



**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 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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## Surface Water Operations Protective Dry Suits

(AEL reference number 01SW-01-SUIT)

*In order to provide emergency responders with information on currently available surface water operations protective dry suits, Science Applications International Corporation (SAIC) conducted a comparative assessment of surface water operations protective dry suits for the System Assessment and Validation for Emergency Responders (SAVER) Program in May 2011. Detailed findings are provided in the Surface Water Operations Protective Dry Suits Assessment Report, which is available by request at <https://www.rkb.us/saver>.*

### Background

Surface water operations protective dry suits are used by certified water rescue personnel during search and rescue operations in moving water. These suits are available in assorted styles and materials with a variety of features and capabilities.

### Assessment Methodology

Prior to the assessment, eight emergency responders were chosen from various jurisdictions to participate in a focus group. Participants possessed strong backgrounds in surface/swift water rescue, search and rescue, firefighting, and emergency medicine. The group's primary objectives were to recommend evaluation criteria, product selection criteria, and possible scenarios for the assessment.

Based on focus group recommendations, market research, and product availability, the following dry suits were assessed:

- Extreme SAR Dry Suit (NRS SAR), NRS Rescue;
- Swift Water Rescue Dry Suit PRO (Mustang PRO), Mustang Survival;
- SAR GORE-TEX® Dry Suit (Kokatat SAR), Kokatat Inc.; and
- Extreme Relief Dry Suit (NRS Extreme Relief), NRS Rescue.

Six responders served as evaluators for this assessment. All evaluators had at least 5 years of experience using surface water operations protective dry suits.

Evaluators were tasked to participate in two phases of the assessment: the specification assessment and the operational assessment. During the specification assessment, evaluators assessed the dry suits based on vendor-provided information and specifications. During the operational assessment, evaluators performed water rescue operations in Class I (slow), Class II (moderate), and Class III (swift) currents.

## Assessment Results

Evaluators rated the surface water operations protective dry suits based on the evaluation criteria established by the focus group. The focus group assigned each criterion 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 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. The advantages and disadvantages of each dry suit, as identified by evaluators, are listed in table 2. For product specifications, see table 3. To view how each of the surface water operations protective dry suits scored against the evaluation criteria assigned to the SAVER categories, see table 4.

The following paragraphs provide a brief summary of evaluator comments and feedback on the surface water operations protective dry suits used during the assessment; the complete assessment report includes a breakdown of evaluator comments by evaluation criteria. The dry suits are listed from highest to lowest composite score.

### NRS SAR

The NRS SAR received a composite score of 81. The following paragraphs provide a summary of evaluator comments and feedback on the NRS SAR dry suit.

The NRS SAR is made of 400-denier material, which is approximately twice the thickness of the other NRS suit evaluated during the assessment. According to evaluators, it is a good value and is offered in a variety of colors. The seals were comfortable and not too constricting, and the suit



SAVER Category Definitions	
<b>Affordability</b>	groups criteria related to life-cycle costs of a piece of equipment or system.
<b>Capability</b>	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 relevant tasks.
<b>Deployability</b>	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.
<b>Maintainability</b>	groups criteria related to the maintenance and restoration of a piece of equipment or system to operational condition by responders.
<b>Usability</b>	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. Dry Suit Assessment Results<sup>1</sup>**

Dry Suits	Composite Score	Affordability (20% Weighting)	Capability (30% Weighting)	Deployability (15% Weighting)	Maintainability (5% Weighting)	Usability (30% Weighting)
NRS SAR	81	86	76	78	65	86
Mustang Pro	78	70	81	73	64	86
Kokatat SAR	76	68	76	78	66	83
NRS Extreme Relief	72	80	66	78	71	71

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.

provided good mobility. The padded knee did not move around as it did in other suits; the knee padding is a good feature for a suit in this price range. The suit features internal suspenders and buckles that were easy to adjust. The left shoulder and right leg pockets are conveniently placed, especially for a right-handed responder. NRS provides many do-it-yourself repair parts and instructional videos.

Noted disadvantages of the NRS SAR include a 1-year limited manufacturer warranty and a limited selection of available sizes; smaller sizes are not available. In addition, padding in the seat would be preferred, and the suit needs more reflective material for added visibility.



