

TECHNICAL RESCUE

EMS, EXTRICATION, SAR, AQUATIC, ROPE, DIVE, TACTICAL & USAR



ISSUE
80

DOLPHIN 1

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OCEAN α

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FRONT COVER:



Actsafe have been busy expanding their range of powered ascenders and are now under the ownership of SKYLOTEC. The cover image is from last year's GRIMP (rescue) day held in Namur, Belgium and features a firefighter using an Actsafe RCX as a winch to raise a Search Dog and Handler.

See page 2 for more on powered ascenders.

CONTENTS

Left: This issue's GUIDE is Confined Space Rescue Stretchers capable of being hoisted which come in 4 broad types, one of which is flat-sheet roll up stretchers pioneered by the SKED and now emulated by many including this Saviour Medical 'Technical Rescue' version using load-bearing grommet eyes and colour-coded straps. **page22**



Above: Rich Denham and Nick Appleton look at how to right a car to make extracting the casualty an easier and safer proposition – do it gently! **page58**



Above: Dave Halliwell explains just how realistic you can make your water rescue training with a manikin that looks unnervingly real and even reacts to resus attempts in the same way as a drowning victim. The first of a few articles we have on hyper-realism. **page14**



Above: The guru himself, Mike Croslin, joins Mitch Sasser in rectifying what he sees as a decades long shortcoming of his original swiftwater rescue teachings and persuades you to adopt team safety procedures that negate the need to enter the water. **page66**



Talking of gurus, Reed Thorne continues his Pulley series with a slightly left-field look at Back-Ties, ably represented in this cover shot from WSAR#10 by SMC's Vector Edge Management System set up to allow the stretcher to be hauled. **page48**

...is the same style and format as **TECHNICALRESCUE** and **ARBCLIMBER** magazines.



SKYLOTEC POWER ASCENDERS



Swedish powered ascender pioneer Actsafe is now part of the German access giant SKYLOTEC and in these two images, the multi-role capabilities of their RCX model is being demonstrated. Aside from being a powered ascender/descender capable of transporting a rescuer (and casualty if the combined load remains below 250kg/550lb) up or down a rope at speeds of up to 24m/78ft per minute, it is also an incredibly capable winch. When we first used battery powered ascenders in the early part of this century we eulogised that they would make excellent mobile helicopter winches and with the latest generation of Actsafe models, here the RCX, it has proven to be the case. With the RCX anchored at a convenient height, a suitable distance from the edge (to allow edge negotiation of the load/rescuer/casualty) all of its capabilities as an ascender translate to being a winch with the proviso that if the rope runs over an edge without an efficient roller there is some increased friction and therefore work-effort on the part of the motor which will alter performance slightly.

In this competition scenario, the single operator is able to use the throttle and allow the hauled trail rope to be pulled through and pile or coil at his feet with the occasional stop for a tidy up. If extra personnel were available, a second person would probably control the belay while the operator controlled the main winch line exiting the RCX and made sure it coiled or stowed neatly as it reels in. Instead, leaving the RCX to do its stuff, the single operator is able to take in the slack of the red belay rope in time with the winch line and this is running through a Petzl Maestro. This particular Actsafe model is using their Variable Rope Grab system which allows use of various rope diameters from 6 to 11mm though this is very much dependant on load – generally 6 to 10mm rope is for loads not exceeding 150kg/330lb.

The key thing to note when using the RCX as a winch is that the operator's position needs to allow comfortable access to the throttle while allowing good line of sight to the load or, at the very least, to the rope as it comes over the edge. Direct hands-free radio communications with personnel on the face or at the bottom will assist the operation if visual sight of the load being hauled by the operator is not possible. Of course, you can bypass manual control of the ACX using its Bluetooth remote control which can be used up to 150m/492ft away.

Ascender Positioning Point

Carry handle

Emergency Descent button/lever

Bi-directional Throttle

LED Battery Status (on rear face)

Power Button (on-off) with LED

Emergency Stop Button

Titanium Sling-retaining Bolt

Carabiner/Anchor Connection Sling

Rope Cover

Rope Guide (behind cover)

SPECIFICATIONS

MODEL:	ACTSAFE RCX
SWL/WLL:	250kg /550lb
ASCENT SPEED:	0-24m/78ft per min Continuous adjustment.
BATTERY RANGE:	Approx. 200m/656ft with 100kg/220lb load 20°C/68°F
CHARGING TIME:	90 min
TEMP RANGE:	-10°C/14°F to + 40°C/104°F
DIMENSIONS:	33 x 28 x 27 cm/13 x 11 x 10.6"
WEIGHT:	13 kg/28.6 lb
ROPE DIAMS:	6-11mm (6-10mm only for loads up to 150kg/330lb)
WEB:	www.actsafe.se

MAIN PICTURE & FRONT COVER:

GRIMP/Rescue Day 2021, Namur, Belgium.
Team: Höhenrettung Fire Service Düsseldorf, Germany.
Challenge: Dog Rescue Scenario.

PRODUCTS – ROPE STUFF

TRISKELION TriPod

www.rescuemagazines.com

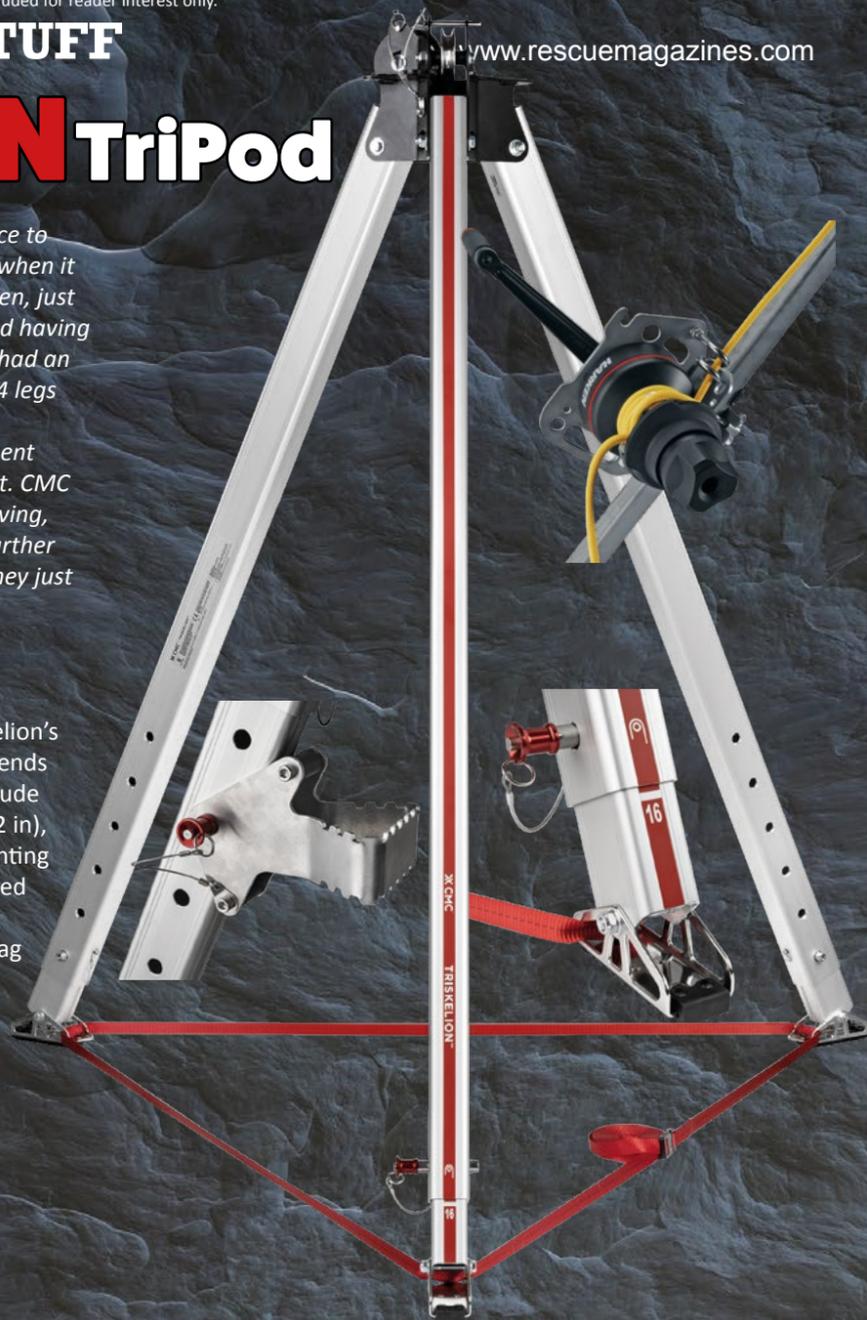
[ED: This model bears more than a passing resemblance to the Arachnipod that we reviewed about 18 years ago when it was marketed by Ferno. It was an excellent product then, just needing better numbering of the adjustment holes, and having done that, it's an even better tripod now. Back then it had an unusual gantry attachment option mounted between 4 legs but this tripod was always the main component with rectangular cross section legs, loads of useful attachment options and most particularly, excellent working height. CMC have always been great at spotting products worth saving, preserving and/or evolving and this is no exception. Further evidence, that most things in our industry never die, they just circle back round at some point.]

