

# Battery-Powered Cutting Tools for Vehicle Extrication

## **Market Survey Report**

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### FOREWORD

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NUSTL manages the System Assessment and Validation for Emergency Responders (SAVER) program, which provides information on commercially available equipment to assist response organizations in equipment selection and procurement. SAVER knowledge products provide information on equipment that falls under the categories listed in the DHS Authorized Equipment List (AEL), focusing primarily on two main questions for the responder community: "What equipment is available?" and "How does it perform?" The SAVER program works with responders to conduct objective, practitioner-relevant, operationally-oriented assessments and validations of commercially available emergency response equipment. Having the right tools provides a safer work environment for responders and a safer community for those they serve.

NUSTL is responsible for all SAVER activities, including selecting and prioritizing program topics, developing SAVER knowledge products, and coordinating with other organizations to leverage appropriate subject matter expertise. In conjunction with DAGER Technology, NUSTL conducted a market survey of commercially available Battery-Powered Spreading, Cutting, and Spreading/Cutting Combination Vehicle Extraction Tools. This equipment falls under the AEL reference number 03SR-02-TPHY titled Tools, Power.

SAVER reports are available at www.dhs.gov/science-and-technology/saver-documents-library.

Visit the NUSTL website at <u>www.dhs.gov/science-and-technology/national-urban-security-technology-laboratory</u> or contact the lab at <u>NUSTL@hq.dhs.gov</u>.



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## **EXECUTIVE SUMMARY**

Emergency responders use battery-powered rescue tools to access persons trapped within vehicles. Opening or removing areas of a damaged vehicle from around an injured person could prevent further injury caused when removing them from the vehicle.

Between March 2022 and July 2022, the Systems Assessment and Validation for Emergency Responders (SAVER) program conducted a market survey of commercially available battery-powered cutting rescue tools or "cutters." This market survey report is based on information gathered from manufacturer and vendor websites, additional internet research, industry publications, and a government-issued request for information that was posted on the System of Award Management website at <a href="https://sam.gov/opp/aa6e7232803445b8b51e105545a476ff/view">https://sam.gov/opp/aa6e7232803445b8b51e105545a476ff/view</a>. The survey identified 17 battery-powered cutters for vehicle extrication ranging in price from \$9,970 to \$14,420.

Each manufacturer offers models that differ based upon size and cutter opening. The cutters in this report range in size from 33.7 lbs. to 58.4 lbs. with cutter openings ranging from 5.8 inches to 10.2 inches. Generally, as the size of the cutter increases, the cutter opening becomes larger and cutter ratings become greater, as defined by National Fire Protection Association's (NFPA) "Standard on Rescue Tools," NFPA 1936. Seven of the cutters are powered by readily available commercial-off-the-shelf (COTS) batteries, while ten cutters use a proprietary battery, which in some cases support enhanced capabilities such as underwater use. Additionally, features such as the capability of inhouse maintenance, Ingress Protection rating and training offerings may also be of interest to responder agencies.

The purpose of this report is to provide emergency responders with information that will guide their agencies in making operational and procurement decisions. Each agency should consider overall capabilities, technical specifications, and limitations of battery-powered cutting rescue tools for vehicle extraction in relation to their specific operational needs when making equipment selections.

Performance of these products and information included in this report has not been independently verified by the SAVER program.

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## **1.0 INTRODUCTION**

Emergency responders use battery-powered spreading, cutting and spreading/cutting combination tools for extraction of persons trapped within vehicles. To minimize any further harm, responders use these tools to open or remove areas of a damaged vehicle from around the injured person, rather than removing the victim from the vehicle.

Between March 2022 and July 2022, the System Assessment and Validation for Emergency Responders (SAVER) program conducted a market survey of portable battery-powered spreading, cutting and combination tools for vehicle extrication. <u>This market survey report focuses solely on</u> <u>battery-powered cutting tools, covering 17 models.</u> Additional reports on spreading and combination rescue tools will be published at <u>www.dhs.gov/science-and-technology/science-and-technologydirectorate/saver/st-battery-powered-rescue-tools-vehicle-extrication</u>. This report is based on information gathered from manufacturer and vendor websites, internet research, industry publications, and a government-issued request for information that was posted on the System of Award Management website at <u>https://sam.gov/opp/aa6e7232803445b8b51e105545a476ff/view</u>. The U.S. Department of Homeland Security (DHS) Science and Technology Directorate's (S&T's) Technology Scouting Group also contributed to the market research used in the development of this report.

Products included in this report meet the following criteria:

- Single-person portable
- Battery-powered
- Self-contained
- Compliant with the National Fire Protection Association's "Standard on Rescue Tools," NFPA 1936 [1].

Due diligence was performed to develop a report that is representative of products in the marketplace.

## 2.0 BATTERY-POWERED VEHICLE EXTRICATION TOOLS OVERVIEW

Emergency personnel responding to automobile accidents often encounter trapped or injured individuals needing immediate medical care and extrication. Inclement weather, inaccessible locations, harsh terrain, and unpredictable environmental conditions often hinder the deployment of patient care and extrication equipment. In some situations, rescue personnel must carry equipment to crash sites including hard to reach off-road locations, steep embankments, marshy wetlands, or submerged areas. Battery-powered rescue tools for vehicle extrication are more portable than tethered systems and eliminate the need to transport support equipment, such as hydraulic pumps, air compressors, and generators. This can increase the speed with which responders can arrive on the scene.

Once on the scene, first responders often find a damaged vehicle body structure surrounding the victim(s), preventing full access. In these rescue operations, the primary goal in victim extrication is to quickly open or remove the damaged vehicle from around the injured victim, which minimizes the potential for inflicting further physical harm while removing the victim from the vehicle. Battery-powered vehicle extrication tools can provide responders with the ability to maneuver around the vehicle with their equipment and coordinate rescue operations quickly and efficiently.

#### 2.1 Background

Modern rescue tools have their genesis in American stock car racing. George Hurst, a racing equipment manufacturer, observed race crews taking over an hour to extricate a driver from a damaged vehicle following an accident. The crews used slow-cutting circular saws that created sparks, a less than ideal situation in a potentially fuel-soaked area. In 1961, Hurst filed a patent for a hydraulically powered spreading tool to enable track rescue crews to quickly spread apart roll cages to extricate drivers. [2] The original extrication system, the HURST Rescue Tool hydraulic spreader, was produced in 1971 and following its successful integration into motorsports, became a resource for emergency services. [3]

Early extrication systems relied on gasoline-powered hydraulic pumps large enough to fill the bed of a pickup truck. These pumps were connected to a handheld spreader unit via two hydraulic hoses. Since their initial design, systems have become smaller and stronger. The introduction of the lithiumion battery enabled manufacturers to produce self-contained, portable, handheld vehicle extrication tools with onboard electrohydraulic pumps. These battery-enabled systems are capable of many of the tasks that formerly required using tools with separate power units.

