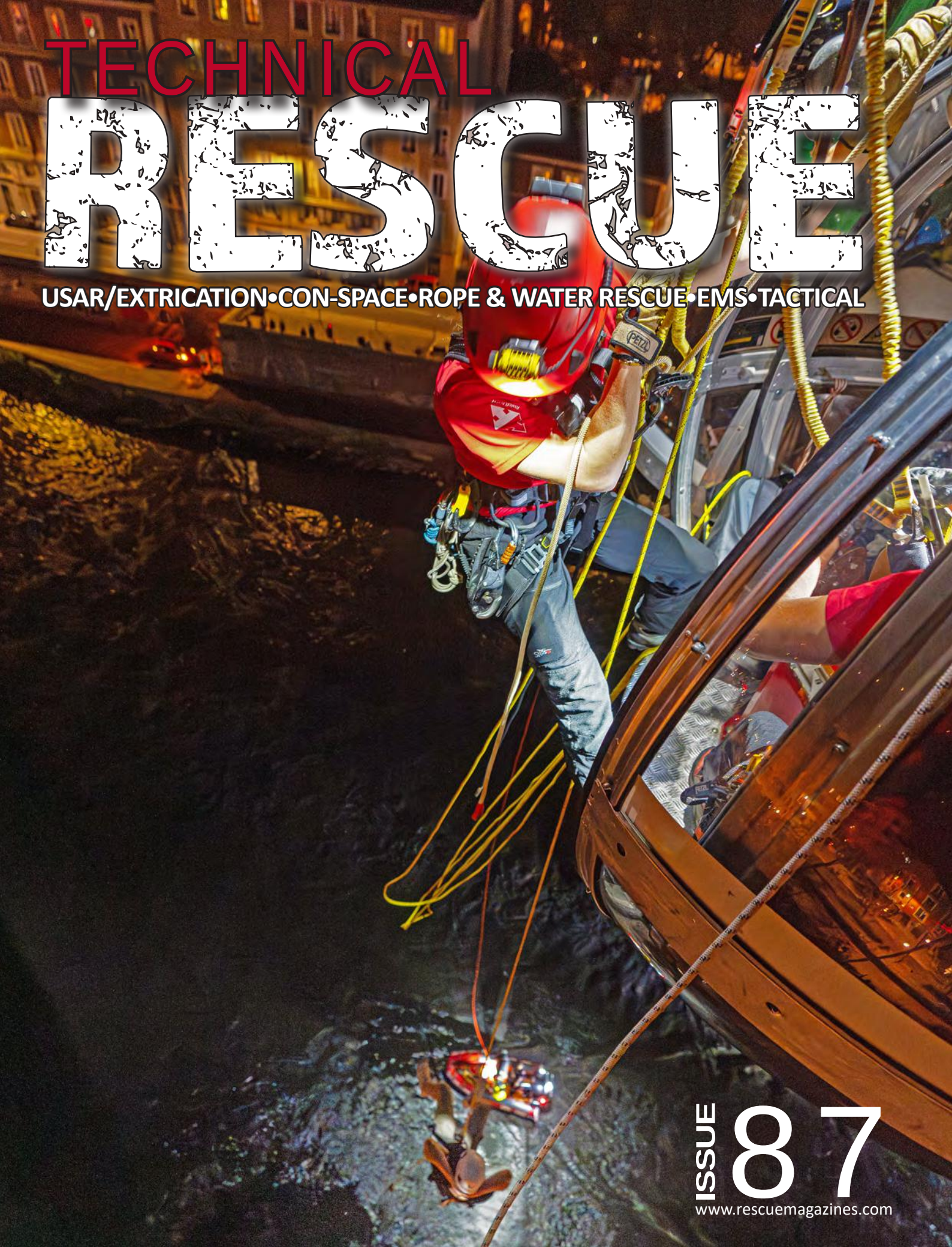
TECHNICAL RESCUE

USAR/EXTRICATION•CON-SPACE•ROPE & WATER RESCUE•EMS•TACTICAL



ISSUE 87
www.rescuemagazines.com

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This is how we see the world.

We are committed to **creating safer places**.
For those who **work and play** in the vertical and dark worlds.
For those who want **to access their own inaccessible** every day.
We are **independent** and completely free to choose our own endeavors.
To maintain **industrial excellence**, paying attention to our impact.
To be pioneers in the pursuit of **perpetual innovation**.
Sharing, educating, building. **Together**.

This is how we see the world.
We are PETZL.

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ON-THE-COVER:
Rescue Specialists carry out a night evacuation exercise from the Bastille cable car in downtown Grenoble, 'Casualties' are packaged into a *Pitagor* evacuation triangle and lowered one by one (using a Petzl Maestro Descender) to a waiting rescue boat below
photo courtesy © PETZL DISTRIBUTION - Lafouche

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FRONT COVER
The lowering phase of a night exercise in Grenoble , France to rescue stranded occupants of gondolas. Virtually all equipment used here is from Petzl - see ON_THE-COVER feature on page 2

Cover & Images: Bastille cable car (Gondola) rescue by rescue specialists in Grenoble, France

Petzl's Professional Rescue Solutions

Petzl is a world-renowned leader in work-at-height and rescue equipment, recognised for its commitment to safety, innovation, and ergonomic design. Their professional rescue solutions are not merely a collection of individual components but a comprehensive suite of integrated systems developed in collaboration with rescue professionals and designed to maximise efficiency, reliability and safety in demanding vertical environments. The underlying philosophy - that equipment should be intuitive, highly efficient, and adaptable - solidifies Petzl's position as a top choice for technical rescue professionals worldwide.

Petzl Helmet & Lighting Solutions

With features like FLIP&FIT system, CENTERFIT, and replaceable comfort foam Petzl helmets ensure a stable, comfortable fit for a wide range of head sizes and shapes. Petzl's professional headlamp range of **PIXA, XENA, SWIFT RL** and **DUO RL** are simple to integrate with either headband straps for easy use on and off a helmet or tool free mounting plates for the slots on **VERTEX** and **STRATO** helmets for a streamlined system.

XENA - Powerful, rechargeable and lightweight headlamp. 1400 lumens. Designed for technical rescue professionals, the XENA® headlamp offers an excellent weight-to-power ratio (185 grams / 1400 lumens). The battery pack is in the rear, making it balanced and comfortable to wear. Durable, it is fall and impact resistant. It is also waterproof and dustproof, making it suitable for various work conditions. Three beam types and five lighting levels provide optimal visual comfort in a variety of situations. It features a rotating knob that is easy to use, even when wearing gloves. Wear the lamp on your head or mounted on a variety of helmet types using compatible accessories for a convenient solution. Rechargeable via USB-C, the battery is removable and replaceable.

Having accessed the gondola using Petzl's ROLLCAB Cable Pulley (belayed from the nearest intermediate tower), one rescuer proceeds to reassure the stranded passengers, packaging one at a time into a PITAGOR evacuation harness. The second rescuer guides them outside the gondola door and begins lowering using a Maestro auto-lock descender. A boat below receives the passenger and the rope and harness are retrieved ready for the next one. Note the extensive use of double lanyards for safety and movement around the gondola with large MGO hooks and shock absorbing ABSORBICA.

PITAGOR Evacuation Triangle

The PITAGOR evacuation triangle is designed for rescue operations and cable lift evacuations. The ergonomic shape of the seat and the presence of shoulder straps makes suspension more comfortable than with a classic evacuation triangle. Color-coding differentiates the back and seat, as well as the closure system, making it easier to put on the evacuee. The high-strength TPU tarp material allows regular to intensive use.

The Petzl FALCON Harness Series: *Precision, Comfort, Mobility. The Petzl FALCON harness series (FALCON, FALCON ASCENT, and FALCON MOUNTAIN) prioritise lightweight design, exceptional comfort during suspension, and maximum mobility and are designed to be part of a larger Petzl ecosystem, e.g. with the addition of TOP chest harness and other accessories. They are the preferred choice for rescue professionals and anyone requiring a minimalist yet highly functional sit harness for prolonged periods of work or rescue in suspension.*

Lightweight Construction: All FALCON harnesses are designed to be as light as possible without compromising strength, comfort or durability. This reduces fatigue during long workdays and improves agility. Semi-Rigid, Slim Design: The waistbelt and leg loops are semi-rigid and slim, offering excellent support and comfort during suspension, while minimizing bulk. This allows for greater freedom of movement, essential for dynamic work positioning. Breathable Padding: The contact areas feature breathable foam padding, ensuring comfort even in warm conditions and during extended periods in suspension.

The Pillar of Control - Petzl hardware and ropes

MAESTRO: *A flagship descender for technical rescue. Its design incorporates an integrated progress-capture pulley, allowing for seamless transition between lowering and hauling, which is critical in rescue scenarios involving two-person loads or complex rigging. The MAESTRO is engineered for heavy loads (up to 280 kg, depending on the model and rope compatibility) and is a foundational device for Rope Systems.*

BEAM 11mm Rope *is designed for rescue professionals. Its diameter provides a solid grip and great strength. The specific rope construction limits compression and low elongation provides superior efficiency and comfort when handling heavy loads*

ID (S, L, and EVAC) *feature an anti-panic function and an AUTO-LOCK system, simplifying operations and improving control during accompanied descent rescues or standard lowering.*

ABSORBICA-Y MGO *is a double lanyard with compact energy absorber, designed for progression on a vertical structure or a horizontal lifeline, and for passing intermediate anchors. It works with users who weigh between 60 and 140 kg. It's ready to use, with two large-opening MGO connectors on the end of the lanyard and an OK TRIACT-LOCK connector for harness attachment. It is available in two versions: 80 (rope arms), or 150 FLEX (elasticized arms).*

ROLLCAB Pulley: *Petzl's specialist cable-car pulley has a 500kg working load and operates on wire cables (or ropes) to provide a safe means of reaching the gondolas/chairs. It can operate on 55mm/2.1" cables and should have a back up lanyard alco clipped to the cable.*

In with the New at AMKUS

We reported some time ago that *Amkus* in Indiana had ditched their traditional hose-fed hydraulic tools and gone for battery tools only. 2025 saw them further ratify or simplify their range into three Light Rescue tools and five Heavy Rescue tools in a fetching new 'copper' -coloured livery. What a pleasure to be able to refer to tools by a 'name' instead of a complex series of code numbers!

The light tools consist of a cutter *LRC*, spreader *LRS* and combi tool *LRCT* and while the term 'light' might be relative, especially since there isn't a huge difference between the weight and performance parameters of these tools and their previous ION range, all of these new tools incorporate carbon-fibre in their construction so presumably they might all have otherwise been heavier than their predecessors. The Heavy Rescue range consists of a spreader *HRS*, Short-Blade Cutter *HRSB*, Long blade cutter *HRLB* and a ram *HRR*. All of them have maintained the readily available and affordable *DeWalt* 60v system so existing ION -series users can transition easily (and more gradually) to the new tools as the *ION*s come up for renewal. All tools have on-board LED illumination of the working tips via that little square box you see above the blade union in the picture above.

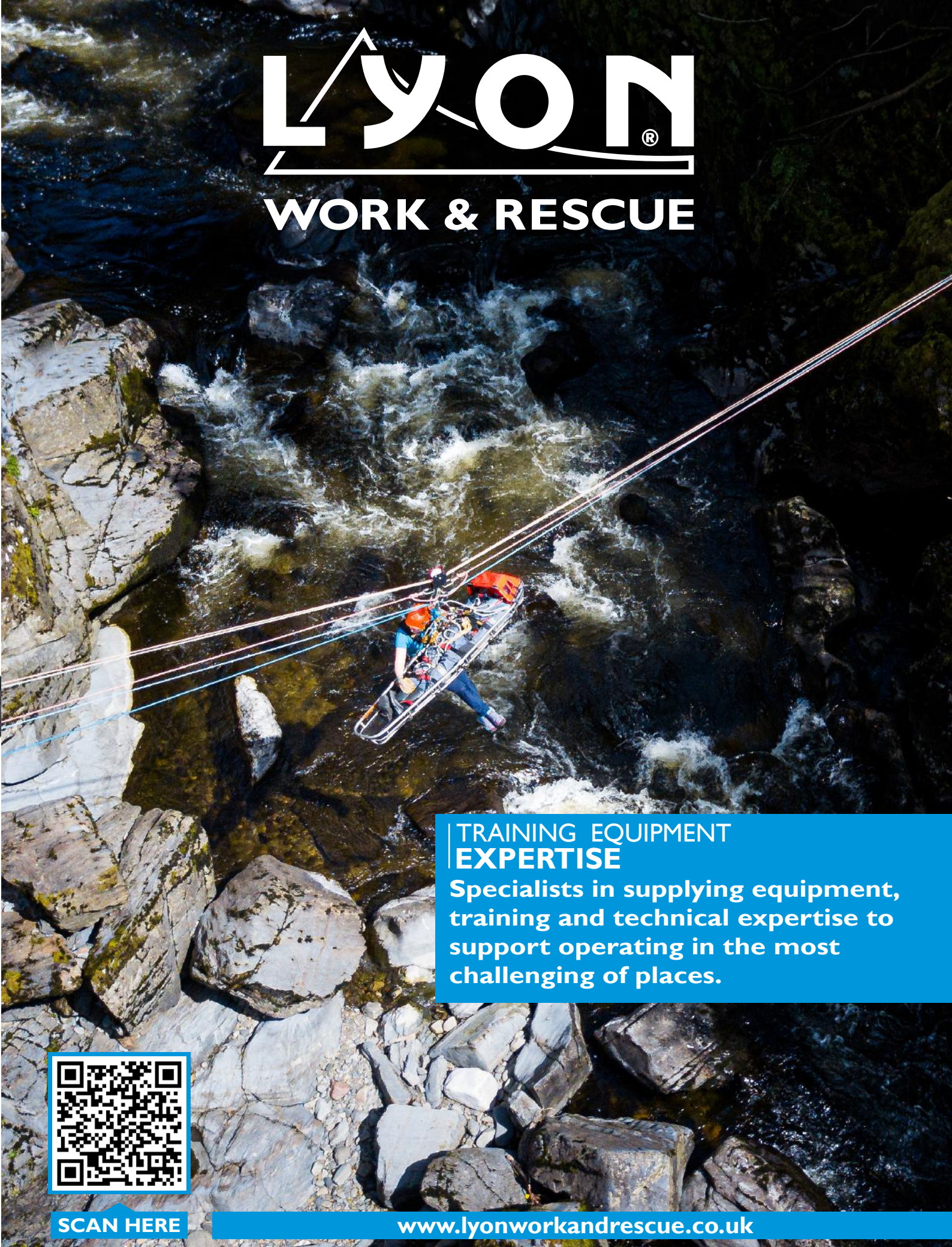
Below we have compared the spec of the new cutters with the now discontinued ION range but full specifications for all eight tools in this new *Amkus* range can be found in our **USAR/EXTRICATION BUYERS GUIDE**.
https://accessandrescue.hflip.co/BuyersGuidetoUSARextrication.html

CUTTER	Light Rescue	Heavy Rescue short blade	Heavy Rescue long blade	ION ic650	ION ic700 short blade	ION ic750 long blade
POWER SOURCE	60v DeWalt Battery (weight ~1.2kg/2.6lb)			60v DeWalt Battery (weight ~1.2kg/2.6lb)		
WEIGHT IN HAND	22.2kg 43.6lb	25.2kg 55.4lb	25.2kg 55.4lb	23.7kg 52.3lb	25.6kg 56.6lb	26kg 57.3lb
MAX (theoretical) CUT FORCE	1154kN 129.7 UStons	1560kN 175.4 UStons	1560kN 175.4 UStons	1154kN 129.7 UStons	1560kN 175.4 UStons	1560kN 175.4 UStons
CUT OPENING	160mm 6.3"	147.3mm 5.8"	178mm 7"	158mm 6.2"	147.3mm 5.8"	178mm 7"
LENGTH	853 mm 33.6"	826mm 32.5"	856mm 32.5"	851mm 33.5"	830mm 32.7"	856mm 33.7"
WEBSITE	www.amkus.com					

The ***EXPERT 55*** pack from **Petzl** is the latest addition/update to a highly regarded series of packs. It is a 'cabinet'-style pack that can stand on end to access the top helmet pouch (or whatever else you ant to store in it) via the lid or a side 'door' or lay flat on the ground and part or fully open. The rucksack straps can be covered by one of the lid flaps (cabinet-door) during transport, hauling and dragging to stop snagging of straps. The rucksack straps are fully fledged 'hiking' class adjustable straps with padding including a waistbelt. As with their previous organiser packs, there is a lid pocket and ID pouch, the two ends can be zipped open to access the interior, numerous mesh pockets (eight on the *EXPERT 55*), a row of six clip points and 12 larger loops on the inside. The yellow grab/haul handle is rated to 50kg. Designed for intensive use, the *EXPERT* is available in 55 Litre and 40 Litre models and in all-black or yellow/black. Its durable construction includes TPU material and a welded base with reinforced fabric. Cost is around £222/$270/€220

NEW in 2026
Versatile & cavernous Rope Pack

www.Petzl.com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www.lyonworkandrescue.co.uk

WINCH PLATE ADAPTER

Graviton is a specialist Dutch company that make a handful of products (so far) for the rope access and rescue markets including bespoke leg extensions for the *Arizona Vortex*, A heavy duty chainsaw ring for *Stihl* saws and a debris net with inflatable frame to protect people below during protracted operations whwre there is a risk of dropping bits & pieces or knocking debris loose.

Graviton's *Theia*, is an advanced winch plate adapter designed for seamless compatibility with the Harken LokHead 500. Theia is meticulously engineered to provide enhanced functionality, featuring a mid-rope entry pulley and a versatile baseplate mounting option, making your high-altitude and complex rigging tasks safer and more efficient.

KEY FEATURES:
Effortless Mounting: ***Theia*** features a baseplate adapter that allows for quick and secure installation, so you can focus on the task at hand without worrying about setup complexities.
Extended Rope Angles: Engineered to handle rope angles up to 90 degrees, ***Theia***'s efficient pulley system with needle roller bearings ensures smooth operation, giving you the flexibility you need in demanding environments.
Textile-Friendly Design: With specially designed rigging points, Theia is gentle on ropes and textiles, making it possible to directly tie in to ***Theia***.
Stable and Secure: Achieve rock-solid stability with ***Theia***'s ratchet strap mounting system. No matter the challenge, your setup will remain steady and secure.
Superior Construction: Crafted from CNC machined 7075-T6 aluminium, ***Theia*** stands up to the toughest conditions, offering unparalleled durability and reliability.

Compatibility: ***Harken Lokhead 500***, CE, EN 1496:2017
MBS: 23kN
Material: CNC Machined 7075-T6 Aluminium and stainless steel with Anodising.

www.gravitoninnovations.com

XMonster Shield Pro Rope for Powered Ascenders

Not just for powered ascenders but this is certainly a very good use for *Xmonster*'s Aramid sheathed rope. It has a red inner braid to warn of undue wear to any given section of rope. Ropes like this cost a little more than regular rope because of the specialist materials and construction but if you can afford it the *Shield Pro* is equally applicable to any discipline that exposes the rope to excessive heat/flames and/or sharp and abrasive surfaces. A tight and firm 32 carrier sheath provides smooth running and low elongation. Certifed to ANSI & NFPA 2500. Also available with sewn eye as a lifeline.

SPECIFICATIONS

Diameter:	11.5mm / 7⁄16"	
MATERIALS		
Core:	Premium Nylon 66	
Inner Red Sheath	Premium Nylon 6	
Outer Sheath	Aramid	
Breaking Strength:	43.5kN	
Knot Breaking Strength:	25.1N	
Elongation	@50kg/150kg:	1.48%
	@300lbs	4.0%
	@600lbs	6.1%
	@1,000lbs	8.3%
	@1,800lbs	9.9%
Construction:	32 strand	
website:	www.xmonster.com	

NEW TAC LIGHTS

LEDLENSER of Germany has launched a new series of three, high performance tactical flashlights, engineered for law enforcement and emergency services. Each model is USB-rechargeable and constructed to military-grade standards.

◆Multi-Lens Technology: Dual-lens optical system lets users switch between a broad floodlight, focused long-range spotlight, or both beams at once.

◆RGB Light Modes: Integrated red, green, and blue LEDs (model dependent) preserve night vision, aid navigation and tracking. Each model also includes tactical strobe and other light functions for emergencies or self-defence.

◆Intuitive Controls (Mode Select Ring & Tail Switch): Emphasis on rapid, instinctive operation. The TAC7R have a *Mode Select Ring* around the head, allowing instant mode switching (e.g. brightness levels or strobe) with a simple twist. All models have a tactical End Cap Switch for momentary or constant-on light

◆Rugged, Mission-Ready Design: Constructed with hard-anodized aluminum housings, engineered to withstand shock, water, and extreme temperatures, and has been tested under real-world tactical conditions.

Note: Ledlenser supports their product quality with a 7-year extended warranty (with product registration), underscoring its commitment to long-term reliability.

TAC7R (High-Output All-Rounder) £160/$310/€160

Delivers up to **3200 lumens** of bright white light, projecting a beam up to approximately **370 meters**. It features the full suite of TAC technologies, including the Mode Select Ring and all three RGB light options (red, green, blue) built in. TAC7R is ideal for switching from wide-area searches to focused identification at a moment's notice.

TAC6R (Compact Tactical Companion) £120/$230/€120

Compact tactical torch designed for mobility without sacrificing performance. Outputs up to **2000 lumens** with a beam distance of ~**370 meters**. Instead of a mode ring TAC6R has a tactical tail switch interface, providing intuitive, rapid control of light modes with one hand. 18650 Li-ion battery and aluminium body.

TT3R (Versatile Multi-Mission Torch) £150/$240/€150

Outputs up to **1900 lumens** with a beam range of about **300m**, combining flood and spot beams to handle both close-quarter and distance illumination. Includes additional red and blue light modes for signalling or low-profile use, as well as a built-in strobe function.

All three TAC models have optional accessories and mounting solutions like remote pressure switches for silent operation, Picatinny rail mounts, universal mounting brackets, adjustable lanyards, and colour filters for added versatility. Also anti-roll rings and quick-release belt holsters allow the lights to be configured for hands-free use, equipment mounting, or duty carry.

www.ledlenser.com

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EQUIPMENT THAT EXCEEDS

YOUR EXPECTATION.

CASCADE RESCUE
BY HARKEN

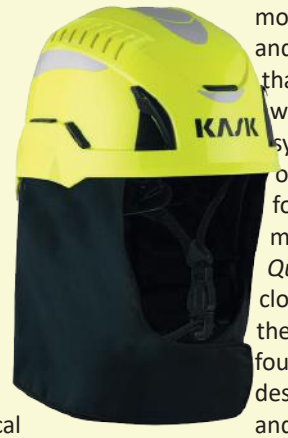
Cascade Rescue litters are purpose-built to function as a patient packaging and patient movement system that exceeds the expectations of rescue professionals. Our NFPA Steel Litters, CE Certified Titanium and Stainless Steel Professional Series Litters and UL Certified Litters are ideal for difficult access and confined space rescues. Built in the USA, competitively priced, and manufactured by a company that has been in business since 1962. Our Professional Series Litters are what rescue professionals require in demanding technical rescues.

Rescues can be dangerous. ***It's best to get gear from a company who understands that.***

844.414.RESQ
CASCADE-RESCUE.COM

MULTI-ROLE QUANTUM by KASK

KASK, the premium designer and manufacturer of performance head protection, introduces the *Quantum* series, a helmet platform engineered for wildland firefighting, technical rescue, mountain rescue, and water rescue applications when equipped with *Quantum* protection panels. Conceived to respond to the evolving demands of emergency operations, Quantum sets a benchmark in the rescue helmet category. Its development reflects the progression of rescue and climbing helmet design, advancements in material technology, and the increasingly complex scenarios faced during technical interventions and natural disasters.



