



**Homeland
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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 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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Intrinsically Safe Exhaust Fans

(AEL reference number 19GN-00-FANE)

In order to provide emergency responders with information on currently available intrinsically safe exhaust fan technologies, capabilities, and considerations, Science Applications International Corporation (SAIC) conducted a comparative assessment of intrinsically safe exhaust fans for the System Assessment and Validation for Emergency Responders (SAVER) Program in June 2010. Detailed findings are provided in the Assessment Report on Intrinsically Safe Exhaust Fans, which is available by request at <https://www.rkb.us/saver>.

Background

Intrinsically safe exhaust fans are critical response tools used by search and rescue teams and other responders for ventilation of confined spaces where hazardous conditions exist. Intrinsically safe is a term used to describe a condition that exists when a spark or thermal effect generated during normal functioning or specific fault conditions is unable to ignite a given explosive atmosphere. Intrinsically safe exhaust fans are constructed of a variety of materials that may include metals and plastics with fan blades that are generally made of aluminum, fiberglass, or plastics to ensure that they are non-sparking. These fans are available in many sizes and configurations. The two primary means of powering exhaust fans are electric motor or pneumatic (compressed air) motor.

Assessment

The SAVER Program conducted a market survey to investigate currently available intrinsically safe exhaust fans. The primary objective of the market survey was to provide the nation's emergency responders with an overview of the intrinsically safe exhaust fans available, as well as their capabilities, features, and considerations.

Prior to the assessment, eight emergency responders were chosen from various jurisdictions to participate in a focus group. Participants possessed strong backgrounds in fire service, search and rescue, and hazardous materials (HAZMAT) response. The focus group's primary assignment was to develop intrinsically safe exhaust fan evaluation criteria; however, they were also tasked with recommending possible uses and operational outcomes to support the assessment plan development. The group's final task was to recommend for evaluation specific intrinsically safe exhaust fans considered potentially beneficial to the response disciplines. The focus group recommended that the assessment utilize both electric and pneumatic exhaust fans with close specifications to determine if there are any significant differences between the two different power sources.

Based on focus group recommendations, market survey research, and system availability, the following intrinsically safe exhaust fans were assessed:

- Americ Corporation VAF-3000P

- Air Systems International, Inc. SVB-E8EXP
- Euramco Safety AFi75XX
- Unifire, Inc. UF-9515-01EX.

Eight responders served as evaluators for this assessment. Each evaluator had at least 7 years of combined experience in emergency response disciplines including firefighting, HAZMAT, emergency medical response, and/or search and rescue.

Evaluators were tasked to conduct search and rescue operations at a simulated grain silo collapse, a sewer system ventilation, an auditorium ventilation, and a building collapse. The assessment environment and activities performed were replicable should there be a future need to repeat an identical or similar assessment.

Assessment Results

Evaluators rated the intrinsically safe exhaust fans based on the evaluation criteria established by the intrinsically safe exhaust fans focus group. Each criterion was assigned to one of the five SAVER categories, and then assigned a weight for its level of importance. Once the criteria were weighted, the five SAVER Program categories were assigned a percentage value to represent the level of each category’s importance relative to the other categories.

Table 1 displays the composite assessment scores as well as the category scores for each product. Higher scores indicate a higher rating by evaluators. For product specifications, see table 2. To view how each

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.

intrinsically safe exhaust fan scored against the evaluation criteria assigned to the SAVER Program categories, see table 3.

The following paragraphs provide a brief summary of evaluator comments and feedback on each intrinsically safe exhaust fan used during the assessment. The systems are listed from highest to lowest composite score. The complete assessment report includes a

Table 1. Intrinsically Safe Exhaust Fan Assessment Results¹

Product	Composite Score	Affordability (10% Weighting)	Capability (30% Weighting)	Deployability (25% Weighting)	Maintainability (5% Weighting)	Usability (30% Weighting)
Americ Corporation VAF-3000P	80	64	87	78	81	80
Air Systems International, Inc. SVB-E8EXP	76	61	79	67	67	85
Euramco Safety AFi75XX	73	54	71	76	73	81
Unifire, Inc. UF-9515-01EX	71	50	77	57	80	82

Note:

¹ 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.

breakdown of evaluator comments by SAVER categories.