The CMC Triskelion is the first industrial rescue tripod certified to NFPA as well as CE standards and the new benchmark for rapid deployment, ease of use, and versatility. With its 5.5-10 ft working height. The Triskelion's height range adapts to fit low-clearance areas and extends to haul patients in full-size litters. Unique features include its compatibility with cable and rope up to 13 mm (1/2 in), anchor points for pulley systems, multiple winch mounting options, rectangular legs with built-in stoppers, tethered push pins, high contrast graphics, pivoting feet, quick-connect webbing hobble strap, and reinforced carry bag for single or two-person transport.

- Min Working Height: 1.7 m (5.5 ft)
- Max Working Height: 3.1 m (10 ft)
- Tripod Weight: 32 kg (70 lb)
- Packed Length in Bag: 2.1 m (7 ft)
- Inside Diameter of Feet:
 - Minimum Height: 158 cm (62.2 in)
 - Maximum Height: 282 cm (111 in)
- Outside Diameter of Feet:
 - Minimum Height: 193 cm (76 in)
 - Maximum Height: 317 cm (124.8 in)
- MBS: Attached directly to head: 36 kN (8,093 lbf)
- MBS: Attached to leg over pulley: 22 kN (4946 lbf)
- Certification: NFPA 1983 (2017 ED) – General Use
 - EN 795:2012 Type B for Single Person Use
 - CEN/TS 16415:2013 Type B for 2 Person Use
- Two head-mounted stainless steel pulleys compatible with cable and rope up to 13 mm (1/2 in)
- Three side-plate anchor points ideal for 4:1s like the CSR2 pulley system
- Three tie-off points for additional rigging or stabilization
- Several mounting options for the Harken LokHead Winch and DBI-Sala Salalift II Winch
- Legs are secured using large, quick-action, ball-lock push pins that are easily handled with gloves
- Large, ball-lock push pins reassuringly snap into place even with gloved hands and robust lanyards keep them from getting lost or separated
- High contrast graphics are easy to see in low light

- Leg height numbering is clearly communicated in noisy environments
- Additional icons guide winch installation to align with head-mounted pulleys
- Pivoting feet with non-slip tread and spiked tips adapt to a variety of surfaces and angles
- Red webbing hobble strap secures all three legs with a single quick-connect Cobra Buckle lighter than chain and faster than using multiple lengths of material
- Includes a reinforced carry bag with a diagram indicating proper orientation for balanced single-person transport
- Accessories (Sold Separately) include LokHead & Salalift II Winch adapters (\$450 & \$300)
- Foot Step Kit (x2) to reach tripod head after setup (\$350)
- Ground Stake Kit (x3) (\$231)
- RETAIL PRICE Exc accessories = \$2100

www.cmcpro.com



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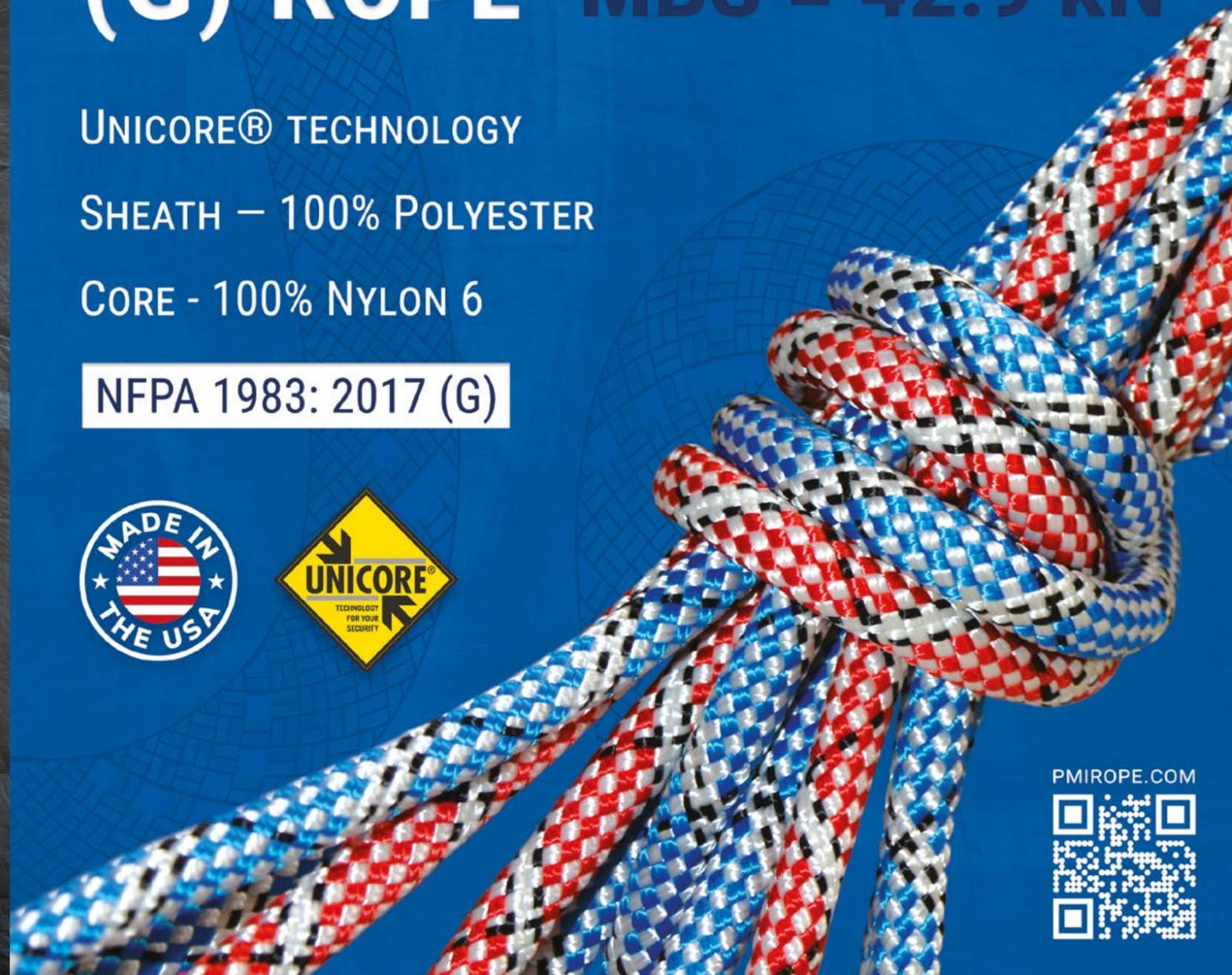
11 MM EXTREME PRO™ (G) ROPE MBS = 42.9 kN

