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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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Summary

Combination Hydraulic Power Tools

(AEL reference number 03SR-02-TPHY)

In order to provide emergency responders with information on currently available hydraulic power tool technologies, capabilities, and limitations, Science Applications International Corporation (SAIC) conducted a comparative assessment of combination hydraulic power tools for the System Assessment and Validation for Emergency Responders (SAVER) Program in January 2010. Detailed findings are provided in the Assessment Report on Combination Hydraulic Power Tools, which is available by request at <https://www.rkb.us/saver>.

Background

Combination hydraulic power tools are used by fire service and search and rescue personnel to gain access to victims following a vehicle accident, building collapse, or other incident. For vehicle accidents, these tools are designed to cut vehicle roofs, window and door posts, and door hinges. They are used to spread materials to break door hinges, crush fenders, and lift dashboards. Combination hydraulic power tools are also employed to rescue victims trapped in a confined space by lifting heavy objects and spreading and cutting rebar and other materials. Combination hydraulic power tools are equipped to perform multiple functions and can be quickly deployed.

Assessment

The SAVER Program conducted a market survey to investigate currently available hydraulic power tools. The primary objective of the market survey was to provide an overview of the hydraulic power tools available to the nation's emergency responders as well as their capabilities, features, and limitations. In addition, the market survey report provided state and local jurisdictions with user-friendly information about a sample of the many hydraulic power tools offered for search and rescue applications.

Prior to the assessment, eight emergency response personnel were chosen from various jurisdictions to participate in a focus group. Participants possessed strong backgrounds in firefighting, emergency medicine, search and rescue, and hazardous materials (HAZMAT) response. Additionally, two participants had experience in law enforcement. The focus group's primary assignment was to develop combination hydraulic power tool 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 specific hydraulic power tools considered potentially beneficial to the response disciplines for evaluation.

Based on focus group recommendations, market survey research, and tool availability, the following combination hydraulic power tools were assessed:

- Holmatro CT 4150
- TNT SLCC-30

- Genesis 16c Brute Vario
- Hurst® High Pressure SC 550.

Eight responders served as evaluators for this assessment. All evaluators had at least 7 years of combined experience in emergency response disciplines with at least 4 years of experience conducting search and rescue operations (e.g., vehicle extrications, confined space rescues).

Evaluators were tasked to setup equipment, respond to victim extrication and entrapment scenarios, and lift a vehicle. The assessment environment and activities performed were replicable should there be a need to repeat an identical or similar assessment in the future. The activities performed in this assessment were consistent with this scenario and with the operational objectives that may exist in a similar incident.

Assessment Results

Evaluators rated the combination hydraulic power tools based on the evaluation criteria established by the 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. To view how each hydraulic power tool scored against each of the evaluation criteria assigned to the SAVER

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.

Program categories, see table 2. For product specifications, see table 3.

The following paragraphs provide a brief summary of evaluator comments and feedback on each hydraulic power tool used during the assessment. The tools are listed from highest to lowest composite score. The complete assessment report includes a breakdown of evaluator comments by individual criterion.

Table 1. Hydraulic Power Tools Assessment Results¹

Model	Composite Score	Affordability (10% Weighting)	Capability (30% Weighting)	Deployability (30% Weighting)	Maintainability (10% Weighting)	Usability (20% Weighting)
Holmatro CT 4150	78	65	77	83	72	82
TNT SLCC-30	78	72	83	72	78	82
Genesis 16c Brute Vario	75	66	80	75	69	77
Hurst® High Pressure SC 550	74	61	74	75	72	80




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.

Holmatro CT 4150

The CT 4150 tool tied for the highest composite score and usability score and has the top score in the deployability SAVER category. Evaluators commented that the CT 4150 can operate two tools simultaneously and can be changed under pressure. Evaluators stated that the CT 4150 had sufficient cutting force for the assessment tasks and that the tool's spreading capacity is smooth and controllable without stalling. Evaluators also noted that the CT 4150 lifted the car with ease. The CT 4150's blades are tough and do not bend or flex even under high pressure. Evaluators agreed that the blades are very durable, maintain sharpness, and open and close at very controllable speeds. Evaluators also noted that the control of the blades' speed is safe and easy when cutting and spreading, and it can be controlled by the operator with the hand valve or throttle control of the handle; although one evaluator said he experienced some difficulties when cutting.