MULTI-STANDARD CERTIFIED PROTECTION

- EN 16471 for wildland firefighting,
- EN 16473 for technical rescue,
- EN 12492 for mountaineering.
- When fitted with Quantum protection panels, it also complies with EN 1385 for canoeing and white-water sports

Quantum counters risks encountered in critical operations, from high-energy impacts to exposure to heat, flame,and chemically aggressive conditions. At the same time, stability, comfort, and usability under pressure remained essential performance parameters. The helmet achieves this balance through a fire- and chemical-resistant polycarbonate external shell combined with a high-density EPS internal shell covered in thermoformed polystyrene. This construction enhances impact absorption, structural durability and ease of cleaning and decontamination.

OPTIMIZED FIT, COMFORT & PERFORMANCE

The *Adaptive Fit* system conforms to different head shapes and maintains stability during dynamic movement. The large-diameter rear dial allows precise micro-adjustment, while ergonomic side wings cradle the back of the neck and a self-adjusting hinge ensures the system remains correctly positioned as the wearer moves. The fire-resistant acrylic chinstrap incorporates five adjustment points for optimized retention, and all adjustments can be performed even while wearing gloves, supporting operational efficiency in demanding environments. Internal comfort is further enhanced by multilayer padding constructed with moisture-wicking technology and soft technical textiles that promote long-lasting wearability. The *Click-In* system enables quick removal or replacement of the padding for maintenance and hygiene management.

Quantum is available in a closed-shell configuration or in the ***Cabrio*** version, featuring fourteen ventilation openings designed to improve airflow and thermal regulation. The vents are equipped with anti-intrusion metal mesh to prevent debris penetration, and the Cabrio configuration integrates a sliding closure system for controlled ventilation management according to environmental conditions.

TASK-SPECIFIC OPTIONS & INTEGRATION

The helmet is designed with integrated slots to accommodate *KASK* eye, face, hearing,and weather protection systems, as well as protection panels that expand its field of application. A front attachment point supports further customization, allowing seamless integration of accessories such as headlamps and identification holders.

As with all *KASK* helmets, *Quantum* undergoes internal rotational impact performance testing in accordance with the *KASK* Rotational Impact ***WG11*** Test, reinforcing the brand's commitment to advanced head protection engineering.

With *Quantum, KASK* delivers a versatile and technically advanced solution tailored to modern emergency response, where reliability, adaptability and certified protection are fundamental requirements.

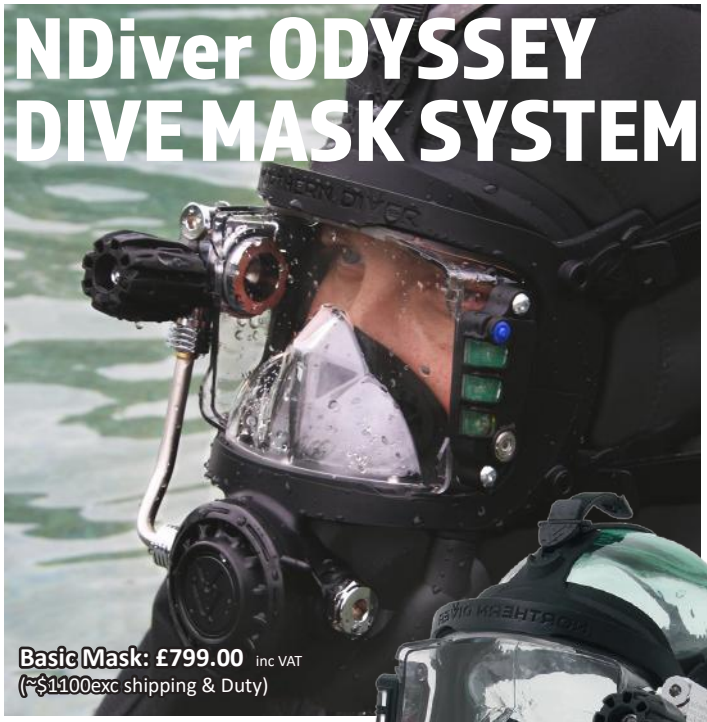
www.kask-safety.com

The **RESTUBE AUTOMATIC 180** is an automatically activated rescue throw device that has been specially developed for professional use in water rescue. The system activates automatically upon water contact via a cellulose tablet. Reliable and fast deployment is ensured by two main components: a water activator and a 38g stainless steel CO_2 cartridge. After use, the system can be quickly rearmed by replacing both components. It is ideal for emergency services such as the fire brigade, police, *DLRG* and other water

Buoyancy:	180N(~18kg) for rescuing up to 4 persons
Activation:	Automatic release of the CO2 cartridge upon contact with water
Reusability:	Easy maintenance by replacing the CO2 cartridge and water activator
Weight:	560g / 1.2lb
Dimensions :	**Packed:** L 290 x W100mm /11.4 x 4" **Inflated:** L 840mm / 33"
Option:	18m/60ft buoyant rescue line
Bag material:	Nylon
Max. no of uses:	100
Maintenance:	After each release; at least once a year
Certified release mechanism:	ISO 12302-7:2007
Country of Origin:	` Germany
Cost:	£221 / $300 exc duty / €255
Web:	**www.restube.com**

rescue organisations. Its automatic release function upon contact with water provides fast and safe first aid for up to four people – even from a safe distance, whether from the shore, a boat, a helicopter or a drone. Seven integrated grab loops provide reliable hold points – ideal for maintaining contact in offshore conditions or swiftwater environments. They also assist rescue personnel in recovering individuals from the water – even under dynamic operational conditions. In its closed state, the system measures just 29 cm and weighs only 560 g – ideal for gear setups with limited space, where every gram and centimeter matters. Perfect for use in emergency vehicles, boats, helicopters, and backpacks. Three reinforced attachment loops enable seamless integration of additional gear – for maximum operational flexibility. Four integrated reflective strips provide enhanced visibility – even in low-light or adverse weather conditions. With RESTUBE AUTOMATIC 180, emergency services are optimally prepared for emergencies and can save lives without putting themselves in danger. In combination with the 15-metre-long, buoyant rescue line from AUTOMATIC 180, it is approved as a rescue throwing device in accordance with the Lake Constance Shipping Regulations and offers a compact, space-saving alternative to the classic lifebuoy. Restube is in use with over 200 agencies worldwide including New York Fire Dept, New York Police Dept, the UK's RLSS and ADAC LuftRettung (Germany's largest Air rescue/Medvac organisation).

NDiver ODYSSEY DIVE MASK SYSTEM



Designed specifically for military, commercial and rescue divers, the *Odyssey* Full Face Mask delivers unmatched safety, reliability and comfort in the most extreme underwater environments. The *Odyssey* is rigorously tested to ensure peak performance down to 50m in cold water (4°C ± 2°C).

ADVANCED BREATHING SYSTEM: The Odyssey features an integrated high-performance second-stage regulator built directly into the mask frame. This low-profile design reduces drag, minimises CO_2 build-up, and ensures effortless breathing even in the harshest conditions. With stainless-steel breathing tubes for enhanced durability, it's built for mission-critical reliability time after time, dive after dive.

UNCOMPROMISED SAFETY & VISIBILITY:
- CE-certified single system – No third-party integrations, ensuring seamless performance.
- Universal fit with enhanced sealing – Secure, comfortable fit across different face shapes.
- Low-profile design – Optimised for wide peripheral vision, even with mounted equipment.

EXTENSIVE AND ADAPTABLE FEATURES (Optional Additions):
- Integrated Side Block – Enables simultaneous use of main and bailout cylinders, ensuring a fail-safe gas supply in emergency situations.
- Low Air Warning System (LAWS) – Provides instant, wireless visual alerts for critical air levels.
- Torch Rail Mount – Allows secure attachment of underwater torches for hands-free illumination.
- Spark Welding Visor – Optional visor upgrade for protection during underwater welding operations.

Every Odyssey now comes equipped with Miflex low-pressure hoses as standard. Featuring a double-braided nylon safety exterior, these hoses resist abrasion, snags and UV degradation, while offering nearly double the burst pressure of traditional hoses — enhancing reliability and durability in the most demanding diving conditions.

BUILT FOR EXTREME ENVIRONMENTS: Tested beyond limits, Odyssey withstands cold-water operations, challenging visibility and high-pressure diving conditions. Featuring an anti-free flow mechanism, heat exchanger system and reinforced impact-resistant polycarbonate lens, it ensures clear vision and optimal performance at all times.

MASK CONSTRUCTION

- **Frame Material**: Reinforced, high-impact rigid nylon frame for strength and flexibility
- **Lens Material**: High-grade, impact-resistant polycarbonate
- **Skirt Material**: Soft, hypo-allergenic silicone for a secure, leak-proof seal. Tested on a variety of head shapes to ensure effective fit in any gender and size (± 5-95 percentile of people)
- **Weight**: 1.4kg (3.1lbs) with side block, 1.0kg (2.2lbs) without

REGULATOR & BREATHING SYSTEM

- **Second Stage Type:** Pneumatically balanced
- **Hose Type**: *Miflex*, low pressure, double braided
- **Breathing Performance**: 1.0 joules/litre @50M, 4°C water, BPM 62.5 l/m
- **Pre-Dive / Dive Lever**: Ergonomically designed for precise airflow control
- **Heat Exchanger**: Twin heat system for cold-water performance

SIDE BLOCK [OPTIONAL ADDITION]

- **Material:** Precision-machined CZ121 brass housing with chrome-plated finish
- **Valve Control**: Single-handed operation, even in zero visibility
- **Dimensions**: 68.5 × 60 × 44.5mm
- **Weight**: 2.3kg (5.0lbs)

LOW AIR WARNING SYSTEM (LAWS) [Optional Addition]

- **Wireless RF Design**: Eliminates wiring and reduces snag hazards
- **Receiver Mounting**: Designed for clear visual alerts without obstructing vision
- **Battery:** Rechargeable lithium-ion cell, 4-5 day runtime, full charge in 2 hours
- **Transmitter Compatibility**: Fits all first-stage regulators with 7/16x20UNF thread

CERTIFICATIONS & ENVIRONMENTAL PERFORMANCE

- **Certification**: EN250:2014 & PPE Regulation 2016/425
- **Depth Rating**: 0-50 metres / 164 ft
- **Temp Rating**: <10°C and cold water 4 ± 2°C (39.2 ± 3.6°F)
- Storage Temperature: -10°C (14°F) to +50°C (122°F)

www.ndiver-rescue.com

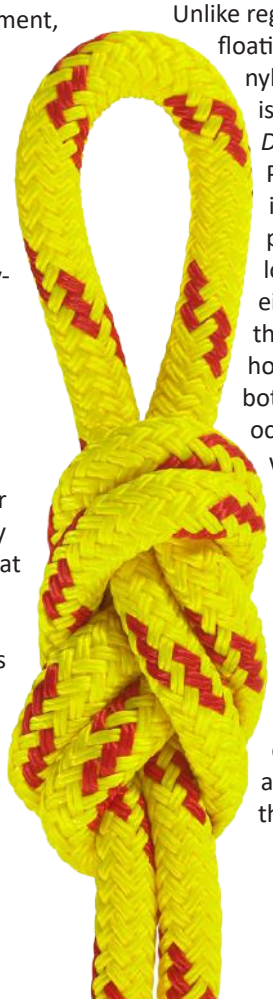
4-13mm

WATER RESCUE ROPES

This guide is for FLOATING ROPES ONLY. There are a good many canyoning & caving ropes in the separate Guide in our **ROPE RESCUE EQUIPMENT BUYERSGUIDE** that do not float but may be useful to water rescuers as they are designed to have low water absorption, be robust and of course are much stronger and can be used for descent/ascent. Floating ropes in smaller diameters are rarely stronger than 1000kg/2200lbs unless they contain HMPE/*Spectra/Dyneema* etc because they don't need to be - the water is supporting the weight of the load. If we put aside canyoning ropes and utility uses such as raft grab lines and mooring rope, operational WATER RESCUE ROPES fall into two broad categories -

1) **THROWLINES:** ropes in diameters from 6 to 10mm (but can be as small as 4mm and as large as 11mm). These are carried in floating throwbags which are thrown to a person in need or indeed, from a rescuer in need. The idea being to create a means to either tow a person to safety or to create a fixed (light) ferry line that can be used to transport equipment, rescuer or strandee to and/or from a precarious in-water location such as a vehicle in-water or a mid stream rock. These will be floating, high visibility ropes, sometimes with reflective threads which shine brightly when a light is shone in its general direction. Throwlines are not necessarily short lengths in small bags, the title picture shows a bagged 200m length - this can be used for long ferry-lines or long pulley systems etc.

2) **RIGGING and TETHER LINES**. These are larger diameter ropes which are usually also floating but shore-based rigging require greater strength will often use regular (sinking) Nylon/polyester rescue ropes. Where the rigging is set up over and in-water dedicated water rescue ropes are used because they are designed NOT to absorb water and to float so that they won't be lost or snag during set-up and retain strength and handling in the water. Some are strong enough to be used for abseiling/rappelling and cross over into canyoning/caving like *Beal's Water Pro* but we're generally talking more about a larger floating rope that can be used over and in water for hauling/highlines etc. and for stronger/larger tethers to water craft and rescue swimmers and for heavier-duty ferry lines.



CONSTRUCTION

Unlike regular rescue and access ropes, water rescue uses floating materials and so replaces the usual polyester and nylon threads with polypropylene and HMPE which is High Modulus Polyethylene commonly seen as *Dyneema* and similar much higher strength fibres. Polypropylene is the very material we warn against in rope rescue because it has a very low melting point and doesn't stand up to high speed and heavily loaded descents. Many don't stand up to UV well either becoming brittle and weak after log exposure though some are UV-stabilised to improve this. It does, however, float and maintain strength when wet which both nylon and polyester fail to do as well. There are occasions when regular rescue ropes might be used in water rescue. This can be very high-load applications like stabilising an in-water vehicle, tethering a much larger water craft or when you need the rope or portions of the rope to sink in order to negotiate an obstacle such as fallen trees or surface contaminants like oil and possibly even burning oil! The other thing to note is that some ropes are purposely more 'knobbly' - ie. a bumpy rather than smooth outer surface - this is to improve grip when hauling especially since it's always going to be wet. Look for a lower weave/strand/carrier count or an indication in the notes that this is an intended design feature.

IN THE FOLLOWING TABLES.....
All of the ropes in this guide will float so the first column indicating with a black square, that the rope floats is somewhat superfluous. We have put it there to highlight the fact that most of these are intended only to be loaded by a floating person or craft.

ROPE DIAMETER: We really do need to talk about ditching inches as a measurement for rope diameters because they are so imprecise and complex that even US rescuers and companies usually refer to them in millimeters (mm) as a more precise measurement. Does anybody really get rope diameters in inches unless it's ½", ¼", ¾ and maybe ⅜"? A 10mm rope for instance is ²⁵⁄₆₄" and 8mm is ⁵⁄₁₆" , why would you?

COST: Not all ropes are sold by the metre, many are intended to be replacement lengths for an associated throw bag so we've used a ratio of the shortest length sold and rounded up by 10%. This is the most expensive way to price rope so these may not be exact but they give you a rough idea. Prices are per metre with **per foot** also shown for US $Dollars. All prices **EXCLUDE Splices/Sewn eyes** unless otherwise stated We usually round the prices up but if it seems a little precise it will be a manufacturers stated retail cost. We also now show a straight currency conversion in burnt-orange £$€ - this is NOT an accurate cost because it precludes import duty and bulk shipping but it again gives you a rough idea for comparison.

WEIGHT - This is the WEIGHT or MASS per metre and per 100feet. We have made conversions based on a linear mass density conversion rounded to one decimal place (we occasionally sneak in two if it's .25 for a quarter).

MATERIALS Unlike life-safety/rescue ropes, polypropylene is the most common material in water rescue ropes simply because it is light, cheap and most importantly -because it floats. Most water rescue ropes are designed for lateral loading (pulling) through or across water NOT lifting or winching vertically out of the water. This is why Polypropylene can be used instead of (or in addition to) the usual nylon and polyester which would otherwise sink in water.
POLYPROPYLENE has a low meting point so cannot be use in camming hardware like descenders and ascenders where the contact pressure creates a lot of heat - it would simply melt and/or separate into two lengths of rope. Counter-intuitively for rope used almost exclusively outdoors including in salt water, Polyproylene doesn't resist UV well either, the fibres quickly become brittle and slough off if exposed to too much sunlight. Luckily, they spend most of their working lives housed

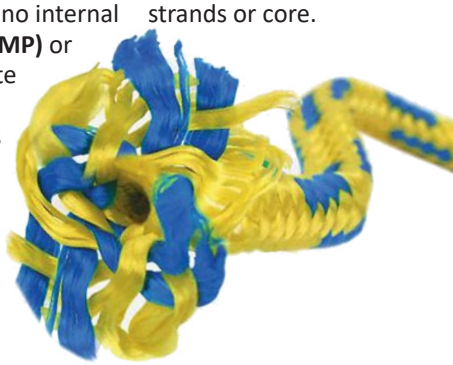
inside a bag like the *Force 6* throwbag on the right.

Where throwlines 'progress' to vertical life safety ropes they incorporate one or more of the familiar, stronger and more resilient rope rescue fibres:
NYLON is referred to in Europe as *polyamide* because Nylon is Dupont's trade name and differentiated by some as such or as Nylon 66 or *Perlon*. Nylon has good strength to weight ratio and shock absorption, doesn't melt at too low a temperature (around 460° F or 238° C), can operate in wet and ice (albeit at reduced capacity) and is pretty robust when it comes to being dragged over rough edges. Nylon absorbs more water than Polyester but is stronger when wet and provides more elasticity so it's often used for the core material.
POLYESTER can withstand abuse from Nylon's nemesis acid which doesn't tend to be a consideration for wilderness rescuers or arborists but it's also a bit tougher than nylon, has a slightly higher melting point (around 480° F or 249° C) and retains more strength when wet.
There are some other specialist materials used in rope manufacture - principal amongst these is Aramid, Kevlar, *Technora* and *Dyneema*. These are much stronger and more abrasion resistant fibres than polypropylene and make the difference between a floating throwline for dragging a person or craft to safety and a rope that can be used with specialist hardware including cams and even fully fledged high angle abseiling/ascending/hauling. As we've mentioned in our other rope Guides you can't tell a polyester from a nylon from a polypropylene just by looking so some manufacturers like *PMI* use special marking to denote material - in *PMI*'s case barber-pole' sheath runners denote nylon and a cross-pattern denotes polyester content, this is a simple idea that would transfer well to marking polypropylene and it we would be good to see this adopted more widely.

MBL is Minimum Breaking Load (or MBS -Minimum Breaking Strength if given in kiloNewtons (kN), The units of force are kN and lbf but they pretty much equate to the more recognisable kg and lb. These Minimum Breaking Load figures are based on a dry, brand new rope in a straight line with no bends in it. Breaking strength in a figure 8 knot can be up to 50% less depending on how well the knot is tied and a spliced rope will reduce by at least 10% .

ELONGATION/STRETCH
This is far more relevant to load-supporting life safety ropes than it is for water throwlines but we have included it because some are capable of being used for higher loads where the proportion of stretch versus load is useful. The first figure is the industry standard degree of stretch at **10% of the minimum breaking load**. This is some harsh treatment and would rarely concern a climbing rope unless you're huge, it's more for rigging ropes being subjected to high loads and, even worse, dynamic loads. **20% of the minimum breaking load** is listed as 30% in our other rope guides but we've shown specifically 20% here simply because it is the figure given by *Liros* and *HF Ropes* - we otherwise don't usually see this as a quoted metric.
The third figure is used mostly in Europe is for **Static Elongation at 50 to150kg** loading over a set time period. The fourth figure is the **US norm for stretch at 136kg/300lbs** and this is much more indicative of a climber's body mass. Finally we included the highest elongation figure, the industry/rescue driven **@1000lbs/454kg** as the highest of three figures (with the middle figure being @600lb). Make sure you check the heading and subtle colouring!

SHEATH CONSTRUCTION: This is expressed as the number of carriers/threads used to construct the outer 'jacket' or braid. Unlike arborist ropes that are universally described by the number of braids, kernmantle ropes are described by the carrier or thread count. The lower the number, the more flexible the rope will be. Kernmantle (**KM**) is technically any rope with a sheath over a separate core but is more usually a single 32 carrier (16 braid) or 48 carrier (24-braid) sheath over parallel core fibres with less stretch than traditional arb ropes. Double braid (**DB**) means the core package (comprised of multiple bundles of fibres) has its own woven sheath. The core bundles can be separate from each and parallel or twisted together in a plait or braid. Many water throwlines are Hollow Braid **(HB)** which means that it is comprised of just a braided sheath with no separate core. The rope is not 'hollow' in terms of there being a gap through the middle during use but when it is not under load you can 'concertina' the rope together and see the outer strands separate and perhaps see daylight out the other side because there are no internal strands or core.
Some ropes are a multiplait **(MP)** or **simple braided** plait (not quite a kernmantle) where a low thread-count sheath overlays or is braided to the core as one structure- not hollow but not double braid or kernmantle. We don't see mulitiplait in life safety ropes outside of water rescue.



SUITABLE FOR:: ALL of the ropes in this GUIDE can be used as a **THROWLINE** in some capacity albeit that lighter lines can be thrown further and with greater ease and longer lengths are more easily carried than a nylon kernmantle 11mm for instance. Some ropes are able to be used in pulleys and non-camming hardware even if they have relatively low strength and are all polypropylene construction. Only a few can be used for vertical (out of water) life support that would include camming devices - ascenders, descenders and belay devices. *Beal ProWater* and the Taiwanese '*Ropers*' water rescue have an MBS of 25kN so can function in all standard rope rescue applications as well as in water.

STANDARDS: Unusually for rope, or indeed any equipment used by rescuers, floating throw-ropes do not come under any specific European CE standards or compliance other than the very general 'General Product Safety Regulation' (GPSR 2023/988), which came into force in December 2024 and simply indicates that a product is fit for purpose. This is obviously not the case with all water rescue ropes since some can be used for vertical loading and/or are intended for

1/2" BW-HR3
Strong & durable hybird
Polyester/Polypropylene design
5,000 lbf. @ 89 g/m

9.5mm NFPA Sure-Grip
Braided HMPE fiber core with
an innovative tactile sheath
4,923 lbf. @ 40 g/m

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www.bluewaterropes.com

other life-safety purposes and therefore meet the standards requirements for those disciplines but not specifically for water rescue applications. However, NFPA in the US, has stepped up and specifically covers requirements for throwlines including visibility, degree of/duration a line can float, strength of rope in terms of construction and if spliced/sewn. For instance, NFPA2500 requires that after a 24-hour immersion in water, the entire length of the throwline must float to the surface within one minute.