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NFPA 1983: 2017 (G)

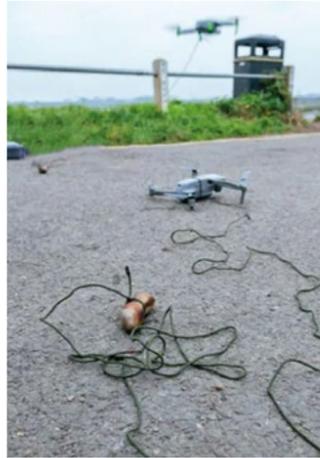


PMIROPE.COM



FISHING for DOGS

[ED: We don't usually deal with 'news' items and this is classic online sensationalism fodder but this ingenious use of a drone by a newly formed SAR team highlights not only the plethora of uses for drones/UAVs but also of the increased involvement of volunteer teams dedicated to the use of drones. This will be good and bad I suspect with some well-meaning teams cluttering up an already congested incident scene but for those teams/agencies not already looking at an in-house drone facility, increased availability of a drone with a competent pilot can only be a good thing. In this incident, a Jack Russell terrier escaped from her owner onto the low-tide mudflats and reed beds of Langstone Harbour in Hampshire, UK. After two previous days of fruitless locating with the drone and then chasing on foot and kayak another plan was needed. It was clear that the dog was too spooked to be approached and the tide was again about to come in with her stubbornly installed on a reed island. There is a hovercraft in the area that would likely have scared the dog in any direction so normally this would require the Coastguard's Mud Rescue Team with a mud sled or perhaps the Fire Service with inflatable Mud Paths leap-frogging out to the dog. Instead Police hoped to speed up the process using the Denmead Drone Search & Rescue Team which was on-scene providing locations to ground searchers. DDSAR was formed three years ago to assist lowland search efforts of lost persons and pets. They tied freshly cooked sausages (an important difference to a cold, palid offering from a local store's refrigerator) to their drones with string. Having verified with CAA that they were OK to use the airspace, they dangled the bait that would have attracted many a human rescuer, and lured the dog back across an area of mud that can be treacherous for people and larger animals. This is a remote-operated variation on the old trick of using cheese to get an ice/mud/water-stranded dog into your boat or onto your sled but it's worth mentioning that even this safe-approach measure with a drone could backfire if the dog were to lunge at, and succeed in getting, the prize. This could presumably bring your drone down? Piloting skills and good line of sight to the target are essential. While many rescuers will bemoan their diminishing opportunities to perform hands-on rescues, the more safety and legislation minded management of teams and services will see this as further opportunities to limit the exposure of rescuers to potentially dangerous situations. In a similar vein, Mike Croslin's article later this issue emphasises a need to keep swiftwater team member OUT of the water and while he is not mentioning drones, this is clearly another means already being used for placing lines rather than swimming them. Drones/UAVs and any number of new acronyms for the same thing will continue to be the biggest advance in rescue since the lifeboat or helicopter and will continue to evolve and morph into all manner of unmanned vehicles. It's not a new concept by any means but it seems to have taken a great many years longer than we originally predicted to become an accepted norm].



[ED: **Edilgrappa** is a brand we weren't familiar with at all even though Italians have been using them since 1977 making them one of the oldest hydraulic rescue tool companies around! To start to rectify over 30 years of ignorance on our part, we've listed their heavy-duty NFPA and lighter combi tools and a dedicated curve-blade cutter as examples from their heavy duty range using the very capable DeWalt 18//54v (20/60v in the US) FlexVolt battery which includes electric rams, dedicated cutters & spreaders. There is also another battery range using the Ogura-style electric-drill handle format (pic below) rather than throttle grip and DeWalt 18v batteries. This range has a dedicated cutter, spreader, peddle cutter and rebar cutter. As an example, their USAR re-bar cutter cuts to 189kN and weighs 9.8kg].
www.edilgrappa.com



ITALIAN E-HYDRAULIC RESCUE TOOLS

	MDC390N Combi	MDC300-T30BOCombi	F180-2P BO Cutter
Max Opening (Tips)	394 mm / 15.5"	302mm / 11.9"	-
Cutters Opening:	185 mm / 7.3"	-	185mm / 7.3"
Operating pressure	70 MPa (700 bar)	55MPa (550 bar)	70 MPa (700 bar)
Cutting classification *	A6 / B7 / C6 / D7 / E7		24mm/1" max bar diameter
Cutting Force:	n/a	375kN (38.3t) / 84,303lbf	871 kN (88.8t) / 195,808 lbf
Max SPREAD force	39.7 kN (4 t) / 8,925 lbf*	134kN (13.7t) / 30,124 lbf**	60.6kN (6.2t) / 13,623 lbf*
Min SPREAD force	29.6 kN (3 t) / 6,654 lbf*	45kN (4.6t) / 10,116 lbf*	-
CRUSHING Force:	n/a	64kN (6.5t) / 14,387 lbf	-
PULLING Force:	n/a	45kN (4.6t) / 10,116 lbf	-
Motor	54V Brushless	54V Brushless	54V Brushless
Dims LxWxH (closed) **	861 x 274 x 241 mm 34 x 10.8 x 9.5"	731 x 245 x 236mm 28.8 x 9.6 x 9.3"	832 x 262 x 283mm 32.75 x 10.3 x 11.1"
Dims LxWxH (open) **	754 x 360 x 241 mm 29.7 x 14.2 x 9.5"	659 x 303 x 236 mm 26 x 12 x 9.3"	817 x 280 x 283mm 32.2 x 11 x 11.1"
Tool Weight**	22.2 kg / 48.9 lb	14.3 kg / 31.5 lb	22.5kg / 49.5 lb
Battery Weight:	eg. 9Ah= 1kg/2.2 lb	eg. 9Ah= 1kg/2.2 lb	eg. 9Ah= 1kg/2.2 lb
EN 13204 classification	BK30 / 390-H-22	BK46 / 302-F-13	BC180J-22.5
NOTES:	180° rotating head	-	180° rotating head

* NFPA 1936 * 25mm from tips (blades closed) **150mm from tips (blades closed) **Dimensions and weight without battery

[ED: **Edilgrappa** is a brand we weren't familiar with at all even though Italians have been using them since 1977 making them one of the oldest hydraulic rescue tool companies around! To start to rectify over 30 years of ignorance on our part, we've listed their heavy-duty NFPA and lighter combi tools and a dedicated curve-blade cutter as examples from their heavy duty range using the very capable DeWalt 18//54v (20/60v in the US) FlexVolt battery which includes electric rams, dedicated cutters & spreaders. There is also another battery range using the Ogura-style electric-drill handle format (pic below) rather than throttle grip and DeWalt 18v batteries. This range has a dedicated cutter, spreader, peddle cutter and rebar cutter. As an example, their USAR re-bar cutter cuts to 189kN and weighs 9.8kg].
www.edilgrappa.com



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LEATHERMAN

www.leatherman.co.uk

Seeker R6V^{mk2} Water Rescue Helmet

[ED: We don't see this range so much outside of its home area of Aus/NZ even though the Pacific brand is well known and been around longer than most. The R6 is part of a multi-role range tweaked for each sector of rescue, in this case water but also technical rescue, extrication, medical and fire] The R6V MkII Seeker from Pacific Helmets has been designed specifically for water rescue and water recreation applications.