#### **2.2 Current Technologies**

Spreaders, cutters, and spreader/cutter combination tools used in vehicle extrication operations have traditionally relied on tethered lines attached to hydraulic pumps to pressurize the hydraulic fluid going to the tool. Battery-powered extrication tools are self-contained hydraulic systems that electrically power an internal high-pressure pump and pistons to control the flow of hydraulic fluid through input and output valves and chambers. These systems typically use a synthetic fluid known as phosphate-ester, which is non-flammable and electrically non-conductive [2]. Battery-powered tools have the advantage of being self-contained, eliminating tangling and tripping hazards from hydraulic hoses or electrical cords. These self-contained systems allowing rescue personnel to operate independently and to use multiple tools (such as spreaders and cutters) simultaneously, providing faster rescue operations.

Battery-powered tools also enable first responders to access tighter spaces, reduce tripping hazards, and provide more flexibility to quickly remove mangled metal from around a trapped victim.

Battery-powered rescue tools are somewhat larger and heavier than traditional, tethered rescue tools because they include the power supply and hydraulic unit within one handheld system. Additionally, the run times for the battery-powered tools are limited by the battery used to power the system and incidents may require the use of replacement batteries. Other capabilities listed in the manufacturer-provided specifications (such as cutter opening and NFPA cutter rating) of battery-powered rescue tools match those of traditional hydraulic rescue tools.

#### 2.2.1 Battery-Powered Cutters

Cutters can have long serrated blades or a large, open, curve-like jaw, as show in Figure 2-1, that operates on the same principle as the spreader when opening and closing. Cutters have heat-treated blades that can cut various types of metals, including round bar, flat bar, round pipe, square tube, and angle iron. Typically, in vehicle extrication operations, curved cutters are used to cut door hinges, curved door posts, steering columns, and roof tops, while straight blades are used to cut flat and angled steel, mounting brackets, and drive train components. The different types of blades and their cutter ratings are discussed in Section 2.3.3.



Figure 2-1. Genesis Rescue 236-SL3 EFORCE Cutter Image Credit: Genesis Rescue Systems

#### 2.3 Key Components

Battery-powered cutters require a power source, external operating components (e.g., on/off switch, variable speed control, hand grip) and a variety of cutting blades. Some manufacturers offer advanced features, such as temperature monitoring, roll warnings—which assists with ensuring positioning of the blades and tools to ensure safety of the user and the integrity of the tool—or the ability to operate underwater.

#### 2.3.1 Power Options

Like other battery-powered rescue tools, cutters are typically powered by a removable, rechargeable, lithium-ion battery pack inserted directly into the body of the tool. Some cutters use proprietary manufacturer batteries, while others use commercial battery packs common to construction tools like drills and circular saws. Proprietary batteries may have advantages in certain features such as the ability to be charged while installed on the tool. Conversely, agencies may see advantages to construction tool batteries, including ready availability, relatively lower cost compared to proprietary batteries, and shared use with the agency's other tools such as drills, impact wrenches, reciprocating saws, or metal shears.

Some manufacturers offer flexible options for powering the tools, including external battery packs with increased amp-hour (Ah) capacities versus on-tool batteries. External battery packs, however, require a corded connection to the tool and require the user to wear the battery pack using a shoulder strap. Some manufacturers also offer the ability to supply backup power to the tools using an available alternating current (AC) connection, enabling rescuers to continue to work even if all batteries have been expended.

#### 2.3.2 External Operating Components

Battery-powered cutters commonly have a cylindrically shaped main body, an on-off switch, variable speed control lever, cutting blades, and hand grip as shown in Figure 2-2. The tools also have a protective cover that protects the motor from debris and the operator from moving parts. Some systems have a fixed hand grip, while others have rotating or adjustable hand grips that adjust to improve leverage.





Image Credit: Holmatro

Many cutters include indicators that monitor the power supply and hydraulic fluid reservoir. Some advanced models have load indicators that show the pressure range the tool is operating under, the remaining amount of capacity, and roll warnings that alert the operator that the blade is off center. Some tools also have temperature sensing and heat-protection mechanisms that protect sensitive electronic components and automatically adjust the speed to protect the motor from burning out. Some systems are designed to operate in unique environments, such as underwater.

#### 2.3.3 Cutter Head and Blades

The mechanism that opens and closes the blades is the cutter head. Cutters have different blade options to best fit the various contours of the vehicle. Larger blades may be required for more difficult deep cutting reach, with smaller curved blades having an advantage in reducing blade twisting and torque when cutting harder material. Figure 2-3 shows an example of two different blade styles—a short, curved blade and long straight blade. The short blade cutter would be better suited to cutting rounded pipes or tube posts. The long blade would be better suited for cutting sheet metal or extending cutting capabilities where needed. Each battery-powered cutter has an NFPA cutter rating that indicates its ability to cut various types of metal, including round bar, flat bar, round pipe, square tube, and angle iron. Section 2.7 describes the NFPA cutter ratings in more detail.



Figure 2-3. AMKUS iS700 Short Blade Cutter (left) and AMKUS iS750 Long Blade Cutter (right)

#### 2.4 Applications

Today's vehicles have engineered crash-deflection zones or points that improve passenger safety by helping absorb impact and direct the crash away from the passenger area. Rescue crews that understand vehicle anatomy and collision crash points can perform timely vehicle extrication as a coordinated team effort. First responders using a spreader can effectively spread, squeeze, and pull damaged metal to clear a path to the victim or provide an opening in the vehicle for the use of additional tools. First responders using a cutter can cut through vehicle components to remove sections of the vehicle or provide relief cuts to displace components. First responders working together simultaneously on different areas of the vehicle can quickly gain access to a trapped or injured victim. For example, one team can work on cutting off the roof while another works to spread open the driver's side door or pull away the steering column.

The focus of this report is on cutters used in vehicle extrication. However, these tools are also used for industrial accidents, search and rescue operations in collapsed structures, trench rescue, tactical breaching, and anywhere else there is a need for power cutting.

#### 2.5 Additional Considerations

Battery-powered cutters are available with various capabilities. Additional features and greater capabilities typically translate to increased weight and cost. Agencies considering purchasing battery-powered cutters should refer to their normal vehicle extrication workload and balance their equipment needs with their operational requirements. Basic selection considerations include the weight, dimensions (length, width, height) and ergonomic design of the tool, which will impact the personnel operating the equipment.

Other factors to consider include the following:

- Ease of use
- Portability (i.e., ease of dismounting, carrying, and maneuvering in off-road environments)
- Replacement batteries (proprietary or commercially available)
- NFPA certification
- Specialized tool training requirements
- Cleaning and decontamination procedures
- Cutter blade replacement procedures
- Warranty agreements
- Maintenance requirements.

Agencies may also request a list of authorized service centers and determine if loaner equipment is available during long-term equipment repairs.

#### 2.6 Emerging Technologies

Some manufacturers have begun using Electronic Direct Drive (EDD) technology to replace hydraulics in battery-powered rescue equipment.