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HMPE/PE= High Modulus Polyethylene
KM=Kernmantle DB= Double Braid
MP=Multiplait/Simple Braid
HB = Hollow Braid

Ø mm Inches"	FLOATS	MODEL VARIANT Product Code	COMPANY	ORIGIN	COST per Metre /3.28ft per Foot	WEIGHT g/m lb/100'	MATERIA SHEATH CORE
11mm >⅜"	■	Pro Water Unicore 5034xx	BEAL		£4.02 $5.40 $1.70 €4.62	80g 5.4lb	Nylon Neoprene/
6.5mm ¼"	■	Suregrip 5046xx	BLUEWATER		£2.50 $3.35 $1.05 €3.15	23.7g 1.6lb	Polypropy Polypropy
9.5mm <⅜"	■	Suregrip 502400	BLUEWATER		£4.30 $5.75 $1.77 €4.85	40.3g 2.7lb	Polypropy HMPE(Dyne
9mm >⅜"	■	Suregrip 5034xx	BLUEWATER		£2.20 $2.95 $0.92 €2.50	49.3g 3.3lb	Polypropy Polypropy
11.5mm 7/16"	■	Suregrip 50246xx	BLUEWATER		£2.90 $3.90 $1.20 €3.30	56.7g 3.8lb	Polypropy Polypropy
8mm 5/16"	■	R3 River Rescue 5068xx	BLUEWATER		£2.20 $2.95 $1.10 €2.50	34.4g 2.3lb	Polypropy Polypropy
9mm ⅜"	■	R3 River Rescue 5068xx	BLUEWATER		£2.65 $3.60 $1.15 €3.05	64g 4.3lb	Polypropy Polypropy
13mm ½"	■	R3 River Rescue 5068xx	BLUEWATER		£3.00 $4.05 $1.40 €3.45	82.4g 5.5lb	Polypropy Polypropy
11mm 7/16"	■	HR3 Hybrid 5014xx	BLUEWATER		£2.85 $3.75 $1.15 €3.45	61g 4.1lb	Polyprop/ Polypropy
12.7mm ½"	■	HR3 Hybrid 5019adminxx	BLUEWATER		£3.20 $4.25 $1.30 €3.90	88.9g 6lb	Polyprop/ Polypropy
7.5mm ¼"	■	NFPA 293387	CMC		£3.90 $5.20 $1.59 €4.80	30g 2lb	Polypropy Dyneem
9.5mm ⅜"	■	SRT 292957	CMC		£3.50 $4.65 $1.43 €4.30	58.1g 3.9lb	Nylon Polypropy
11mm 7/16"	■	Redi-Line 292763	CMC		£2.10 $2.75 $0.85 €2.55	34.3g 2.3lb	Polypropy -
11mm 7/16"	■	River Rescue 293220	CMC		£3.65 $4.85 $1.49 €4.20	74.6g 5lb	Nylon Polyolef
4mm ⅛"	■	Beach Line PPAQBLB4	COURANT		n/a	~18g ~1.2lb	Polypropy -

WATER RESCUE ROPES

SHEATH %. This is the opposite to CORE percentage so we haven't bothered listing both - do the math(s). The higher the sheath percentage the stiffer the rope. It will therefore usually have a much higher initial resistance to abrasion over an edge or sheath creep under high loads from a camming device. Many throwropes are hollowbraid with no core so a 100% sheath!

SPECIFIC GRAVITY%. In terms of the rope's ability to float. Water's Specific Gravilty is 1 (or 100%) so ropes less than that like Polypropylene at around 0.91 will float while Nylon at 1.14 and Polyester at 1.3 will sink unless countered by the buoyancy of enough neoprene or polypropylene like *Ropers Dolphin Max* at 1.34.

ALS:	CONSTRUCTION CARRIER/BRAID	STANDARDS	SPLICEABLE PRE-SPLICED PRE-SEWN	REFLECTIVE	THROWLINE	TECH HARDWARE USE	ABSEILING/CAMS	MBL MINIMUM Break Load Spliced Sewn Knotted	@10% MBS @30% MBS @50-150 kg @300LB/136K @1000 lb/454kg	SPECIFIC GRAVITY SHEATH %	OTHER COLOURS		NOTES	WWW.
Nylon	KM*	CE A	■	-	●	■	■	25.5kN 57lbf	3.6%	33% -			*Unicore= sheath and core are bonded to stop sheath slippage	beal-planet.com
lene lene	MP	-	■	-	■	●	-	4.4kN 1000lbf	00%	77.3% -			variable diameter sheath strands to enhance grip	bluewaterropes.com
lene eema)	DB	NFPA	■	-	■	●	●	21.9kN 4918lbf	00%	62.6% -			variable diameter sheath strands to enhance grip	bluewaterropes.com
lene lene	MP	-	■	-	■	●	-	9.7kN 2200lbf	00%	57.8% -			variable diameter sheath strands to enhance grip	bluewaterropes.com
lene lene	MP	-	■	-	■	●	-	15.5kN 3500lbf	3.8% 1.3%	49% -				bluewaterropes.com
lene lene	MP	-	■	-	■	■	-	8.9kN 2000lbf	2.9% 9.6%	58% -			More substantial multi-role rope than *Suregrip*	bluewaterropes.com
lene lene	MP	-	■	-	■	■	-	15kN 3000lbf	3.1% 7.7%	58% -			More substantial multi-role rope than *Suregrip*	bluewaterropes.com
lene lene	MP	-	■	-	■	■	-	17.8kN 4000lbf	1.3% 9.1%	50% -			More substantial multi-role rope than *Suregrip*	bluewaterropes.com
/PES lene	DB 16	-	■	-	■	■	●	15.5kN 5000lbf	1.3% 3.8%	50% -			'Hybrid' refers to the combination of Polyester and Polypropylene fibres in the sheath	bluewaterropes.com
/PES lene	DB 16	-	■	-	■	■	●	22.2kN 5000lbf	1% 3.2%	50% -			'Hybrid' refers to the combination of Polyester and Polypropylene fibres in the sheath	bluewaterropes.com
lene na	KM	NFPA	-	-	■	●	-	15kN* 3372lbf	-	~32% -			*3 sigma. Max length 731m/2400ft	cmcpro.com
lene	KM	-	-	-	■	■	■	13kN* 2922lbf	-	- -			*3 sigma. Max length 366m/1200ft	cmcpro.com
lene	HB	-	■	-	■	-	-	10kN* 2248lbf	-	- -			*3 sigma. Max length 549m/1800ft	cmcpro.com
fin	KM	-	■	-	■	■	■	16.45kN* 3700lbf	-	- -			*3 sigma. Max length 746m/2448ft Originally a New England Rope continued by Teuf for CMC	cmcpro.com
lene	HB 12	-	■	-	■	-	-	2kN 450lbf	-	- -			Available in 300m lengths for beach/coastal recovery operations	mycourant.com

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	Ø mm Inches"	FLOATS	MODEL VARIANT Product Code	COMPANY	ORIGIN	COST per Metre /3.28ft per Foot	WEIGHT g/m lb/100'	MATERIA SHEATH CORE
	8mm 5/16"	■	Jet Line PPJL80B0	COURANT		£2.10 $2.80 $0.85 €2.00	31g 2.1lb	Polypropy Polypropy
	10mm 25/64"	■	Jet Line PPJLA0C0	COURANT		£2.30 $3.00 $0.95 €2.20	45g 3lb	Polypropy Polypropy
	5mm 13/64"	■	PPM5 05819xxx	HF SAFETY		£0.70 $0.65 $0.25 €0.60	12g 0.8lb	Polypropy -
	8.5mm 21/64"	■	PPM8 05820xxx	HF SAFETY		£1.20 $1.20 $0.40 €1.10	30g 2lb	Polypropy -
	7.5m 19/64"	■	KM7.5 05822xxx	HF SAFETY		£1.10 $1.10 $0.35 €1.00	21g 1.4lb	Polypropy Polypropy
	10mm 25/64"	■	KM10 05821xxx	HF SAFETY		£1.75 $1.70 $0.55 €1.60	45g 3lb	Polypropy Polypropy
	8mm 5/16"	■	Syntec 5823xxx	HF SAFETY		£4.60 $4.95 $1.50 €4.50	31g 2lb	Polypropy Dyneem
	6mm 1/4"	■	Reflecta 02100-0600	LIROS		£1.20 $1.60 $0.50 €1.40	20g 1.4lb	Polypropy -
	8mm 5/16"	■	Reflecta 02100-0800	LIROS		£1.90 $2.55 $0.80 €2.20	30g 2lb	Polypropy -
	8mm 5/16"	■	Throwline8 16S230.91	LOMO		£0.60 $0.80 $0.25 €0.70	23g 1.55lb	Polypropy -
	10mm 25/64"	■	Throwline10 16S330.91	LOMO		£1.10 $1.50 $0.45 €1.30	33g 2.2lb	Polypropy -
	6mm 1/4"	■	Marstron JF00xx	MARLOW ROPES		£1.15 $1.60 $0.55 €1.35	17.6g 1.2lb	Polypropy -
	8mm 5/16"	■	Marstron JF01xx	MARLOW ROPES		£1.90 $2.55 $0.85 €2.20	27g 1.8lb	Polypropy -
	10mm 25/64"	■	Marstron JF018xx JF019xx	MARLOW ROPES		£2.75 $3.75 $1.20 €3.20	50g 3.4lb	Polypropy -
	6mm 1/4"	■	Hercules -	NAMAH ROPES		£1.20 $1.55 $0.50 €1.40	23.5g 1.58lb	UHMWP UHMWP
	8mm 5/16"	■	Hercules -	NAMAH ROPES		£1.55 $2.00 $0.65 €1.80	40g 2.7lb	UHMWP UHMWP
	10mm 25/64"	■	Hercules -	NAMAH ROPES		£2.50 $3.20 $1.00 €2.90	58g 3.9lb	UHMWP UHMWP

WATER RESCUE ROPES

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lene lene	KM 32	-	■	■	■	●	-	9kN 2023lbf	-	- -				mycourant.com
lene lene	KM 32	-	■	■	■	■	-	12kN 2698lbf	-	- -				mycourant.com
lene	MP 8	-	■	-	■	-	-	3.92kN 877450lbf	<10%	- 0.91			made by Liros	paddle-people.com
lene	MP 8	-	■	-	■	-	-	115.5kN 24731237lbf	<10%	- 0.91			made by Liros	paddle-people.com
lene lene	KM 16	-	-	-	■	-	-	8.44.9kN 18881102lbf	<8%	- 0.91			made by Liros	paddle-people.com
lene lene	KM 16	-	-	-	■	●	-	137.6kN 29231709lbf	<8%	- 0.91			made by Liros Marketed by some canoe shops with all-red marker threads (4 bands)	paddle-people.com
lene na	KM 16	-	-	-	■	■	-	2410.7kN 53952406lbf	<1.5%	- <0.96			made by Liros	paddle-people.com
lene	MP 8	-	-	□	■	-	-	5.5kN 1237lbf	<12%	- -				liros.com
lene	MP 8	-	-	□	■	-	-	9kN 2023lbf	<12%	- -				liros.com
lene	HB 16	-	■	-	■	-	-	8.5kN 1912lbf	-	- 0.91				lomo.co.uk
lene	HB 16	-	■	-	■	-	-	9.9kN 2226lbf	-	- 0.91				lomo.co.uk
lene	MP 8	-	■	-	■	●	-	3.9kN 877lbf	-	- -			Also available as enhanced *Marstron Plus* and *Excel Marstron Plus* ropes	marlowropes.com
lene	MP 8	-	■	-	■	●	-	6kN 1349lbf	-	- -			Also available as enhanced *Marstron Plus* and *Excel Marstron Plus* ropes	marlowropes.com
lene	MP 8	-	■	-	■	●	-	11.1kN 2495lbf	-	- -			Also available as enhanced *Marstron Plus* and *Excel Marstron Plus* ropes	marlowropes.com
PE PE	KM 16	-	-	-	■	●	-	24kN 5395lbf	-	44% -				namahropes.com
PE PE	KM 16	-	-	-	■	■	-	42kN 9442lbf	-	44% -				namahropes.com
PE PE	KM 16	-	-	-	■	■	-	65kN 14613lbf	-	44% -				namahropes.com

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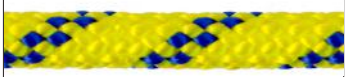
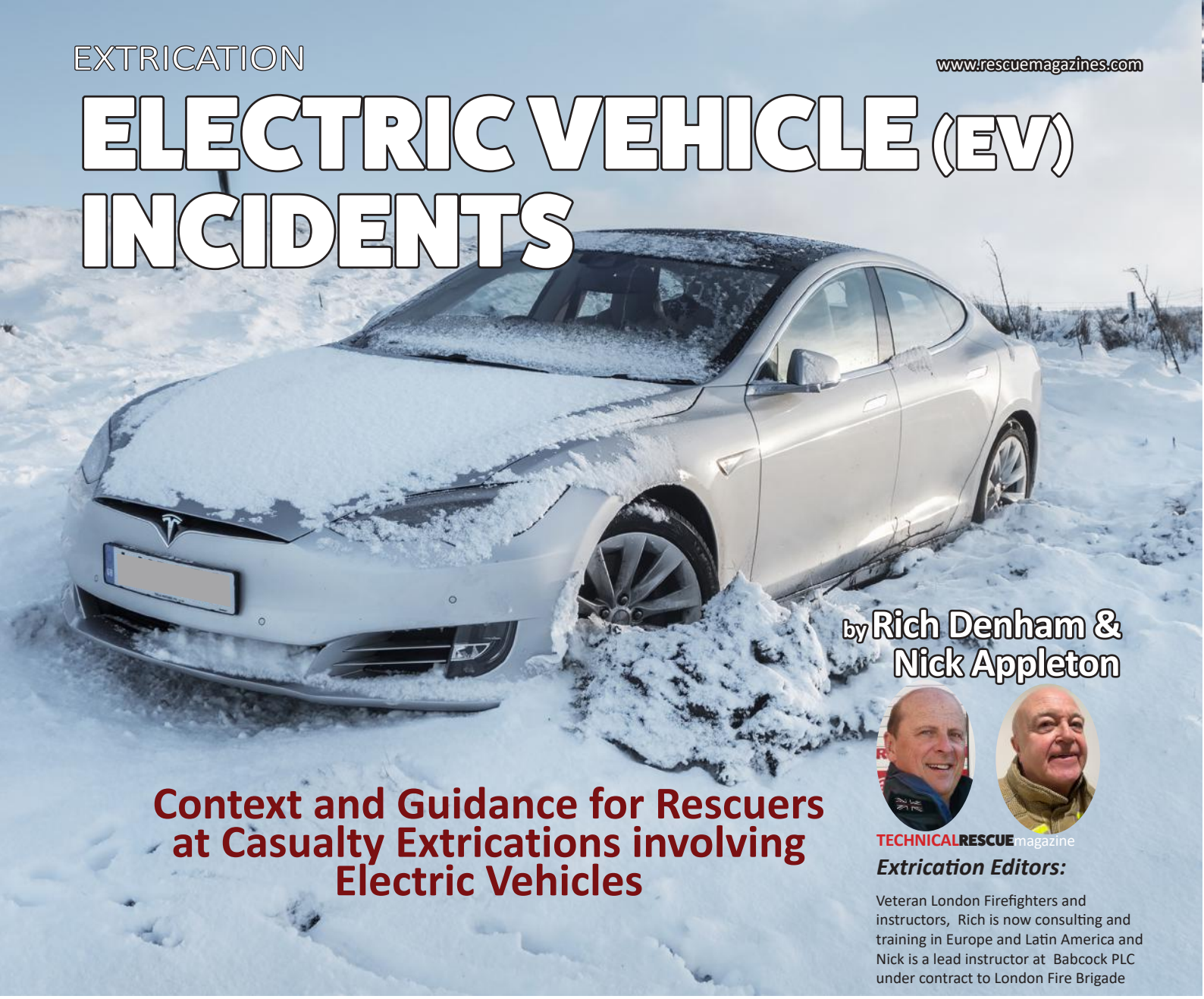
	8mm 5/16"	■	Throwline AC106	NOOKIE		£2.20 $2.95 $0.90 €2.55w	26g 1.75lb	Polypropy Polypropy
	10mm 25/64"	■	Throwline AC100	NOOKIE		£2.50 $3.35 $1.00 €2.90	40g 2.69lb	Polypropy Polypropy
	6mm 1/4"	■	H2O Swiftwater 3Q-08x	PELICAN		~£1.50 ~$2.00 ~$0.60 ~€1.85	25.3g 1.7lb	Polypropy Polyprop/Dy
	8mm 5/16"	■	H2O Swiftwater 3Q-10x	PELICAN		~£1.95 ~$2.60 ~$0.80 ~€2.25	34.2g 2.3lb	Polypropy Polyprop/Dy
	9mm 3/8"	■	H2O Swiftwater 3Q-12x	PELICAN		~£2.10 ~$2.80 ~$0.85 ~€2.45	50.6g 3.4lb	Polypropy Polyprop/Dy
	9mm 3/8"	■	NFPA H2O Rescue 3PN-12x	PELICAN		~£2.55 ~$3.35 ~$1.00 ~€2.90	46.1g 3.1lb	Polypropy Polypropylene
	8mm 5/16"	■	Water Rescue 3PX-10x	PELICAN		~£1.60 ~$2.10 ~$0.65 ~€2.45	27.5g 1.85lb	Polypropy Polypropy
	9mm 3/8"	■	Water Rescue 3P-12x	PELICAN		~£1.80 ~$2.40 ~$0.80 ~€2.80	27.5g 3.4lb	Polypropy Polypropy
	11mm 7/16"	■	Water Rescue 3P-14x	PELICAN		~£2.20 ~$2.90 ~$0.95 ~€3.35	69.9g 4.7lb	Polypropy Polypropy
	7mm 9/32"	■	MFP Throwline -	TEUFELBERGER		£1.05 $1.44 $0.44 €1.30	27.1g 1.8lb	Polypropy -
	8mm 5/16"	■	MFP Throwline -	TEUFELBERGER		£1.50 $2.00 $0.62 €1.80	28.2g 1.9lb	Polypropy -
	7.5mm 19/64"	■	NFPA Throwline -	TEUFELBERGER /MAXIM		£3.75 $5.00 $1.54 €4.60	29.8g 2lb	Polypropy HMPE (Dyne
	9.1mm 23/64"	■	Polygrip -	TEUFELBERGER		£2.55 $3.40 $1.05 €4.60	43.1g 2.9lb	Polypropy Nylon
	11mm 7/16"	■	Water Rescue -	TEUFELBERGER		£0 $4.30 $1.32 €3.20	78.9g 5.3lb	Nylon Polypropy
	10mm 25/64"	■	Rescue Throwline -	WRS INTERNATIONAL		£1.45 $1.95 $0.60 €1.70	55g 3.7lb	Polypropy Polypropy
	8mm 1/4"	■	Dolphin Max -	X-MONSTER		n/a	34.5g 2.3lb	Polypropy UHMWP
	9.5mm 1/4"	■	Dolphin Max -	X-MONSTER		n/a	45.6g 3.1lb	Polypropy UHMWP

WATER RESCUE ROPES

ALS:	CONSTRUCTION CARRIER/BRAID	STANDARDS	SPLICEABLE PRE-SPLICED PRE-SEWN	REFLECTIVE	THROWLINE	TECH HARDWARE USE	ABSEILING/CAMS	MBL MINIMUM Break Load Spliced Sewn Knotted	@10% MBS @30% MBS @50-150 kg @300LB/136K @1000 lb/454kg	SPECIFIC GRAVITY SHEATH %	OTHER COLOURS		NOTES	WWW.
lene lene	MP 12	-	■	-	■	-	-	9kN 2023lbf	4.5%	- -				nookie.co.uk
lene lene	MP 12	-	■	-	■	-	-	13kN 2915lbf	4.5%	- -				nookie.co.uk
lene neema	MP 16	NFPA	■	□	■	●	-	14.2kN 3200lbf	-	- -				pelicanrope.com
lene neema	MP 16	NFPA	■	□	■	■	-	15.1kN 3400lbf	-	- -				pelicanrope.com
lene neema	MP 16	NFPA	■	□	■	■	●	22kN 4950lbf	-	- -				pelicanrope.com
lene e/Nylon	KM 24	NFPA	■	□	■	■	●	16kN 3600lbf	-	- -				pelicanrope.com
lene lene	MP 16	NFPA	■	□	■	●	-	6.67kN 1500lbf	-	- -				pelicanrope.com
lene lene	MP 16	NFPA	■	□	■	●	-	13.3kN 3000lbf	-	- -				pelicanrope.com
lene lene	KM 24	NFPA	■	□	■	■	-	14.7kN 3300lbf	-	- -				pelicanrope.com
lene	HB 12	CE A NFPA UIAA	■	-	■	-	-	6kN 1350lbf	-	- -			MFP=Multi-Filament Polypropylene	teufelberger.com
lene	HB 12	CE A NFPA UIAA	■	-	■	-	-	7.56kN 1700lbf	-	- -				teufelberger.com
lene eema)	DB 16	NFPA	■	-	■	●	-	19.3kN 4335lbf	-	- -				teufelberger.com
lene	KM 16	NFPA		-	■	●	-	15.6kN 3505lbf	-	- -				teufelberger.com
lene	DB 20	CE A NFPA UIAA	■	-	■	■	-	16.45kN 3700lbf	-	- -				teufelberger.com
lene lene	KM 32	-	-	-	■	■	-	12kN 2698lbf	-	- -				wrsinternational.com
lene PE	KM	NFPA 2500	■	■	■	■	-	23.1kN 5192lbf	-	1.38 00%			Enhanced grip & higher strength core	xmonstersafety.com ropersrope.com
lene PE	KM	NFPA 2500	■	■	■	■	■	26.5kN 5957lbf	-	1.38 00%			Enhanced grip & higher strength core	xmonstersafety.com ropersrope.com

ELECTRIC VEHICLE (EV) INCIDENTS



by Rich Denham & Nick Appleton

Context and Guidance for Rescuers at Casualty Extrications involving Electric Vehicles

TECHNICALRESCUE magazine

Extrication Editors:

Veteran London Firefighters and instructors, Rich is now consulting and training in Europe and Latin America and Nick is a lead instructor at Babcock PLC under contract to London Fire Brigade

1. INTRODUCTION

Electric vehicles (EVs) are now a common sight on our roads, especially in urban areas where battery duration and recharging options are not an issue. Inevitably, we are experiencing an increasing number of Road Traffic Collisions (RTC) / Motor Vehicle Collisions (MVC) involving such vehicles. This requires first responders to adapt to the ever evolving hazards they are confronted with when attending these incidents and how to mitigate those risks while still adhering to general extrication protocols that apply at any vehicle accident

.

When performing space creation and vehicle extrication involving these vehicles, rescuers must consider electrical, structural - and thermal - risks that differ from conventional road traffic.

Note that your own organisation's protocols and procedures regarding EVs and associated fire hazards will always have primacy.

2. CONTEXT

There are differing views worldwide on how to deal with actual EV lithium ion traction battery fires and this has been discussed at length in other publications specialising in firefighting. From a technical rescue perspective we will be relating this only to electric vehicles involved in an RTC with the potential to go into thermal runaway, and how first responders can stay safe and effect a rescue if necessary.

To support understanding, the following contextual information should be considered:

I. THERMAL RUNAWAY

- **Definition**: A single-cell event where internal heat generation exceeds the rate of heat dissipation, leading to an exponential temperature rise, venting of flammable gases, and potentially fire or explosion.
- **Mechanism**: Triggered by electrical abuse (overcharging, short circuits), mechanical damage

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(crushing, nail penetration), or excessive external temperature, it involves a sequence of internal chemical reactions (e.g., separator melting, electrolyte decomposition, cathode/anode reactions) that release significant energy as heat.

- **Outcome**: Destruction of the individual cell and a high risk of ignition due to the release of hot, flammable gases.

II. THERMAL CASCADE

- **Definition**: The process where the extreme heat and fire from one cell experiencing thermal runaway transfers to neighbouring cells, causing them to also enter thermal runaway.
- **Mechanism**: Heat transfer pathways (conduction, convection, radiation) through the battery system cause vulnerable adjacent cells to reach their trigger temperature threshold (around 80°C to 200°C, depending on conditions).
- **Outcome**: A large-scale, potentially catastrophic event involving an entire battery pack or energy storage system, which is much more severe and difficult to manage than a single-cell failure.

As can be seen, Thermal Runaway is an uncontrolled, self-sustaining increase in temperature within a single battery cell (or other system) due to a positive feedback loop of exothermic (heat-releasing) chemical reactions.

Whilst Thermal Cascade is the spread of this thermal runaway event from one failed cell to adjacent, healthy cells within a battery module or pack. So, runaway is the primary event, while a cascade is the dangerous chain reaction that can occur as a consequence within a multi-cell system if not properly mitigated. However, the term thermal runaway has become widely used as a catch all phrase by first responders to describe any incident involving the uncontrolled overheating of the traction battery in Electric Vehicles.