Made with a Fibretuff composite shell, the Seeker provides integral strength and excellent penetration protection. This lightweight shell is chemical and UV resistant with inherent heat and flame resistance. The specialised ventilation system can be opened and closed depending on the situation – when closed the vent is sealed, water tight. One Size Fits All. Ratchet adjustable headband for head sizes between 52-61cm. Downsize padding available for smaller head sizes.

Helmet weight: 630g ± 5%

Standards: • EN 1385:2012

Selective clauses of EN443:2008 as follows:



- Protection against hot solids
- Protection against molten metal
- Flame resistance
- Surface electrical insulation
- Resistance to liquid chemical

Fibreglass composite shell provides integral strength and excellent penetration protection. This lightweight shell is chemical and UV resistant with inherent heat and flame resistance. Expected service life of 15+ years with proper care and maintenance.

Easi-On-Off (EOB) bases for torch and face shield (optional). Easi Glide Torch Holder and torch sold separately.

Water Release Holes.

Removable Ear Protection Covers (optional).

Pacific ratchet adjustable headband, sizing range from 52–64cm (downsizing adjustment kits and XL sizes available). Simple operation with a single gloved hand. Comes with comfortable front and rear padding which is easily removable and replaceable for decontamination.



Dynamic Sealed Ventilation System (DSVS™) open/close vent for maximum helmet ventilation and user comfort. Water tight seal when closed.

Reflective trim with high retro-reflectivity for increased visibility (optional).

Customised Decals (badges, wording, and rank markings) are available by request.

Rubber Straps to secure accessories such as goggles (optional).

Form Moulded PE padding provides excellent shock impact absorption.

Pacific low profile buckle can be easily secured, released, and adjusted.

4-point chin strap. Single handed adjustment at multiple locations for maximum comfort and stability. Chin cup or chin loop optional.

Comms Bracket allows helmet mounted Titan Comms with Boom Microphone (optional).

FEATURES

- PACIFIC FIBRETUFF SHELL provides integral strength and excellent penetration protection. This lightweight shell is chemical and UV resistant with inherent heat and flame resistance. Expected service life of 15+ years with proper care and maintenance.
- PREMIUM REFLECTIVE TRIM with high retro-reflectivity for increased visibility. 8 pieces 3M680, supplied fitted to

the helmet (option)

- DYNAMIC SEALED VENTILATION SYSTEM (DSVS™) open/close vent for maximum helmet ventilation and user comfort. Water tight seal when closed.
- COLOUR. Available in over 25 colours. inc Fluorescent Orange pictured, fluoro Yellow, Yellow, Red, White.

COST: AU\$176.00–AU\$189.20 exc GST

www.pacifichelmets.com

WRS Rescue PFD

[ED: There have been a raft (so to speak) of buyouts and amalgamations in our industry in the past couple of years but this one is a little more symbiotic than most –

manufacturer WRS Inflatables, well known in the UK for water rescue craft like the D-Board on the right, has joined forces with retailer Condor Safety in Belgium to become WRS International with an expanded range of products including water rescue helmets and this PFD, a joint production with outdoor firm Peak UK.]

A unique entry system is a revolutionary redesign of PFD fitting and use. The WRS Rescue PFD has two front panels, each connected to the rear PFD panel with a shoulder strap, side panel, side straps and waist strap. The user wraps the outer front panel over the inner, secures the wrap connection with two super strong side buckles, a rescue harness, a shoulder whistle clip and a side release waist buckle.

Fitting adjustment with the easy to use 40mm shoulder and side straps, along with 25mm waist straps, offers the perfect fit. For an even more secure fit, removable 40mm leg loops can be attached. Available in S/M, L/XL & XXL ISO Approved. Professional cut with smooth lined styling.

Unique, patent pending, front-opening, wrap style PFD. Tough ripstop 500d Cordura / 200d nylon shell. 90-110N of Gaia environmentally friendly soft flotation foam. Cost €206 www.wrsinternational.com



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(208) 322-3600

SKYLOTEC and Petzl's gear packs are not to be confused with equipment organisers like the Courant Cross or CMC Lotus Tech-Pack which are designed to house individual items of rope hardware and software and present them in a methodically laid out fashion flat on the ground. These Duffels or Duffles are cavernous bags with good carrying options and some compartmentalisation of equipment...but mostly, they're cavernous spaces into which you stuff stuff rather than organise it and in which, Hannibal Lechter could easily have transported some of his unfortunate victims. Like most hold-alls, neither of these two models hold their shape when empty or half full though each has a smaller bag option (Petzl=65L, SKYLOTEC=60L) which do tend to hold their shape better. There's a lot of competition in this band of products and we could have picked any number of quality duffels to compare the rectangular with the barrel-shape.

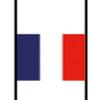
Each uses lightweight but very sturdy, waterproof materials often described as 'Tarpaulin' but thicker than any tarp we've ever used and in the case of Petzl they go out of their way to distance their fabric from PVC, instead stating that their TPU is PVC-free. No such shyness with SKYLOTEC, theirs is unashamedly PVC. Either way, with the minimum of pockets, loops and hooking-on points there is no unnecessary bag weight with each weighing around 1.5kg/3.3lb when empty. Of course, once you've filled these you can barely lift them off the ground and in fact the slightly smaller Petzl bag is rated to carry 5kg more than the 5L larger SKYLOTEC. We don't see that as anything other than semantics in estimating working load limits – each seems as strong the other and they are well put together with bar-tacked (Petzl) or box-stitched (SKYLOTEC) load points stitched through reinforcing webbing. The Petzl has welded and sewn seams on the bottom to protect contents and bag if put on wet ground and the SKYLOTEC uses 1200D Polyester which is similar in feel to 1000D Cordura. While not waterproof in the submersible sense (like an Ortlieb) both offer excellent water resistance and Petzl also boasts UV resistance that SKYLOTEC doesn't but after years of dragging over rough surfaces you'll have shredded these long before the sun degrades the fabric enough to care.