The EDD technology converts lithium battery power to output force and relies on a gearbox and motor.<sup>1</sup> By not using hydraulics, operators no longer risk contamination of hydraulic fluid from dust, dirt, debris, or moisture, which can damage hydraulic systems. While none of the products in this market survey employ EDD, it is currently commercially available in some cutting and combination cutting/spreading tools.<sup>2</sup>

In 2023, a cutter by Genesis Rescue System capable of cutting F7 rated rectangular tube, ultra-highstrength, low-alloy 4130 steel per NFPA guidelines is anticipated to hit the market. Additionally, technological advances are being incorporated such anti-theft features which allow remove deactivation of a tool as well as location services.

#### 2.7 Standards/Certification Programs

The National Fire Protection Association (NFPA) 1936, "Standard on Rescue Tools," 2020 Edition, describes the design, performance, testing, and compliance standards for vehicle extrication tools.

NFPA 1936 includes mandatory design criteria, including safety systems, the use of non-combustible hydraulic fluids, manual control designs, labeling, and many other features intended to improve performance and prevent injury to the operator or persons being rescued.

To assist responders in selecting equipment appropriate for their intended tasks, NFPA 1936 established requirements on the testing of rescue tools in order for them to be advertised as NFPA-compliant. This testing must be conducted by an Occupational Safety and Health Administration (OSHA)–approved third-party laboratory. Manufacturers are required to publish these results for each tool for which they wish to claim NFPA compliance. Users should be aware that while NFPA results are third-party tested, some manufacturers may still advertise "maximum" cutting force claims for their tools, which may be engineering calculations that cannot be realistically achieved due to other limiting factors, e.g., cutting force after the point where the blade opening has fully closed. This report quotes NFPA cutter ratings as measured in third-party testing, not the manufacturer's claimed maximum cutting force specification or other measures.

NFPA 1936 standardized tests applicable to battery-powered cutting tools include the cutter opening measurement, the product's operating noise level in decibels measured at 4 meters (approximately 13 feet), and the alphanumeric cutting performance levels for various material categories expressed as A#/B#/C#/D#/E#/F#. This cutting performance level is based on the ability of a cutter to cut specific grades and thicknesses of formed steel stock, including:

- A. A-36 hot-rolled round bar
- B. A-36 flat bar
- C. Schedule 40 A-53 grade B round pipe
- D. A-500 grade square tube
- E. A-36 angle iron

<sup>&</sup>lt;sup>1</sup> Text on the RESQTEC website that accompanies a graphic comparing hydraulics with EDD explains: "Fewer steps means greater efficiency. High-energy consuming components (a hydraulic pump, fluid, valves, seals & tubing) all reduce the battery's runtime, as they use precious battery energy. Eliminating these steps greatly boosts the system's efficiency." RESQTEC, "EDD Technology," [Online]. Available: <a href="mailto:rescue.resqtec.com/edd-technology-2/">rescue.resqtec.com/edd-technology-2/</a>. [Accessed 28 March 2022].

<sup>&</sup>lt;sup>2</sup> Power Hawk Technologies, Inc., "P4 Rescue Tool," [Online]. Available: <u>www.powerhawk.com/p4-rescue-tool</u>. [Accessed 28 March 2022].

The numeral following the letter designator indicates the increasing thickness of the stock on a scale from 1 to 9, with designated dimensions unique to each test piece. For example, for the rating of D3, the D means that the tool is can cut an A-500 Grade Square Tube, and the 3 means that the tool can cut through the dimension of 1 inch by 0.08 inch of thickness. For each of the materials, A–E, the cutter must, in one continuous motion, completely sever the material. The test must be repeated a minimum of 12 times with the thickest material in each of the five categories. The cutter must sever the thinnest material in each of the five categories to pass the NFPA 1936 cutter test (see Figure 2-4).

Material Category	A Round Bar	B Flat Bar	Ro	C ound Pipe	D Square Tube	E Angle Iron
	6			6		d'
Material	A-36 Hot-Rolled	A-36	Schedule	40 A-53 Grade B	A-500 Grade	A-36
Performance Level	Diameter (in.)	Thickness × Width (in. × in.)	Nominal size (in.)	OD × Wall Thickness (in. × in.)	Dimension × Wall Thickness (in. × in.)	Square Dimension × Thickness (in. × in.)
1	3%	1/4 × 1/2	3∕8	0.68 × 0.09	$\frac{1}{2}$ $\times$ 0.06	1/2 × 1/a
2	1/2	¼ × 1	3⁄4	1.05 × 0.11	$1\frac{3}{4} \times 0.06$	1 × ½
3	5%	¼ × 2	1	1.32 × 0.13	1 × 0.08	11/4 × 3/16
4	3⁄4	¼ × 3	11/4	1.66 × 0.14	$1\frac{1}{4} \times 0.12$	1½ × ¾
5	7/8	¼ × 4	11/2	1.90 × 0.15	1½ × 0.12	1½ × ¼
6	1	¾ × 3	2	$2.38 \times 0.15$	$1\frac{3}{4} \times 0.12$	1¾ × ¼
7	11⁄4	3% × 4	21/2	2.88 × 0.20	2 × 0.15	1½ × ¾
8	1½	¾ × 5	3	3.50 × 0.22	21/2 × 0.19	2 × ¾
9	1¾	3% × 6	31/2	4.00 × 0.23	3 × 0.19	2½ × ¾

For SI units 1 in. = 25.4 mm.

FIGURE 5.6.13.3 Cut Testing and Level Performance Rating.

#### Figure 2-4. Cut test and level performance rating chart from NFPA 1936

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With the most recent release of NFPA 1936, an optional F# test was added for manufacturers who claim the ability of their tool to cut high-strength materials. The specific material required for the high-strength materials cutting test is:

F. Rectangular Tube, Ultra High-Strength, Low-Alloy 4130 steel per American Materials Specifications (AMS) 6371, heat treated to a minimum 32 Rockwell Hardness (HRC) profile per the American Society for Testing and Materials (ASTM) A519/A519M

This test was designed to mimic the materials used in some modern vehicle roof pillars. For material F, the cutter must, in one continuous motion, completely sever the material. The test must be repeated a minimum of six times with the thickest material claimed (see Figure 2-5). Failure to successfully complete the high-strength material cutting test does not constitute failure of the NFPA 1936 cutting test detailed in the preceding paragraphs.

Material Category Material	F Rectangul Ultra High-3 Low-A 4130 per Al H/T to min 3 Profile per ASTM	Aar Tube Strength Iloy MS 6371 32 HRC A519/A519M
Performance Level	Outside Dimensions	× Wall Thickness
	$mm \times mm \times mm$	in. $\times$ in. $\times$ in.
1	25 × 50 × 1.7	$1 \times 2 \times 0.065$
2	$25 \times 50 \times 2.1$	$1 \times 2 \times 0.083$
з	$25 \times 50 \times 3.04$	$1 \times 2 \times 0.120$
4	50 × 76 × 3.178	$2 \times 3 \times 0.125$
5	$50 \times 76 \times 4.78$	2 × 3 × 0.188
6	50 × 101 × 4.78	$2 \times 4 \times 0.188$
7	50 × 101 × 6.4	$2 \times 4 \times 0.250$

FIGURE 5.6.15.1 High-Strength Materials Cut and Level Performance Rating.