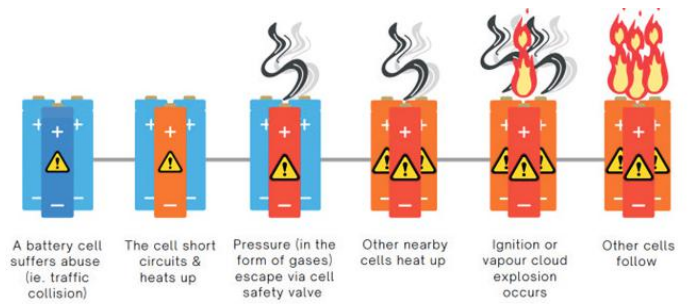
3. EV BATTERY ABUSE

"EV battery abuse" is the term used to refer to extreme conditions that go beyond normal operation, such as mechanical impacts and compression (including from crash damage and rescue tools), overcharging, extreme temperatures, and over-discharge, which can all lead to safety hazards like fires or explosions.

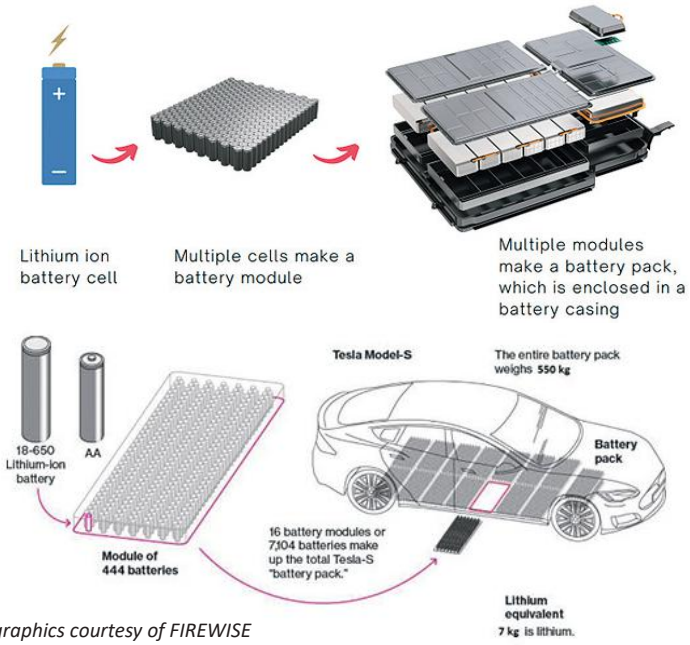
Types of EV battery abuse

- **Mechanical abuse**: Physical damage from events like vehicle collisions, where the integrity of the traction battery compartment has been compromised by penetration or crushing.
- **Electrical abuse**: Stress from overcharging or over-discharging, where the battery is charged beyond its safe limit or fully drained.
- **Thermal abuse**: Exposing the battery to excessive heat or rapid temperature changes.

It can be seen that in a motor vehicle collision it is mechanical abuse of the battery which is the hazard of concern



graphics courtesy of FIREWISE



graphics courtesy of FIREWISE

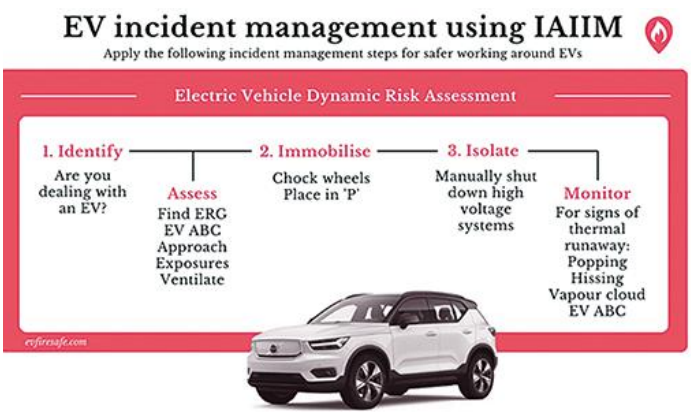
4. RESCUER SAFETY

Having a safety protocol in place to ensure safe management of incidents involving EVs is self-evident best practice.

IAIIM

One such protocol option is IAIIM (see table below), which was developed by EV Firesafe together with a team of international experts to assist first responders when attending incidents involving Electric Vehicles. FirewiseUK Learning Academy is the leading UK training provider teaching the IAIIM protocol which has been adapted to be included by the London Fire Brigade among UK Fire and Rescue Services for dealing with EV incidents.

The principle of the IAIIM is illustrated below:



THE KEY POINTS OF IAIIM EXPLAINED:

Identify

- Hazards – Dynamic Risk Assessment
- MAKE/MODEL/YEAR & type – BEV, PHEV, HV
- Driver & obtain history/timeline, battery State of Charge
- Refer to Emergency Response Guide (ERG)

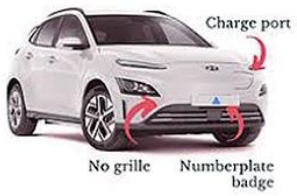
EV identification

Charging ports are usually placed in one of a few common areas, depending on the vehicle's design and manufacturer. It could be located:

- At the front side (driver or passenger side)
- On the rear quarter panel
- On the front grille
- Near the rear side, close to the boot.

EV's do not usually have a grille at the front of the vehicle because they don't have an engine to cool. Removing the grille also helps reduce drag, helping EV's travel further on a single charge.

EV's do not have an exhaust pipe as there is no combustion engine.



There are relatively few obvious registration or plate markings to indicate an electric vehicle.

The **US, Canada and Australia/NZ** have none at the time of writing though some states are moving towards voluntary 'personal' plates but that would likely be seen as a 'novelty' plate rather than an easily identifiable marker.

China and **Austria** probably have the most obvious marking currently with fully green plates (pics below right) while the **UK** has a green strip on one side of the number plate though this is not yet compulsory (pics below-left).

NORWAY has number plates that begin with "EL", "EK", or "EV" this is widely used across the country especially for tolls, ferries and parking

GERMANY has an optional "E" suffix on plates (e.g. B-AB 123E) This is used for access to low-emission zones and parking.

NETHERLANDS has no visual marker, but EVs are identifiable electronically by plate database as they are in **Japan** and **Korea**.

ASSESS

Use Mobile Data Terminal if available such as *Moditech*

- Stability of vehicle
- Extent of damage to vehicle. SRS activated?
- If an airbag has deployed then the traction battery should be automatically isolated.
- Casualties
- Warning symbols on dashboard
- Signs of Thermal Runaway:
- Noises – whistling or popping?
- Vapours - light and/or dark ('Gassing off')? Gas Detection Monitor,
- Jet like flames?
- Battery Temperature use Thermal Image Camera >60degrees C
- High voltage cable runs under the vehicle near the centre. Orange cables carry very high voltage and can run inside trunking or bodywork, depending on the vehicle. Orange sheathing indicates high voltage.
- Under bonnet components can retain a residual charge. Cabling loses its residual charge as soon as relays are turned off, however some components under the bonnet can retain a significant charge even after the battery is disconnected.
- The battery pack will retain its charge indefinitely so must be always considered 'live'. Take care that the area about to be cut does not contain hidden cables running through internal recesses or behind trim panels and never cut into any orange cables.
- As the cabling runs centrally under the vehicle it is not in an area that firefighters are likely to cut into.
- Even if the cable is damaged, the relay should kick out instantly, however best practice is not to cut or touch.
- If the vehicle is on its side or roof, the orange cable run should be avoided. Be aware these cable runs can be found closer to the sills in newer vehicle models, and a full visual check must be made first.

IMMOBILISE

Approach the vehicle at 45-degrees for your safety

- Risk of unexpected violent movement forwards or backwards
- Risk of flaming out from the underside of vehicle due to positioning of the battery along the floor pan

Chock all wheels

- Use large round edge purpose made wheel chocks

Apply brake

- EV vehicles use electronic parking brakes (EPBs) instead of traditional handbrake levers.

Select 'PARK'

- EVs, in common with most modern automatic cars, use an electronic gear selector. There's no mechanical linkage – everything is controlled electronically. Ensure the vehicle's gear selector is placed in PARK.

ISOLATE

Turn off the vehicle's ignition

- EVs use a start/stop button instead of a traditional key ignition system as there is no engine to start. By pressing the start/stop button, it powers on the vehicle's systems and puts it into READY mode, meaning it's ready to drive.
- EVs utilise smart key integration. This means that once the 'key', which will usually be the fob or owner's phone, is detected, the vehicle will turn on.
- Ensure the vehicle keys, fob, or phone are placed at least 5m away from the vehicle (or in a Faraday pouch to block the radio signal to the vehicle).
- Most EVs have built-in systems that automatically disable the high voltage when airbags deploy or the vehicle is in a severe crash, but manual overrides offer an extra layer of safety.

- **Cut Loops**: A wire or cord, often under the front hood (bonnet), that responders cut in two places to remove a section, breaking the high-voltage circuit (e.g. Tesla).

- **Pull Fuses**: Marked connectors or fuses in the fuse box that, when pulled, isolate the high-voltage system (e.g., Hyundai, some European models).

Cut the first responder loop to isolate the high-voltage system, which will de-energise the vehicle safely. The first responder loop can be located in various areas depending on the vehicle and manufacturer. It could be located:

- Inside the front boot/trunk (most common)
- Behind a marked access panel
- Near the driver-side footwell or dashboard (less common)

Disconnect low voltage battery (lead acid or increasingly becoming lithium ion)

Under no circumstances should first responders attempt to remove the high voltage Manual Service Disconnect (MSD). Orange plug often located under the rear seat and integral to the outer casing of the HV traction battery.

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MONITOR

Throughout incident monitor appointing a designated safety officer for signs of Thermal Runaway:

- Noises – whistling or popping
- Visual – light or dark vapour
- Gas Detection Monitor
- Thermal Image Camera >60°C

5. EV EXTRICATION OPTIONS

For casualty rescue purposes, an EV involved in a Road Traffic Collision can be seen as being in one of two 'thermal states' – stable or in runaway:

EV not in thermal runaway (stable)

In an electric vehicle collision it is imperative that, during rescue operations to free a trapped casualty, the battery compartment is not compromised during any cutting, spreading or ramming techniques.

The minimum amount of tool use necessary to safely free the trapped casualty should be employed.

In modern vehicles due to the advanced design of the crash safety cells the likelihood of the dashboard and steering wheel assembly intruding rearwards and trapping the casualty has been significantly reduced. Subsequently the requirement to perform dashboard relocations such as dash rolls/lifts which have the potential to inflict damage to the battery compartment in the floor pan has likewise been reduced involving a viable casualty.

In an upright vehicle the hierarchy of extrication (see TRMag 84) remains the same with the inclusion of snatch-rescue at 1) as a first consideration:

1. (Snatch-Rescue? Immediate threat to life or unconscious and absent / ineffective breathing) **Self-Extrication, potentially assisted**
2. **Extricate through adjacent door**
3. **Extricate through side** remove 2 doors then remove B post (do not spread at the base of the B post or work against the sill/rocker panel)
4. **Extricate through rear** – remove roof

These evolutions can all be achieved without compromising the integrity of the battery compartment.

If there is a need to use rams to relocate vehicle parts in order to free the trapped casualty then the push point for the base of the ram cannot be the sill/floorpan or the base of the B post, and so utilisation of other strong points in the vehicle such as the lock position (see below) on the B post will need to be employed.

EV IN THERMAL RUNAWAY

If any of the signs of the traction battery starting to go into thermal runaway are present and the casualty is not physically trapped, an immediate (snatch) rescue should be performed by a crew wearing breathing apparatus covered by a further breathing apparatus crew with a charged hose line for protection in case of flame out from the underside of the vehicle.

If the casualty is physically trapped and the vehicle has started to gas off then the only option is for a rescue crew wearing breathing apparatus to attempt to the free the entrapment using the quickest possible means available. There is very little time available before the vehicle will catch fire and so speed is of the essence.

Any casualties rescued should be immediately removed to a safe distance away (determined by operational HAZMAT protocols) and upwind of the incident. No personnel without breathing apparatus including medical staff should be deployed in the vicinity of any EV in thermal runaway.

6. CONCLUSION

As with all rescue work, pre-knowledge and context are essential for scene and

rescuer safety.
In this connection the IAIIM protocol is a comprehensive tool designed for first responders attending electric vehicle incidents.

Ease of use and a logical progression in the protocol will help reduce the hazard to emergency services personnel when dealing with RTCs/MVCs involving Electrical Vehicles.

Training in the relatively new hazard of electrical vehicle incidents is essential for first responders in order to fully understand the risks they are confronting.

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A ~~YOUNG PERSON'S~~ VIKING'S GUIDE TO....

ANCHORS & ANCHOR SYSTEMS..

part5

LINEAR ANCHORS

by Reed Thorne
Ropes that Rescue AZ, USA

Our resident rope genius, Reed 'the Red' Thorne, started a new and quite complex series in TR83 on anchoring so Refer to part 1 for definitions.

This series includes(ed):

- ANCHOR TYPES/LOADING
- BOMBPROOF ANCHORS
- FLOATING ANCHORS
- LINEAR ANCHORS
- MULTI-POINT ANCHORS

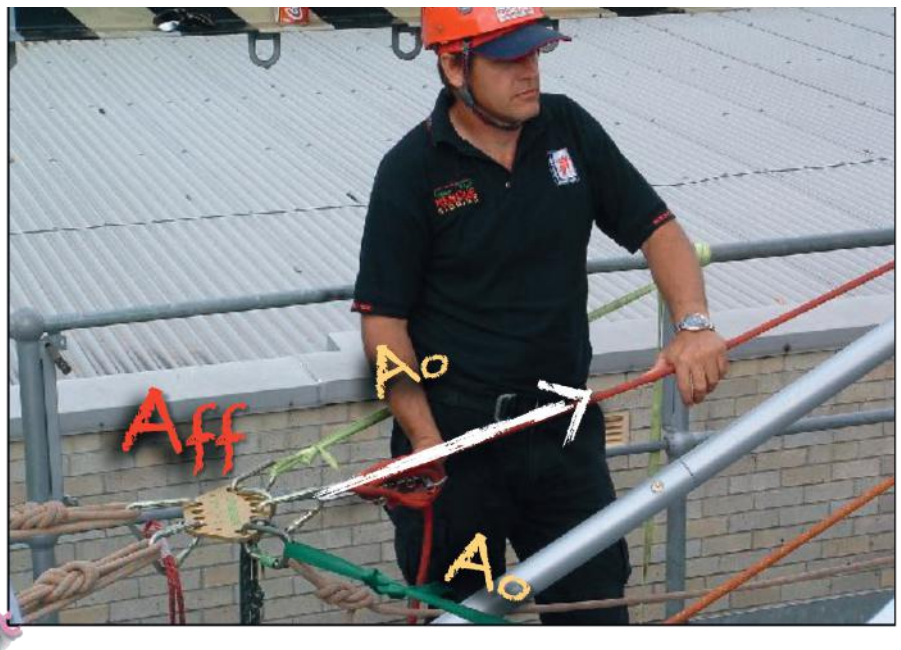
below: A Ponderosa pine tree is back tied in two directions for anticipated forces applied by a future pulley system. Both back ties are attached to a single W3P2 on the tree.

opposite-bottom: A juniper tree it double back tied to the right to resist forces on it from a 9:1 compound pulley system.

DEFINITION:
Linear rope systems between single anchor points which either apply tension as in a pre-tensioned backtie or hold in opposition as in a front tie.

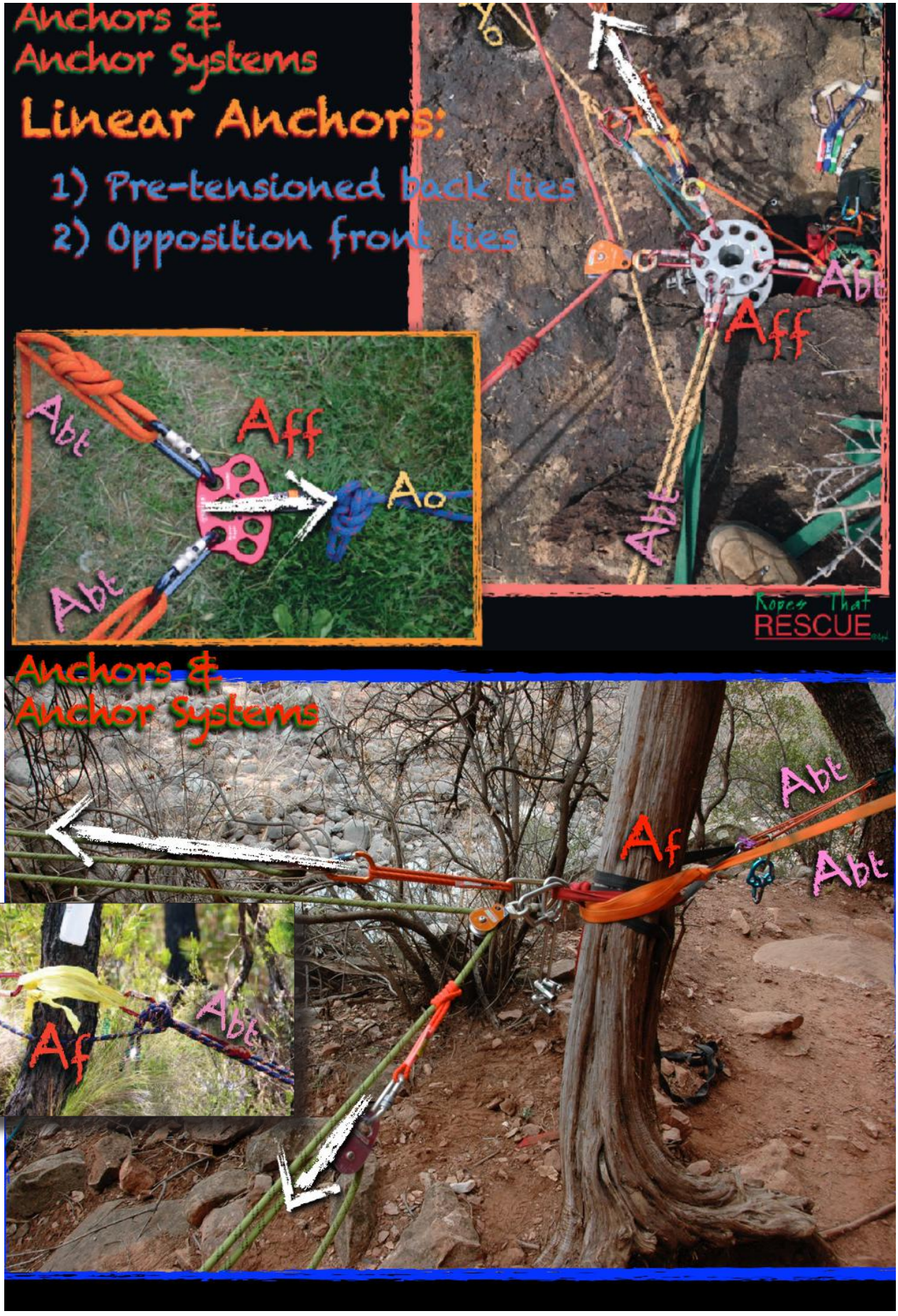
1. **PRE-TENSIONED BACK TIE**: (pic right) Those linear anchors consisting of non-working pulley systems which focus another point-anchor and hold back away, oppositely, from the intended applied force.

2. **OPPOSITION FRONT TIE**: (pic right) Those linear anchors which are used forward towards the edge from any focused floating anchor rigging plate/pod for the purpose of restraining it while the application of tension is applied. A single piece of cordelette or webbing is normally sufficient
[Author's note: (Slang term for the front opposition anchor: "Gila Monster")]



Anchors may also be strengthened and held in place with linear pre-tensioned back tie anchors discussed later (see right). The acronym for a back tie is:

"**A** sub **bt**"
or
"A_{bt}"
...and for an opposition front tie:
"**A sub o**"
or
"A_o"


Anchors &
Anchor Systems
Linear Anchors:
1) Pre-tensioned back ties
2) Opposition front ties
Abt
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Ropes That
RESCUE
Anchors &
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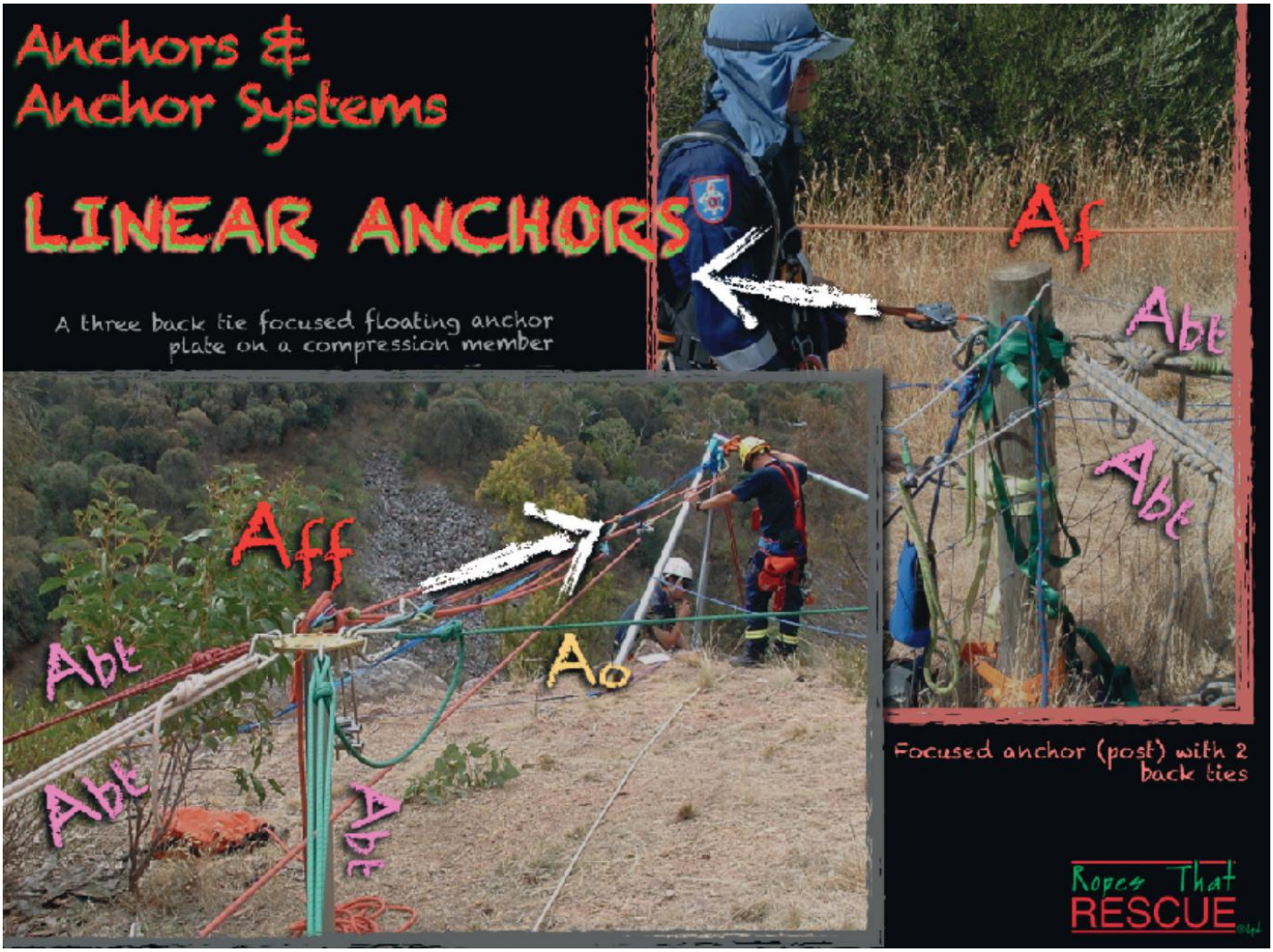

In the past, we used larger 1/2" (12.7mm) ropes for our main and belay and used many lengths of 7/16" (11.1mm) ropes for all the ancillary rigging including all back ties and guying of high directional frames. Today, with the advent of stronger *Technora*®, *Dyneema*® and other "hybrid" yarns, we have dropped to a lighter weight, smaller diameter but comparatively stronger rope. These include many of the new tactical and canyoning rope that we now see increasingly thanks to that sports popularity.