**Mustang PRO**

### **Mustang PRO**

The Mustang Pro received a composite score of 78. The following paragraphs provide a summary of evaluator comments and feedback on the Mustang Pro dry suit.

The Mustang Pro is a comfortable, waterproof suit that has a soft neck seal and pliable suit material. It is the only assessed suit that provides substantial padding; it features hinged knee and elbow padding and adjustable, removable tailbone padding. The Mustang PRO has additional reinforced material on the lower body and forearms as well as on the waist, knees, arms, and cuffs. The suit is also equipped with

adjustable thigh straps. The neoprene cuffs can be trimmed to fit, and a chart with trimming and sizing instructions is included.

The Mustang PRO does not have pockets and is heavier than the other suits. Although the knee pad is hinged and substantial, it did not stay in place while swimming during the assessment and gave the sensation of entanglement; this feature requires repeated use for comfort and familiarity. The suit's numerous extra adjustments can be bothersome when donning. The lower portion of the suit is not breathable.



**Kokatat SAR**

### **Kokatat SAR**

The Kokatat SAR received a composite score of 76. The following paragraphs provide a summary of evaluator comments and feedback on the Kokatat SAR dry suit.

The Kokatat SAR was easy to don and doff and was user-friendly overall. The suit does not include suspenders and lacks adjustability; however, optional suspenders are available. The GORE-TEX material is waterproof, windproof, and breathable, and the neck seal is protected with a hook-and-loop overcuff. The Kokatat SAR kept users dry, was not restrictive, and allowed good range of motion. The shoulder and thigh

pockets are good features; the thigh pocket has a separate slash pocket that allows easy access and provides a place to store gloves. Kokatat Inc. will personalize this suit with patches provided by the customer at no charge; embroidery or screen printing incurs additional cost.

The suit has a purge valve on the arm; however, some evaluators recommended that it would be better placed on the shoulder. It was sometimes difficult to bleed air out of the suit, and the drain holes in the pockets did not drain quickly enough. There is not enough reflective material, and much of the reflective taping was covered by the personal flotation device (PFD). The Kokatat SAR has no padding and the liner, which is not attached to the outer shell, created drag. While the suit was comfortable overall, the wrist and neck seals were tight and uncomfortable; however, evaluators noted that the suits were shared and the seals could not be trimmed for a better fit. The cost of the suit is high compared to the other assessed suits, and evaluators were unable to find dry suit information on the manufacturer's Web site.



**NRS Extreme Relief**

## **NRS Extreme Relief**

The NRS Extreme Relief received a composite score of 72. The following paragraphs provide a summary of evaluator comments and feedback on the NRS Extreme Relief dry suit.

The NRS Extreme Relief is a good basic suit for the cost and is the least expensive of the assessed suits. If the suit could not be repaired, the cost is such that it could be easily replaced. The manufacturer offers repair kits and how-to-repair videos. The suit is available in multiple colors, and fabric swatches for patching are included on the hang tag. The suit had the most comfortable neck and wrist seals of the assessed suits. The

wrist and ankle cover straps stayed closed, but the neck closure cover came open. The rubber booties were comfortable but sometimes difficult to don and doff.

The suit is not equipped with pockets or a suspender system, and the relief zipper flap is not attached. On overcast, rainy days when the temperature was cooler, air could be felt through the suit with a liner; however, on clear days with warmer temperatures, the suit was comfortable.

## **Conclusion**




Evaluators were able to successfully complete the assessment tasks with the NRS SAR, Mustang PRO, Kokatat SAR, and NRS Extreme Relief dry suits. Analysis of evaluator comments and scores revealed the following common observations concerning the assessed surface water operations protective dry suits:

- Evaluators placed a high value on lightweight suits that were highly breathable and easy to don. In addition, they favored gaskets that were comfortable, strong, and could be sized for a customized fit, and booties that were easy to don and not bulky inside the outer boot.
- Evaluators preferred suits constructed of durable materials including reinforcement and padding on the elbows, seat, and knees.
- Evaluators favored suits with highly visible colors and reflective tape and piping on the sleeves and legs that could easily be seen while wearing a PFD or while in the water.
- Evaluators liked suits that were equipped with hook-and-loop closures at the neck, wrists, and ankles that remained secure; adjustable internal suspenders, belts, and thigh straps for improved fit; and easy-to-access pockets placed in convenient locations on the suit arms and legs.
- Evaluators preferred suits designed with relief zippers for added comfort and convenience.
- Evaluators placed a high value on suits that kept them dry and did not leak at the gaskets or seams.
- Evaluators favored suits equipped with drainage holes or vented mesh in the pockets and/or cuff areas that allowed water to drain easily and quickly.
- Evaluators favored suits that provided wind resistance and thermal support, produced minimal drag, and provided a comfortable range of motion.
- Evaluators preferred suits that were constructed of quality materials with features that matched the cost of the suit.


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. Dry Suit Advantages and Disadvantages**

Dry Suits	Advantages	Disadvantages
 <p><b>NRS SAR</b> Composite Score: 81</p>	<ul style="list-style-type: none"> <li>• Internal suspenders, adjustable buckles</li> <li>• Adjustable waist cord</li> <li>• Visible red color</li> <li>• White sleeve with reflective, glow-in-the-dark material available</li> <li>• Reflective arm, wrist material</li> <li>• Comfortable suit</li> <li>• Drainage around the neck</li> <li>• Moisture protection</li> <li>• Thigh and arm pockets</li> <li>• Reinforced, padded knees</li> <li>• Relief zipper</li> <li>• Cost vs. quality</li> <li>• Accessories reasonably priced</li> <li>• Field repairable</li> <li>• Ease of care, maintenance</li> </ul>	<ul style="list-style-type: none"> <li>• Rubber bootie difficult to don and doff</li> <li>• Rubber bootie difficult to get into boots</li> <li>• Small range of sizes available</li> <li>• Seat seam wore through</li> <li>• Leg ripped early in assessment</li> <li>• No reflective material on legs</li> <li>• No seat pad</li> <li>• Arm pocket drain hole too big</li> <li>• Entry zipper location</li> <li>• Added cost for logos and patches</li> <li>• Hand washing of suit recommended</li> </ul>
 <p><b>Mustang PRO</b> Composite Score: 78</p>	<ul style="list-style-type: none"> <li>• High quality</li> <li>• Number of features</li> <li>• Stretchable fabric</li> <li>• No drag</li> <li>• Soft, pliable neck seal</li> <li>• Waist, thigh adjustments</li> <li>• Seals easy to cut down</li> <li>• Strong neoprene cuffs</li> <li>• Comfortable, easy-to-don GORE-TEX® booties</li> <li>• Zippered pant legs</li> <li>• Buoyant</li> <li>• Reinforced around wrists, ankles, knees, seat, and thighs</li> <li>• High visibility</li> <li>• Easy-to-adjust belt</li> <li>• Adjustable seat pad</li> <li>• Hinged elbow, knee pads</li> <li>• Range of motion</li> <li>• 6-year shelf life</li> <li>• Can be machine washed and dried</li> </ul>	<ul style="list-style-type: none"> <li>• Suspenders too long, flimsy</li> <li>• Heavy out of water</li> <li>• Minimal reflective material</li> <li>• Excessive length of neck drawstrings</li> <li>• Loose seat pad</li> <li>• Wrist, ankle closures came loose</li> <li>• Leakage</li> <li>• Cost</li> <li>• High-priced Mustang Survival brand accessories</li> <li>• Conflicting care instructions</li> <li>• Company recommends manufacturer perform repairs</li> <li>• No repairs offered after 6 years</li> </ul>
 <p><b>Kokatat SAR</b> Composite Score: 76</p>	<ul style="list-style-type: none"> <li>• Material quality, weight</li> <li>• Highly breathable</li> <li>• Size range/availability</li> <li>• GORE-TEX booties</li> <li>• Durable</li> <li>• High visibility</li> <li>• Hook-and-loop neck overcuffs</li> <li>• Large thigh pockets with hook-and-loop flap</li> <li>• Strap for bootie</li> <li>• Arm air relief valve</li> <li>• Reflective shoulder, wrist accents</li> <li>• Optional storm hood</li> <li>• Sleeve pocket</li> <li>• Moisture protection</li> <li>• Relief zipper (female offered)</li> <li>• 2-year limited warranty</li> <li>• Reasonable accessory prices</li> <li>• Machine washable</li> <li>• Patches sewn at no cost</li> <li>• Embroidery, screen prints available</li> </ul>	<ul style="list-style-type: none"> <li>• Pockets created drag</li> <li>• Lacked adjustability</li> <li>• Liner not attached to shell</li> <li>• Wrist, neck seals uncomfortable</li> <li>• No padding</li> <li>• Thigh pockets slow to drain</li> <li>• Arm air relief valve location</li> <li>• Amount/location of reflective material</li> <li>• Cost</li> <li>• Propriety</li> <li>• Difficult to find information on Web site</li> </ul>