#### Figure 2-5. High-strength materials cut and level performance rating chart from NFPA 1936

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NFPA 1937, "Standard for the Selection, Care, and Maintenance of Rescue Tools," 2021 Edition [4] provides best practices for agencies to use in procurement, inspection, operations, ongoing maintenance, and recordkeeping. Prior to purchasing battery-powered rescue tools, agencies should review the selection section of NFPA 1937, particularly as it relates to conducting a risk assessment of the potential hazards anticipated, operating restrictions, usage frequency, service requirements, and environmental factors specific to their jurisdiction.

## **3.0 CUTTERS**

This section provides information on 17 battery-powered cutters. General characteristics and specifications of the products are provided in Table 3-1. The tools are listed alphabetically by manufacturer in the specifications table and in the tool descriptions. The SAVER program obtained the product information presented in this report directly from manufacturers, vendors, and their websites, from March to July 2022. In some cases, manufacturers do not have or publish all available specifications on their tools. It is highly recommended to request and obtain the most current specifications from the vendor or manufacturer when requesting a quote. The information in Section 3.0 has not been independently verified by the SAVER program.

Below are definitions of the product information in Table 3-1, listed in column order.

Weight: This refers to the weight of the rescue tool in a ready-to-use configuration with the battery.

**Dimensions:** This refers to the rescue tool's overall dimensions (in length, width, and height) in a ready-to-use configuration.

**NFPA Cutter Opening:** This refers to the smallest distance between the cutter blade tips with the cutter blades fully opened.

**NFPA Cutter Rating:** This is a standard measurement for a cutter's performance against various materials, including A: round bar, B: flat bar, C: round pipe, D: square tube, E: angle iron, and F: rectangular tube. The numbers correspond to the thickness of the material. The higher the number, the stronger the tool (see Figures 2-4 and 2-5).

**Power Supply:** The source of power for the tool unit; for all products in this market survey, a removeable/replaceable battery is specifically identified for each product in Table 3-1

**COTS (Power Supply):** This indicates whether the power supply is available as a commercial off-theshelf (COTS) battery. Cutters that use a COTS battery are designated with a "Yes" and those that use a proprietary battery from the cutter manufacturer are designated with a "No."

**IP Rating:** The Ingress Protection (IP) rating is used to identify the level of protection an electrical enclosure provides against environmental conditions to include solids and liquids. The first IP number indicates the protection level against solids and second IP number indicates the protection level against liquids. For example, for the rating of IP54, the 5 means that the tool is dust-protected (but not dust tight), and the 4 means that the tool can withstand water splashing from any direction. For the rating of IP58, the tool is dust-protected (but not dust tight), and the tool is dust-protected (but not dust tight), and the tool can be immersed in water beyond 1 meter with no harmful effects. Appendix A describes the ratings. For products where IP rating information was not available "--" is indicated in the table.

**MSRP:** This is the manufacturer suggested retail price (MSRP) in U.S. dollars. It only includes what comes standard with the rescue tool. Sometimes batteries, chargers, and other accessories are not included in the base price and must be purchased separately.

Cutter Manufacturer and Model	Weight (Ib.)	Dimensions (L x W x H) (in.)	NFPA Cutter Opening (in.)	NFPA Cutter Rating	Power Supply	COTS (Power Supply)	IP Rating	MSRP
AMKUS Rescue ION iC550	48.3	30.6 x 9.5 x 9.5	5.8	A6/B5/C6/D7/E7	DeWalt FLEXVOLT 60V	Yes	-	\$9,970
AMKUS Rescue ION iC700	56.6	32.7 x 8.7 x 11.6	5.8	A7/B8/C7/D9/E8/F4	DeWalt FLEXVOLT 60V	Yes	-	\$11,250
AMKUS Rescue ION iC750	57.3	33.7 x 8.7 x 11.6	7	A8/B9/C7/D9/E9/F4	DeWalt FLEXVOLT 60V	Yes	-	\$11,250
Genesis ALL9 EFORCE	58	40.5 x 11.7 x 9.5	10.2	A9/B9/C9/D9/E9	Milwaukee 28V	Yes	IP54	\$14,420
Genesis C195-SL3 NXTGEN	45.4	35.4 x 9.3 x 9.5	7.3	A8/B9/C7/D9/E9/F4	Milwaukee 28V	Yes	IP54	\$12,930
Genesis C236-SL3	51.8	38.7 x 10.2 x 9.5	8.3	A8/B9/C8/D9/E9/F4	Milwaukee 28V	Yes	IP54	\$12,720
Genesis C365-SL3	56.9	38.6 x 11.7 x 9.5	6.7	A8/B9/C8/D9/E9/F5	Milwaukee 28V	Yes	IP54	\$14,420
Holmatro PCU30CL	33.7	31.9 x 10.6 x 11.3	6.7	A6/B5/C6/D6/E6/F2	28V Lithium- Ion (Li-ion) battery	No	IP57	\$11,535
Holmatro PCU40	41.9	32.8 x 10.6 x 11.8	6.7	A7/B7/C6/D7/E8/F3	28V Li-ion battery	No	IP57	\$12,095
Holmatro PCU50	47.4	35.1 x 10.6 x 10.8	7.2	A8/B8/C7/D9/E9/F4	28V Li-ion battery	No	IP57	\$12,480

 Table 3-1. Battery-Powered Cutter Specifications and Features

Cutter Manufacturer and Model	Weight (Ib.)	Dimensions (L x W x H) (in.)	NFPA Cutter Opening (in.)	NFPA Cutter Rating	Power Supply	COTS (Power Supply)	IP Rating	JASM
Holmatro PCU60	55.1	37.3 x 10.6 x 13	8.1	A9/B9/C9/D9/E9/F4	28V Lithium- Ion	No	IP57	\$13,660
HURST S 377 E2	45.2	36.8 x 9.3 x 11.1	8.1	A7/B8/C7/D7/E8	HURST EXL eDRAULIC 5 Amp-hour (Ah) battery	No	IP54	\$11,020
HURST S 788 E2	52.6	38.9 x 10.5 x 11.1	7.9	A8/B9/C8/D9/E9/F4	HURST EXL eDRAULIC 5 Ah battery	No	IP54	\$11,850
HURST S 799 E2	58.4	39.8 x 10.9 x 11.1	8.0	A9/B9/C9/D9/E9/F5	HURST EXL eDRAULIC 5 Ah battery	No	IP58	\$12,850
HURST S 378 E3	43.2	33.3 x 9.3 x 10.0	8.0	A7/B8/C7/D8/E8/F4	HURST 5 Ah or 9 Ah battery	No	IP58	\$12,142
HURST S 789 E3	52.2	35.7 x 10.5 x 10.0	8.1	A8/B9/C8/D9/E9/F5	HURST 5 Ah or 9 Ah battery	No	IP58	\$12,951
HURST S 799 E3	57.3	36.6 x 10.4 x 10.0	8.0	A9/B9/C9/D9/E9/F5	HURST 5 Ah or 9 Ah battery	No	IP58	\$13,930