So now, we are only bringing two or three larger diameter ropes for our main and belay line, and the rest of the rigging is done with this smaller hybrid cordelette from the tactical and canyoning side. This has lessened the amount of rope that we now carry and lightens our packs considerably.

Pre-tensioned back ties can be built with just about any mechanical advantage (MA) but generally the larger the rope diameter, the less MA you will need to support the object you are tying back or guying. It is also easier to grasp a larger rope and get more stretch energy with a lower MA.

Sterling Rope Company has a product called PowerCord® which is just 6mm in diameter and is rated at 4,429# (19.7kN) with a braided *Technora*® core. So, if you are using this with a standard 3:1 non-working back tie, you are way stronger than any carabiner or 1/2" rope you are using as your main line. It is the dental floss principle of using seemingly smaller high strength cords or fiber to form a very very strong anchor.

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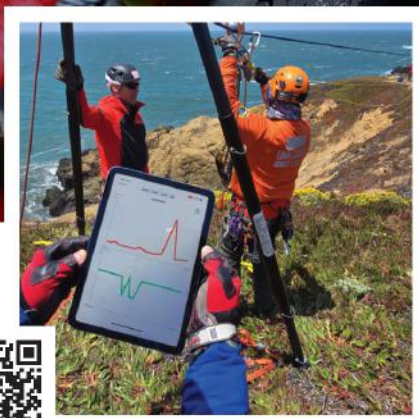

This product complies with regulations (EU) 2016/425 relating to PPE

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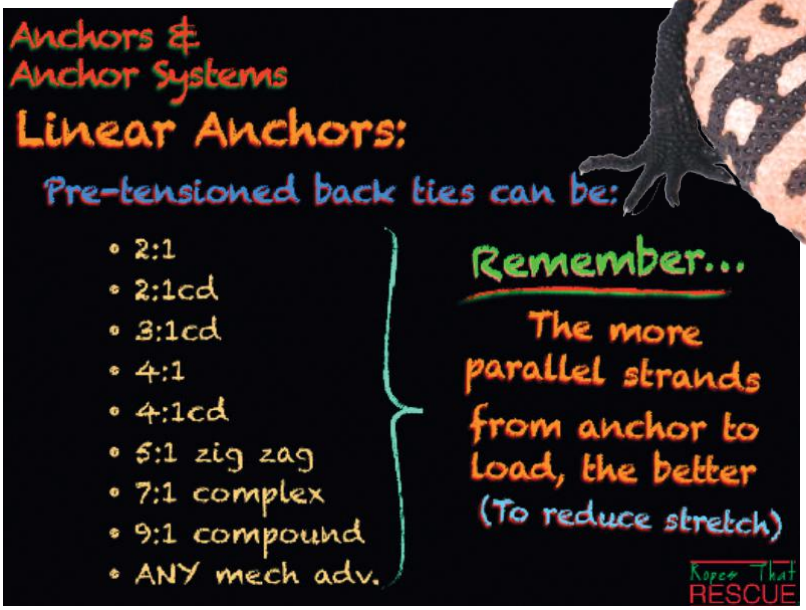
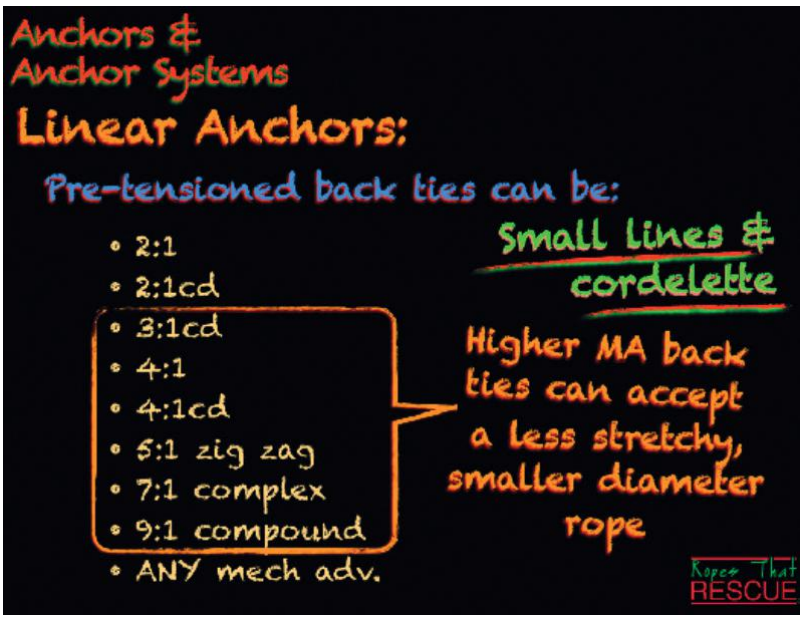
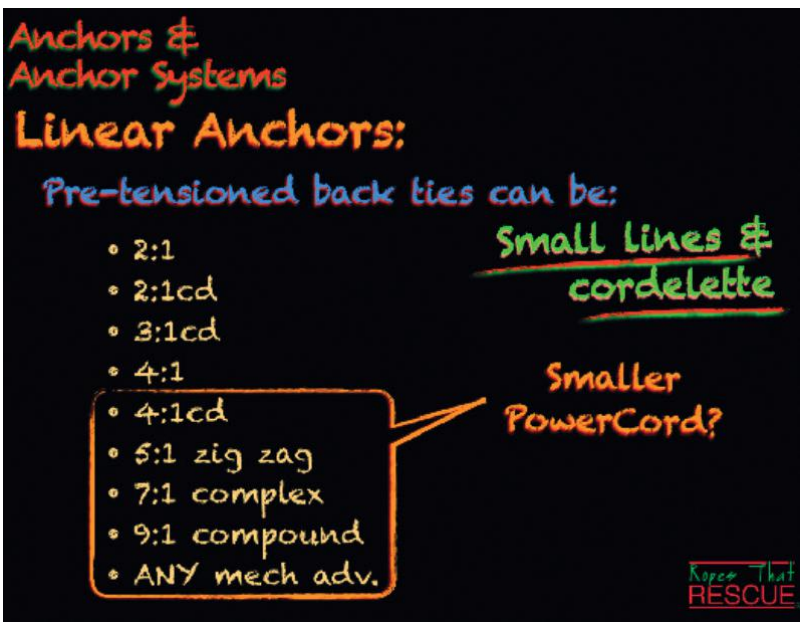


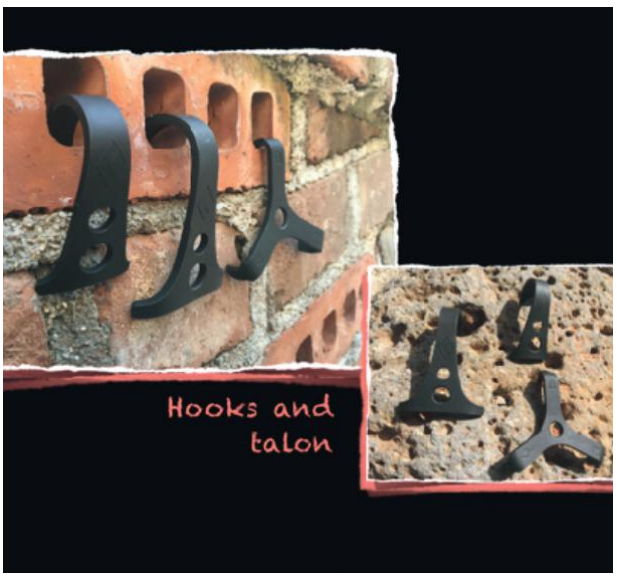


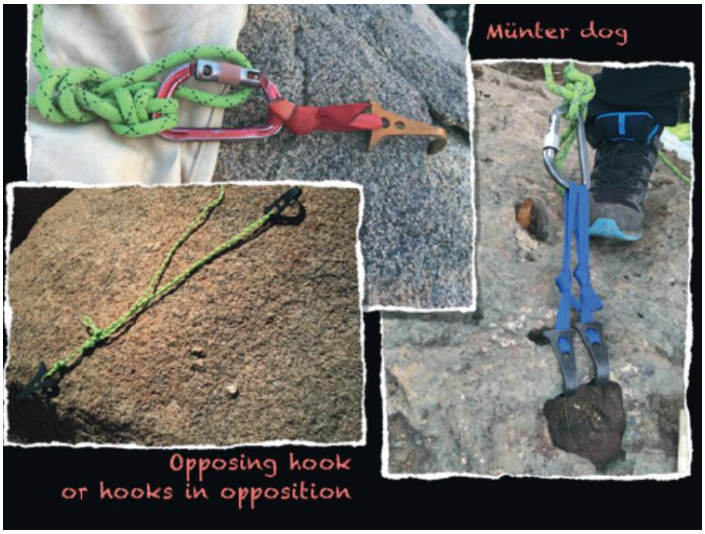


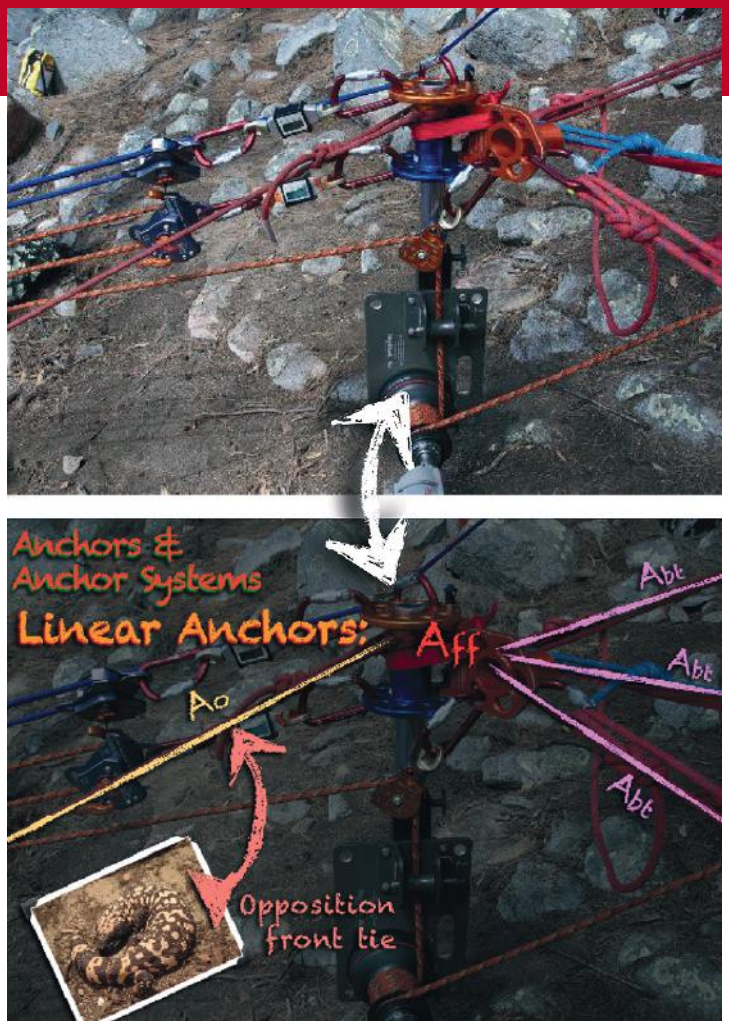
The "GILA MONSTER" (slang)

The opposition front tie (A_o) for any focused floating anchor (including a A_{bff}) is usually a single piece of rope, cordelette, webbing rigged from a suitable front anchor or anchors which is mainly meant to resist back tying forces. This opposition is normally not a mechanical advantage but merely a restraint to hold the focus of the focused floating anchor.

Many times if the force on the focused floating anchor is sufficient, the opposition front tie may come loose. This is perfectly normal and should not cause alarm. Opposite, the two photo far right show a short rigging pod with several back ties (as it is a "bombproof focused floating anchor pod) with a single 11.1mm front tie to the left. Sometimes, two front ties are needed to hold the focus if one good anchor cannot be found on the operation center line.







[*Author's note: RTR had been using small aid climbing hooks and "beaks" for attaching to the front edge on rock or on metal grating in industry. These make great "Gila Monsters" because they are so easy to place. The "talon" has three different tips on one piece and is very stable like a three legged stool. Be careful using hooks though in that they can become dislodged during the tensioning process and come out of position like a projectile. Try to always place at least two so if one comes out the other can catch it.*]

MULTI-POINT ANCHORS

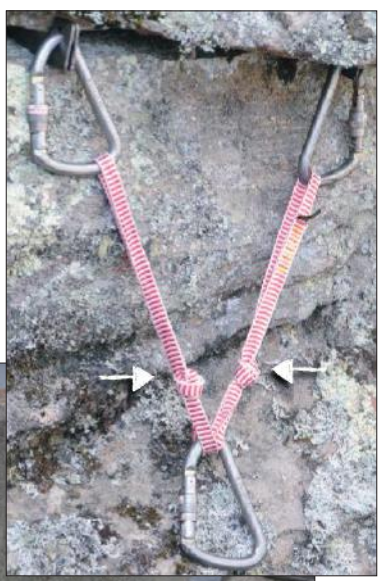
A 3x1 system anchor from rock protection

Above: A massive anchoring system for a two trackline highline on a vertical wall in southern Utah using 14 drilled baby angle pitons. The focus of each of the 5:1 distributing anchors was continually changing as the mass came down the sloping highline so as to not overload any single piton.

Left: A self-equalizing anchor with two anchor points (placed pitons). It was for a top rope climbing route where the direction may change left or right. The potential for a sizable drop if one anchor pulls out is significantly reduced by the limiting knots placed near the focus point

Definition:
A system composed of two or more marginal anchors none of which will be able to hold the entire intended force alone. Each marginal anchor "contributes" to the whole in a way where if one fails, it does not lead to catastrophic failure of the entire system. The acronym for a system anchor is:

"**A** sub **mp**"
or
"$\mathbf{A_{mp}}$"



A couple of 2x1 anchors (1, 2, 3 & 4) being equally loaded by another 2x1 anchor at a small hydro dam. Notice the crush carabiners restricting compression of the webbing for ease of breakdown after the operation.

Two types OF MPA's:

1. Sliding (Self-equalizing/Load distributing):

• Those system anchors that are self equalizing between the multiple points. Also known as a self equalizing anchor or SEA, a term that fell out of favour for a while because one anchor's failure may cause significant shock load of the surviving anchors so LDA or Load Distributing Anchor is also used. Distributing or equalizing anchors are only used where there is the potential for the focus to change during an operation. Two examples are shown at right top and middle.

The issue with these distributing anchors is the risk of significant shock forces onto the remaining anchors in the system if one marginal anchors pulls out. This could consequently lead to a chain reaction failure of the entire system anchor. Keeping the legs of the distributing anchor as short as possible will eliminate some of these huge shock forces (central image above).

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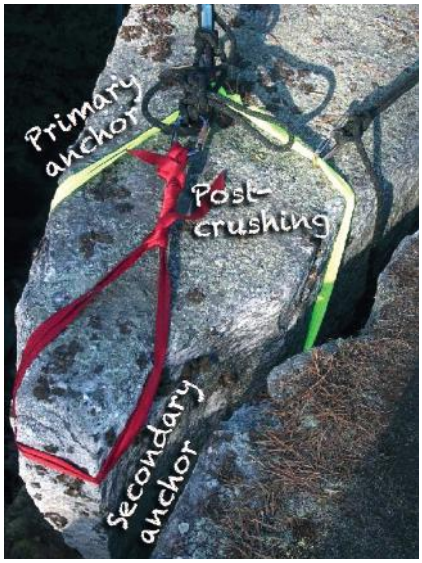
Below-right, the riggers did not initially know where the focus of the anchor needed to be when the 3x1 distributing anchor was built so allowed the directional (see *OmniBlock* pulley at left) to fully load and then came back and did a post seizing with a small amount of accessory cord (referred to as whipping). Essentially, this is the same as the fixed anchor (#3) at the concluding of the seizing but with equal loading on each leg.

2. Fixed Multi-Point Anchors

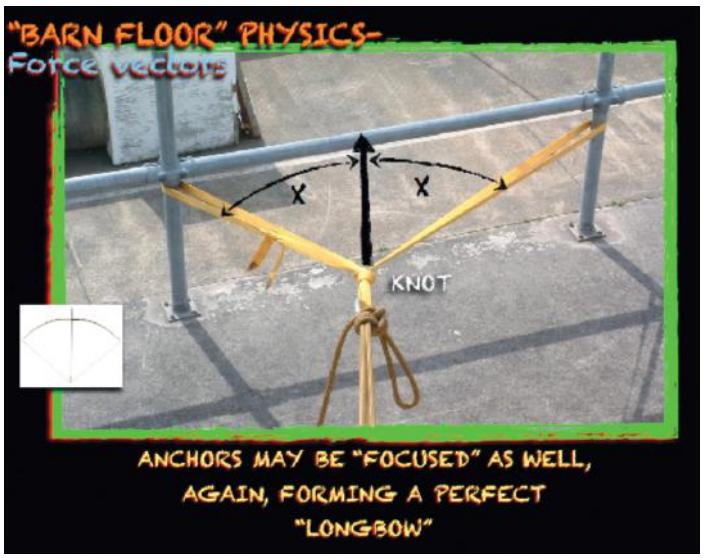
- *Those system anchors that are manually focused by tying a knot to "fix" and equally share loading between all the marginal anchor points. If one anchor fails, there is minimal shock loading onto the remaining anchors.*
- *Multiple anchor points within a multi-point anchor which may or may not be sharing force applied equally, and in fact one or more may indeed be only backing up other anchors with the majority of load.*

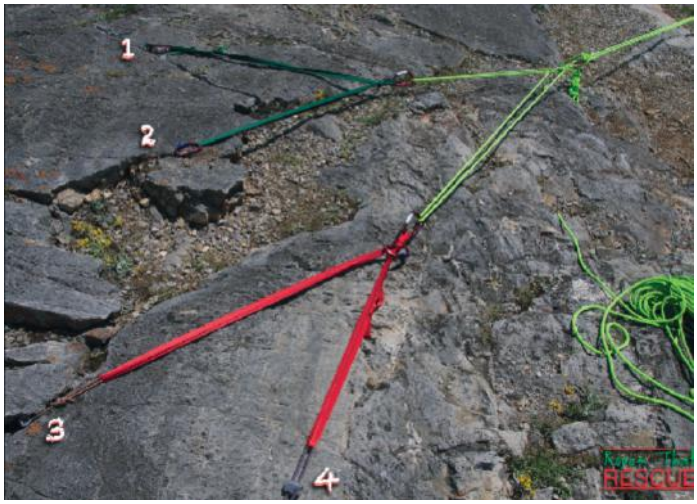
Far-Left: Two hooks used into the same carabiner (constituting a system anchor) with little slack on either one. **Opposite**: A Fixed Multi-Point Anchor where both pieces of webbing around this rock horn are tied in such a way that if one failed the remaining anchor would immediately take the load. The rigger cleverly used a crushing of the triangle to tension up the webbing nearest the top of the rock to get the exact amount of length

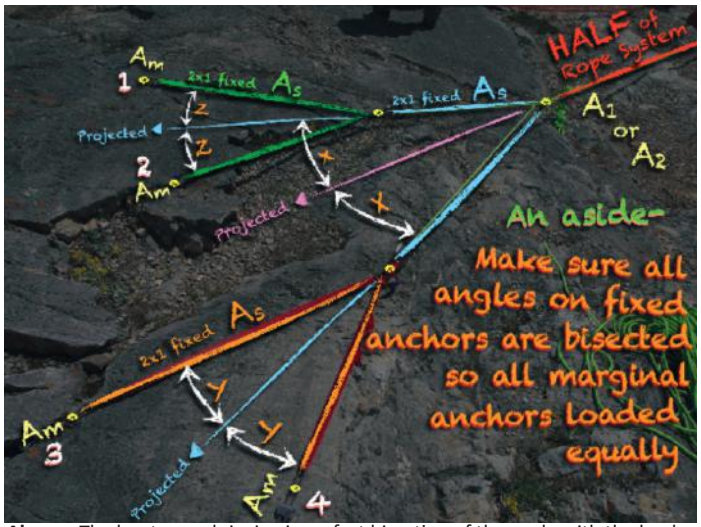


One anchor's failure may cause some shock load of the surviving anchors however the good part about multi-point anchors is that they are usually rigged to reduce all slack in the system. Multi-point anchors are sometimes used as system anchors if there is no practical way of building a distributing or fixed anchor. Two or more marginal anchors are all rigged at various lengths to back each other up in case another fails. This rigging is made up so as to minimize and potential shock loading of the surviving anchor.

Fixed anchors are by far the most common used in rescue work and general rigging as they have the qualities of a good distributing anchor and also the good qualities of a multi-point rigged for the least shock force if one anchor pulls. They are considered therefore “the best of both worlds” in many cases. The builder must take great care in constructing this anchor whether in a 2x1, 3x1, 4x1 or more as to equally load all legs going to each marginal anchor. Normally the easiest to construct is the 2x1 and build on top of those with other 2x1’s (images overleaf). In constructing the 2x1 fixed anchor, it is important to imagine an English Long Bow and if you were shooting an arrow from one. In order to be a good archer you must perfectly bisect the drawn string with the arrow. This perfect bisect will then put the same amount of force on each marginal anchor. You are aiming for a 50%-50% split but if it ends up at 45%-55% you are still probably good. It takes much skill to do this actually.





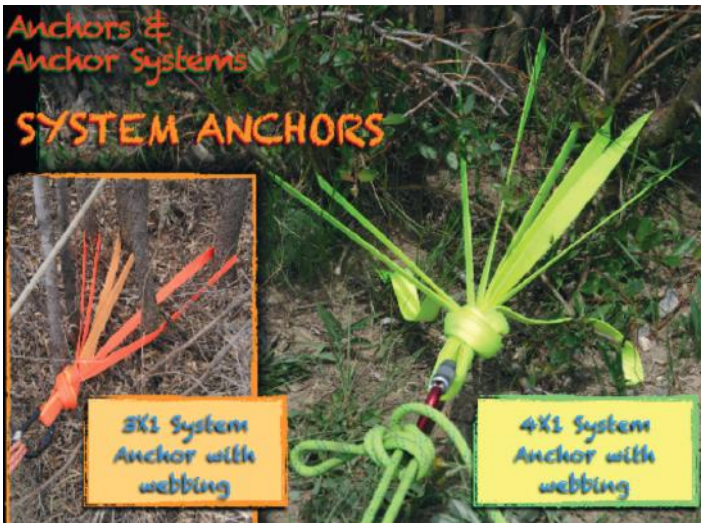


Above - The key to good rigging is perfect bisection of the angle with the load applied symmetrically through the middle of the angle created by your anchor rigging.

Fixing a 3x1 multi-point anchor or higher takes much skill and practice because the center leg often goes slack when the knot is tied. A variety of different knots may be used to fix the focus on the multi-point anchor. In the **photo below**, we have a 20' piece of webbing (*Author's note: You need more than you would think!*) used with a simple figure of eight fixing knot (overhands in this amount of webbing are difficult to untie after loading).