Both use the chunkier zips that we favour and this is crucial because we are all guilty of overloading these things and putting a knee on them to force the zip closed – this is the weak point on virtually all gear bags that have a zipped main compartment and once that zipper starts to skip some teeth leaving an unexpected opening you rarely get it back again to full functioning glory. Both sets of double zips can be padlocked with the

Petzl Duffel 85 vs Skylotec Duffle 90

by Richard Hackwell & Ade Scott



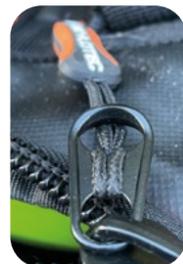
MODEL/ Litres	COMPANY	ORIGIN	COST inc Tax/VAT	WEIGHT	MAX DIMENSIONS	MATERIALS	REMOVABLE LUGGAGE HANDLES	REMOVABLE BACK STRAPS	REMOVABLE SHOULDER STRAP	INTERNAL EXTERNAL GEAR LOOPS/EYES	SIDE/END HANDLES	ID PANEL KEY CLIP	EXT. POCKETS MESH	INT. POCKETS MESH	BOOT/HELMET BAG	PADDED STRAPS	PADDED BACK	SEWN WELDED BASE	COMPRESSION STRAPS	INTERNAL HOOKS	LOCKABLE	WATERPROOF/RESIST	MAX WLL	COLOURS	NOTES	WWW.
 DUFFEL 85	PETZL		£130 \$150 €140	1.55kg 3.4 lb	70x40x32cm 28x16x13"	TPU (PVC-free), polypropylene, steel, nylon	■	■	■	6* 8	2 2	■	- -	1 1	■	■	■	■	4	8	■	■	70kg 154 lb 35kg 77 lb	■ ■	also a 65L model *intended for use as shoulder strap eyes	petzl.com
 DUFFLE 90	SKYLOTEC		£90 \$110 €100	1.4kg 3 lb	70x40x40cm 28x16x16"	Tarp PVC, 1200D Polyester	■	■	■	6 -	2 -	■	- 1	2 -	-	-	-	■	-	1	■	■	- 30kg 66 lb	■	Also a 60L model	skylotec.com



Skylotec zipper having a reinforced and flared section of metal joining the eye to the body of the zip. SKYLOTEC has snazzy high-viz and tactile zip pulls while Petzl has stuck with tied cord zip-pulls.

Their main compartments are accessed using a 3-sided D-shaped opening. Both are good sized openings but the Petzl offers larger and easier access to the interior by virtue of its rectangular shape compared to the SKYLOTEC's barrel shape. The lids of each house full-width interior pockets – two mesh pockets in the SKYLOTEC and one mesh, one solid pocket in the Petzl which is additionally backed by foam, not so much to protect the pocket contents as to provide padding for your back when using the rucksack straps. But it won't replace the need to pack the soft stuff at the top/lid side of the bag otherwise any pointy objects will be protruding into your back.

Thereafter there are a few differences between them – the Petzl has a boot or helmet compartment accessible only from the outside and therefore intruding at least a third of the way into the interior. This is bagged to separate it so that muddy or wet boots won't mess up your clean duds on the inside. The SKYLOTEC doesn't have this but it does have a small outside zipped pocket which the Petzl does not. Petzl's boot/helmet compartment works well for mid sized boots, we struggled with higher leg fire-rescue or chainsaw boots but it is, alternatively, suitable for most helmet-types and accessories. The boot-pocket lid has a clear ID pouch which the SKYLOTEC does not have. Finally for the







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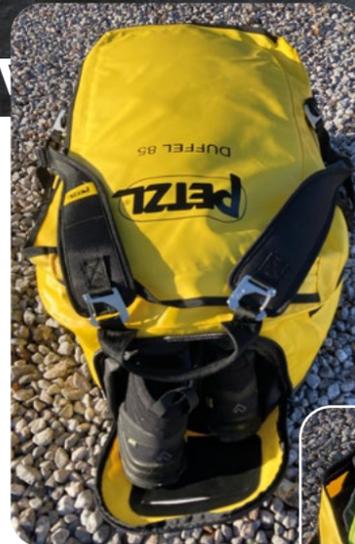
GEAR REVIEW

main compartment, only the Petzl has compression straps to secure a part-filled bag so that everything stays in its place during transport.

The SKYLOTEC carry handles on the top of the bag are fixed and unpadded. The Petzl's uses the detachable and padded backstraps as the carrying handles too. This means they're more comfortable and curve OK to fit your palm.

There are three pairs of web eyes in which to connect the thin, wire-gated strap hooks, two at the top and four along the rim of the lid. Although Petzl doesn't tout these as eyes we have listed them in the table as external eyes because they are clearly load bearing and at least two are always available to use at any one time – maybe all 6 if you take the handles off altogether which is handy for travel because you still have 4 side handles to lift and shift and less to get snagged. SKYLOTEC's two end handles are good for pulling it out of the truck or off a carousel while Petzl has an additional two side handles that work as 'suitcase' handles, a useful alternative to the hold-all/back straps. The webbing used to create SKYLOTEC's handles are sewn over to create a more substantial grip but are otherwise not padded.

SKYLOTEC's back-straps (or shoulder strap if you want to carry it down by your side) are padded and adjustable in length and can be detached but it's a bit more of a mission because you have to unthread the 4 chunky plastic buckles. These aren't full-on rucksacks that Wilderness SAR teams would want to carry for long distances, and they're not designed to be. The back straps are good for short distances and to keep hands free for other kit but if you had to choose one to carry further than the other it would be the Petzl. If you had less to spend and had to choose one to carry the most gear but your vehicle did most of the carrying then it would be the SKYLOTEC.



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Internal storage/organisation is limited in both – it's mostly about the space to get larger items in – the SKYLOTEC for instance can take a whopping 230metres of 11mm rope and while this isn't the intention you can deploy straight out of the bag clipping into the end handles. The Petzl has 6 rolled webbing eyes around the interior to clip some carabiners and hardware clear of the general melee going

on in the bottom of the bag with all your other gear. Try as we might, we always tended to keep adding bits of hardware better suited to an organiser resulting in the inevitable – having to tip out all the contents to find just one item quickly. We ended up putting equipment organisers like the Lyon roll-up pockets, into the bags to get the best of both worlds – large area storage with easily found, well organised small stuff. More hardware means you may be tempted to overload the bags but take note of the Working Load Limit – weigh some gear to see what that really means then try to stay roughly within those limits.

As an example Rich uses the Petzl bag as a Rescue 'Go-Bag' with: Boots, helmet, heavy jacket, mid layer, life jacket, throw line, ancillaries (carabiners, slings, gloves, check cards etc) and as an Arborist Climber bag with: Boots, helmet, jacket, mid layer, chainsaw trousers, harness, ancillaries (carabiners, slings, gloves, socks, personal cas-care kit etc.) while Ade has royally abused the SKYLOTEC as a rope-pack with 2x Lyon Organisers containing 3.5 metric tonnes of hardware and carabiners, a full body harness and sit harness, helmet with visor, ear defenders and headtorch, tag-line and 50m 11mm rope. This exceeds the WLL by at least 5kg so doesn't get carried too far from the vehicle or test-rig and tends to get dragged a lot more than it should – testament to how hardwearing that base reinforcement is.

There isn't much to choose between the bags as you might expect of two quality brands, however the Petzl is the more refined of the two – it feels better organised even when in chaos, aided by quality construction, materials and key features as well as the option of high vis yellow or low-vis black. The SKYLOTEC bag is a solid workhorse and a more than capable representative of this genre. It's a bit bigger, but a little cumbersome when fully loaded, compression straps and some inside loops would help. Officially the SKYLOTEC is up to a third cheaper though some stores retail them both at about the same price.