#### 3.1 AMKUS Rescue Tools

The AMKUS Rescue Tools ION series cutters are constructed of an aluminum alloy. The cylindrically shaped housing contains an electric direct-current (DC) motor, hydraulic pump, and electronics used to drive mechanical linkages that drive the cutter blades. Each ION series cutter operates on a COTS 60V DeWalt FLEXVOLT lithium-ion battery that mounts to the top of tool. A rotary-wheel control valve actuator controls the motor and hydraulic pump and has three operating positions: open, off (neutral), and close. The control valve actuator is equipped with a "deadman" safety feature, stopping the unit when the operator releases pressure from the actuator.



Figure 3-1. AMKUS Cutter
Image Credit: AMKUS Rescue Systems

The startup time for each AMKUS ION series

cutter is instant, and the average run time for the cutters is 45 minutes. The tool shuts down automatically after being idle for 20 minutes. The cutter blades and center bolt are designed to be narrow to give the AMKUS cutter improved access to cutting surfaces. The ION series cutter has 360-degree, lockable, rotating handles and dual LED lights built into the tool's handle. The LED lights have three levels of intensity and are powered separately using CR123 batteries. The LED lights have a battery-saving feature that automatically shuts them off after 15 minutes of inactivity.

The AMKUS ION series cutters are NFPA 1936 compliant. Data on IP ratings or operating noise levels for the AMKUS tools was not available. AMKUS cutters have an operating temperature range of -25°F to 140°F. AMKUS electric motors, batteries, and chargers are not waterproof and are not intended for immersion. Each tool has an AMKUS warranty that covers defects in material and workmanship for 10 years from the date of manufacture for the original owner. The MSRP for each spreader is listed below under the individual tools. Batteries and battery chargers are purchased separately. The 60V DeWalt FLEXVOLT lithium-ion battery cost is estimated at \$320.

AMKUS carries three models of ION battery-powered rescue cutters: the iC550, the iC700, and the iC750.

#### 3.1.1 AMKUS iC550

The AMKUS iC550 Cutter, as shown in Figure 3-2, is AMKUS's smallest and lightest battery-powered cutter. The iC550 weighs 48.3 pounds and measures 30.6 inches long, 9.5 inches wide, and 9.5 inches high. The iC550 has a cutter opening of 5.8 inches and an NFPA cutter rating of A6/B5/C6/D7/E7. The AMKUS iC550 has an MSRP of \$9,970, which does not include the cost of the batteries.



Figure 3-2. AMKUS iC550 Image Credit: AMKUS Rescue Systems

#### 3.1.2 AMKUS iC700

The AMKUS iC700 Cutter, as shown in Figure 3-3, has shorter cutting blades to reduce twist and torque when cutting harder materials like ultra-high strength steel. The short cutting blades also increase the cutting speed of the iC700. The iC700 weighs 56.6 pounds and measures 32.7 inches long, 8.7 inches wide, and 11.6 inches high. The iC700 has a cutter opening of 5.8 inches and an NFPA cutter rating of A7/B8/C7/D9/E8/F4. The AMKUS iC700 has an MSRP of \$11,250, which does not include the cost of the batteries.

#### 3.1.3 AMKUS iC750

The AMKUS iC750 Cutter, as shown in Figure 3-4, is AMKUS's largest and heaviest battery-powered cutter. The iC750 is a large blade cutter that weighs 57.3 pounds and measures 33.7 inches long, 8.7 inches wide, and 11.6 inches high. The iC750 has a cutter opening of 7 inches and an NFPA cutter rating of A8/B9/C7/D9/E9/F4. The AMKUS iC750 has an MSRP of \$11,250, which does not include the cost of the batteries.

#### 3.2 Genesis Rescue Systems

The Genesis Rescue Systems EFORCE series of battery-powered extrication tools are constructed of anodized aluminum and tool steel housing. Each tool contains an electric DC motor, piston-driven high-pressure hydraulic pump, and electronics used to drive mechanical linkages that open or close the blades to cut objects. Genesis Rescue Systems uses a COTS Milwaukee 28V battery. The Milwaukee batteries have an estimated run time of 20–25 minutes and charge in less than an hour. They have a push-button indicator to show remaining charge left in the battery. Milwaukee batteries have overload protection to prevent damage to the tool in heavy-duty situations and discharge protection to prevent cell damage. The battery mounts on the rear of the control handle using sliding rails. Milwaukee batteries have a 3-year warranty.

The Genesis Rescue Systems EFORCE battery-powered tools are activated using the on/off switch on top of the control handle with operating functions using the rocker lever located below the control handle. Each tool has a startup time of about 1–2 seconds. The rocker lever controls the opening and closing of the motor. The tool will run as long as the rocker level is actuated.

The Genesis EFORCE battery-powered tools are NFPA 1936 compliant. They have an operating temperature range between -4°F and +132°F. The Genesis EFORCE systems have an ingress protection rating of IP54 (i.e., protected against dust and splashes). Genesis EFORCE tools should not be operated in submerged conditions. Genesis Rescue Systems does not test their tools for noise output, so noise output data is not available. Each Genesis EFORCE has a tool lifetime (estimated at 10 years) manufacturer's defect warranty with no extended warranties. Genesis offers in-service training with the purchase of the tools. Annual service for Genesis tools is recommended. Maintenance can be performed by a local Genesis vendor or in-house by Genesis trained personnel.

The MSRP for each cutter is listed under the individual tool descriptions. The MSRP for the tool does not include the required batteries and chargers.



Figure 3-4. AMKUS iC750 Cutter Image Credit: AMKUS Rescue Systems



Figure 3-3. AMKUS iC700

Image Credit: AMKUS Rescue Systems

The Milwaukee 28V battery cost is estimated to range from \$160-\$230. Accessories such as the Genesis E-Pack E28 Power Bank are available for purchase separately. The Genesis EFORCE series has four models of battery-powered cutters: All9 EFORCE, C195-SL3, EFORCE, C236-SL3 EFORCE, and the C365-SL3 EFORCE.

#### 3.2.1 Genesis Rescue Systems All9 EFORCE

The Genesis All9 EFORCE Cutter, as shown in Figure 3-5, weighs 58 pounds and measures 40.5 inches long, 11.7 inches wide, and 9.5 inches high. The tool uses a brushless drive motor and has a cutter opening of 10.2 inches with an NFPA cutter rating of A9/B9/C9/D9/E9. The All-9 EFORCE has an MSRP of \$14,420.