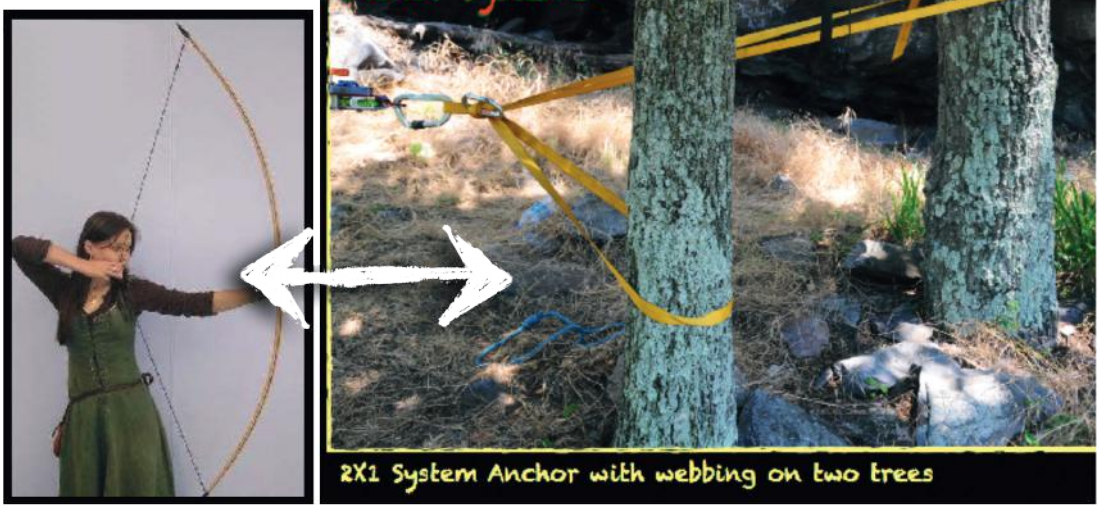
In the photo above, a very large overhand "football knot" in accessory cord was used for this 5x1 fixed anchor (easy to untie after loading). Below, the popular double becket bowline which can be adjusted easily to the exact focus needed. With that connection you do not need a carabiner which allows several ropes to be threaded through the glue- in eye anchor in the rock. Webbing, rope and/or cord can all be used for this.

Webbing looped around vegetation and small shrubs in wilderness makes for a very strong anchor if you keep the webbing low to the ground as seen below. It takes practice to get all the legs the same tension as shown.



The pictiure above shows a 3x1 on three freshly cut olive trees where the rigger used small wood dowels as crush elements to allow an airspace in the fixing knot for ease of untying.

In the image on the right, a 30' piece of webbing between two trees with an overhand fixing knot and a crush carabiner for the same reason. Again, always think of the English long bow and bisect the angle in your webbing.



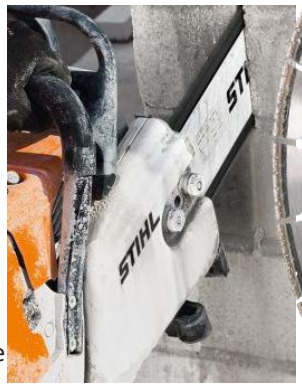
Webbing or cord fixed multi-point anchors can also be used on the opposite end of your linear anchors (top right). These two 1x3's (instead of a 3x1) are holding a tree limb as a spreader bar for a highline tensioning system which is seen beyond the tree.

In the photo bottom-right, an unusual anchoring arrangement where three baby angle pitons driven into soft sandstone are being used in two differing directions with 2 mirrored 3x1 multi-point anchors from 20' pieces of webbing.

Also check the image on the title page where a couple 2x1 anchors (1, 2, 3 & 4) are being equally loaded by another 2x1 multi-point anchor at a small hydro dam. Notice the crush carabiners for ease of breakdown after the operation.

And that concludes this series on anchor systems.

DISC CUTTERS & ROTARY SAWS



Large disc-cutters (also called Cut-Off saws) together with concrete cutting chainsaws, are just about the noisiest and messiest rescue tools in our arsenal especially if they are petrol/gas driven. They are very much a construction industry tool that rescuers co-opt and modify for specific uses but many are simply off-the-shelf tools doing the same job in rescue that they do on a construction site. Since they are required to cut through metal rebar and roller shutters, concrete and brickwork they are kicking up dust and/or sparks from the second they make contact and this can be a scary and dangerous ordeal for a casualty if they are in close proximity. Often used for long access-opening cuts, disc cutters are a heavy load with big engines creating a lot of torque. You can feel the gyroscope style motion when you hold one in free space and squeeze the trigger. These and chainsaws have been used for decades by North American fire crews in particular to cut ventilation holes in roofs during fires to vent the smoke. European firefighters mostly deal with heavy masonry, slate, composite and metal tiles rather than wooden shingles so they don't see the same style of use during firefighting.

LUBRICATION / COOLING/ DUST-SUPPRESSION

Disc cutters and fast moving chains produce a horrendous amount of dust when used for cutting concrete or brick and a tremendous amount of heat when cutting metal so there are a number of mitigating options which all involve water. Water can be applied to the rotating blade and/or the cutting area although water on the blade will migrate quickly to the cut-site anyway. This can be entrained via a standard 1/2"/25mm garden hose style adaptor - *Hozelock* in yellow for instance. This can be via a hose to a tap or a pressurised hand pump like the *Stihl* model above or a battery powered pump like the *Husqvarna WT15i* on the-right which can follow the cutting tool to the remotest of locations. Hydraulic tools have oil-filled hoses and an additional water hose that directs water directly into the bar's chain groove in the same was a a wood-cutting chainsaw feeds lubricating oil. The three major brands in disc cutters are *Husqvarna, Makita* and *Stihl* (though arborists will also be familiar with Echo), but, because of the day-to-day industrial applications for disc cutters, there are brands here that we don't see so often in rescue despite their huge multi-national status - *Hilti* for instance which has tools used by many disaster response teams - incidentally their home flag is Lichtenstein in case it's not familiar to you. The Austrian *Zipper* model is from their construction battery range which so far includes this and a cement mixer running on the common battery. One model that US rescuers in particular will have been familiar with is *CUTTERS EDGE* which produced a concrete cutting chainsaw on the *Jonsered* platform (which we still have but it has seen better days!) and a rotary/circular saw which we also operated along with the K38 Partner (as it used to be) and a *Stihl* - All were petrol/gas variants as battery had not, at that time, caught up with enough grunt for concrete and rebar cutting, with the *Stihl* model being by far our most manoeuvrable in more confined spaces (but not true confined space because liquid fuel combustion engines produce dangerous exhaust fumes). Another industrial giant that has functioned in rescue since the start is the *Stanley* (*Stanley-Black&Decker* but bought by Swedish company *Epiroc AB* in 2024 so we may see more changes?) hydraulic cutting system able to deal with most materials whether they be in a true confined space or even under water. This is an unusually large, noisy, unwieldy and expensive item but for those services that bought them even decades ago,they're usually still going strong

TOOL	PETROL/ GAS	BATTERY	CORDED ELECTRIC	HYDRAULIC (HOSE)
ADVANTAGES	Highest power-to-weight ratio – excellent for thick concrete, asphalt, steel	Zero emissions – safe indoors, tunnels, confined spaces	Zero emissions	Zero emissions at the tool
	Completely mobile – no cables, batteries, or power packs	Much quieter than petrol & now similar cut capabilities (in concrete/steel etc.)	Lower cost than battery or petrol (unless using intelligent powerpacks)	Can run underwater
	All-day runtime with quick refuelling	Instant start, minimal maintenance	Consistent power (no fuel or battery fade), Unlimited run time.	Extreme and consistent cutting power & torque
	Works anywhere (remote sites, roads, demolition)	Excellent safety profile (no fuel, no cables)	Lightweight & simple design	Very durable & reliable with long working-life
DISADVANTAGES	Emissions & fumes – unsafe indoors without ventilation	High upfront cost for batteries and chargers	Tethered to power supply (if using a power pack/gennie this is high additional cost	Requires hydraulic power pack - high additional cost
	Noise & vibration – operator fatigue, stricter H&S controls	Limited runtime – battery swaps needed for heavy use	Cable management & trip hazards	Heavy hoses reduce mobility and manoeuvrability
	More maintenance (fuel mix, filters, spark plugs)	Less peak power than petrol for very thick or reinforced cuts	Limited on-site flexibility	High purchase & setup cost
	Cold starts & reliability issues over time	Cold weather impacts battery performance	Less torque than petrol or hydraulic under heavy load	Specialist equipment & training

and a testament to the merit of that initial, seemingly high, financial outlay. Its hydraulic pump and hoses can operate a wide range of tools including breakers, drill and impact wrenches as well as the two tools included here - the rotary saw and concrete cutting chainsaw. There will be occasions when this is the only tool that can deal with your rescue problem either because of its sheer power or the fact that is can operate under water or in a water torrent. However, such incidents will be infrequent and for the most part, unless you are a dedicated dive team, you may well be looking for the quieter, non-polluting and easier to manoeuvre battery tools or the extra grunt of (but equally manoeuvrable) petrol/gas saws or the cheapest and continuously running (unless there's a power outage) corded saw. This latter point is usually enough to put off prospective buyers but since most fire vehicle still carry an on-board power system or a transportable generator, such tools are worth considering - the average fire department could probably buy 20 corded tools for the price of a full hydraulic system! There are pneumatic wood cutting chainsaws that can be used underwater but we have not included them here because they are wood (soft-material) chainsaws rather than metal/masonry cutting but they will be in the **USAR-EXTRICATION BUYERS GUIDE** version of this article.

Confined spaces and proximity to a casualty is perhaps the key consideration for rescue (as distinct from recovery). Petrol tools disgorge exhaust fumes thus limiting where they can be used, indeed *Makita* has stopped active selling of fuel saws in North America in favour of battery. Regardless of the power source, all disc-cutters kick out a huge amount of dust and sparks and noise and vibration.

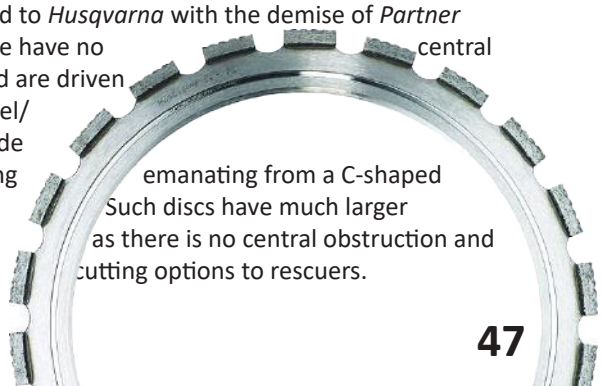
VIBRATION can be dangerous in unstable structures and exacerbate traumatic injury,

SPARKS can be an ignition source in contaminated atmospheres and/or or cause burns

DUST can be a choking and clogging hazard and equally diffficult it can obscure visibility over the entire rescue scene

HEAT can damage the cutting blade/chain and remains a skin-contact hazard long after the tool has stopped running. Since we're talking about masonry and metal, it is not usually an ignition source but if wood and other materials are in and around the cutting site, it would be a consideration.

Luckily, all of these things can be mitigated. Most tools have a water spray adjunct to suppress dust and sparks and cool the blade. Back in the last century, we experimented with gels to help suppress dust and sparks hoping it would improve vibration. It didn't, and while spark suppression and short term dust limiting was really good, it didn't cool the blade so well, and quickly became 'engorged' with dust and was non-functional unless renewed every few minutes. These days an additive in the water (borrowed from mining) is used. At the time of writing there doesn't seem to have been much advance on this so water, delivered by regular ½" hose or a power pump like the *Husqvarna* battery powered model opposite, is the way to go. Hydraulic systems can have an additional water (blade-cooling/lubricating/dust-suppressant) hose incorporated into an 'umbilical' with the hydraulic oil hoses for continuous feed from as far away as you have hose length for. Note that some heavier fuel models have wheels to position the disc back and forth rather than just a stand for pivotting. Also note that we have included all disc size models but in any given range, the larger tools will fit a smaller disc if the arbor /spindle is the same size or can be converted whereas a smaller disc tool will NOT fit a larger disc. Note also that there is a RING disc, now mostly confined to *Husqvarna* with the demise of *Partner* tools, and these have no central spindle, instead are driven by a drive-wheel/ cog on the inside of the outer ring emanating from a C-shaped drive housing. Such discs have much larger cutting depths as there is no central obstruction and offer different cutting options to rescuers.



IN THE FOLLOWING TABLES.....

Any use, feature, accessory or component that is inherent in the tool is shown as a solid coloured square ■■■■
If it's an option it is shown as an outline square □□□□
A circle ●in the 'USE' columns indicates that this feature is only partially present and/or is OK for that purpose but not ideal.
A model variant is shown in cyan blue and any features or specifications that differ from the standard are also in cyan or will have a cyan outline to a black or orange square ■■.

MODELSERIES VARIANT: The model name which can also be the product code. **SERIES** is the common platform (if there is one) and normally associated with other tools using the same battery type across a range of tools like Electro-hydraulic rescue tools ■, powered ascender/winch ■,Lighting ■, Recip Saws ■, Concrete breaker ■ or wood chainsaw ■ but could also be petrol tools (eg the same engine as their chainsaws).

VOLTAGE: The battery voltage for the specific types of battery used.... or **FUEL: 2 stroke** using requiring a premix or you mix in an oil additive to a required ratio, usually 25:1 or 50:1 or **4-stroke** used 'neat' with no premix additive.

ORIGIN: The company's home country, not necessarily the country of manufacture which is indicated by an inset flag or two equally sized flags if the tool is made in both countries.

COST: Full retail RRP/MSRP including VAT/Tax. Often available for less. Any price in burnt orange £$€ is a currency conversion only and will not include import duty, international shipping etc. for separate battery prices and specifications see our Guide to Batteries in the **USAR BUYERSGUIDE**.

TOOL-ONLY WEIGHT: Refers to the weight of the tool WITHOUT the default battery or a tank of fuel (see next category).

WEIGHT of Default BATTERY/Full FUEL Tank/default cutting disc some are specific disc weights, most are approx.(~) weights for generic diamond disc diameters,- add these to the previous **TOOL-ONLY WEIGHT** to get the operational weight-in-hand that the rescuer has to hold.

BATTERY Ah Options The default AmpHour and optional batteries available for this tool

FUEL CAPACITY: Size of the fuel tank in ml/millilitres

POWER OUTPUT: in **kW**/Kilowatts and **CC** (cubic centimetres (Cylinders for petrol engines) and Horsepower **hp.** Remember that kW is not the same as kWh. kW is the instantaneous power draw that can be compared to a petrol-engine's burst of power. kWh is effectively the stored power of the battery and is a much lower figure. kW and their cc equivalent conversions vary with engine. ie. 3.2kW may be shown a 60-7cc

DURATION: Default BATTERY

Full FUEL Tank: The approximate runtime with a full fuel tank or fresh (new) battery remembering that temperature and age/condition of battery will adversely affect run-time and performance. Petrol engines not so affected unless the fuel mix is not correct or fuel is contaminated.

LENGTH inc Disc: Length of tool to the end of the disc guard, ***with* std abrasive disc** as that's how they are usually stored.

WIDTH/HEIGHT: These tools can be quite bulky in terms of storing on your vehicle and this is almost always dictated by the handle. Some way to quickly detach or fold the handle would be a useful way to save several inches of height and width but it's never been addressed, maybe because it would be a weak-point considering the force and weight applied to the handle during operation.

BLADE: MAX DIAMETER: The physical size of the disc to its outer edges. The guard will dictate the maximum diameter of disc the tool can accommodate. NB: **larger disc models will take a smaller disc if the arbor is the same** (or use a collet converter).

CUTTING DEPTH: Usually this will be to the obvious centre spindle or the disc-mount surrounding it but some may have specialist teeth inserts intended only for more shallow cuts than the overall disc diameter would imply.

SPINDLE (ARBOR) DIAMETER: The all-important size of the hole in the disc into which the spindle or mounting bolt will fit. ***This has to be exact*** to ensure the disc rotates cleanly with no undue clearance that would cause vibration/oscillation and perhaps even lateral movement - either of which would severely limit effectiveness and might cause the disc to shatter.
A collet (thick metal ring) can be used to alter the spindle size to fit discs with different bores - imperial to metric for instance.

SOUND POWER: Is the acoustic 'energy' emitted by the tool regardless of operator (ear) distance from the tool. This is not so much measured as calculated from Sound Pressure measurements within a sound-calibrated (absorption) room.

SOUND PRESSURE is measured at the operator's ear or a metre from the tool at a defined tool load - in the case of circular saws it is with the blade inside a cut.

FEATURES

WATER FEED: Typically needs to be from 5 to 8 litres per minute. ■=Regular (off-the-shelf) hose attachment ranging from ½" /12.7-13mm to ¾" / 19mm
■=Hand Pump - usually with a 'stirrup' on top of a plastic tank to pump the water via a hose attachment
■=Battery Pump offers hands-free constant flow to a predetermined or adjustable flow rate.

TOOL-FREE FUEL DISC: Fuel/oil tank lids can be opened by hand (traditionally a screwdriver was used). **DISCS** can be changed without a spanner.

FUEL PUMP DECOMP: Assisted starting of petrol/gas models. A manual **fuel pump/bubble** for **priming** and a **Decompression** button or valve to reducing pressure in the cylinder.

LED LIGHTS SCRENCH: The cutting area is illuminated by on-board LED lights-usually only on battery tools.. **SCRENCH:** A screwdriver/wrench for changing the disc etc. ■ = it mounts directly on the tool. ●= supplied with tool but not mounted

CARRY STRAP: Usually a shoulder strap and used to carry the tool from the vehicle but can also help to alleviate weight in hand during use. **CART:** A wheeled, sack-truck style mount that carries the weight of the tool which is then rotated into its cutting position while still attached to the cart. Mainly used by civil road and rail crews carrying out maintenance but can have uses in rescue other than building collapse.

UNDER-WATER-USE: Some battery tools can or will be able to be used in water but NOT under water which is basically just hydraulic saws and shown as ■. All can be used in the rain and some have an IP rating for water resistance (not dust) check our BATTERY GUIDEs for specific battery details. **CONFINED SPACE USE:** Related to the above but indicates no exhaust fumes to kill entrants. However, the nature of the tool and what it is cutting often causes a huge amount of sparks and/or heat so is a significant explosion risk in silos, petro-chemical tanks etc. unless meticulously spark/heat suppressed.

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IMAGES NOT TO SCALE
£$€= Currency Conversion only- no duty/shipping
OTHER TOOLS IN RANGE:
■=Cut/Spread/Ram tools ■=Recip Saw ■=Lighting
■=Wood Chainsaw ■=Breaker/Drill
■=Ascender/Winch
WATER FEED: ■Hose ½" ■HandPump ■BatteryPump
□□□= Option ~ approximate
●○= Partial feature/ OK, but not ideal

	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	SDCS691X2 54v -	DEWALT	■■■■■		£850 $900 €980 £180 x2 $185 x2 €208 x2	19.2kg 42.2lb	1kg x2 2.2lb x2 ~1kg ~2.2lb	9Ah 6, 12, 15Ah -
	CSG-7410ES 12" 2 stroke -	ECHO TOOLS	■		£1050* $1400* €1200*	9.9kg 21.8lb	0.52kg 1.1lb ~1kg ~2.2lb	- 700ml 23.7 US floz
	CSG-7410ES 14" 2 stroke -	ECHO TOOLS	■		£1200* $1600* €1360*	10.7kg 23.5lb	0.52kg 1.1lb ~1.2kg ~2.6lb	- 700ml 23.7 US floz
	DSH 600-X-30 DSH 600-X-12" 2 stroke 2251367	HILTI	-		£1370 $1595 €1580	9.85kg 21.7lb	0.64kg 1.4lb ~1kg ~2.2lb	- 870ml 29.4 US floz
	DSH 700-X-30 2 stroke 2357945	HILTI	-		£1680 - €1930	11.5kg 26.2lb	0.67kg 1.5lb ~1kg ~2.2lb	- 900ml 30.4 US floz
	DSH 700-X-35 DSH 700-X-14" 2 stroke	HILTI	-		£1720 $1630 €1965	11.8kg 26lb	0.67kg 1.5lb ~1.2kg ~2.6lb	- 900ml 30.4 US floz
	DSH 900-X 35 2 stroke **2265862**	HILTI	-		£1980 - €2280	11.9kg 26.2lb	0.67kg 1.5lb ~2.5kg ~5.5lb	- 900ml 30.4 US floz
	DSH 900-X-16" 2 stroke	HILTI	-		- $2100 -	11.9kg 26.2lb	0.67kg 1.5lb ~2.5kg ~5.5lb	- 900ml 30.4 US floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
3.7kW 73.5cc	- 00mins	933mm 36.7"	236mm 9.3"	241mm 9.5"	300mm / 12" 100mm / 4" 20mm / 25/32"	114.6db 103.6db 4.2m/s²	■	■ -		■	- ■	- ■	Dual Batteries	dewalt.com
3.2kW 4.3hp 73.5cc	- 20mins	735mm 28"	430mm 17"	290mm 11.5"	300mm/12" 100mm / 4" 20mm / 25/32"	109.2db 98.7db f5m/s² r5.1m/s²	■ ■ ■	■ -	■ ■	□	- ■		brass hose valve. 4-stage air filtration. *ES= Easy Start version	echotools.com
3.2kW 4.3hp 73.5cc	- 20mins	740mm 29"	430mm 17"	300mm 12"	350mm / 14" 125mm / 4.9" 20mm / 25/32"	109.2db 98.7db f5m/s² r5.1m/s²	■ ■ ■	■ -	■ ■	□	- ■		brass hose valve. 4-stage air filtration. *ES= Easy Start version	echotools.com
3.2kW 4.3hp 63.3cc	- ~20-30mins	558mm 22"	326mm 12.8"	370mm 14.6"	300mm / 12" 120mm / 4.75" 20mm / 25/32"	102db 2.5m/s²	■ ■ ■	■ -	■ ■	■ □	- ■			hilti.com
3.5kW 70cc	- ~24-30mins	800mm 31.8"	261mm 10.3"	434mm 17.1"	300mm / 12" 125mm / 5" 20mm / 25/32"	96db 4.9m/s²	■ ■ ■	■ -	■ ■	■ □	- ■		Not in USA	hilti.com
3.5kW 70cc	- ~18-27mins	808mm 31.8"	261mm 10.3"	434mm 17.1"	350mm / 14" 125mm / 5" 20mm / 25/32"	96db 4.9m/s²	■ ■ ■	■ -	■ ■	■ □	- ■			hilti.com
4.2kW 87cc	- ~14-20mins	856mm 33.7"	266mm 10.5"	466mm 18.3"	400mm / 16" 150mm / 6" 20mm / 25/32"	102db 5.2m/s²	■ ■ ■	■ -	■ ■	■ □	- ■		Not in USA	hilti.com
4.2kW 87cc	- ~13-19mins	860mm 33.8"	270mm 10.6"	466mm 18.3"	400mm / 16" 150mm / 6" 20mm / 25/32"	100db 5.2m/s²	■ ■ ■	■ -	■ ■	■ □	- ■		Not yet in Europe	hilti.com