Some disadvantages of the CT 4150 were noted. Evaluators stated that the flat shape of the cutting blades on the CT 4150 causes the tool to turn sideways and makes it difficult for the tool to achieve optimum leverage. The wide base of the tool blades allows for a solid cut to be established; however, the fixed and regular depth of the blade serrations allows for minor slippage. Evaluators stated that the shape of the CT 4150 blades caused them to slide down the surface and push away from fairly thick materials. Evaluators

	 Pros	<ul style="list-style-type: none"> • Lightweight, portable system • Easy hook-up • Well-balanced • Quiet power unit • Good for single-person operation • Single hose • Less storage space required; smaller, more compact • Lights on power unit and in tool handle
	 Cons	<ul style="list-style-type: none"> • Lacked power, slipped, and blades twisted • Reduced cutting speed • Tool required to check oil • Controls inaccessible while wearing firefighter gloves • Bowing of hose in tight spaces • Increased operational length of tool due to hose attachment
Holmatro CT 4150	Composite Assessment Score: 78	

agreed that the blades need to be more contoured with sharper teeth to bite metal. They explained that the grip of the jaws is solid, but the tool twists under high pressure and on heavier materials. Evaluators reported that the controls on the CT 4150 are recessed and difficult to use when wearing firefighting gloves. The control is secured by the user's entire hand during operation and heavy gloves could hinder tool operation; however, evaluators agreed that the shape of the controls allows the tool to be operated from various positions.




TNT SLCC-30

The TNT SLCC-30 tied for the highest composite score and usability score and received the top score in the capability, maintainability, and affordability SAVER categories.

Evaluators reported that the tool cuts extremely well in both the accelerated and normal modes, and the power tool makes excellent cuts at multiple angles.

Evaluators agreed that the cutting surface is large and the blades are very strong, which should enable them to last for years with heavy use and still retain their integrity. Evaluators stated that the cutting edge goes all the way up the blades to allow users to snip their way into shallow or tight places, and also to make deep cuts. Evaluators agreed that the SLCC-30 was more than adequate for the tasks encountered during the assessment. Evaluators agreed that the operating, opening, and closing speed of the SLCC-30 is very fast.

Evaluators identified some disadvantages with the SLCC-30. When used to spread, the tool lacks force when in the accelerated mode. Evaluators stated that due to the power and speed of the SLCC-30, it may be


	 Pros	<ul style="list-style-type: none"> • Powerful, fast • Lower list price • Easy maneuverability • Contoured blades • Accelerator feature on power unit • Limited lifetime warranty
	 Cons	<ul style="list-style-type: none"> • Heavy, unbalanced power unit; hard-to-carry, single handle grip • Additional training required for safety reasons due to power/speed • Difficult to align mono-coupling; unable to disconnect under pressure
TNT SLCC-30	Composite Assessment Score: 78	

difficult for inexperienced responders to handle safely. Evaluators agreed that the SLCC-30 is easy to maneuver around obstacles and up and down stairs; however, they stated that it is difficult for one person to carry, especially over long distances. Evaluators suggested that two handles, as opposed to one, would make it easier to transport.

Genesis 16c Brute Vario

The 16c Brute Vario received the second highest composite score. Evaluators reported that the 16c Brute Vario is equipped to operate two tools simultaneously or one tool in overdrive mode. Evaluators described the tool as very powerful, quick, efficient, and durable. Evaluators said it has a remarkable cutting capacity and performed well on the grate spreading and cutting task. Evaluators also stated that the wide tips made lifting more stable and easy to maintain, and was strong enough to lift one side of a car with ease. The 16c Brute Vario’s blades remained very sharp and cut three metal grate layers with very little twist. Evaluators stated that the 16c Brute Vario easily makes strong cuts into metal with very little backwards movement of the tool. An evaluator noted that the 16c Brute Vario was the only tool that did not twist during the assessment; however, two evaluators said that the tool twists on thicker materials. Other evaluators agreed that the tool provides a remarkable cut with very little torque. Evaluators stated that the tool opens and closes at a good speed in normal operating mode and is exceptionally fast in an accelerated mode. One evaluator noted that the push button control, as opposed to the typical control system, is great for stopping, cutting, or spreading, and is quick and reliable with no delays. Another evaluator stated that the push button control allowed him to operate the tool with precision. Evaluators explained that correctly utilizing this feature requires training and practice before mastering it completely. Evaluators said that the tool controls can be manipulated to work at any speed, and that the accelerated mode speed is easily controlled with the hand lever.