#### 3.2.2 Genesis Rescue Systems C195-SL3 EFORCE

The Genesis C195-SL3 EFORCE Cutter, as shown in Figure 3-6, weighs 45.4 pounds and measures 35.4 inches long, 9.3 inches wide, and 9.5 inches high. The tool has a cutter opening of 7.3 inches with an NFPA cutter rating of A8/B9/C7/D9/E9/F4. The Genesis C195-SL3 is equipped with replaceable NXTgen blades as shown in Figure 3-6. NXTgen cutting blades are made from a high strength alloy and are inserted on the cutting edges of the cutting blades. The NXTgen inserts can be easily changed to maintain sharpness of the cutting edge. The Genesis C195-SL3 has an MSRP of \$12,930.

#### 3.2.3 Genesis Rescue Systems C236-SL3 EFORCE

The Genesis C236-SL3 EFORCE Cutter, as shown in Figure 3-7, weighs 51.8 pounds and measures 38.7 inches long, 10.2 inches wide, and 9.5 inches high. The tool has a cutter opening of 8.3 inches with an NFPA cutter rating of A8/B9/C8/D9/E9/F4. The Genesis C236-SL3 can optionally be equipped with NXTgen blades as shown in Figure 3-7. NXTgen cutting blades are made from a high strength alloy and are inserted on the cutting edges of the cutting blades. The NXTgen inserts can be easily changed to maintain sharpness of the cutting edge. The Genesis C236-SL3 has an MSRP of \$12,720.

#### 3.2.4 Genesis Rescue Systems C365-SL3 EFORCE

The Genesis C365-SL3 EFORCE Cutter, as shown in Figure 3-8, weighs 56.9 pounds and measures 38.6 inches long, 11.7 inches wide, and 9.5 inches high. The tool has a cutter opening of 6.7 inches with an NFPA cutter rating of A8/B9/C8/D9/E9/F5. The Genesis C365-SL3 EFORCE has an MSRP of \$14,420.



Figure 3-5. All9 EFORCE Image Credit: Genesis Rescue Systems



Figure 3-6. C195-SL3 EFORCE with NXTGEN Blade Inserts

Image Credit: Genesis Rescue Systems



Figure 3-7. C236-SL3 EFORCE with NXTGEN Blade Inserts

Image Credit: Genesis Rescue Systems



Figure 3-8. C365-SL3 EFORCE Image Credit: Genesis Rescue Systems

#### 3.3 Holmatro Rescue Systems

The Holmatro Pentheon series of cutting tools feature a blade canted down at a 30° cutting angle, and a patented flat central bolt, the i-Bolt (see Figure 3-9), that allows the cutter better access to confined spaces due to its smaller size compared to a traditional bolt. The combination of inclined

cutting angle and the 360° carrying and control handle on Holmatro cutting tools is intended to give rescuers better ergonomics to make high and low cuts. Holmatro Pentheon rescue tools are based on an integrated hydraulic pump that allows for stepless speed maximization. The motor and pump are controlled by an electrical and mechanical (mechatronic) system designed to deliver the maximum oil flow over the full pressure range.



Figure 3-9. Holmatro i-bolt design Image Credit: Holmatro

The mechatronic system replaces the changeover valves in traditional multi-pump systems. The electric motor and the hydraulic pump share the same shaft, allowing for a smaller tool.

Holmatro Pentheon Cutters use a proprietary 28.8V battery that has a semi-circular shape that fits around the tool. Holmatro batteries will operate for approximately 60 minutes and take about 60 minutes to recharge. The battery has a reserve power feature that will generate enough power to remove the tool from a cut without "hot swapping" the battery. Using a daisy chain power cord, the battery can be charged while on the cutter (when not operational) via a magnetic connection from the charger. Additionally, while plugged into the charger a spare battery and the battery on the tool can charge concurrently, ; in that case, the battery on the tool is prioritized. LED indicators on the tool, battery, and charger provide information on the battery temperature, state of charge, and state of health.



Figure 3-10. Holmatro's integrated motor and pump design Image Credit: Holmatro

Holmatro cutting tools can operate in low- and high-speed modes using the centrally positioned control handle at the back of the tool. Operators can manipulate the control handle from any position along the 360° carrying handle at the front of the tool. The carrying handle has built-in LED lights that are powered by the main battery. At maximum pressure, the maximum force indicator LED illuminates, accompanied by an audible warning. Holmatro Pentheon cutters use an automatic start/stop and "deadman" feature to preserve battery life. The cutter turns off when not being used and stops at maximum pressure to save energy.

The Holmatro Pentheon series cutters are NFPA 1936 compliant. They operate in temperatures from -4°F to 131°F and have an IP57 rating. The battery packs have an IP67 rating. The Holmatro Pentheon cutting tools can operate while completely submerged in fresh or salt water up to a maximum depth of 3.28 feet for 60 minutes. The battery pack can be changed while the tool is submerged. Annual maintenance by a Holmatro Certified Technician is recommended. Holmatro offers a training program for agencies so that they can conduct in-house maintenance.

Each tool has a lifetime Holmatro warranty that covers defects in material and workmanship for the original owner. The electronic circuit boards inside the tools are warrantied for 1 year and the batteries are warrantied for 2 years. The MSRP for each cutter, which includes two batteries and a charger, is listed within the individual tool sections. Optional accessories include an extra battery for \$734 and a 24 VDC battery charger for \$494. Other optional accessories are a daisy chain power cord, on-tool charging cord, tool diagnostics cord, battery diagnostics tool, and mains power connector.

Holmatro carries four models of Pentheon battery-powered rescue cutters: the PCU30CL, the PCU40, the PCU50, and the PCU60.

#### 3.3.1 Holmatro Pentheon PCU30CL

The Holmatro Pentheon PCU30CL Cutter, as shown in Figure 3-11, is Holmatro's compact and light (CL) cutter. The PCU30CL weighs 33.7 pounds and measures 31.9 inches long, 10.6 inches wide, and 11.3 inches high. The tool uses a five-stage pump and has a cutter opening of 6.7 inches. The PCU30CL has an NFPA cutter rating of A6/B5/C6/D6/E6/F2 and an operating noise level of 66 dBA at 13 feet (or 4 meters). The Holmatro Pentheon PCU30CL has an MSRP of \$11,535.

#### 3.3.2 Holmatro Pentheon PCU40 Cutter

The Holmatro Pentheon PCU40 Cutter, as shown in Figure 3-12, weighs 41.9 pounds and measures 32.8 inches long, 10.6 inches wide, and 11.8 inches high. The tool uses a five-stage pump and has a cutter opening of 6.7 inches. The PCU40 has an NFPA cutter rating of A7/B7/C6/D7/E8/F3 and an operating noise level of 66 dBA at 13 feet. The Holmatro Pentheon PCU40 cutter has an MSRP of \$12,095.