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■=Wood Chainsaw ■=Breaker/Drill
■=Ascender/Winch
WATER FEED: ■Hose ½" ■HandPump ■BatteryPump
□□□= Option ~ approximate
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	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	NURON DSH600-22 ATC 22v 2294225	HILTI	■ ■ ■ ■		£1125 $1400 €1295 £305 x2 $241 x2 €352 x2	~9kg 19.8lb	1.31kg x2 2.88lb x2 ~1kg ~2.2lb	9Ah 5.2, 12, 13.5Ah
	NURON DSH700-22 ATC 22v 2294227	HILTI	■ ■ ■ ■		£1200 $1400 €1385 £305 x2 $241 x2 €352 x2	~10.3kg 22.6lb	1.31kg x2 2.88lb x2 ~1kg ~2.2lb	9Ah 5.2, 12, 13.5Ah
	NURON DSH900-22 ATC 22v **2307655**	HILTI	■ ■ ■ ■		£1350 $1750 €1555 £375 x2 $315 x2 €425 x2	~11.1kg 24.5lb	1.46kg x2 3.2lb ~1.2kg ~2.6lb	12/13.5Ah 5.2, 9, 13.5Ah
	SmartGuard K770 2 stroke 970 46 00-01	HUSQVARNA	-		£850 $1140 €980	10.2kg 22.4lb	0.67kg 1.5lb ~1.2kg ~2.6lb	- 900ml 30.4 US floz
	SmartGuard RESCUE K770 2 stroke 967 68 xx-xx 967 80 xx-xx	HUSQVARNA	-		£1030 $1400 €1220	10.2kg 22.4lb	0.67kg 1.5lb ~1.2kg ~2.6lb	- 900ml 30.4 US floz
	SmartGuard RESCUE K970 2 stroke **967 28 37-01** 967 28 78-01	HUSQVARNA	■		£1250 $1650 €1470	11kg 24.3lb	0.75kg 1.6lb ~2.5kg ~5.5lb	- 1000ml 33.8 US floz
	SmartGuard RESCUE K970 2 stroke 967 63 xx-xx	HUSQVARNA	■		£1860 $2500 €2320	11kg 24.3lb	0.75kg 1.6lb ~2.5kg ~5.5lb	- 1000ml 33.8 US floz
	SmartGuard RESCUE K970 Ring 370 2 stroke 967 27 xx-xx	HUSQVARNA	■		£5020 $6700 €5900	13.8kg 30.3lb	0.75kg 1.6lb ~1.2kg ~2.6lb	- 1000ml 33.8 US floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC (equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
3.2kW (60cc)	~20-30mins -	660mm 25.9"	290mm 11.4"	350mm 13.8"	300mm / 12" 120mm / 4.75" 20/25.4mm/ 25⁄32"/1"	107db	■ ■ ■	- -	- -	■ □	- ■	- ■	Requires 2 batteries. spindle diam option of 20mm or 1". 'Top-handle' model *Can communicate health and charge status when on tool	hilti.com
3.5kW (70cc)	~22-30mins -	740mm 29.1"	290mm 11.4"	350mm 13.8"	300mm / 12" 120mm / 4.75" 20/25.4mm/ 25⁄32"/1"	107db	■ ■ ■	- -	- -	■ □	- ■	- ■	Requires 2 batteries. spindle diam option of 20mm or 1". *Reinforced concrete. *Can communicate health and charge status when on tool	hilti.com
4.3kW (90cc)	~14-20mins -	740mm 29.1"	290mm 11.4"	420mm 16.5"	355mm /14" 152mm / 6" 20/25.4mm/ 25⁄32"/1"	116db	■ ■ ■	- -	- -	■ □	- ■	- - ■	Requires 2 batteries. spindle diam option of 20mm or 1". *Reinforced concrete. *Can communicate health and charge status when on tool	hilti.com
3.7kW 4.5hp 73.5cc	- ~40-50mins	605mm 23.8"	225mm 8.9"	391mm 16.3"	350mm / 14" 125mm / 5" 20mm / 25⁄32"	115dB 101dB f2m/s² r2.3m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	WIll also take 12" Disc. ***Smartguard*** is an additional hinged guard for the top-front quarter segment of the disc and is available for the models below	husqvarna.com
3.7kW 4.5hp 73.5cc	- ~40-50mins	605mm 23.8"	225mm 8.9"	391mm 16.3"	350mm / 14" 125mm / 5" 20mm / 25⁄32"	115dB 101dB f2m/s² r2.3m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	WIll also take 12" Disc. *Smartguard* additional disc guard option or variant	husqvarna.com
4.8kW 6.5Hp 93.6cc	- ~20-30mins	661mm 38"	214mm 8.4"	444mm 17.5"	400mm / 16" 155mm / 6.1" 25.4mm / 1"	115dB 104dB f3.8m/s² r4.2m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	WIll also take 14" Disc *Smartguard* additional disc guard option or variant weighing around a kg/2.2lb	husqvarna.com
4.8kW 6.5Hp 93.6cc	- ~20-30mins	661mm 38"	214mm 8.4"	444mm 17.5"	400mm / 16" 155mm / 6.1" 25.4mm / 1"	115dB 104dB f3.8m/s² r4.2m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	WIll also take 14" Disc *Smartguard* additional disc guard option or variant . RESCUE = higher vis, larger starter handle and inc strap	husqvarna.com
4.8kW 6.5Hp 93.6cc	- ~20-30mins	785mm 31"	224mm 8.8"	431mm 17"	370mm /14" *270mm/10.6" -	115dB 104dB f2.7m/s² r3.4m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	*Ring saws are driven by drive-wheels (cogs) inside the reinforced housing NOT by a central spindle - hence the much greater cutting depth.	husqvarna.com

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	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	SmartGuard RESCUE K970 Ring 430 2 stroke 970 60 xx-xx	HUSQVARNA	■		£5070 $6800 €4480	14.2kg 24.3lb	0.75kg 1.6lb ~2.5kg ~5.5lb	- 1000ml 33.8 US floz
	K1270 II 2 stroke 967 97 87-01 967 97 87-01	HUSQVARNA	-		£2500 $2300 €2400	13.6kg 30lb	0.9kg 2lb ~2-2.5kg ~4.4-5.5lb	1250ml 42.3 US floz
	K1270 Rail 2 stroke 96798 xx-01	HUSQVARNA	-		£3560 $3700 €4100	16kg 35.2lb	0.9kg 2lb ~2-2.5kg ~4.4-5.5lb	1250ml 42.3 US floz
	BLi/BX K540i 36v 9706640-01	HUSQVARNA	■ ■ ■		£960 $1100 €1150 £350 $480 €400	4.2kg 9.25lb	1.9kg 4.25lb 0.8kg 1.76lb	9Ah* 5.2, 6, 9.4,15Ah -
	Pace K1 - 300 94v Pace 970 51 92-01	HUSQVARNA	■		£1600 $1800 €1700 £1045 $803 €950	7.2kg 15.8lb	5kg 11lb ~1kg ~2.2lb	8Ah 4Ah -
	Pace K1- 350 94v Pace 970 44 58-03	HUSQVARNA	■		£1700 $2000 €1900 £1045 $825 €950	7.4kg 16.3lb	5kg 11lb ~1.2kg ~2.6lb	8Ah 4Ah -
	K7000 Chain 200-480, 220-240v Corded 970 75 62-01	HUSQVARNA	■		£6300 $8200 €7300	9.1kg 20lb	- 3.2kg 7.1lb	- -
	K970 Chain 2 stroke 967 66 05-01	HUSQVARNA	■		£3752 $4620 €4200	9.6kg* 21.1lb	0.75kg 1.6lb 3kg 6.6lb	1000ml 33.8 US floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC (equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
4.8kW 6.5Hp 93.6cc	- ~20-30mins	815mm 32"	224mm 8.8"	495mm 19.5"	430mm /16" *350mm/13.8" -	115dB 104dB f3.5m/s² r3.4m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	*Ring saws are driven by drive-wheels (cogs) inside the reinforced housing NOT by a central spindle - hence the much greater cutting depth.	husqvarna.com
5.8kW 7.8hp 120cc	- ~25-35mins	730mm 28.7"	243mm 9.6"	434mm 17.1"	350/400mm 14/16" 118/145mm 4.6/5.7" 22/25.4mm/⅞"/1"	117dB 104dB f4.5m/s² r3.7m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	Will take 14" disc	husqvarna.com
5.8kW 7.8hp 120cc	- ~25-35mins	730mm 28.7"	243mm 9.6"	434mm 17.1"	350/400mm 14/16" 118/145mm 4.6/5.7" 22/25.4mm/⅞"/1"	117dB 104dB f3.4m/s² r3.5m/s²	■ ■ ■	■ -	■ ■	■ □	- ■	- -	RAIL= cut-positioning arm locks onto rails for precise pivot cut Will take 14" disc Reversible cutting arm cuts closer to substrate.	husqvarna.com
~2kW (2.7hp) (50cc)	10-16mins -	558mm 22"	200mm 7.9"	330mm 13"	250mm / 10" 100mm / 4" 25.4mm / 1"	112.7dB 101.5dB f 3.7m/s² r 2.4m/s²	■ ■ ■	- -	- -	□ -	- ■	- ■	Reversible cutting arm cuts closer to substrate. K535i discontinued *This tool takes batteries from the *BLi* and newer *B..X* series	husqvarna.com
~3.75kW (5)hp (50cc)	20-40mins -	648mm 25.5"	221mm 8.7"	423mm 16.6"	300mm / 12" 121mm /4.75" 20/25.4mm/ 25/32"/1"	113dB 102dB f2m/s² r1.1m/s²	■ ■ ■	- -	- -	■	- ■	- ■	Extra blade guard. *Pace* is *Husqvarna*'s high capacity construction battery series	husqvarna.com
~3.75kW (5)hp (50cc)	20-40mins -	648mm 25.5"	221mm 8.7"	400mm 15.75"	350mm / 14" 145mm / 5.7" 20/25.4mm/ 25/32"/1"	105dB 95dB f2.2m/s² r2m/s²	■ ■ ■	- -	- -	■	- ■	- ■	Extra blade guard. *Pace* is *Husqvarna*'s high capacity construction battery series. Can take Rail cutting guide	husqvarna.com
5.5kW (7.5hp) (120cc)	Unlimited -	681mm 26.8"	187mm 7.4"	476mm 18.7"	450mm / 17.7" 450mm / 17" -	- 99dB f2.7m/s² r2.1m/s²	■ ■ ■	- -	- -		- ■	- ■	Requires the Husqvarna PP65 powerpack or equivalent for 1 or 3 phase 'intelligent' power, adjusting speed for material being cut.	husqvarna.com
5.5kW (7.5hp) (120cc)	- ~20-30mins	688mm 27.1"	214mm 8.4"	481mm 19"	450mm / 17.7" 450mm / 17" -	112dB 102dB 2.7m/s²	■ ■ ■	■ -	■ ■		- ■	- -		husqvarna.com

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	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	K3600 mkII 100-120v	HUSQVARNA	-		£6170 $7480 €7000	8.3kg 18.3lb	- ~1.2kg ~2.6lb	- -
	K760 Cut-n-Break 2 stroke 9671957-01	HUSQVARNA	-		£2800 $3750 €3280	9.6kg 21.1lb	0.67kg 1.5lb 1.9kg x2 4.2lb x2	- 900ml 30.4 US floz
	K4000 Cut-n-Break 100-120v 9670835-01	HUSQVARNA	-		£2610 $3490 €3050	8.4kg 18.5lb	- 1.9kg x2 4.2lb x2	- -
	K4000 mkII 220=480v	HUSQVARNA	-		£1200 $1210 €1250	7.6kg 16.7lb	- ~1.2kg ~2.6lb	- -
	K7000 220-480v corded	HUSQVARNA	-		£5,900 $7905 €6100	9.8kg 21.6lb	- ~2.5kg ~5.5lb	- -
	K2500 Hydraulic	HUSQVARNA	-		£2500 $3630 €2900	8.3kg 18.3lb	- ~2.5kg ~5.5lb	- -
	K40 Compressed Air	HUSQVARNA	-		£2660 $4445 €2875	9.9kg 21.8lb	- ~1.2kg ~2.6lb	- -

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
4.3kW (5.7hp) (<175cc)	Unlimited -	730mm 00"	175mm 00"	410mm 00"	370mm / 14" 270mm / 10.6" -	117dB 104dB 4.5m/s²	■ ■ ■	-	- -	- -	- ■	- ■	corded to mains or a generator	husqvarna.com
3.7kW 5hp 150cc	- ~40-50mins	798mm 31.4"	246mm 9.7"	446mm 17.6"	2x 230mm / 2x 9" 400mm / 16" -	- 101dB f1.9m/s² r2.8m/s²	■ ■ ■	-	■ ■	■ □	- ■	- -	twin-bladed, extra deep cutting tool cuts two grooves then levers out the slither with on-board tool) allowing further depth progress	husqvarna.com
2.7kW (3.6hp) (60cc)	Unlimited -	867mm 34.1"	225mm 8.9"	325mm 12.8"	2x 230mm / 2x 9" 400mm / 16" -	- 95dB f3.2m/s² r3.4m/s²	■ ■ ■	- -	- -	■	- ■	- ■	twin-bladed, extra deep cutting tool cuts two grooves then levers out the slither with on-board tool) allowing further depth progress	husqvarna.com
2.7kW (3.6hp) (<110cc)	Unlimited -	631mm 24.8"	221mm 8.7"	313mm 12.3"	350mm / 14" 125mm / 5" 25.4mm / 1"	105dB 95dB f3.5m/s² r3.5m/s²	■ ■ ■	- -	- -	- -	- ■	- ■	corded to mains or a generator	husqvarna.com
5.5kW (7.4hp) (<220cc)	Unlimited -	681mm 26.8"	187mm 7.4"	476mm 18.7"	400mm / 16" 155mm / 6" 25.4mm / 1"	111dB 96dB 1.8m/s²	■ ■ ■	- -	- -	- -	- ■	- ■	corded to mains or a generator	husqvarna.com
5.2kW (7hp) (<210cc)	Unlimited -	727mm 28.6"	260mm 10.2"	462mm 18.2"	400mm / 16" 145mm / 6" 25.4mm / 1"	107dB 85dB f7.5m/s² r5.2m/s²	■ ■ ■	- -	- -	- -	- ■	● ■		husqvarna.com
3.2kW (4.3hp) (<130cc)	Unlimited -	685mm 27"	235mm 9.25"	420mm 16.5"	35mm / 14" 125mm / 5" 25.4mm / 1"	107dB 92dB f9.5m/s² r5.2m/s²		- -	- -	- -	- ■	● ■	Requires Air compressor to operate	husqvarna.com

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	LXT DCE090xxx XEC01xxx 36v (2x 18v) -	MAKITA	■■■■■	●	£410 $555 €470 £120 x2 $165 x2 €130 x2	4.9kg 10.8lb	0.66kg x2 1.45lb x2 ~1kg ~2.2lb	2x6Ah 5, 4 Ah -
	XGT CE001xxx GEC01xxx 80v (2x40v) -	MAKITA	■■■■■	●	£950 $1700 €1090 £280 x2 $330 x2 €280 x2	10.3kg 22.7lb	1.9kg x2 4.2lb x2 ~1.2kg ~2.6lb	2x 8Ah 6, 5 , 4 Ah -
	XGT CE002xxx GEC02xxx 80v (2x40v) -	MAKITA	■■■■■	●	£1100 $1490 €1260 £280 x2 $330 x2 €280 x2	11.3kg 24.9lb	1.9kg x2 4.2lb x2 ~1.2kg ~2.6lb	2x 8Ah 6, 5 , 4 Ah -
	XGT CE003xxx GEC03xxx 40v -	MAKITA	■■■■■	●	£370 $700 €425 £280 x2 $330 x2 €280 x2	5.5kg 12.1lb	1.9kg 4.2lb ~1kg ~2.2lb	8Ah 6, 5 , 4 Ah -
	XGT CE004xxx 40v -	MAKITA	■■■■■	●	£400 $540 €460 £280 x2 $330 x2 €280 x2	5.8kg 12.8lb	1.9kg 4.2lb ~1kg ~2.2lb	8Ah 6, 5 , 4 Ah -
	EK6101 2 Stroke -	MAKITA	■	●	£820 $1050 €830	8.5kg 18.7lb	0.52kg 1.1lb ~1kg ~2.2lb	700ml 23.7 US floz
	EK8100* 2 Stroke -	MAKITA	■	●	£1290 $1760 €1900	10.3kg 22.7lb	0.8kg 1.83lb ~2.5kg ~5.5lb	1100ml 37.2 US floz
	EK7650H EK7651H 4 Stroke -	MAKITA	■	●	£1220 $1665 €1600	12.9kg 28.4lb	0.8kg 1.83lb ~1.2kg ~2.6lb	1100ml 37.2 US floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC (equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
* (75.6cc)	10-20mins -	554mm 21.8"	241mm 9.5"	283mm 11.1"	230mm /9" 88mm / 3.5" 22.23mm / ⅞"	114db 103db f5.9m/s² r4m/s²	■ ■	- -	- -	□ -	■ ■	- -	* Not given No Load Speed =6600rpm. 'AFT' stops the motor if the disc jams	makita.com
4kW* -	-mins 115 rebar cuts -	786mm 31"	272mm 10.7"	433mm 17"	355mm / 14" 127mm / 5" 20/25.4mm/ 25/32"/1"	120db 109db 2.5m/s²	■ ■	- -	- -	□ -	■ ■	- ■	* No Load Speed =5300rpm Heavier duty tool. 'AFT' stops the motor if the disc jams	makita.com
4kW* -	>10mins -	825mm 32.5"	272mm 10.7"	487mm 19.2"	355mm / 14" 127mm / 5" 20/25.4mm/ 25/32"/1"	117db 106db 2.5m/s²	■ ■	- -	- -	□ -	■ ■	- ■	* No Load Speed =4200rpm Extra blade guard Heavier duty tool. 'AFT' stops the motor if the disc jams	makita.com
1.7kW* -	>10mins -	603mm 23.7"	240mm 9.5"	350mm 13.78"	230mm /9" 88mm / 3.5" 17mm / 11/16"	116db 105db 3m/s²	■ ■	- -	- -	□ -	■ ■	- ■	* No Load Speed =6500rpm 'AFT' stops the motor if the disc jams	makita.com
1.7kW* -	>9mins -	663mm 26.1"	240mm 1.6"	406mm 16"	305mm / 12" 121mm / 4.75" 20mm / 25/32"	110db 99db 3.8m/s²	■ ■	- -	- -	□ -	■ ■	- ■	* No Load Speed =5000rpm 'AFT' stops the motor if the disc jams	makita.com
3.2kW 4.2hp 61cc	~<45mins ~70-160 1" rebar cuts	554mm 21.8"	241mm 9.5"	283mm 11.14"	305mm / 12" 110mm / 4.3" 22.23mm / ⅞"	113db 97db *3.7m/s²	■ ■	■ -	■ ■	□ -	- ■	- -	* vibration damping system. Gas tools phasedout in N.America. NB: *DPC6430* DISCONTINUED	makita.com
4.2kW 5.6hp 81cc	~<45mins ~100-240 1" rebar cuts	616mm 24.5"	235mm 9.25"	276mm 10.9"	406mm / 16" 147mm / 5.75" 20mm / 25/32"	110db 100db *-5.5m/s²	■ ■	■ -	■ ■	□ -	- ■	- -	*Replaced DPC8132. Gas tools phasedout in N.America. No-load speed 9350rpm *Higher, 3rd party Vibration figures appear to be incorrect	makita.com
3kW 4.1hp 75.6cc	- ~<50mins ~120-260 1" rebar cuts	780mm 30.7"	310mm 12.2"	455mm 17.9"	355mm / 14" 122mm / 4.8" 20mm / 25/32"	102db 92.7db f2.7m/s² r1.8m/s²	■ ■	■ -	■ ■	□ -	- ■	- -	Reversible cutting arm for centred & offset cuts. Note: 4-stroke - no fuel mix. Gas tools discontinued in N. America. No-load speed >9350rpm	makita.com

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OTHER TOOLS IN RANGE:
■=Cut/Spread/Ram tools ■=Recip Saw ■=Lighting
■=Wood Chainsaw ■=Breaker/Drill
■=Ascender/Winch
WATER FEED: ■Hose ½" ■HandPump ■BatteryPump
□□□= Option ~ approximate
●○= Partial feature/ OK, but not ideal

	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	M18 Forge FCOS230-121 18V 4933471696	MILWAUKEE	■■■■■■		£420 $435 €480 £380 $440 €400	4.5kg 9.9lb	1.54kg 3.4lb ~1kg ~2.2lb	12Ah 3,5,6,8Ah -
	MX Fuel COS350G2 72V 4933464881 / 4933479969 / 4933480482	MILWAUKEE	■■■		£1700 $1950 €1750 £1500 $1320 €1400	9kg 19.8lb	7kg 15.4lb	12Ah 8Ah
	DS06 Hydraulic DS06300001	STANLEY	■		£1500 $1600 €1700	4.5kg 10lb	- ~1.5kg ~3.3lb	- -
	DS11 Hydraulic DS113000 UW	STANLEY	■		£3000 $3800 €3500	~11kg ~24.2lb	- ~2kg ~4.4lb	- -
	DS12 Hydraulic DS1231801	STANLEY	■		£3900 $5000 €4600	~11.8kg ~26lb	- ~2.4kg ~5.3lb	- -
	AP TSA 230.1 36V 4864-0116620	STIHL	■■		£510 $680 €590 £290 $330 €410	3.9kg 8.6lb	1.8kg 3.96lb ~0.8kg ~1.8lb	7.6 Ah 2.6,5.8.8Ah -
	AP TSA 300 36V TA02-0116600	STIHL	■■		£870 $1160 €1000 £440 $590 €500	6.3kg 13.9lb	2kg 4.4lb ~1kg ~2.2lb	8.8 Ah 2.6,5.7.6Ah -
	AP TSA 500 72V TA01-0116600	STIHL	■■		£2000 $2670 €2320 £440x2 $590 x2 €500 x2	9.1kg 20lb	2kg x2 4.4lb x2 ~1.2kg ~2.6lb	2x 8.8 Ah 2.6,5.7.6Ah -

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC equivalent) Hydraulic Pressure Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
1.8kW (2.1-2.7hp) (30-35cc)	6-10mins 68 cuts -	660mm 26"	250mm 9.9"	320mm 12.6"	230mm / 9" 85mm / 3.35" 22.2mm / ⅞"	125db 114db 1.8m/s²	■ ■	- -	- -	□ -	- ■	- ■		milwaukee.com
4.7kW (~6.3cc) (~85-90hp)	~12mins -	793mm 31.2"	254mm 10"	404mm 16"	350mm / 14" 125mm / 5" 20/25.4mm/ 25/32"/1"	125.3db 114.3db 3.04m/s²	■ ■	- -	- -	□ -	- ■	- ■	*Fuel* is *Milwaukee*'s higest capacity and largest battery	milwaukee.com
0-140 bar/ 000-2000 ps	- Unlimited	690mm 27"	180mm 7"	230mm 9"	330/380/460mm 13/15/18" 305mm / 12" -	103.4db 96db f9.9m/s² r5.7m/s²	*■	- -	- -	- -	- -	■ ■	Stanley now owned by Epiroc Sweden *Water-feed direct to bar groove. CS05 & CS06=wood cutting versions	stanleyhydraulic.com
0-140 bar/ 000-2000 ps	- Unlimited	890mm 35"	230mm 9"	280mm 11"	380/460mm 15/18" 356mm / 14" -	108db 100db f5m/s² r5m/s²	*■	- -	- -	- -	- -	■ ■	*Water-feed direct to bar groove. Flow Range 12 gpm / 45 lpm Working Pressure 1000-2000 psi / 70-140 bar	stanleyhydraulic.com
0-140 bar/ 000-2000 ps	- Unlimited	1020mm 40"	230mm 9"	280mm 11"	460mm / 18" 450mm / 17" -	108.6db 100.6db f5m/s² r5.3m/s²	*■	- -	- -	- -	- -	■ ■	*Water-feed direct to bar groove. UW= underwater version	stanleyhydraulic.com
2.1kW (~2.8HP) (<45cc)	14-22mins -	550mm 21.6"	150mm 5.9"	240mm 9.4"	230mm / 9" 70mm / 2.75" 20mm / 0.78"	1150db 104db f 4.3m/s² r 2.4m/s²	■ ■ ■	- ●*	- -	□ -	- ●	● -	*Spindle lock mechanism simplifies disc release but still need to tighten/loosen nut	stihl.com
2.5kW (~3.3HP) (<55cc)	12-22mins -	742mm 29.2"	000mm 00"	00mm 00"	300mm / 12" 110mm / 4.3" 20mm / 0.78"	116db 105db f 3m/s² r 2.3m/s²	■ ■ ■	- ●*	- -	□ -	- ●	● X4	*Spindle lock mechanism simplifies disc release but still need to tighten/loosen nut	stihl.com
4.2kW (~5.6HP) (<75cc)	20-40mins -	821mm 32.3"	000mm 00"	00mm 00"	350mm / 14" 129mm / 4.9" 20mm / 0.78"	117db 106db f 2.4m/s² r 2m/s²	■ ■ ■	- ●*	- -	□ -	- ●	● X4	uses double AP500 36v batteries and can be used with PS3000 power pack. *Spindle lock mechanism	stihl.com

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=Ascender/Winch
WATER FEED: =Hose ½" =HandPump =BatteryPump
= Option ~ approximate
= Partial feature/ OK, but not ideal