Americ Corporation VAF-3000P

The Americ Corporation VAF-3000P received the highest composite score. The pneumatic fan has a free airflow rate of 2,063 cubic feet per minute (cfm) and an adequate amount of airflow to ventilate a confined space, but it does not adequately ventilate larger areas. The VAF-3000P is easy to operate, the housing and fan blade appear durable and well-constructed, and the fan is lightweight and easy to transport. The 12-inch air duct size is appropriate to conduct confined space operations, though the airflow is restricted by the design of the duct. The fan performs well during positive and negative pressure applications, but when using the duct during negative pressure ventilation operations, the duct collapses and restricts the airflow. The National Electric Code (NEC) hazardous location information is clearly visible and is solidly affixed to the fan housing. The directional arrow for airflow is clearly visible and molded into the housing. The fan offers good value for the price and a 1-year limited warranty, the details of which are clearly outlined in the user’s manual. The user’s manual also provides good part and repair information.

	<p> Pros</p> <ul style="list-style-type: none"> • Compact size • Good weight • Portability • Durable housing and fan blade • Easy to operate • Metal placards on housing • Easy to maintain • Low noise level • Understandable user’s manual • Good parts and repair information • Reasonable cost, value of system • Molded airflow directional arrow
	<p> Cons</p> <ul style="list-style-type: none"> • Large air compressor required (100 psi @ 38 cfm) • External lubricator and moisture separator required • Location and design of grounding strap • No continuous lip on the flange • Difficult to tighten plastic buckles on duct • Collapse of duct under negative pressure
<p>Americ Corporation VAF-3000P</p>	<p>Composite Assessment Score: 80</p>

The noise level of the VAF-3000P is low, though noise from the required air compressor could interfere with communication during operations. The fan requires an air compressor large enough to maintain a constant pressure of 100 pounds per square inch (psi). Manipulating the duct tensioning device and connecting the grounding strap to the fan is slightly difficult to perform while wearing gloves. In addition, the ducts are easy to position, but do not remain attached to the collar or flange of the fan. The in-line lubricators and moisture separators must be installed prior to operating the fan, and neither are included with the fan. The ducts have an accordion design that collapses easily for storage, but may be difficult to transport without a carrying case; a case can be purchased at an additional cost.

Air Systems International, Inc. SVB-E8EXP

The Air Systems International, Inc. SVB-E8EXP received the second highest composite score. The electric fan is designed to adequately ventilate confined spaces with a free airflow rate of 1,570 cfm. The fan is very stable and quiet, and the overall construction of the fan appears durable and able to withstand harsh environmental conditions. In addition, the fan performs well during positive pressure ventilation, but the duct collapses during negative pressure ventilating. The fan operates from a 115-volt (V) power source and does not include a plug. It does feature an explosion-proof switch and

	<p> Pros</p> <ul style="list-style-type: none"> • Low noise level • On/Off switch • Sturdy, well-built construction • Metal placard on housing • How-to-use chart on housing • Available in package/kit • Very stable during operation • Powerful motor
	<p> Cons</p> <ul style="list-style-type: none"> • Two-person carry required • Added weight due to large motor • Tools required to attach ground cable • Limited versatility due to 90-degree intake/exhaust angle • No lip on intake flange to secure duct • Exhaust shroud too short • Buckle fasteners on duct • Collapse of duct during negative pressure
<p>Air Systems International, Inc. SVB-E8EXP</p>	<p>Composite Assessment Score: 76</p>

can be directly wired to a power source. The control switch is easy to operate, but is not clearly labeled. NEC hazardous location information is clearly visible and is attached using durable adhesive material. Labels detailing operational and performance specifications are affixed to the housing. The fan can be purchased as part of a kit, and information regarding the 1-year warranty is provided in the user's manual.

For larger spaces, the fan does not provide sufficient ventilation. The fan is easy to operate while wearing gloves; however, gripping and adjusting the tensioning devices on the ducts and attaching the ducts to the fan causes minor difficulties. The intake flange is long enough and has a ridge to help secure the duct, but the exhaust flange is slightly shorter and flat, which allowed the duct to slip at times during the assessment. The buckles that secure the ducts do not appear to be able to withstand prolonged use. The weight distribution is not balanced when one person carries the fan; therefore, a two-person carry is preferred.

