addition, an attached lanyard enabled hands-free transport. The TAC Stick was rated high in the affordability category because the product literature clearly listed the replacement parts for the detector.

Disadvantages to the TAC Stick included the detector's low alarm volume and the large separation between the strengths of the high and low detection settings; evaluators recommended a medium setting. Like the AC HotStick, the settings were easy to inadvertently change when placing the detector in its protective carrying case.

	<b>Pros</b> <ul style="list-style-type: none"> <li>• Field of detection</li> <li>• Repair cost estimates in manual</li> <li>• Ability to pinpoint sources</li> <li>• Padded pouch</li> <li>• Carrying lanyard</li> <li>• Waterproof</li> <li>• Long battery life</li> <li>• Easy to clean</li> <li>• Insulated</li> <li>• Beeps only when alarming</li> </ul>
	<b>Cons</b> <ul style="list-style-type: none"> <li>• Alarm volume</li> <li>• Easy to muffle speaker</li> <li>• Difficult battery replacement</li> </ul>
<b>TAC Stick®</b>	<b>Composite Assessment Score: 79</b>


## V-Watch™ Fire

The V-Watch Fire received the third highest overall score. The Nomex® carrying case is electrically shielded and flame resistant. The detector is lightweight and also offers a belt clip for convenient hands-free use. It was noted that the battery was easy to replace with an average battery shelf life of 2 years, or 1-year battery life with intermittent use.



**V-Watch Fire low AC detection**  
Photo courtesy of CDP



	<b>Pros</b> <ul style="list-style-type: none"> <li>• Easy battery replacement</li> <li>• Mute button</li> <li>• Easy to use</li> <li>• High visibility color</li> <li>• Hands-free detection</li> <li>• Beeps only when alarming</li> <li>• Appears durable</li> </ul>
	<b>Cons</b> <ul style="list-style-type: none"> <li>• Difficult to use in a hand-held manner</li> <li>• Small test button</li> <li>• Hard to see/hear alarms</li> <li>• Easily shielded by body</li> <li>• Low voltage field of detection</li> <li>• Difficult to use wearing gloves</li> </ul>
<b>V-Watch™ Fire</b>	<b>Composite Assessment Score: 65</b>

The V-Watch Fire continuously monitored for AC fields, and the detector sounded quickly for high voltage sources. This detector has user-friendly controls; the two controls on the detector—mute and test—were both clearly labeled and easy to read.

Another advantage to the detector is its easy-to-use instruction manual. Evaluators stated that the manual for the V-Watch Fire is simple and easy to understand and includes several illustrations showing the various detector components. The manual also features several illustrations depicting the user's proximity to an electric field based on the position of the detector and the type of AC encountered. The illustrations are helpful, and the manual is well organized for easy reference.

Reported disadvantages to the V-Watch Fire include a short detection distance when detecting low voltage AC. Additionally, the audible and visual alarms are difficult to distinguish while wearing personal protective equipment (PPE), and the detector is difficult to operate while wearing heavy gloves.


### Salisbury 4769

The Salisbury 4769 received the second lowest overall score. Evaluators reported that the detector is weather



**Salisbury 4769 low AC detection**  
Photo courtesy of CDP

resistant and commented on the convenience of the included protective case. The visual alarm for the Salisbury 4769 is easy to see in low and natural light, and

	<b>Pros</b> <ul style="list-style-type: none"> <li>• Weather resistant</li> <li>• High visibility color</li> <li>• Carrying case</li> <li>• Easy to see alarm</li> </ul>
	<b>Cons</b> <ul style="list-style-type: none"> <li>• Directional</li> <li>• Static alarms</li> <li>• Constant alert tones</li> <li>• Strenuous to carry</li> <li>• Cost</li> <li>• Awkward battery replacement</li> <li>• Poor instructions</li> <li>• Switch too close to handle</li> <li>• Speaker not weather-sealed</li> <li>• Location of test mode</li> <li>• Requires gloves or extension pole</li> <li>• Alarms if inadvertently bumped</li> <li>• Weak battery connection point</li> </ul>
<b>Salisbury 4769</b>	<b>Composite Assessment Score: 63</b>

the high-visibility orange color of the detector makes it easy to locate in dark environments.

