



**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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Portable Breathing Air Compressors

As a part of the SAVER program, sponsored by the U.S. Department of Homeland Security (DHS), Texas A&M Engineering, including Texas Engineering Extension Service (TEEX) and Texas Transportation Institute (TTI), conducted comparative assessments of portable breathing air compressors (PBACS) in November 2006.

Background

PBACs are used to fill self-contained breathing apparatus (SCBA) cylinders for mobile breathing air applications such as fire fighting, diving, remote rescue, hazardous materials (HAZMAT) response, and similar offsite applications, where the transport of replacement tanks to the location and/or the availability and accessibility of wheeled compressor/cascade systems is limited.

Assessment

A PCAC focus group was held to solicit suggestions for assessment criteria. Identified criteria included were equipment cost, warranty, bottle fill rate (which includes flow rates and speed to fill), ease of moisture dump (condensation drainage), ease of fuel filter change, ease of spark plug change, ease of compressor filter change, readability of gauges, and readability of sensors (visual alarms). Additional criteria identified during test planning, and during consultation with subject matter experts (SMEs), were included in the assessment. These criteria are system size, transportability, ease of engine oil change, ease of changing compressor oil or greasing compressor, training materials, and user safety.

The SAVER Program has established five categories to assist in the development of factors for comparison of emergency response



Figure 1. SME Filling a PBAC

equipment assessed by the SAVER Program (affordability, capability, deployability, maintainability, and usability). Criteria selected by the focus group were incorporated into one of the five SAVER categories, and a percentage weight was assigned.

The PBAC focus group identified six scenarios in which the systems are most commonly used, including building collapses, mud slides, trench rescues, mine rescues, tunnels, and shipboard/marine rescues. The test scenario required the SMEs to perform tasks and activities that first responders would encounter while using PBACs in extended operations (figure 1).

The Homeland Security Council scenario used for the PBAC assessment is that an 8.0 earthquake has occurred in the New Madrid Seismic Zone. Because primary air refilling systems and resources are being utilized in building collapse searches and firefighting operations in Memphis, Tennessee, a specialized rescue team with a limited bottle cache and air compressor system is sent to perform a trench collapse search and rescue at a construction site for a

new state highway. Fire responders must transport the compressors, refill spent bottles, and service the compressor units, and necessitated by extended operations.

The following PBACs included in the assessment were identified through a technology and market survey conducted by Texas A&M Engineering in October 2006, or at trade shows:

- AireTex Compressors, W-31 Gas H (*AireTex*)
- American Airworks, Fast 35 (*American Airworks*)
- Bauer Oceanus-G from Industrial Air Services, Inc. (*Bauer*)
- Mako Compact 6 S from Survival Air Systems (*Mako*)
- Rix Industries, SA-6G (HE-H) (*Rix*)

Assessment Results

In the assessment of the individual PBAC units that made up the test set, the *Mako* and the *American Airworks* were the two highest over all rated systems by evaluators. The *Rix* and the *AireTex* were the two lowest overall rated systems. The Bauer system held the middle overall rating.

The results are listed by SAVER category in table 1, along with corresponding category weights. Results are on a 100-point scale.

Mako

SMEs found the *Mako* system's bottle fill time to be reasonable, with easy-to-read gauges, an easily accessible regulating valve, and a very visible carbon monoxide (CO) sight glass monitor. Maintenance appeared to be very straightforward with easily assessable hardware, while still providing for user and system safety with a protective shroud. The

System	Composite Score	Affordability (.10 Overall Weighting)	Capability (.30 Overall Weighting)	Deployability (.40 Overall Weighing)	Maintainability (.10 Overall Weighting)	Usability (.10 Overall Weighting)
Mako	81	79	66	89	89	84
American Airworks	79	92	65	86	87	75
Bauer	69	66	68	65	90	75
AireTex	57	92	50	48	86	53
Rix	57	28	100	28	65	61

Table 1. SAVER Category and Composite Scores ^a

^a Scores Containing in the report may be listed in different numerical scale. For the purpose of the SAVER Summary, listed SAVER category scores are unweighted and rounded to the nearest whole number using 100-point scale.

SMEs observed the system as easy to carry and very balanced. They liked the simplicity of the system and the manual.

One SME observed the only drawback was that when the system reached maximum pressure it would kill the engine (as it is designed to do), and he would have to restart the engine again to fill another bottle. The SME felt there was little time to change the bottle, forcing system shutoff every time. All SMEs agreed that they would rank the Mako system first of the five PBAC units that were evaluated.

American Airworks

SMEs observed that the *American Airworks* systems performed well, started easily, easily blend moisture, and had simple to use gauges. The SMEs also found the system very easy to carry, including through doorways.

Although easy to carry, the SMEs though the *American Airworks* system seemed off balance. One SME thought there might be two little clearance

between the handle and engine when carrying with a gloved hand. Another concern was that the pop-off valves were set at 4,500 psi, causing the relief valve to go off when attempting to fill the SCBA bottles to 4,500 psi. SEMs thought a widened footprint in the frame of the system would prevent it from tipping over.

Bauer

SMEs observed the Bauer system as easy touse and relatively quick in filling bottles. SMEs concurred that it had the best manual of the five compressors. They expressed that the system was easy to carry and was fairly balanced, but if the system was dropped or tipped over, the regulator could snap. SMEs were impressed with the adjustable regulator and the rest-resistant stainless steel case.

The SMEs’ primary suggestion for improvement was to add quick-disconnect fittings in order to prevent damage to the regulator. Although the compressor system was solidly based, one SME expressed that

the vibrations caused the two pressure gauges to be hard to read. One concern was that although it was fairly straightforward to change the inflow air filters, a specialized tool would need to be built to complete the task since one was not supplied with the system and is not part of a typical station toolbox.

AireTex

SMEs reported that the *AireTex* compressor system ran well, noting an easy startup and a full-fill pressure of 4,500 psi. They also believed the *AireTex* had a good warranty. SMEs, however, were very concerned with the comparatively longer time the system took to fill bottles and its difficulty to transport. They found the system awkward to carry. In order to carry this system under rapid transport requirements, a user would have to hold the system by the motor but could not do so if the engine was hot. The durability of the system was an additional concern because of unprotected hardware, contributing to a perceived reduction in user safety.

Rix

The SMEs were impressed with several aspects of the *Rix* system, especially with the comparatively low bottle-filling time, the balanced frame, and the descriptive user's manual.

SME concerns about the *Rix* system included the lack of a CO monitor and changeable filter for the compressor. An hour meter was not provided with the system, and since maintenance is required every 25 hours, it would be difficult to know when maintenance is required without detailed tracking. The SMEs also found the system to be very heavy with only two carriers, but it was extremely maneuverable with four. Because of the *Rix* system compressor type, SMEs were worried that after warranty expiration it would be difficult to find

someone who could fix it. Finally, one SME stated the pressure gauge was not user-friendly because they had to squat down to read it.

In order to improve the system, SMEs suggested adding an hour meter and a CO meter, and to angle the pressure gauge upward to make it easier to read.

Conclusion

In the assessment of the individual PBACs units that made up the test set the *Mako* and the *American Airworks* were the two highest overall rated systems. The *Rix* and the *AireTex* were the two lowest overall rated systems. The Bauer system had the middle overall rating.

For more detailed assessment results, the full report and reports on other technologies are available at the SAVER Web site <https://www.rkb.us/saver>.