Euramco Safety AFi75XX

The Euramco Safety AFi75XX received the third highest composite score. The pneumatic fan provides 2,042 cfm of free airflow, which is sufficient for confined space operations. The fan can be used for positive and negative pressure ventilation operations, though the airflow is restricted when the duct collapses during negative ventilation. The fan can be easily operated while wearing gloves. The control knob is easy to locate, grip, and operate, but adjustments to the lubricator, oil adjustment knob, and air drain cockpit valve can be difficult. The labels are easy to identify, read, and understand, and include a directional airflow indicator. They are affixed with adhesives but the adhesive may fail with normal exposure to the elements, leaving no directional airflow indicator or specifications. The accordion design of the duct collapses easily for storage and transport.

The duct design reduces the amount of airflow, which is most likely due to the ridges or baffles in the duct that create friction. The NEC hazardous location information is not clearly visible or understandable. The durable plastic housing should withstand long-term use, though the in-line components are mounted in a way that may subject them to damage. The AFi75XX requires an air compressor that can sustain a rate of 40 cfm, which is not normally

	<p>↑ Pros</p> <ul style="list-style-type: none"> • Good size and weight • Supplied with lubricator and moisture separator • Open-shut valve easy to operate • Heavy-duty ground wire connector • Durable housing • Continuous lip on duct flange • Duct tightening device • Airflow indicator label
	<p>↓ Cons</p> <ul style="list-style-type: none"> • Large air compressor required (80 psi @ 40 cfm) • Awkward to carry • Lubricator and moisture separator not protected • Possible cross-threading of plastic threads on moisture separator • Exhaust muffler orientation • Duct flange too narrow • High noise level during operation • Collapse of duct under negative pressure • Adhesive labels peeling from housing • Manuals unorganized, not user-friendly
<p>Euramco Safety AFi75XX</p>	<p>Composite Assessment Score: 73</p>

available in many jurisdictions. In addition, in-line lubricators and moisture separators must be installed prior to operating the fan; these components are included with the fan. Attaching the duct to the fan and tightening the tensioning devices causes minor difficulty. Although the flange of the duct has a continuous ridge to secure the duct, the flange is short and should be extended to allow more room to mount the duct. The noise level of the fan slightly hinders the ability to communicate; the air compressor required to power the fan produces enough noise to hinder communication. A longer air line would help to reduce noise levels. The fan is lightweight but unbalanced, and it can only be carried from one side due to the protruding components. One responder can carry the AFi75XX with little difficulty. The user's manual is vague and lacks organization.

Unifire, Inc. UF-9515-01EX

The Unifire, Inc. UF-9515-01EX received the lowest composite score. The electric fan has a free airflow rating of 3,400 cfm, which is more than adequate to provide ventilation in confined spaces. The airflow is adequate during positive pressure applications, but the adapter collapses during negative pressure tasks. An adhesive label on the fan provides the NEC hazardous location information; hazardous location information

	 Pros <ul style="list-style-type: none"> Balanced weight when carried High airflow rate Easy to operate Heavy-duty construction Versatile; can be used for cooling or smoke ejection Stable during operation Continuous lip on duct flange
	 Cons <ul style="list-style-type: none"> Two-person carry required Large storage and transport space required Reducer for duct not rigid 16-inch duct not suitable for all confined space operations No airflow directional indicator High noise level during operation
Unifire, Inc. UF-9515-01EX	Composite Assessment Score: 71

is also provided in the fan’s literature in an easy-to-read format. The fan appears durable and can be used for multiple tasks, including cooling and smoke ejection. The UF-9515-01EX operates from a 115-V power source. The fan is supplied with an explosion proof rated plug, but does not have a switch to power the fan on and off. The retention system can be easily gripped and the tensioning devices can be easily adjusted while wearing gloves. The cost of the UF-9515-01EX is comparable with other assessed fans, as is the 1-year warranty.

The adapter that is included with the fan reduces the duct size from 16 inches to 8 inches. The reducer is composed of a flexible vinyl material and has no rigidity. As a result, it immediately collapses during operation when placed on the intake flange, which completely restricts the airflow. The fan produces noise that can slightly hinder some users’ ability to communicate during operations, though all assessment tasks were completed with minimal interference. Due to the shape and weight of the fan, it is difficult for one responder to carry it for more than a short distance. The UF-9515-01EX is well-balanced, but not lightweight. The user’s manual lacks a parts list or illustrations but does have sections that describe maintenance and repair procedures.

