



**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 unbiased 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 DHS, 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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## Assessment Report on Lifting Airbags

*In order to provide emergency responders with information on currently available lifting airbag capabilities and limitations, Science Applications International Corporation (SAIC) conducted a comparative assessment of lifting airbags for the SAVER Program in July 2007 and provided findings in the Assessment Report on Lifting Airbags, which is available by request at <https://www.rkb.us/saver>.*

### Background

Emergency responders commonly use airbags during rescue operations to lift vehicles, heavy machinery, and debris that has fallen upon or otherwise trapped victims. Airbags require minimal clearance for operation and can be used in small spaces or areas where other lifting equipment may not easily fit.

### Assessment

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

The focus group reached a consensus that an assessment focusing on comparable high-pressure lifting airbags would be most beneficial to the emergency response community. Based on focus group recommendations and market survey research, the following lifting airbags were assessed:

- Paratech Incorporated Maxi Force "Suburban Rescue" Air Bag Kit
- Vetter Air Lifting Bag High Pressure Kit (106R078)
- RESQTEC® NT 127 Lifting Air Bag Kit
- Matjack Sentinel Package.

Eight emergency response practitioners served as assessment evaluators. Each of the lifting airbags was used to replicate search and rescue activities involving concrete rubble and vehicle wreckage. In the first station, evaluators lifted and cribbed a concrete truss structure (or "double T") and two circular concrete slabs, simulating a typical response to a building collapse, industrial entrapment, or excavation collapse incident.

In the second station, evaluators were tasked to safely and rapidly extricate a simulated victim (mannequin) trapped by vehicle wreckage using the various lifting airbags. In order to complete this task, participants located lifting points, determined the stability of the base, inflated the airbags, inserted stabilizing cribbing, and lifted the vehicle to extract the mannequin.

### Assessment Results

Evaluators rated the lifting airbag systems based on the weighted evaluation criteria established by the lifting airbags focus group within the five SAVER



**Concrete lifting**

categories. The scoring system was based on a 100-point scale and utilized the evaluation criteria weighting factors established by the focus group. The evaluator category and composite scores are shown in table 1. Higher scores indicate better airbag performance.

The following sections provide a brief summary of the evaluator comments and feedback on each lifting airbag system. The sections present the lifting airbag models from highest to lowest evaluator scores. The full report includes a breakdown of evaluator comments by individual criterion.

### *Paratech*

The Paratech received the highest score in the capability, usability, and affordability categories. Evaluators commented that the Paratech airbag system appears durable and well built, and its surface has a soft rubber coating with a raised grid pattern. They noted that the regulator gauge, pressure relief valve, and controller appear durable and capable of withstanding repetitive emergency responder use.

Evaluators stated that the Paratech kit is packaged for quick deployment and can be set up and operational in less than 10 minutes. They also commented that its components are clearly labeled. The Paratech airbags

can be placed in a clearance of approximately 1 inch, and the center markings enable the user to properly position the bags. Evaluators stated the airbags are designed without handles, but each of the airbags with a 10-ton rating or higher are equipped with eyelets, which allow for safe vertical placement and retrieval, as well as easy carrying. The airbags can be stacked two high in order to increase lift height; however, evaluators noted that stacked Paratech airbags demonstrate a slight tendency to roll when fully inflated. Evaluators remarked that the airbag controller is easy to operate and works well with a gloved hand but becomes difficult to operate after extended use due to the stiff control buttons.

### **SAVER 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. Lifting Bag Assessment Results<sup>a</sup>**

<b>System</b>	<b>Composite Score</b>	<b>Affordability</b> (15% Weighting)	<b>Capability</b> (30% Weighting)	<b>Deployability</b> (20% Weighting)	<b>Maintainability</b> (15% Weighting)	<b>Usability</b> (20% Weighting)
Paratech	<b>81.1</b>	75	85	83	66	89
Vetter	<b>76.5</b>	65	82	85	70	73
RESQTEC®	<b>71.7</b>	64	80	60	76	74
Matjack	<b>71.1</b>	55	79	80	67	66

Note:

<sup>a</sup> 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.

 	<p style="text-align: center;"> <b>Pros</b></p>	<ul style="list-style-type: none"> <li>• Durable, well-built</li> <li>• Large center markings</li> <li>• Raised, grid pattern surface</li> <li>• Deadman feature</li> <li>• Durable controller, color-coded buttons</li> <li>• Detailed setup instructions</li> <li>• Smooth inflation/deflation</li> <li>• Easy transport</li> <li>• Sturdy case</li> <li>• Inventory list</li> <li>• 1-year warranty</li> </ul>
	<p style="text-align: center;"> <b>Cons</b></p>	<ul style="list-style-type: none"> <li>• Hoses appear to kink easily</li> <li>• No inspection requirements</li> <li>• Stiff control buttons</li> <li>• Slow deflation rate</li> <li>• No handles</li> <li>• Needs an improved grip to reduce slippage when fully inflated</li> </ul>
<p style="text-align: center;"><b>Paratech</b></p>	<p style="text-align: center;"><b>Composite Assessment Score: 81.1</b></p>	