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Hyper-Realistic Training for Water Rescue

Realistic Training for Water Rescue using a manikin designed specifically for first responders

by Dave Halliwell MSc Paramedic & Paul Savage OBE



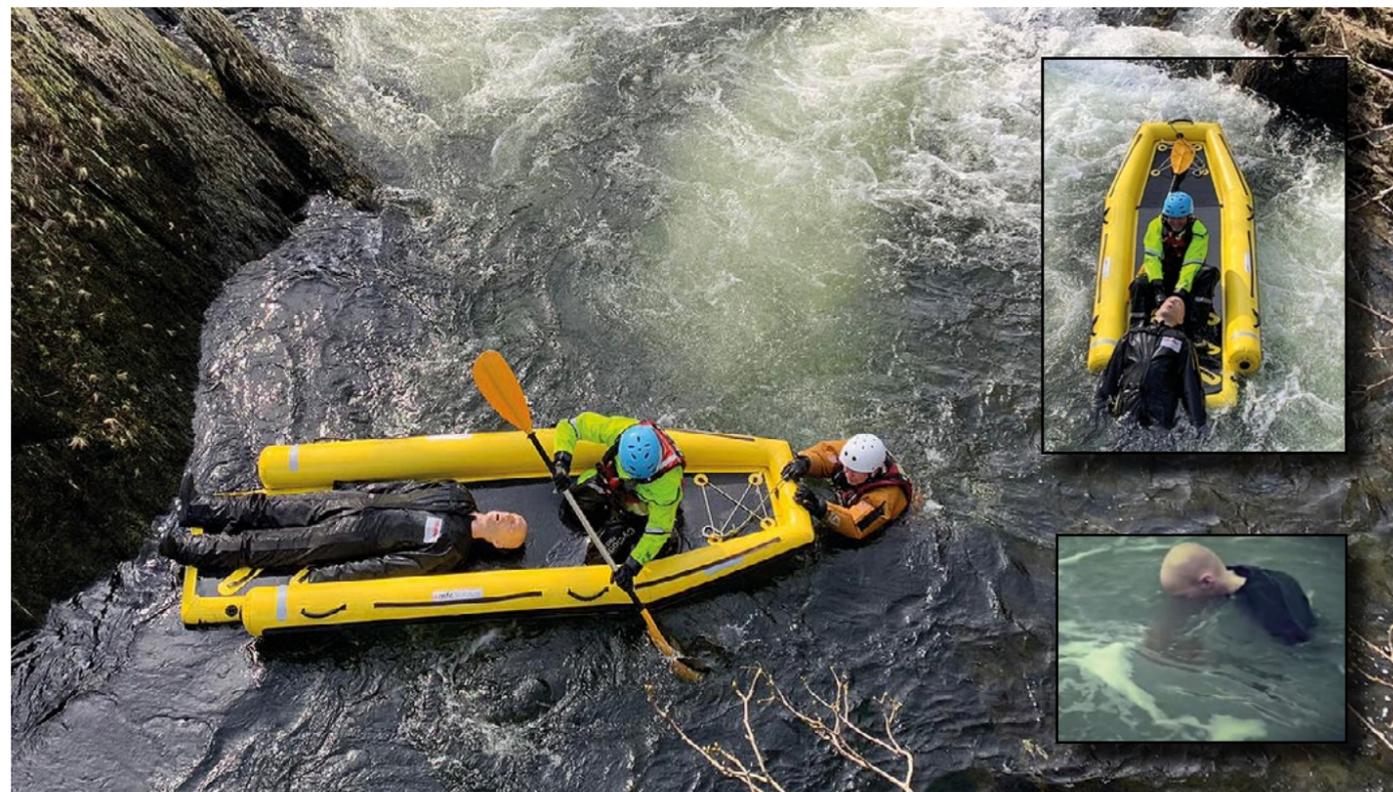
In early 2020 just before the start of the Covid 19 pandemic, there was a chance meeting between two old friends where the subject of medical realism in water rescue was discussed over a coffee. Paul Savage OBE – a passionate educator, chair of UKSAR Medical Group and previous Clinical Lead for the Royal National Lifeboat Institution (RNLI) as well as Managing Director of Saviour Medical Ltd, and David Halliwell a hospital and field paramedic and medical educator from the very first issue of this magazine were discussing their perceived shortfalls in water rescue education.

Their joint frustrations centred around the science of drowning, including the need to replicate airway management issues associated with the drowning process including the bubbling and foaming often witnessed associated with the surfactant washout from the lungs.

David and Paul felt that many Paramedics and other rescue teams were unprepared for the airway issues which can be found in a large percentage of patients in water rescue situations and Global Guidelines and Resuscitation education rarely mentions the likelihood of Pulmonary Oedema and Foam being present, or how to manage it, yet getting it wrong has many consequences.

The 2 friends saw a need for a “Realistic weight Advanced Life Support Water Rescue Manikin” which the guys felt could also be positioned in water to be – immersed and submerged.

Frustrations were also voiced between Paul and David that water rescue teams often swap over between the “wet” water rescue manikin, and the “dry” Advanced Life Support Manikin. The swapping over of Manikins allows for a loss of realism in any scenario and causes potential educational shortfalls in learners. Traditionally the medical ALS Manikins do not like to get wet, are not realistic in weight and can be full of complicated electronics. Therefore these ALS Manikins are rarely used, for example, on a moving rescue craft, where the initial resuscitation would commence and the medical accuracy is required.



David (a paramedic for over 25 years) is a founding director of a company called *Lifecast Body Simulation* based in Elstree Movie Studios in London, which makes incredibly realistic manikins for medical education – (see the picture opposite of our *Older Lady Manikin*) – this new type of realistic manikin is used by hospitals and paramedic education teams around the world.

David uses the hashtag #thisisamanikin in his social media posts to highlight that he is not posting photographs of real people – only manikins. He likes to stress the importance of realism in training. His frustrations from years of using the more traditional plastic manikins was that they simply didn't work for his students... David explains...“my experience of plastic based manikins is that they really were not assisting the students to learn real world skills, the learning was always constrained by the capability of the manikin, students could often be heard to say ‘its not like this in the real world’ and so working closely with my business partners we set out to change all of that stuff.”

We had been inspired by the writing of David Gaba, a neonatologist and editor of the *Society of Simulation in Healthcare Journal*, -writing in 2009 Gaba suggested ‘... simulation can be a powerful tool for delineating strengths and weaknesses of our systems and processes including the handling of delicate issues of professionalism and ethics. It is good for us to know how clinicians really behave (or at least how they are likely to behave) rather than to merely assume that our typical “good clinicians” already know everything about relevant protocols or principles of ethical care and can readily implement them when things turn sour.

The writings of David Gaba were instrumental in getting our teams to think differently, and helped us make sense of what we were seeing in the real world. For water rescue – David set about designing a manikin which was more realistic and could cover all of the aspects reflected in the discussions he had previously engaged in with the RNLI's Paul Savage, and in doing so would touch base with Paul occasionally to sense-check his knowledge and the science.

The first prototypes of the drowning manikins were toddlers, (3 year old manikins with semi-solid chests) these manikins would not float, but were perfect for testing the bubbling (pulmonary oedema) functionality of the rescued child.

Lifecast and its USA partner *Echo Healthcare* have recently used the same Toddlers to challenge participants at the EMS World Competition in Texas USA. Once the Mechanism to create the Bubbling and foaming had been designed, and was working, the team turned their attention to other important issues, linked to the realities of water rescue, most notably the realism associated with the weight of adult patients and the ability to make a manikin float in a manner that replicated a real patient prior to rescue.

David had previously worked with the team from *Ruth Lee* in the UK, and so reached out to their CEO, Paul McDonnell, to see if there was any possibility of working together to build a hybridised manikin – tough, heavy and robust – (the *Ruth Lee* element) whilst also anatomically accurate for skills such as advanced airway management, and CPR – (the *Lifecast* bit.).



Both teams began drafting designs and as a result the 2 part *Realistic Advanced Water Rescue* manikin was born. An heavy outer bodysuit over a realistic torso as detailed in the image above.

It probably sounds simple to design a manikin, but to find polymers which would give realistic chest recoil for both ventilation and chest compression was a challenge, the design went through over £100,000 of iterations before the final solution could be made.