	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	TS 410 2 stroke 4238-0112800	STIHL			£1260 $1685 €1460	9.6kg 21.1lb	- 0.5kg 1.1lb ~1kg ~2.2lb	- 710ml 24 us floz
	TS 420 2 stroke 4238-0112810	STIHL			£1270 $1670 €1480	9.8kg 21,6lb	- 0.5kg 1.1lb ~1.2kg ~2.6lb	- 710ml 24 us floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC (equivalent) Hydraulic Pressure (Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
3.2kW 4.4HP 66.7cc	- ~14-16mins	525mm 20.7"	360mm 14.1"	260mm 10.2"	300mm / 12" 100mm / 4" 20mm / 0.78"	109db 98db 3.9m/s²	■ ■ ■	■	■ ■	□ □	- ■	● -		stihl.com
3.2kW 4.4HP 66.7cc	- ~15mins	545mm 21.4"	360mm 14.1"	270mm 10.6"	350mm / 14" 125mm / 4.9" 20mm / 0.78"	109db 98db 3.9m/s²	■ ■ ■	■	■ ■	□ □	- ■	● -		stihl.com

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	SERIES / MODEL / VARIANT / VOLTAGE/FUEL / product code	COMPANY	TOOLS IN RANGE	ORIGIN	COST Default BATTERY inc tax / VAT	WEIGHT TOOL ONLY exc Battery exc Fuel exc Disc	WEIGHT Default BATTERY Full FUEL Tank Cutting Disc/ Bar&Chain	BATTERY Ah OPTIONS / FUEL CAPACITY
	TS 440 2 stroke 4238-0112820	STIHL	□		£1370 $1850 €1610	11.1kg 24.4lb	- 0.5kg 1.1lb ~1.2kg ~2.6lb	- 710ml 24 us floz
	TS 480i 2 stroke 4250-011-2804	STIHL	□		£1290 $1725 €1495	10kg 22lb	0.53kg 1.2lb ~1kg ~2.2lb	- 720ml 24.4 us floz
	TS 500i 2 stroke 4250-0112810	STIHL	□		£1360 $1820 €1580	10.2kg 22.5lb	0.53kg 1.2lb ~1.2kg ~2.6lb	- 720ml 24.4 us floz
	TS 700 Cutquik 2 stroke 4224-0112801US	STIHL	□		£1610 $2150 €1970	11.6kg 15.6lb	0.9kg 2lb ~1.2kg ~2.6lb	- 1200ml 40.6 us floz
	TS 800 Cutquik 2 stroke 4224-0112821US	STIHL	□		£1425 $1900 €1700	12.5kg 28lb	0.9kg 2lb ~2.5kg ~5.5lb	- 1200ml 40.6 us floz
	TSA 910i 2 stroke TB01-0112820	STIHL	□		£1980 $2650 €2300	12.9kg 28.4lb	0.9kg 2lb ~2.5kg ~5.5lb	- 1200ml 40.6 us floz
	GS 461 Rock Boss 2 stroke 4252-20000xx	STIHL	□		£2690 $3560 €3120	7.5kg 16.6lb	0.57kg 1.25lb 1.6kg 3.5lb	780ml 26.4 us floz
	ZI BTS350T 2 stroke -	ZIPPER	□		£850 $1140 €890	12kg 5.4lb	1.1kg 2.4lb ~1.2kg ~2.6lb	1500ml* 50 us floz

RESCUE DISC CUTTERS/CUT-OFF SAWS

POWER OUTPUT CC (equivalent) Hydraulic Pressure (Flow-rate)	DURATION Default BATTERY Full FUEL Tank @ full revs in re-concrete	LENGTH	WIDTH	HEIGHT	BLADE MAX DIAMETER MAX CUT DEPTH SPINDLE DIAMETER	SOUND POWER PRESSURE VIBRATION f=front r=rear	WATER FEED	TOOL-FREE FUEL/DISC	FUEL PUMP DECOMP.	CARRY STRAP CART	LED LIGHTS SCRENCH	UNDER-WATER/ CONFINED SPACE USE	NOTES	www.
3.2kW 4.4HP 66.7cc	- ~15mins	552mm 21.7"	486mm 19.1"	336mm 13.2"	350mm / 14" 125mm / 4.9" 20mm / 0.78"	109db 98db f 3.9m/s² r 3.6m/s²	■ ■ ■	-	■ ■	□ □	- ■	● -	Higher torque than 410 & 420 uses 2-stage belt drive to disc. TS480i Discontinued	stihl.com
3.9kW 5.3HP 72.2cc	- ~14mins	730mm 28.7"	336mm 13.2"	486mm 19.1"	300mm /12" 100mm / 4" 20mm / 0.78"	112db 98db 2.2m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	Not UK. electronically controlled fuel injection for greater efficiency.	stihl.com
3.9kW 5.3HP 72.2cc	- ~13-15mins	580mm 22.8"	370mm 14.5"	280mm 11"	350mm / 14" 125mm / 4.9" 20mm / 0.78"	112db 98db f 2.4m/s² r 2m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	electronically controlled fuel injection for greater efficiency.	stihl.com
5kW 6.8HP 98.3cc	- ~17-19mins	840mm 00"	390mm 15.3"	300mm 12"	350mm / 14" 125mm / 4.9" 20mm / 0.78"	120db 108db f 5.9m/s² r 4.4m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -		stihl.com
5kW 6.8HP 98.3cc	- ~16-18mins	890mm 00"	495mm 19.5"	335mm 13.2"	400mm / 16" 145mm / 5.6" 20mm / 0.78"	113db 101db ~f 6.6m/s² ~r 4.5m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	Can take after-market Rail cutting guide	stihl.com
6.2kW 8.4HP 102.1cc	- ~16-18mins	670mm 26.3"	390mm 15.3"	300mm 12"	400mm / 16" 145mm / 5.6" 20mm / 0.78"	~114db ~102db ~f 6.5m/s² ~r 3.9m/s²	■ ■ ■	■ -	■ ■	□ □	- ■	- -	electronically controlled fuel injection for greater efficiency with smaller mass. Can take after-market Rail cutting guide	stihl.com
4.3kW 5.8HP 77cc	- ~20-30mins	930mm 37"	320mm 12.6"	300mm 12"	457mm / 18" 145mm / 5.6" -	115db 105db f 4.5m/s² r 4m/s²	■ ■ ■	■ -	■ ■	□ -	- ■	- -	Price includes concrete cutting chain	stihl.com
3.5kW 4HP 74cc	- ~20-30mins	705mm 28"	355mm 14"	480mm 19"	350mm / 14" 125mm / 4.9" 25.4mm / 1"	116db - 2.5m/s²	■	-	■ ■	□ -	- -	- -	*Unusually large fuel tank. T= upgraded from original version	zipper-maschinen.at

HOW DO 'GREEN' ROPES STACK UP?

& How 'Sustainable' is a Rope?

by Charlotte Ina-Sterland

The main requirement for arborists, climbers and search and rescue companies in buying rope is that it is strong. Other factors like knotability, shrinkage and spliceability come into the equation, but buyers invariably look for the cheapest option too. Even if the saving is £1 per metre/$1 per foot; these numbers start to rack up when comparing options.

Why Look at Sustainable Options?

'Sustainable' generally either means recycled, or made from a sustainable source (i.e. one which can be regrown or replaced while maintaining a carbon-neutrality). [ED: Despite the alarming temporary rise of climate change denialists in recent years and reversal, if not outright rejection of scientific norms and in-your-face irrefutable evidence of climate change, the term 'carbon-neutral' remains a valid scientific term not a 'woke/hippy/liberal' fabrication. It is still the case that we need to reduce carbon dioxide output. One, rather dim US politician tried to decry a reduction in CO2 because plants need it to produce oxygen! It's a reduction in *excessive* CO2 levels we need not the complete eradication of all CO2 on earth!]

Finding sustainable ways to operate is a challenge. It can be particularly hard in the safety sector because suitability and lightness of materials is so important, and life-safety trumps green credentials but there are some ropes which tick many boxes simultaneously; being light, strong and more carbon neutral than others. There are quite a few products available from well-known companies, as well as non-life-critical components such as gear storage, rope protection etc. We will now take a closer look at which sustainable ropes there are across all rope-user markets, not just rescue because it will usually be the much larger marine or industrial markets that are the catalysts for product development and the rescue and rope access borrows the ideas to produce more targeted life-safety products.

Sustainable Rope Technologies

There are currently two major ways to create rope sustainably; either through recycling rope or through using biomass generated *Dyneema*. We look at how these are created and which companies are using them to successfully bring sustainable ropes to the market.

rPET

The first kind of rope material is rPET (recycled polyethylene terephthalate). This is made by recycling items such as water bottles, food containers and other packaging. These are originally made from fossil fuels. So, recycling PET is a great way to re-use plastic packaging; one of the biggest sources of waste and landfill in the world today. However, the benefit also depends on how the process is managed, since this is also creating a secondary use of fossil fuels. We see a lot of this type of recycling in climbing through fleece clothing, great that so much of it now uses recycled plastics but it would be better if we could ultimately replace synthetic plastics altogether.

Bio Dyneema®

The second kind is ***Bio-Dyneema***. There are two specially crafted forms of this. One is bio-circular feedstock *Dyneema*; the other is circular feedstock. Crandall Turner, the global manager of marketing at *Avient Protective Materials*, who create *Bio-Dyneema* which is used in a range of sustainable rope products, mentions their two specially crafted forms of *Bio-Dyneema*.

Bio-circular feedstock Dyneema is made using renewable feedstock, which is a raw material made from natural, replenishable resources like plants, algae, agricultural waste, wood and pulp. This feedstock is used in green chemistry to make products such as biofuel, bioplastic and solvents. It reduces the environmental impact by using materials which can be grown quickly; reducing energy consumption.

Circular feedstock Dyneema is made using recycled plastic as an input, which is put with feedstock to make ethylene.

'A share of each of these types of *Bio-Dyneema* is used for different kinds of products and the amount of each constituent component is kept track of by measuring the masses of the input and output products. This is done using the 'mass balance approach' which allows for mixing of certified and non-certified mate-rials in the production process by keeping a note of how much of each has been used, rather than keeping them separate,' Turner says. 'Sustainable and conventional raw materials can thus be used together, in the same process. The specific share of sustainable content is then verifiable, allowing

us to label the the mate-rial as bio, bio-circular, or renewable energy derived.' NB: *Dyneema* is a specific brand of Ultra-High-Molecular-Weight Polyethylene (UHMWPE) originally created by Dutch State Mines (DSM) now DSM-Firmenich/Avient). It is made using gel-spinning of ethylene; fibres are drawn, heated, elongated and cooled. The stretching and spinning of fibres leads to molecular alignment, high crystallisation and low density; meaning it is very strong at the same weight as alternatives. Bio-based *Dyneema* simply has a lower carbon footprint since it is made from bio based fibres and renewable feedstock, meanwhile circular feedstock ***Dyneema*** is also more sustainable since it uses recycled plastic.

Key Companies Creating Rope Sustainably

Marlow Ropes have been pioneers of sustainable rope technology since 2019 with their '***Blue Ocean***®' range of ropes, which is strong enough for rescue and arborist activities. It is made using 100% recycled polyester yarn from bottles. The rope is GRS certified, meaning the yarn is checked for its ethical production for the whole supply chain and the content of the recycled materials in the yarn is verified. *Marlow* also sell bio-based *Dyneema* products.

Premium Ropes sell a range of eco ropes made from rPET and *Bio-Dyneema*, in a range of colours and sizes. Their '*Eco-cruiser*,' a double braid polyester line (meaning both core and cover are made from polyester), is available from 4-16mm diameter with a 7.2 tonne breaking strength at the upper end diameter. A spokesperson for the company mentioned that it is 'hard to find recycled polyester' as 'some manufacturers are just breaking up new bottles to make rPET, which is not really recycling'. For this reason they company only offer white *Cruiser XTS* with a coloured tracer in the ***Eco*** version. Their ropes are not certified for human suspension however, and are better suited for other rigging purposes, which is a nod to possible future development.

Toplicht have created their ***Greenline*** rPET rope range, with the minimum breaking load being 4 daN for a 15mm diameter rope. High quality yacht rope, which has a classic look, is made from 100% recycled PET plastic bottles. ***Greenline*** is an abrasion and winch resistant, highly durable and low-stretch all-round rope, made from rPET polyester fibres. This has the same properties as normal PET. '*Toplicht* gets the cordage made from recycled PET bottles by a yarn manufacturer and a rope factory in the Netherlands. The yarn manufacturer is certified according to Global Recycled Standards (GRS) 4.0, which guarantees that its material is made from 100% re-cycled polyester. The PET plastic bottles used come exclusively from Europe to avoid unnecessarily long transport routes. The single-variety PET for one kilogram of high-quality recycled polyester fibre is obtained from around 40 beverage bottles. For this purpose, the collected bottles are shredded into granules and melted down. The fibres

are twisted into yarns, which are finally woven into Greenline rPET cordage. 'The lean and smooth double braid is well suited for halyards, outhauls and sheets. Colour is currently limited- "hemp-like beige with fine green marker thread', the company says. *Toplicht* do not make sustainable ropes for climbing, but they can be used for other rigging purposes.

Lankhorst ropes has been supplying marine contractors with *Lanko Force HL* slings, which are made entirely from post-consumer plastic. Its *Lanko Force Dyneema* is available at a range of diameters from 1/4" to total 6.5 inch diameter ropes, the largest of which has a maximum breaking force of 18kN. While this is often best used for really high load applications, such as marine mooring, the thinner ropes could have similar applications to climbing slings for all kinds of rigging uses.

Sustainable Rope Solutions sell a range of ropes made from both recycled plastic and wool pulp ***Bio-Dyneema*** as well as rPET, because these materials offer the same performance as their non-renewable counterparts. The company also takes a 'wholistic' approach to the idea of sustainable ropes; ensuring longevity of products also.

Mammut have had a slightly different approach to creating sustainable rope. They created their 'Close the Loop' climbing ropes project to tackle waste in climbing ropes. They collected loads of used ropes, and delivered them to ***Aquafil,*** who convert nylon waste from items like rope, fishing nets and fabric scraps into *Econyl* (a form of re-generated nylon). They made t-shirts from this and found this saved 5.41 tonnes of carbon emissions compared to making the t-shirts in the normal way (equivalent to the CO2 emissions of a car in one year).

Sterling Rope promote sustainability throughout their activities. as well as their products, a process begun under previous owner and long-time friend of this magazine, Carolyn Brodsky. over 10 years ago. 'We take back any used dynamic rope- not just ours – and either upcycle or recycle it,' they mention. They have a programme to donate ropes to non-profits, as well as schools, and youth programmes, and those using them for non-safety products like bags. Short ends can also be used for this. Those that are used like this are cut up further and made into carpets. They are also involved in melting old ropes down into pellets which can be used to make plastic toys.

They compiled a report on their 2018 sustainability activities, mentioning that in this time they had 'used 1,110,832 lbs of fibre to make ropes; produced 73,649 lbs of scrap, flat fibre and twisted fibre, sold 100% of scrap fibre to ***Leigh Fibres*** and ***R&M International*** for manufacturing as it is or to melt into pellets. They also recycled large quantities of used or damaged rope, through *Mafia Bags*, and sold rope ends to companies making dog leads; *Mountain Dog* and *Krebs Recycle*. For shorter ropes in good condition they have sold to companies making a diverse range of rope accessories. They also mention that they use approved fibres To keep their processes sustainable they tend to use fibres which have been approved by '*Blue Sign;*' a company making ethically approved textiles, and dispose of fibres using companies like ***Clean Harbors***, who have made a name as a responsible rope disposal service. The company also mentions that they try to make long lasting ropes because this is the ultimate way to keep rope manufacture sustainable.

Teufelberger currently offer four rope types with a 'sustainable character': says Lena Mittendorfer, the company's sustainability manager. 'These include the ***Chameleon*** shown on the title page, which is made with recycled fibres; both durable and eco-conscious. It is tested to EN 1891A and can be used for both single and double rope technique. The colour of the rope depends on the rope put into it', she says and adds, 'it has a great strength'. They have ropes created with responsibly sourced materials, which are sold to support charities, called their '***Charity line***'. Their *Robline Rio Green* is made with recycled materials and they also collect used ropes to use in the production process. They say they 'are experiencing increasing demand for sustainable ropes, since they are able to keep prices affordable without compromising on safety or standards of manufacture'.

Natural Fibre Ropes

Ropes were traditionally made with jute and hemp and many companies still sell these styles because the marine industry and horticulture still demand them. They have their own properties and can be as useful as synthetic ropes in many applications.

Lanex ropes in Czechia, produce a vast array of ropes but also stock hemp rope at diameters ranging from 4mm to 40mm with breaking loads from 117kg to 6354kg. These ropes have strengths such as good resistance to alkalis and organic solvents, low resistance to UV radiation, and low distance to acids, but they are biodegradable.

Similarly, companies like '*Rope Services UK*' and even *Screwfix* offer similar jute ropes. *Shear Rock* (textiles company run by climbers, including the writer of this article) is currently exploring the scope of wool-based ropes because, aside from inherent strength, their material properties include greater stretch before breaking and excellent heat resistance. Other natural fibre ropes include cotton, which is mainstream in the sailing industry, for a range of purposes. Some companies have had to hold back on their sustainable lines since they have not had enough interest, while others are doing really well, showing how heavily some rope makers rely on sailors and climbers as the majority of their users, being interested in these products.

With so many other ways to make the rope industry more sustainable, as explored by companies like *Sterling* and *Mammut* as well as a plethora of strong ropes already available with a lower carbon footprint, it seems only a matter of time before the industry can see the value in prioritising planet as well as product competitiveness. This said, most of the ropes mentioned in this article are created from plastics, which do emit micro-plastics; so there is also scope for other and newer fibres to be explored which can achieve the same strength and desirable properties without shedding plastic particles.

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2026 COURSES

INSTRUCTOR-LEVEL WORKSHOPS for SERIOUS ROPE PRACTITIONERS

We offer many instructor-level workshops on the Arizona VORTEX in differing locations around the US, Canada, UK and Australia (and around the world). See the RTR Open Enrollment Schedule for these offerings under "Artificial High Directional Workshop" or AHDW.

Program Notes: "EARLYBIRD" AND OTHER DISCOUNTS
1) "Earlybird" discount of $200 apply only to those tuitions paid in full up to 90 days before the start date of workshop. "Earlybird" discount do not apply to Purchase Orders.

2) For the Mountain Rescue Workshops, "Earlybird" discount only applies to full tuition paid and not to 50% AZ Volunteer Discount
3) If a single agency is sending five or more to any one workshop, additionl discounts apply. Restrictions and conditions apply. Contact RTR for details

WORKSHOP	STATE COUNTRY DATE FLYER	TYPE	VENUES Classroom-Wilderness or Industrial	Req. Equip *You will NEED*	Dura-tion Days	Physical exertion Easy 1 Hard 10	Prerequisites Program Liaison & Special Notes	Location & Sponsor *Open links for Program FLYERS!*	Tuition *$200 "earlybird" discount for full payment up to 90 days before start date (1)*	RTR Lead Instruc-tor(s)
Mountain Rescue Workshop	AZ April 18-24, 2026	Mountain Rescue	Classroom Industrial & Wilderness	MRW Equip List 7/22	Saturday/ Friday *7 days*	6 hiking required steep terrain	**Prerequisite: Rope Experience** Prior rope rigging experience and climbing ability are strongly recommended.	**Arizona USA** Town of Jerome *See Jerome Fire MRW Flyer*	**$1,600** *(50% off AZ Volunteer discounting available)(2)*	Reed & Keith Thorne
Team Skills Rescue Workshop	CO May 2-8, 2026	General Team Rescue	Classroom Industrial & Wilderness	TSRW Equip list 7/22	Saturday/ Friday *7 days*	5 some hiking	**Prerequisite: Rope Experience** Prior rope rigging experience strongly recommended. Liaison: Lee Brown Phone: (720) 323-0802	**Colorado USA** Mountain View Fire Dept. CO *See CO Program Flyer*	**$1,750** $200 "earlybird" discount See above	Reed & Keith Thorne
Artificial High Directional Workshop	UT May 10-16, 2026	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip List 7/22	Sunday/ Saturday *7 days*	6 some hiking	**Prerequisite: Rope Experience** Prior rope rigging experience strongly recommended.	**Utah USA** *Rock Exotica & South Davis Metro Fire See Utah Program Flyer*	**$1,750** $200 "earlybird" discount See above	Reed & Keith Thorne
Team Skills Rescue Workshop	TX May 28-June 3, 2026	General Team Rescue	Classroom Industrial & Wilderness	TSRW Equip list 7/22	Thursday/ Wed *7 days*	4 some hiking	**Prerequisite: Rope Experience** Prior rope rigging experience strongly recommended. Liaison: Joshua Craft Phone: (806) 340-9740	**Texas, USA** Randall County Fire, TX Palo Duro Canyon State Park See Randall Program Flyer	**$1,250** Register with Randall Co Liaison	Reed & Keith Thorne
Team Skills Rescue Workshop	VA Sept, 19-25 2026	General Team Rescue	Classroom Industrial & Wilderness	TSRW Equip list 7/22	Saturday/ Friday *7 days*	4 climbing stairs	**Prerequisite: Rope Experience** Prior rope rigging experience strongly recommended. Liaison: Amy Burnette Phone: (804) 912-0995	**Virginia USA** Chesterfield Fire & EMS See VA Program Flyer	**$1,750** $200 "earlybird" discount See above	Mike Green & Reed Thorne
Personal Skills Rescue Workshop	MD Sept 26-Oct 2, 2026	Solo-Semi Solo Rescue	Classroom & Industrial ONLY	PSRW Equip list 7/22	Saturday/ Friday *7 days*	9 rope climbing required	**Prerequisite: Climbing Rope** Prior rope rigging experience strongly recommended. Students should be in excellent physical fitness	**Maryland, USA** Union Bridge Fire Dept. *Contact Instructor Mike Green for location & logisitcs*	**$1,750** $200 "earlybird" discount See above	Mike Green & Reed Thorne
Tree Rescue Workshop-Firefighter	CA October 12-18, 2026	Bottom Up Tree Rescue	Classroom & Wilderness ONLY	TRW-F Equip List 7/22	Monday/ Sunday *7 days*	10 tree climbing required	**Prerequisite: Climbing Trees** This program is specifically designed for responding tree emergency personnel in excellent fitness	**California USA** Nevada City *See TRW-F Program Flyer*	**$1,750** $200 "earlybird" discount See above	Keith & Reed Thorne
Offset/Highline Rescue Workshop	AZ Aug 29-Sept 4, 2026	General Team Rescue	Classroom Industrial & Wilderness	OHRW Equip list 7/22	Saturday/ Friday *7 days*	6 hiking required steep terrain	**Prerequisite: Rope Experience** Prior rope rigging experience strongly recommended.	**Arizona USA** Town of Jerome *See Town of Jerome Flyer*	**$1,750** $200 "earlybird" discount See above	Reed Thorne
Tactical Wilderness Rescue Wkshp	AZ October 20-26, 2026	R.E.M.S. Rapid Response	Classroom & Wilderness ONLY	TWRW Equip List 7/22	Tuesday/ Monday *7 days*	7 rough terrain inherent	**Prerequisite: Rope Experience** Concentrates on low and steep angle litter evacuations. Ideal for Rapid Extrication Module Support (REMS) Team Instructors	**Arizona USA** Town of Jerome *See TWRW Program Flyer*	**$1,750** $200 "earlybird" discount See above	Reed Thorne
2027										
Mountain Rescue Workshop	AZ April 17-23, 2027	Mountain Rescue	Classroom Industrial & Wilderness	MRW Equip List 7/22	Saturday/ Friday *7 days*	6 hiking required steep terrain	**Prerequisite: Rope Experience** Prior rope rigging experience and climbing ability are strongly recommended.	**Arizona USA** Town of Jerome *See Jerome Fire MRW Flyer*	**$1,700** *(50% off AZ Volunteer discounting available)(2)*	Reed & Keith Thorne

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