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 (S&T) Directorate of DHS, the SAVER Program conducts objective assessments and validations 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?"

For more information on this and other technologies, contact the SAVER Program Support Office.

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Portable Tire Deflation Devices

(AEL reference number 14SW-01-WALL)

In order to provide emergency responders with information on currently available tire deflation device technologies, capabilities, and considerations, Texas A&M Engineering conducted a comparative assessment of portable tire deflation devices for the System Assessment and Validation for Emergency Responders (SAVER) Program in August 2006. The assessment included both simulated deployment evaluations and operational testing of the systems on concrete pavement at two vehicle speeds: 35 miles per hour (mph) and 70 mph.

Background

Law enforcement officials use tire deflation devices as a way to disable target vehicles. They work by utilizing a row of spikes to pierce tires, effecting a controlled deflation. Tire deflation devices can end road chases without the danger caused by a tire blowout. Tire deflation devices must be capable of safely releasing the air pressure of the tire in a predictable, controlled manner so the vehicle operator can maintain control.

Assessment

Prior to the assessment, 12 law enforcement subject matter experts (SMEs) were chosen from various jurisdictions to participate in a focus group. The focus group's primary assignment was to develop evaluation criteria; however, they were also tasked with recommending possible uses and operational outcomes to support the assessment plan development.

The SAVER Program also conducted a market survey to investigate currently available tire deflation devices. The primary objective of the market survey was to provide an overview of the tire deflation devices available to law enforcement officers as well as their capabilities, features, and considerations.

The tire deflation devices included in the assessment were identified through the market survey conducted by Texas A&M Engineering in April 2006. The following portable tire deflation devices were assessed:

- MagnumSpike!™ fold-out system, purchased through Phoenix International
- MagnumSpike! roll-out system, purchased through Phoenix International
- Stinger Spike System®, purchased through Federal Signal Corporation
- STOP STICK® system, purchased through StopTech, Ltd.

The tire deflation devices were assessed according to the following SAVER criteria: affordability, capability, deployability, maintainability, and usability. Each factor was weighted and given a percentage of importance by the focus group for the purposes of the assessment.

Assessment activities were developed based on input from the focus group. The assessment had a two-phase approach.

Phase I included six law enforcement patrol officers simulating deployment of the systems. The SMEs reviewed the system safety, use, and setup literature provided by the manufacturers, and then used the systems by removing the systems from a trunk compartment, deploying them on asphalt surfaces, and reconfiguring them in storage containers. No spiking of vehicles was included in the Phase 1 assessment.

Phase II included scenario testing of each system on concrete at two speeds (35 mph and 70 mph). Each evolution consisted of "warming" up the tires until their pressure was consistent, then driving a test vehicle over a prepositioned tire deflation device (see figure 1). Six total evolutions per tire deflation device were conducted on the concrete surface: three evolutions with the vehicle driven at 35 mph and three evolutions with the vehicle driven at 70 mph.

Observations on all tire deflation devices assessed in Phase II were obtained from technicians and engineers from Texas A&M Engineering, who also rated the devices.

Assessment Results

The assessment results are a snapshot of the comparative performance of four models of tire deflation devices representing the known market at the time of assessment. Table 1 lists the scores, on a 100-point scale, for the composite rating and the SAVER category ratings based on the devices that were included in the assessment.

The STOP STICK tire deflation device system had the highest overall rating followed by Stinger, the MagnumSpike! roll-out system, and the MagnumSpike! fold-out system.

Assessment results included observations by SMEs and Texas A&M Engineering technicians and engineers. Their ratings, organized by SAVER category, are detailed in the following paragraphs.

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.

Table 1. Tire Deflation Devices Assessment Results[1]

System	Composite Score	Affordability (5% Weighting)	Capability (35% Weighting)	Deployability (30% Weighting)	Maintainability (10% Weighting)	Usability (20% Weighting)
STOP STICK®	**77**	54	67	90	61	87
Stinger Spike System®	**68**	70	65	63	88	72
MagnumSpike!™ Roll-Out	**55**	100	63	54	38	38
MagnumSpike! Fold-Out	**53**	86	64	49	38	37

Note:

[1] Scores contained in the report may be listed in a different numerical scale. For the purposes of the SAVER Summary, listed SAVER category scores are unweighted and rounded to the nearest whole number using a 100-point scale.

Figure 1. Vehicle Being Spiked

Affordability. At the time of the assessment, the MagnumSpike! roll-out system had the lowest price followed by the MagnumSpike! fold-out, the Stinger, and the STOP STICK, respectively. The purchase cost for all tire deflation device systems was between $260 and $380.

Capability. Based on feedback from the SMEs in Phase I, the users rated the STOP STICK system higher than the other systems in spike effectiveness and overall system effectiveness.

In Phase II, Texas A&M Engineering technicians and engineers noted that the capability to deflate the tires that were used in the test, as measured by the number of spiked tires per vehicle and by the rate of deflation for spiked tires, was similar for all systems.

Deployability. In Phase I, SMEs rated the STOP STICK system higher than the other systems. Users had positive comments for all aspects of the STOP STICK system's deployability including its storage location in the vehicle and its ease when deploying the system and retrieving the system for redeployment.

All tire deflation devices were prepositioned for the assessment activities; therefore, deployability was not assessed in Phase II.

Maintainability. Based on feedback from the SMEs in Phase I, the users rated the STOP STICK system higher than the other systems. Ratings were based on overall system durability and the maintainability of the spikes and frame.

Observations by Texas A&M Engineering technicians and engineers were based on requirements to rehabilitate tire deflation device systems after the vehicles had encountered them. The Stinger scored higher than the other systems in the Phase II maintainability assessment.

Usability. Based on feedback from the SMEs in Phase I, the users rated the STOP STICK system higher than the other systems in training materials, controls usability, user safety, and overall system usability.

Based on observations by Texas A&M Engineering technicians and engineers, the Stinger scored higher than the other systems based on the number, type, and projection of loose spikes, ease of cleanup, and controllability of spiked vehicles.

Other Assessment Results

Safety. Field tests confirm several safety concerns that were identified for the MagnumSpike! systems during deployment tests. In particular, numerous spikes turned into projectiles after the system was impacted by a vehicle. During MagnumSpike! deployments that resulted in the system being turned over, users were unable to correct problems without putting themselves at risk of being struck by vehicles or failing to accomplish the mission.

Design and Effectiveness. Based on the assessment results, evaluators were not able to identify a difference among manufacturers in how fast the spiked tires deflated. The speed of deflation appears to be mostly due to the total effective size of the hole made in the spiked tires rather than a particular spike design.

Conclusion

Users preferred the STOP STICK system, followed by the Stinger system and then the MagnumSpike! systems. The STOP STICK system benefits preferred most by users were its easy deployability and retrievability, which increased usability.

All reports in this series, as well as reports on other technologies, are available in the SAVER section of the Responder Knowledge Base (RKB) Web site at https://www.rkb.us/saver.