Evaluators encountered some disadvantages with the 16c Brute Vario. Some evaluators noted that the tool began to stall on thicker materials. Evaluators stated that making shallow cuts with the 16c Brute Vario is difficult and that the blade does not extend far enough down the cutter to provide effective cuts at the tips. They explained that the cutting strength near the tips is significantly reduced. Evaluators reported that the removable tips increase the cutting depth, but removal




	<p>↑ Pros</p> <ul style="list-style-type: none"> • Adjustable handle • Removable tips (to allow full-length cut) • Variable speed • Accelerator feature on power unit • Mono-coupling
	<p>↓ Cons</p> <ul style="list-style-type: none"> • Small handle for firefighter gloves • Heavy power unit • Difficulty connecting coupling to power unit due to firefighter gloves • “Walking” power unit • Grip hindered by push button control • Adjustable handle not stationary during operation; adjustments required during use • Spreading difficulties with wide tips • Minimal content and detail provided in literature
<p>Genesis 16c Brute Vario</p>	<p>Composite Assessment Score: 75</p>

is difficult with the 16c Brute Vario. Evaluators noted that this tool is wide enough to open fully and that it easily cut the car during the assessment. It was noted that it bounces or “walks” away from the start point when in overdrive mode.

Hurst High Pressure SC 550

The High Pressure SC 550 received the lowest composite score. Evaluators stated that they were able to control the tool operation with the control valve and throttle. Evaluators noted that the High Pressure SC 550 is capable of operating two tools simultaneously. Evaluators agreed that the High Pressure SC 550 is easily capable of crushing materials and cuts well if the material is close to the notch of the cutter. Evaluators explained that the tool flattens materials first and then uses its power to cut through them.

Though positive features were noted with the High Pressure SC 550, evaluators reported several concerns. Evaluators stated that the tool is slow and the cutters are weak in the front and have to be repositioned to get a better bite. Concern was expressed that this might present a problem when using the tool in small, enclosed areas. The blades are not very sharp and less sharp after a few uses, and began to slip while cutting. Evaluators agreed that the cutting blades are not flat enough to provide much bite and do not offer a good grip for establishing a purchase point. Evaluators stated that the spreader tips were too blunt and stocky

	 Pros	<ul style="list-style-type: none"> • Very powerful; good for heavy operations • Well-balanced system; good balance between power unit and tool • Multiple hand positioning allowed due to star grip; safe speed operation • Outstanding couplings • Most comparable to dedicated tools • More informative/descriptive literature
	 Cons	<ul style="list-style-type: none"> • Easy to lose grip on tool handle when turning star grip • Slower for normal extrication • Heavy for single-person use; fatigue quickly • Dull cutters crush, shear, and slip while cutting • Forward handle too close to tool when machine is rotated on side
Hurst® High Pressure SC 550		Composite Assessment Score: 74

to get a good purchase when spreading the grates, and they slipped while trying to open small, tight spaces and while lifting the car.

Conclusion

Evaluators were able to successfully complete the assessment tasks with all four of the assessed combination hydraulic power tools. Evaluators observed advantages and disadvantages of the assessed tools, but noted that their results are limited to the combination hydraulic power tool configurations used for this assessment. Additionally, the results indicate that the scores were very close for many criteria and there were aspects of each tool that evaluators liked and disliked, as they related to personal experience and preference. An analysis of the evaluator comments and scores revealed several common observations of the assessed combination hydraulic power tools:

- Evaluators expressed a strong preference for combination hydraulic power tools that are powerful enough to cut and spread quickly, especially if there are no dedicated tools to back them up.


