David explains...“if we were going to make a ‘world first’ and apply for a patent, then I felt it appropriate to try and tackle another personal frustration that I had with traditional CPR manikins – most notably “spring assisted cpr”. Since the 1950s manikins had relied on springs or other unrealistic mechanisms to get the chest back to its original starting height, but this meant that those performing CPR were not learning to do a 50/50 duty cycle –50% of the time in compression and 50% of the time in relaxation- Berg et al 2010. I had concerns that the springs in manikins were recoiling so quickly that the chest was almost always ready to be compressed. This can lead to rescuers having bad habits such as leaning on the chest in the relaxation phase. ...or pushing downwards too quickly. There are many aspects where bad manikin design can lead to bad habits.”

As a self confessed geek, David goes on to explain... “there are researchers out there looking at novel duty cycles; Johnson et al writing in 2014 found that paramedics in the USA had a duty cycle of between 32 and 38%, (a short compression phase

and longer relaxation phase) far less than recommended. To me, this meant that manikins were not replicating the real world CPR, they were actually creating the exact opposite – longer compression phases than relaxation.

The Johnson study from 2014 on real patients was an eye opener for David, since older studies with mechanical chest compressors had shown a 50/60% duty cycle led to greater arterial blood flow, and his own experience with mechanical chest compression had reinforced this view.

So David and the team at *Lifecast* began to design a CPR manikin for the 21st century which did not rely on springs, but used the shape of the human chest to create the strength and recoil. This was achieved successfully. Testing was undertaken with the *Lucas Chest Compressor* and *Autopulse*.

AIRWAY AND VENTILATION DESIGN

Because the *Advanced Water Rescue Manikin* is based on an adult male manikin, the team at *Lifecast Body Simulation* had access to their own design of lifelike adult airway, which could be intubated, and had been used for the preceding 4 years of manikins sales- the team use the *EOLife Ventilation* monitor from the French company *ARCHEON* (ED: see this issue's **PRODUCT NEWS**) to set chest volumes and pressures for their manikins. So they were confident that airway and ventilation could both be addressed in design.



A total of seven prototypes were built and each was refined slightly prior to the torso (chest and head) of the manikin being given to the team

at Ruth Lee for them to design the robust floating / submerging outer body suit.

The team also used the pressure of water to close the lungs on the manikin, thereby allowing for learners to experience drowned manikins with or without pulmonary oedema. (See Picture above)

Once both the suit and torso had been built the team sought to test the manikin in extreme environments, for this phase we used the British military, and the venue of the Royal National Lifeboat Institution survival pool at their training headquarters in Poole, UK. We also joined Liz Baugh from Red Square Medical (a maritime medical education company) and the team from Viking Maritime Skills academy in Dover UK to do sea tests. We tested floatation and medical skills and set up a focus group of key stakeholders from the Military, HEMS Teams and UK Ambulance HART specialists.

Getting a manikin to float like a human being is a challenge and requires an understanding of a number of key scientific principles:

- Pure water has a specific gravity of 1.0 (it's a reference for all other stuff)
- If the specific gravity of the body is less than 1.0 the object/body floats (for the simple purpose of manikin design this was classed as Immersion)

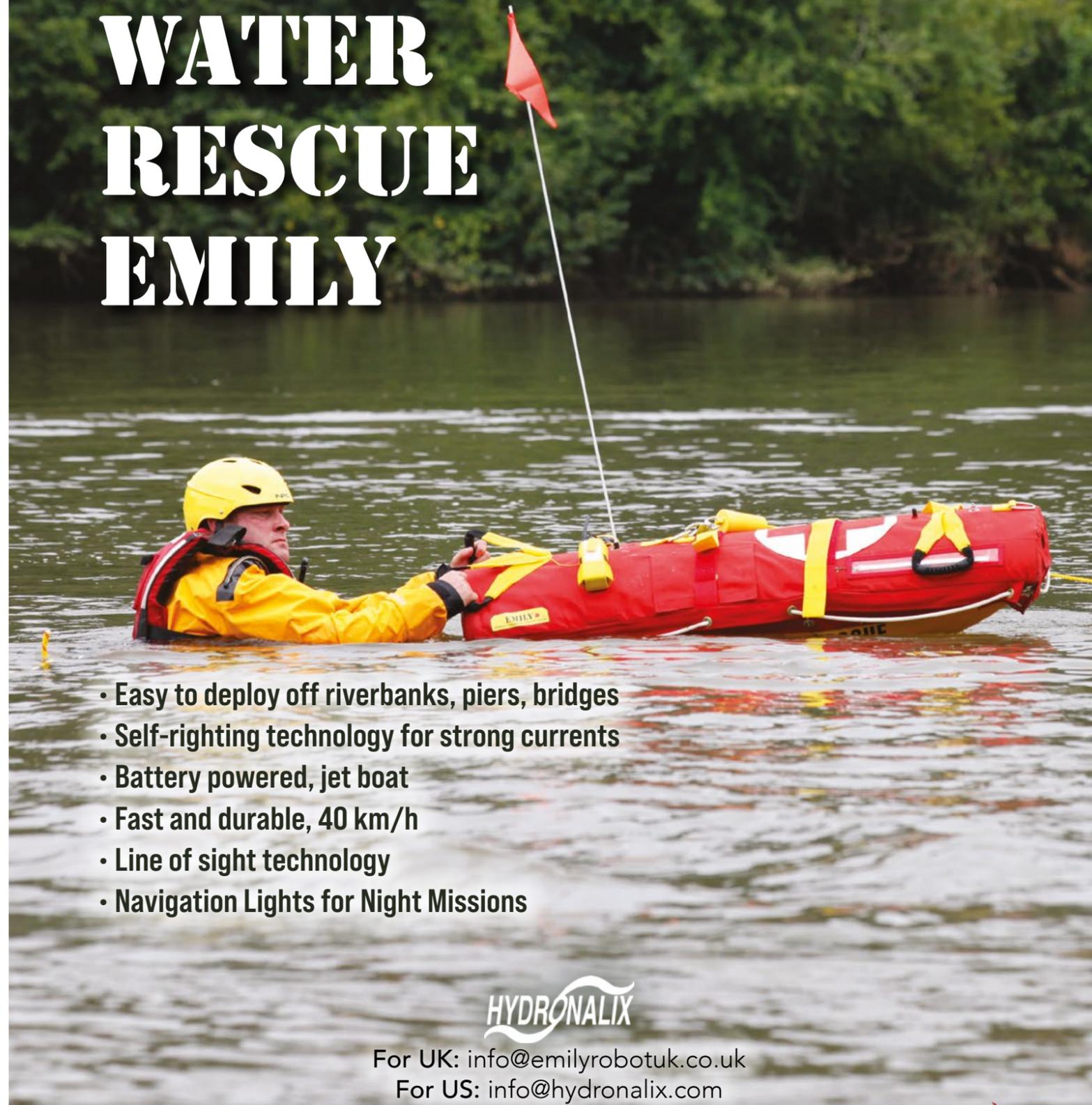
- If the specific gravity is greater than 1.0 the object/body sinks (for the simple purpose of manikin design this was classed as Submersion)
- If the specific gravity is @ 1.0 the object is suspended in the water, neither sinking or floating.

David Explains...“our plan at Lifecast and Ruth Lee was to make a manikin with a specific gravity of 0.98 the same as a human – which would just about float – but which could also have a few lead weights added to it – which would take the specific gravity to 1 and 1.1 (sinking).”