Conclusion

Evaluators observed advantages and disadvantages of the assessed intrinsically safe exhaust fans. They identified the following considerations to assist other responders in procuring intrinsically safe exhaust fans:

- Evaluators preferred exhaust fans that can be easily carried by one responder. They explained that the fan should be constructed of lightweight materials for easy transport from storage to the incident scene.
- Evaluators expressed a strong preference for exhaust fans that are constructed of durable materials. They stated that the housing should be able to withstand prolonged use and the wear of moving the fan from place to place. Evaluators noted that the blades should also be made of a durable material and be protected with a mesh screen or grate. Evaluators agreed that the quality of the exhaust fan should be relative to the cost of each unit.
- Evaluators favored the operation of the pneumatic exhaust fans due to their genuine intrinsic safety and smooth operation. They stated, however, that the requirement to have a large volume of compressed air available, as well as added maintenance requirements and costs, may influence their decision on which fan to purchase.
- Evaluators placed a high value on exhaust fans with easy-to-operate on and off switches or controls. They commented that some exhaust fans have switches that are affixed to the fan housing or are in line with the electrical cable or air hose.
- Evaluators preferred exhaust fan ducts that are easy to connect, flexible, and durable. They further emphasized the importance of ducts remaining securely connected to the fan during ventilation operations. They added that the ducts should be rigid enough to withstand collapsing during negative pressure ventilation. Evaluators also commented that the tightening and securing device on the duct should be easy to manipulate.
- Evaluators placed a high value on carrying cases for the ducts. They noted that without a form of carrier for the duct, the responder will have difficulty transporting the duct from storage to the incident scene. Evaluators also agreed that the carrying case should be sturdy and durable enough to withstand long-term use.
- Evaluators expressed interest in efficient user manuals and associated literature for exhaust fans. They preferred manuals that are clear, concise, and easy to understand. They noted that information on repair parts, service,

maintenance, cleaning instructions, and warranty information is valuable to the user.

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>.

Table 2. Intrinsically Safe Exhaust Fan Specifications

Product	Specifications
Americ Corporation VAF-3000P	<ul style="list-style-type: none"> • Pneumatic 1.0 hp motor • Free airflow rating: 2,063 cfm • Dimensions: 17 in. D x 14 in. W x 21 in. H • Weight: 28 lbs • Fan size: 12-in. diameter • Plastic housing • For use in NEC Classes I-III and Groups A-G hazardous locations
Air Systems International, Inc. SVB-E8EXP	<ul style="list-style-type: none"> • Electric 0.75 hp motor • Free airflow rating: 1,570 cfm • Dimensions: 19 in. L x 23 in. W x 20 in. H • Weight: 79 lbs • Fan size: 8-in. diameter • Steel housing • For use in NEC Classes I-II and Groups C-G hazardous locations
Euramco Safety AFI75XX	<ul style="list-style-type: none"> • Pneumatic GAST 4AM-NRV-50C Motor • Free airflow rating: 2,042 cfm • Dimensions: 16 in. D x 17 in. W x 16 in. H • Weight: 33 lbs • Fan size: 12-in. diameter • ABS plastic housing • No NEC Class specified by manufacturer; states for use in adverse or explosive locations
Unifire, Inc. UF-9515-01EX	<ul style="list-style-type: none"> • Electric 0.50 hp motor • Free airflow rating: 3,400 cfm • Dimensions: 14 in. D x 18 in. W x 18 in. H • Weight: 53 lbs • Fan size: 16-in. diameter • Steel housing • For use in NEC Class I and Group D hazardous locations

Notes:

- ABS = acrylonitrile butadiene styrene
- cfm = cubic feet per minute
- D = depth
- H = height
- hp = horsepower
- in. = inch/inches
- L = length
- lbs = pounds
- NEC = National Electric Code
- W = width

Table 3. Intrinsically Safe Exhaust Fan Criteria Ratings¹

KEY						
Least Favorable		Most Favorable	Americ Corporation VAF-3000P	Air Systems International, Inc. SVB-E8EXP	Euramco Safety AFi75XX	Unifire, Inc. UF-9515-01EX
						
Assessment Criteria						
Affordability						
Equipment Costs						
Maintenance Costs						
Capability						
Airflow						
Hazardous Classifications						
Construction of Fan						
Versatility						
Power Source						
Deployability						
Mobility						
Ventilation Ducts						
Maintainability						
Maintenance Requirements						
Cleaning Requirements						
Usability						
Ease of Use						
Stability						
Noise Level						

Note:
¹ Averaged criteria ratings for each product that was assessed are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.