	<p style="text-align: center;"> <b>Pros</b></p>	<ul style="list-style-type: none"> <li>• Large assortment of airbag sizes</li> <li>• Raised, grid pattern surface</li> <li>• Strap handles on larger bags and eyelets on smaller bags</li> <li>• Lightweight airbags</li> <li>• Durable pressure relief valves</li> <li>• Color-coded controller buttons and extension hoses</li> <li>• Durable, easy-to-connect hoses</li> <li>• Detailed setup instructions</li> </ul>
	<p style="text-align: center;"> <b>Cons</b></p>	<ul style="list-style-type: none"> <li>• Deadman feature does not immediately start/stop airflow</li> <li>• Weak couplings and crimps</li> <li>• No case</li> <li>• Difficult to feather</li> <li>• Slow deflation rate</li> <li>• No warranty information</li> </ul>
<p style="text-align: center;"><b>Vetter</b></p>	<p style="text-align: center;"><b>Composite Assessment Score: 76.5</b></p>	



**Inflated Paratech airbags**

Evaluators stated that the user manual does not specify costs for routine maintenance or individual component replacement costs, but it provides a 1-year warranty against defects in materials and workmanship.

The user manual also includes detailed pictures, easy-to-follow setup instructions, field repair procedures, and complete listing of maintenance/service requirements.

### **Vetter**

The Vetter system received the highest score in the deployability category. Evaluators commented that the surface texture of the Vetter airbags prevents slippage and allows airbags to be used on concrete, wood, and metal, as well as with wet, muddy surfaces. They stated that the airbags appear durable and capable of withstanding repetitive emergency responder use. Evaluators noted that the regulator gauge, controller, and hoses appear solid and durable; however, couplings and crimps on the hose ends seem weak. The Vetter controller is capable of effectively operating two airbags at the same time. The airbags can be stacked two high, and evaluators reported that they remained stable when stacked together during the assessment tasks.

Evaluators reported that the Vetter manufacturer’s user manual includes easy-to-read setup instructions, pictures, illustrations, and troubleshooting information. They stated that the user manual has negligible procedures for making field repairs. The Vetter kit does not include a carrying case and is not packaged for quick deployment. Evaluators stated the Vetter airbag controller is difficult to operate. They explained that, although the controller buttons are clearly marked and color-coded for easy identification, they do not allow the operator to easily control the rate of airflow in or out of the airbags (meaning, feathering). The result is an “all or nothing” air pressure. The Vetter airbags can be placed in a clearance of approximately 1 inch, and the center markings enable the user to properly position the bags. Evaluators reported that one responder can easily and safely position the airbags to perform lifting operations, but one person cannot easily transport the airbag system. They commented that the airbags have two strap handles, which enhance the lifting, moving, and placing capabilities. The Vetter user manual includes a detailed listing of replacement parts, inspection, maintenance, and service requirements including a testing procedure checklist. There was no warranty information available for the Vetter system at the time of the assessment.

### **RESQTEC**

The RESQTEC received the highest score in the maintainability category. Evaluators complimented the manufacturer on the system’s airbag lifting capacity and lift height. They also noted that the RESQTEC airbags may be stacked three high. The

	<p style="text-align: center;"><b>↑</b> Pros</p> <ul style="list-style-type: none"> <li>• Three-airbag stacking capability</li> <li>• Smooth, high lift</li> <li>• Color-coded components and controller buttons</li> <li>• Deadman feature</li> <li>• Easy-to-operate controller</li> <li>• Durable hoses</li> <li>• Step-by-step setup requirements</li> <li>• Vinyl case</li> <li>• Airbag handles</li> <li>• Detailed user manual</li> <li>• Easy transport</li> </ul>
	<p style="text-align: center;"><b>↓</b> Cons</p> <ul style="list-style-type: none"> <li>• Only two same-size airbags in kit</li> <li>• Controller buttons too close together</li> <li>• No protection on valves</li> <li>• Regulator not durable</li> <li>• Slowest deflation</li> <li>• Setup time required for stacking</li> <li>• Large airbag diameter</li> <li>• Insertion height 1-1/2 to 2 inches</li> <li>• Pressure creeps up during use</li> </ul>
<b>RESQTEC®</b>	<b>Composite Assessment Score: 71.7</b>



**Inflated RESQTEC airbags**

that the RESQTEC user manual includes detailed step-by-step setup instructions, limited troubleshooting information, and pictures that are easy to follow. The user manual has no procedures for making field repairs. The RESQTEC kit is configured for quick deployment and can be set up and operational in less than 10 minutes. Evaluators explained that the RESQTEC repositioning times easily exceed 10 minutes due to a slow deflation rate. They stated the RESQTEC airbags include handles, which enhance the safety of personnel during positioning. The RESQTEC user manual includes a complete listing of replacement parts, maintenance, and service requirements. Inspection requirements for other system components (such as O-rings and controllers) are also provided. Evaluators noted that the provided lists are detailed, clearly written, and easy to understand. They also noted the user manual indicates a warranty is provided, but terms and conditions are not clearly described.