#### 3.3.3 Holmatro Pentheon PCU50 Cutter

The Holmatro Pentheon PCU50, as shown in Figure 3-13, weighs 47.4 pounds and measures 35.1 inches long, 10.6 inches wide, and 10.8 inches high. The tool uses a five-stage pump and has a cutter opening of 7.2 inches. The PCU50 has an NFPA cutter rating of A8/B8/C7/D9/E9/F4 and an operating noise level of 66 dBA at 13 feet. The Holmatro Pentheon PCU50 cutter has an MSRP of \$14,000.

#### 3.3.4 Holmatro Pentheon PCU60 Cutter

The Holmatro Pentheon PCU60, as shown in Figure 3-14, weighs 55.1 pounds and measures 37.3 inches long, 10.6 inches wide, and 13 inches high. The tool uses a five-stage pump and has a cutter opening of 8.1 inches. The PCU60 has an NFPA cutter rating of A9/B9/C9/D9/E9/F4 and an operating noise level of 66 dBA at 13 feet. The Holmatro Pentheon PCU60 cutter has an MSRP of \$13,660.



Figure 3-11. PCU30CL Cutter Image Credit: Holmatro



Figure 3-12. PCU40 Cutter Image Credit: Holmatro



Figure 3-13. PCU50 Cutter Image Credit: Holmatro



Figure 3-14. PCU60 Cutter Image Credit: Holmatro

#### 3.4 HURST Jaws of Life

The HURST Jaws of Life battery-powered rescue cutters are constructed of an anti-corrosive aluminum alloy. The cylindrically shaped housing contains an electric, brushless, DC motor, a hydraulic pump, and electronics used to drive mechanical linkages that open or close the blades to cut objects. A star-grip control valve actuator controls the motor and hydraulic pump and is equipped with a "deadman" safety feature that stops the unit when the operator releases pressure from the actuator. Each tool features two LED work lights that are powered by the main lithium-ion tool battery.

Each HURST Jaws of Life cutter operates on a proprietary HURST battery, which differs between HURST cutter lines as detailed below. HURST batteries operate for roughly 50 minutes and take approximately two hours to recharge. The battery mounts to the rear of the tool.

The HURST cutters have slightly curved blades made of dropped-forged alloy tool steel, which has a sandblasted finish and can be reground to be sharpened. The blades of the tool are attached to the piston rod via removable links. The HURST cutters have a rear, fixed handle forward of the battery, and a crossbar-style handle at the base of the cutter jaws to provide a 180-degree grip from either side of the tool. All HURST rescue cutters have an operating temperature range of  $-22^{\circ}$ F to  $+140^{\circ}$ F.

All HURST cutters are NFPA 1936 compliant. Each tool has a HURST warranty that covers defects in material and workmanship for 3 years from the date of manufacture for the original owner. After 3 years, the tool is warranted for parts replacement only (no labor) for an additional 7 years. HURST Jaws of Life provides training with the purchase of their tools. HURST recommends annual maintenance of their rescue tools. Maintenance can be performed by local HURST dealers or HURST can train agencies to conduct their own annual maintenance. The MSRP for each cutter is listed under the individual tool descriptions. All tools are delivered with two tool proprietary batteries, either 5Ah or 9Ah, and a battery charger. HURST has optional 110V battery adapters which can be used to directly power the cutters if 110V AC power is available. Additional batteries can be purchased separately. The 5Ah battery cost is estimated at \$700 and the 9Ah battery cost is estimated at \$800.

HURST Jaws of Life carries two lines of battery-powered rescue cutters: E2 eDRAULIC Cutters and E3 Cutters. The HURST E2 eDRAULIC series of battery-powered rescue cutters has three models—the S377 E2, the S788 E2, and the S799 E2—and uses the HURST proprietary 5Ah battery. There are three models of HURST E3 series battery-powered rescue cutters—the S378 E3, the S789 E3, and the S799 E3—which can be powered by either the HURST 5Ah battery or the larger HURST 9Ah battery.

#### 3.4.1 HURST E2 eDRAULIC Series Cutters

E2 series cutters are IP54 rated, with dust protection and splash protection, but are not rated for underwater immersion. E2 series cutters use proprietary HURST EXL eDRAULIC 5 Ah batteries, which also have an IP54 rating.

#### 3.4.1.1 HURST S377 E2 eDRAULIC Cutter

The HURST S377 E2 eDRAULIC Cutter, as shown in Figure 3-15, is the smallest and lightest rescue cutter in the E2 eDRAULIC line. The cutter weighs 45.2 pounds and measures 36.8 inches long, 9.3 inches wide, and 11.1 inches high.



Figure 3-15. HURST S377 E2 Image Credit: HURST Jaws of Life

The tool has a cutter opening of 8.1 inches and an NFPA cutter rating of A7/B8/C7/D7/E8. The tool has an operating noise level of 71 dBA at 13 feet. The HURST S377 E2 eDRAULIC has an MSRP of \$11,020.

#### 3.4.1.2 HURST S788 E2 eDRAULIC Cutter

The HURST S788 E2 eDRAULIC Cutter, as shown in Figure 3-16, weighs 52.6 pounds and measures 38.9 inches long, 10.5 inches wide, and 11.1 inches high. The tool has a cutter opening of 7.9 inches and an NFPA cutter rating of A8/B9/C8/ D9/E9/F4. The tool has an operating noise level of 71 dBA at 13 feet. The HURST S788 E2 eDRAULIC has an MSRP of \$11,850.

#### 3.4.1.3 HURST S799 E2 eDRAULIC Cutter

The HURST S799 E2 eDRAULIC Cutter, as shown in Figure 3-17, is the heaviest and strongest cutter in the HURST eDRAULIC cutter line. The S799 E2 weighs 58.4 pounds and measures 39.8 inches long, 10.9 inches wide, and 11.1 inches high. The tool has a cutter opening of 8.0 inches and an NFPA cutter rating of A9/B9/C9/D9/E9/F5. The tool has an operating noise level of 71 dBA at 13 feet. The HURST S799 E2 eDRAULIC has an MSRP of \$12,850.

#### 3.4.2 HURST E3 Series Cutters



Figure 3-16. HURST S788 E2 Image Credit: HURST Jaws of Life



Figure 3-17. HURST S799 E2 Image Credit: HURST Jaws of Life

The E3 series cutters include a Turbo function, which allows the cutter blades to move at faster speeds when the tool is working at low pressure levels. E3 series cutters can operate while submerged in both fresh water and saltwater at a maximum depth of 11 feet for 60 minutes using the HURST Jaws of Life 9 Ah battery. The E3 series of cutter has a control panel with indicators for battery level, a load indicator for working tool pressure, an indicator light for the tool's Turbo function, an indicator light to show that a saltwater-compatible battery is installed, a warning light for electronics temperature, and an illuminated direction indicator showing the direction in which the star grip control is activated.

The E3 series of cutters has a "Connect" option that is sold as the E3 Connect series. The E3 Connect series of cutters has the same identical base capabilities as the E3 series but includes an additional Wi-Fi connectivity function. This function enables the tool to wirelessly transmit usage data to HURST's secure cloud servers to facilitate maintenance scheduling, automatically maintain agency usage logs, and conduct detailed error logging.