**Table 2. Dry Suit Advantages and Disadvantages (Continued)**

Dry Suits	Advantages	Disadvantages
 <p><b>NRS Extreme Relief</b> Composite Score: 72</p>	<ul style="list-style-type: none"> <li>• Lightweight</li> <li>• Reinforced knees, seat</li> <li>• Comfortable neck, wrist seals</li> <li>• Comfortable rubber booties</li> <li>• Wrist, ankle straps stayed closed</li> <li>• Reflective material on sleeves</li> <li>• Waist adjustment strap</li> <li>• Hook-and-loop cover on entry zipper</li> <li>• Entry zipper cover kept debris out</li> <li>• Relief zipper</li> <li>• Neck grommets drained quickly</li> <li>• Repair patches included</li> <li>• Field repair video available for seals</li> <li>• Least expensive suit</li> <li>• Cost vs. quality</li> <li>• Multiple colors available</li> </ul>	<ul style="list-style-type: none"> <li>• Rubber booties difficult to don/doff</li> <li>• Minimally breathable</li> <li>• Rip above the knee</li> <li>• Not compatible with thermal protection</li> <li>• Allowed cool air inside</li> <li>• No reflective material on legs</li> <li>• Neck closure came open</li> <li>• No suspender system</li> <li>• Long waist adjustment strap</li> <li>• No pockets</li> <li>• No padding</li> <li>• Relief zipper flap not attached</li> <li>• Must be periodically hand washed per manufacturer instructions</li> </ul>

**Table 3. Dry Suit Specifications<sup>1</sup>**

Specifications	NRS SAR	Mustang PRO	Kokatat SAR	NRS Extreme Relief
Material	Breathable 400-denier Triton™	Breathable GORE-TEX®	Breathable GORE-TEX, nylon	Breathable 200-denier Triton
Seals/gaskets	Latex neck, wrists; attached socks	Adjustable neck; latex wrists, ankles	Latex neck, wrists; GORE-TEX socks	Latex neck, wrists; attached socks
Padding	Elbows, knees, shins	Elbows, seat, knees, shins	None	None
Zippers	Chest, relief, sleeve pocket, thigh pocket	Chest, relief	Chest, relief	Chest, relief
Adjustable components	Suspenders, pull-cord waist	Suspenders, thigh straps, belt	Waist	Waist
Colors	Red/black	Yellow/black	Yellow/black, black	Yellow/gray, blue/gray

Note:

<sup>1</sup> Information was provided by manufacturers and has not been independently verified by the SAVER Program.

**Table 4. Dry Suit Criteria Ratings<sup>1</sup>**

KEY								
Least Favorable					Most Favorable			
					NRS SAR	Mustang PRO	Kokatat SAR	NRS Extreme Relief
<b>Affordability</b>								
Initial costs								
Maintenance costs								
Accessory costs								
<b>Capability</b>								
Suit construction								
Durability								
Operational environments								
Visibility								
Design features								
<b>Deployability</b>								
Ease of donning/doffing								
Transport requirements								
<b>Maintainability</b>								
Storage requirements								
Cleaning requirements								
Maintenance requirements								
<b>Usability</b>								
External moisture protection								
Range of motion								
Protection								
Zipper location(s)								
Exterior drainage								

Note:

<sup>1</sup> Averaged criteria ratings for each assessed product are graphically represented by colored and shaded circles. Highest ratings are represented by full green circles.