Disadvantages to the Salisbury 4769 include the intermittent beeping of the detector to alert the user that the detector is still functioning when no AC is present. The detector also alerted due to static electricity when inadvertently rubbed against an evaluator's PPE or clothing during assessment activities. The switch on the detector is too close to the handle, and the switch label is difficult to read. Evaluators also stated that the Salisbury 4769 speaker is not weather-sealed; the speaker sound was muffled when the detector was used in light rain during assessment activities.




### Tic Tracer 300HV

The Tic Tracer 300HV received the lowest overall score. Evaluators noted that the included instructional manual was helpful and contained several illustrations detailing the use of the detector. The detector is lightweight and easy to use as a hand-held device or on a fiberglass extension pole.

There were several disadvantages noted. The Tic Tracer 300HV does not feature a clip, lanyard, or carrying case for easy transport. It was also reported that the detector is not



**Tic Tracer 300HV low AC detection**  
Photo courtesy of CDP

	 <b>Pros</b> <ul style="list-style-type: none"> <li>• Mine Safety and Health Administration (MSHA) approval</li> <li>• Price</li> <li>• Lightweight</li> <li>• Illustrations in manual</li> <li>• Intrinsically safe</li> </ul>
	 <b>Cons</b> <ul style="list-style-type: none"> <li>• Limited detection range</li> <li>• Low visibility color</li> <li>• Constant alert tones</li> <li>• Not weather resistant</li> <li>• Low volume</li> <li>• No carrying case</li> <li>• Did not appear to be durable</li> <li>• Operating temperature range</li> <li>• No clip or lanyard</li> <li>• Low detection distance</li> <li>• Alarms if inadvertently bumped</li> </ul>
<b>Tic Tracer 300HV</b>	<b>Composite Assessment Score: 59</b>

weather resistant and is difficult to see in low light environments.

## Conclusion

Although evaluator comments and scoring indicated that the five assessed AC Detectors would enable responders to effectively evaluate fire service and rescue operations, it was agreed that some of the devices would be more effective than others.

The assessment helped achieve the overall goal of evaluating the effectiveness of AC Detectors that can be used by emergency responders. The assessment goal was achieved by utilizing and evaluating the AC Detectors in scenario-driven exercises. An analysis of evaluator comments and scores revealed these common observations concerning the assessed AC Detectors:

- AC Detectors that demonstrated the greatest detection distances for the voltage ranges encountered in the assessment were preferred.
- Evaluators expressed a preference for AC Detectors that operated silently and only alerted when AC was detected.
- Thorough training material that covered basic operation, repair estimates, and replacement parts listings were rated favorably.

## 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

KEY						
Least Favorable		Most Favorable				
						
		AC HotStick	TAC Stick®	V-Watch™ Fire	Salisbury 4769	Tic Tracer 300HV
Assessment Criteria						
Affordability						
Lifespan						
Testing/certification cost						
Replacement part cost						
Capability						
Detection distance						
Detection rate						
Flexibility						
User protection						
Voltage current range						
Hands-free detection						
Frequency range						
Redundant alarms						
Field of detection						
Penetration						
Adjustable range						
Deployability						
Battery run time						
Weight/balance						
Easy to carry						
Visibility						
Ease of setup						
Storage requirements						
Secure carry features						
Maintainability						
Testing/certification						
Cleaning requirements						
User replaceable parts						
Usability						
Simple to operate						
User-friendly controls						
Effective alarm						
Easy-to-interpret indicators						
Ease of battery change						
Durability						
Easy-to-use instructions				