### **Matjack**

Evaluators complimented the manufacturer on the heavy, rugged construction of the Matjack airbags. The textured surface and bag thickness create a strong surface grip, which allowed the airbags to remain stable while lifting concrete, wood, and metal surfaces. Evaluators stated that the controller and built-in pressure relief valve hoses are solidly constructed and sufficiently durable to withstand repetitive first responder use. However, the regulator gauge and hose couplings do not appear durable.

Evaluators noted that the controllers are capable of effectively operating two airbags at the same time. The airbags can be stacked two high, and their surface texture allows them to be stacked with no slippage. However, stacked airbags have a tendency to roll when fully inflated.

Evaluators reported that the Matjack airbag kit is not packaged for quick deployment, mainly because it

airbags can be connected together, creating a more stabilized stacked system, and their circular shape allows them to lift more evenly than square/rectangular bags. Evaluators commented that the RESQTEC airbag, hoses, controller, and air pressure regulator appear durable, well built, and capable of withstanding repetitive emergency responder use.

Evaluators stated the airbag controller is compact and easy to operate. They commented that the controller switches are clearly marked and color-coded for easy identification. Evaluators noted that a 1-1/2- to 2-inch clearance is required to insert the airbags. They reported that the load must always be centered on the load plate for optimal stability, and they pointed out that the large diameter of the bags makes it difficult to work the airbags into confined spaces. They commented that the difficulty in positioning the airbags limits the applications in which the system can be used. Evaluators indicated the controller buttons operated smoothly but are positioned too close together, which make it difficult to control two airbags at the same time. They expressed concerns that the operator could inadvertently press the wrong button while wearing rescue gloves. Each airbag is packed in a soft vinyl carrying case, and a hard plastic carrying case with foam cut-outs is provided for all components. Evaluators commented that this system can be easily repackaged for transport. They reported

	 <b>Pros</b>	<ul style="list-style-type: none"> <li>• Thick, sturdy airbags</li> <li>• Stable lifting capability</li> <li>• Textured butyl rubber surface</li> <li>• Strong grip</li> <li>• Handles on larger bags and eyelets on smaller bags</li> <li>• Assortment of airbag sizes</li> <li>• Deadman feature</li> <li>• Durable hoses</li> <li>• Detailed setup instructions</li> </ul>
	 <b>Cons</b>	<ul style="list-style-type: none"> <li>• No case</li> <li>• Weak connections</li> <li>• Controller not ergonomic</li> <li>• Unclear directional arrows on controller</li> <li>• Difficult feathering capabilities</li> <li>• Airbag weight</li> <li>• Regulator not durable</li> <li>• Limited information in user manual</li> </ul>
<b>Matjack</b>	<b>Composite Assessment Score: 71.1</b>	

does not include carrying cases. They indicated that repackaging of the system for transport is difficult without proper carrying cases or other packaging materials. Evaluators stated the airbag controller is easy to operate, but not ergonomically designed. The controller’s directional arrow labeling does not clearly indicate which buttons inflate or deflate the airbags, and evaluators experienced minor difficulties feathering air in or out of the system during the assessment. The Matjack airbags require a 1- to 1-1/2-inch clearance. The larger Matjack bags have handles, which enhance the lifting, moving, and placing capabilities of the airbags; whereas, the smaller airbags do not have handles. Evaluators reported that the user manual includes setup instructions, pictures, and illustrations that are easy to read. The manual also provides service and inspection requirements along with procedures for making minor field repairs. The manufacturer offers a 5-year warranty against defects in materials and workmanship.

## Conclusion

The evaluators were able to successfully complete the assessment tasks with all four of the assessed airbag systems.

An analysis of the evaluator comments and scores revealed these common observations concerning the assessed lifting airbags:

- Evaluators expressed a strong preference for kits with a wide variety of airbag sizes and lifting capacities. An assortment of airbag sizes provides added flexibility for emergency response applications. For example, smaller diameter bags are easier to place in limited openings to create additional lift points for larger bags.
- Evaluators placed a high value on system mobility. Features such as carrying cases and airbag handles simplify transport.
- Evaluators preferred airbags that can be easily positioned for lifting operations. Airbag features such as handles and eyelets enhance lifting, moving, and positioning.
- Evaluators placed a high value on systems with durable airbags and rugged components. Well-built, heavy-duty systems allow for repetitive emergency responder use.
- Evaluators expressed a strong preference for airbag systems that can be easily set up. Components such as color-coded hoses and hand-tightened regulators allow users to easily set up the airbag systems.
- Evaluators preferred airbags that can be quickly deflated. Rapid deflation times enable responders to reposition the bags and expedite lifting procedures during an emergency response situation.
- Evaluators expressed a preference for airbag systems, which included detailed user manuals. Easy-to-follow instructions, detailed pictures, and exploded diagrams enable users to accurately assemble, operate, and maintain the airbag system.

## QuickLook Snapshot<sup>a</sup>



### Note:

<sup>a</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.

All reports in this series, as well as reports on other technologies, are available on the SAVER Web site (<https://www.rkb.us/saver>).