#### 3.4.2.1 HURST S378 E3 Cutter

The HURST S378 E3 Cutter, as shown in Figure 3-18, is the smallest and lightest rescue cutter in the E3 line. The cutter weighs 43.2 pounds and measures 33.3 inches long, 9.3 inches wide, and 10.0 inches high. The tool has a cutter opening of 8 inches and an NFPA cutter rating of A7/B8/C7/D8/E8/F4. The tool has an operating noise level of 67 dBA. The HURST S378 E3 has an MSRP of \$12,142.

#### 3.4.2.2 HURST S789 E3 Cutter

The HURST S378 E3 Cutter, as shown in Figure 3-19, weighs 52.2 pounds and measures 35.7 inches long, 10.5 inches wide, and 10.0 inches high. The tool has a cutter opening of 8.1 inches and an NFPA cutter rating of A8/B9/C8/D9/E9/F5. The tool has an operating noise level of 67 dBA. The HURST S378 E3 has an MSRP of \$12,951.

#### 3.4.2.3 HURST S799 E3 Cutter

The HURST S789 E3 Cutter, as shown in Figure 3-20, is the heaviest and strongest cutter in the HURST E3 cutter line. The HURST S799 E3 weighs 57.3 pounds and measures 36.6 inches long, 10.4 inches wide, and 10.0 inches high. The tool has a cutter opening of 8 inches and an NFPA cutter rating of A9/B9/C9/D9/ E9/F5. The tool has an operating noise level of 69 dBA. The HURST S799 E3 has an MSRP of \$13,390.



Figure 3-18. HURST S378 E3 Image Credit: HURST Jaws of Life



Figure 3-19. HURST S789 E3 Image Credit: HURST Jaws of Life



Figure 3-20. HURST S799 E3 Image Credit: HURST Jaws of Life

## 4.0 MANUFACTURER AND VENDOR CONTACT INFORMATION

In the United States, most battery-powered rescue tools are sold through dealers based upon location. Manufacturers' websites usually provide links to locate vendors. Additional information on the cutters included in this market survey report can be obtained from the manufacturers and vendors listed in Table 4-1.

Manufacturer	Address	Phone Number	E-mail or Web Form	Website
AMKUS	4201 Montdale Dr. Valparaiso, IN 46383	(800) 592-6587	https://amkus.com/Support	www.amkus.com
Genesis	2780 Culver Ave. Kettering, OH 45429	(937) 293-6240	https://genesisrescue.com/ dealer-locator/	www.GenesisRescue.com
Holmatro	505 McCormick Dr. Glen Burnie, MD 21061	(410) 768-9662	info@holmatro.com	www.holmatro.com
HURST	711 N. Post Rd. Shelby, NC 28150	(800) 537-2659	contacthurst@idexcorp.com	www.JawsofLife.com

#### Table 4-1. Manufacturer and Vendor Contact Information

## **5.0 CONCLUSIONS**

Advances in batteries, tool design, and performance have greatly improved the capabilities and effectiveness of battery-powered rescue tools. The portability and ease of deployment of battery-operated rescue tools have improved emergency responder access to hard-to-reach areas, decreased set-up times, and sped up the response to trapped victims.

This market survey report provides information on 17 battery-powered cutters, all of which are singleperson portable, battery-powered, self-contained, and NFPA 1936 compliant. Their prices range from \$9,970 to \$14,420. These tools vary in size, weight, features, and performance. Each manufacturer offers a range of models that differ based upon size and cutter opening. Cutter weights range from 33.7 pounds to 58.4 pounds with cutter openings ranging from 5.8 inches to 10.2 inches. Typically, as the size of the cutter increases, the cutter opening becomes larger and cutter ratings become greater, as defined by National Fire Protection Association performance specifications. Seven of the cutters are powered by COTS batteries which may be more readily available, while ten cutters use a proprietary battery that may offer other capabilities such as the ability to be charged while installed on the tool. Additionally, features such as the capability of in-house maintenance, ingress protection ratings, and training offerings may also be of interest to responder agencies.

Emergency responder agencies should carefully research the overall capabilities and limitations of battery-powered cutters for vehicle extrication in relation to their agency's operational needs when making procurement or acquisition decisions.

## Appendix A. INGRESS PROTECTION LEVELS (IP CODE)

This section provides information on the levels of ingress protection as specified by the 2-digit designations in the IEC 60529 standard [5]. Table A-1 provides levels of solid ingress protection (first digit). Table A-2 provides levels of liquid ingress protection (second digit).

Digit	Object Size Effective Against	General Description
0	No Protection	No protection against contact and ingress of solids
1	> 50 mm	Large surfaces, e.g., back of hand, but no protection against deliberate contact with body part
2	> 12.5 mm	Prevents entry of fingers and similarly sized objects
3	> 2.5 mm	Prevents entry of tools, thick wires, etc.
4	> 1 mm	Prevents entry of most wires, screws, large ants, etc.
5	Dust Protected	Dust ingress not entirely prevented but does not enter in sufficient quantity to interfere with satisfactory operation of equipment
6	Dust Tight	No ingress of dust

#### Appendix Table A-1. Levels of Solid Ingress Protection per First Digit of IP Code

#### Appendix Table A-2. Levels of Liquid Ingress Protection per Second Digit of IP Code

Digit	Water Exposure Protection	General Description
0	No Protection	No protection
1	Vertically dripping water	Vertically dripping water has no harmful effects
2	Dripping water, enclosure tilted up to 15 degrees	Vertically dripping water has no harmful effects when enclosure is tilted at an angle up to 15 degrees of normal vertical position
3	Spraying water	Water sprayed at angles up to sixty degrees from the vertical position has no harmful effects
4	Splashing water	Water splashed against the enclosure from any direction has no harmful effect
5	Water jets	Water projected by a nozzle (6.3 mm) against enclosure from any direction has no harmful effects

Digit	Water Exposure Protection	General Description
6	Powerful water jets	Water projected in powerful jets against the enclosure from any direction has no harmful effects
7	Temporary immersion in water	Ingress of water in harmful quantity is not possible when the enclosure is temporarily immersed in water under standard conditions or pressure and time
8	Continuous immersion in water	The equipment is suitable for continuous immersion in water under conditions more severe than for numeral 7

## 6.0 REFERENCES

- [1] National Fire Protection Association, "NFPA 1936: Standard on Rescue Tools," [Online]. Available: <u>https://www.nfpa.org/codes-and-standards/all-codes-and-standards/list-of-codes-and-standards/detail?code=1936</u>.
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- [3] HURST, "Hurst Jaws of Life," [Online]. Available: <u>https://www.jawsoflife.com/why-hurst#history</u>. [Accessed 22 March 2022].
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- [5] "IP Ratings," International Electrotechnical Commission, 2021. [Online]. Available: <u>https://www.iec.ch/ip-ratings</u>.