- Evaluators placed a high value on combination hydraulic power tools with durable and strong tips. They stated that it is imperative that combination hydraulic power tools are durable enough to withstand repetitive use.
- Evaluators expressed a strong preference for a tool that can be controlled, especially when lifting. They explained that tools that do not allow the responder to gradually lower the vehicle or structure, create the risk that a vehicle or structure may shift or collapse on the victim. They noted that this inability reduces control and safety.
- Evaluators preferred combination hydraulic power tools with serrated and/or curved blades that securely grasp and hold the materials to be cut. They agreed that curved blades support cutting efficiency and ease by preventing the metal from “moving” away from the responder.
- Evaluators expressed a strong preference for combination hydraulic power tools that are adequately sized for quick deployment and storage. They stated that a power tool that is too heavy to be carried by one responder slows deployment and response.
- Evaluators placed a high value on combination hydraulic power tools that are designed to easily create purchase points. They explained that the size and shape of the tips can adversely affect the speed and efficiency of creating a purchase point, especially if the tips are too big or too thick. Evaluators also stated that the flexibility of the hose can have an impact on how easily or quickly the hose can be deployed and repacked.
- Evaluators preferred combination hydraulic power tools with controls that can be easily grasped. They agreed it is essential that the controls do not slip from the responder’s hands while being used, and it is equally important for the responder to be able to maintain a firm and controlled grip during deployment.

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. Hydraulic Power Tools Criteria Ratings¹

KEY					
Least Favorable	➔	Most Favorable			
					
Assessment Criteria					
Affordability					
Power unit costs					
Interoperability					
Maintenance/service contract cost					
Expandable kit					
Accessory costs					
Replacement part costs					
Training costs					
Capability					
Power unit capacity					
Tool capacity					
Cutting blade durability					
Purchase point					
Cutting depth					
Blade grip					
Tool speed					
Changeable tips					
Deployability					
Easy to carry					
Quick setup					
Vehicle storage					
Maintainability					
Maintenance requirements					
Service/maintenance agreement					
Replacement part availability					
Durability					
Fluid compatibility					
Fuel compatibility					

Table 2. Hydraulic Power Tools Criteria Ratings¹ (Continued)

KEY					
Least Favorable	➔	Most Favorable			
					
		Holmatro CT 4150	TNT SLCC-30	Genesis 16c Brute Vario	Hurst® High Pressure SC 550
Assessment Criteria					
Usability					
Simple power unit operation					
Simple tool operation					
Easy to control					
Ergonomic controls					
Hose connections					
Easy to manage hoses					

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.

Table 3. Hydraulic Power Tools Specifications

Hydraulic Power Tools	Product Specifications
Holmatro CT 4150	<ul style="list-style-type: none"> • Dimensions: 33 3/4 in x 9 in x 7 1/8 in • Weight: 31 lbs • Maximum cutting force: 28,300 lbs • Maximum cutting force (in cutting notch): 67,600 lbs • Spreading distance: 14 1/4 in • Maximum spreading force: 7,541 lbs • Maximum spreading force (at back of tips): 16,166 lbs • Maximum pulling force: 14,358 lbs • Maximum operating pressure: 10,500 psi • CORE Technology™ standard • Other: Twin line pigtails available
TNT SLCC-30	<ul style="list-style-type: none"> • Dimensions: 32.5 in x 9 in x 7 in • Weight: 38.8 lbs • Cutter opening: 14 in • Maximum cutting force: 118,800 lbs • Maximum spreading force: 15,820 lbs • Maximum operating pressure: 10,500 psi • Other: Variable speed and deadman controls
Genesis 16c Brute Vario	<ul style="list-style-type: none"> • Dimensions: 33.8 in x 8.5 in x 7.8 in • Weight: 40.7 lbs • Cutter opening: 16.7 in • Maximum cutting force: 112,000 lbs • Spreading distance: 16 in • Maximum spreading force: 22,000 lbs • Maximum pulling force: 12,825 lbs • Maximum operating pressure: 10,500 psi • Other: 3.4-second opening time, 3.9-second closing time
Hurst® High Pressure SC 550	<ul style="list-style-type: none"> • Dimensions: 33.9 in x 9.6 in x 7.1 in • Weight: 44 lbs • Maximum cutting force: 120,300 lbs • Spreading distance: 16.9 in • Maximum spreading force: 50,500 lbs • Pulling distance: 12.6 in • Maximum pulling force: 17,530 lbs • Working pressure: 700 bar • Other: Stargrip control valve

Notes:

- bar = unit of pressure
- in = inches
- lbs = pounds
- psi = pounds per square inch