“We also needed to consider the way that people position themselves in the water when drowned. This positioning relates to a person's specific gravity and is related to how much muscle mass, fat (adipose tissue) & bone density that human individual has.”

- Adipose tissue has a specific gravity of less than 1.0 (Fat floats)
- Bone and muscle tissue have a specific gravity of greater than 1.0
- People with lots of muscle and heavy bone structure and/or with little body fat, do not float easily (SINKERS)
- Those with more body fat and less muscle usually float more easily.
- On average females have a higher body fat % 21-24% than males 15%-20%.
- Consequently females generally float more easily than males. Toddlers have a great deal of density compared with adults, and quite often sink.

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SCIENCE LESSON ALMOST OVER...

The Position of a body in the water is a bit more complicated as David Explains...“the team also needed to understand the affects of centre of mass & centre of buoyancy on a body to help the manikin react in the most realistic manner.”

a direct result of the *Advanced Water Rescue manikin*. The manikin is now being tested in other environments, working at height, vehicle rescue and confined space / mines rescue and TECHNICAL RESCUE will cover these area in a later article. The team have designed another member of the drowning manikin family – due for sale later this year.

CENTRE OF MASS is the point around which the body's mass is evenly distributed, for most people this is in the pelvic region.

CENTER OF BUOYANCY is the point around which the body's buoyancy is evenly distributed. (Affected by the lungs etc.) This can be seen when we try to float in a horizontal position, why do we have a hard time staying there? Because the centre of mass is located below the centre of buoyancy. Because of lungs upper body is relatively less dense compared to the lower body. A body will rotate until the centre of mass is below the centre of buoyancy, and due to momentum the legs continue moving down.



Once the manikin had been tested in the pool, and floated in a realistic manner the team from *Lifecast* and *Ruth Lee* were in a position to begin trials with military and Hazardous Area Response Teams from around the world.

Feedback has been outstanding, and many teams around the world have changed their working practices and policies as

- Links to Websites –
- <https://www.ruthlee.co.uk/manikins-dummies/advanced-water-rescue-manikin>
 - <https://www.lifecastbodysim.com>

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HOIST-CAPABLE CON-SPACE RESCUE STRETCHERS

For the purposes of this article we determine 'Confined-Space' to be taken literally in that it is the extremely limited space within a narrow tunnel or shaft, cave, collapsed structure or man-made structure like a wind turbine or ship. Technically a 'confined-space' is any enclosed area not intended for continual occupancy which could include a Russian salt mine with chambers the size of a small town. This is why so many mine-rescue stretchers and even some cave rescue stretchers like the Kong 911 series are modified but full size rigid baskets – they don't need to manoeuvre through small or tight spaces they just need to be tough and, for industrial sites, meet hazardous atmosphere (ignition) safety considerations. We have included a number of fully rigid stretchers that are specifically marketed as 'con-space' stretchers by virtue of the fact that they are much narrower than their standard size counterparts. But it has to be said that for the majority of 'confined-space' rescues, a regular basket or rigid frame stretcher as listed in our *GUIDE to Rigid Frame Stretchers* in issue 9 of *WILDERNESSAR* magazine, will do the job and models like the Titan-one piece are as light and tough as it gets. Size restriction could be in relation to height rather than width as in a collapse or an underfloor space in which case width of stretcher wouldn't be an issue. So, because this is a largely technical rescue readership with cross-discipline responsibilities, we have limited the stretchers in this GUIDE to those that can be used for raising and lowering in addition to dragging and carrying in the more confined of confined spaces. Incidentally, standards for stretchers can be oddly lacking in most countries, even the US NFPA only applies to certain applications. In Europe there is the *Medical Device Directive* which in the UK is changing in 2023 and means that some brands/models may not be available for use in future. However, UK and key brands will be covered and anything already in service can still be used until it wears out or reaches its end-of-life date. Some with full harness may meet a standard as a life-support harness rather than a stretcher. Bear in mind also that many of the stretchers in this GUIDE, particularly the rigid 'chairs', are NOT suitable for children unless a suitable packaging adjunct is used. In case you think we're plagiarising something you've read before, we've used some of the intro from WSAR#9's article.

There are 4 distinct types of con-space stretcher:

- 1) **RIGID BASKETS** which are metal frames in either one or two pieces and may have a plastic/glass fibre shell insert. One model, the Fastboard is half of a basket stretcher!
- 2) Rigid-base **PLATFORMS**, often with protective wings like the Petzl Nest which doesn't fold down and the Ferno Paraguard which does fold and pack down to a smaller size for easy transport to the casualty.
- 3) **ROLLED** sheets of thin plastic (mostly polyethylene) like the Sked, Rolly, Slix, and Saviour which roll into a small tube the width of the sheet and become rigid when formed longitudinally into a tube or semi-circle. Some are halved.
- 4) **HALF-LENGTH STRETCHERS, VESTS & SEATS** like the LSP, Specpack, Conrest and Skogar which provide excellent spinal and hoist packaging but while 'half' the size of a full length stretcher, rarely pack down to less than the deployed length so are on a par with rolled and folded platforms in terms of bulk. Some like the DragNlift right are a cross between a vest and a roll-up while Lyon's LSYNRAS (pic top).is a cross between a roll-up and a seat.



1) BASKET STRETCHERS

Traditional tubular metal construction is used to construct the strongest of all options, the basket stretcher or litter. This can be a one piece construction or a two piece which breaks apart or hinges in the middle making it easier to transport into a confined space. Generally speaking you wouldn't think of a full-length metal basket as the ideal kit for confined space rescue but its rigidity and strength can be a great asset and the models included here have modifications that make them more suitable to con-space – some are thinner than a regular stretcher like Ferno's *Pinnacle*, Junkin's *JSA 300 CS* and Spencer's *Dakota Light* while others are simply suitable for Con-Space by virtue of their existing design parameters or size like the Kohlbrand *UT2000*, SAR *Alpine* and Ultramedic *Ultramining* models remembering that a confined space is not necessarily restricted by width, it can just as easily be a seam or slit a mile wide but only inches high. All of these stretchers can negotiate uneven rocks and 90 degree edges without affecting the casualty though the open weave design does not lend itself to dragging over small rocks and gravel and would, in such cases, benefit from the addition of a full skid-sheet of polypropylene which is actually the same as many flexible roll-up stretchers that we'll come to shortly. The combination of the two however would generally be considered too bulky and cumbersome in a confined space rather than the wide-open snow fields its designed for. The FAST model shown at the top is a little unusual because it is a rigid half stretcher adapted with harness, strapping and accessories like float-tubes, protective leg shroud and ballistic protection to operate as a half-board-style stretcher. It even offers LED lighting around its perimeter rail, ingeniously simple.

All baskets/litters can be hoisted horizontally and vertically (with appropriately secure strapping) and offer excellent patient protection because they have a rigid frame all around including high sides but it's odd that the only 'confined space rescue' versions of conventional basket stretchers are the open weave metal frames – the addition of a plastic shell that we see in the Ferno 71, Junkin, Kong 911 or Spencer basket are only on full width models. Ferno's *Advantage* would perhaps have been an ideal Con-Space Stretcher had it been maintained in their range because it is narrow and the plastic shell offers protection from pooled water that is often found in horizontal tunnels/pipes. Indeed none of the confined space rescue stretchers in this GUIDE protect the casualty from water ingress unless there is the addition of capsule bag like the Kong, AlpDesign or Tyromont options.



images not to scale

2) RIGID PLATFORM

Where a basket stretcher has raised sides so that the casualty lays 'inside' of the stretcher, a rigid platform has the casualty laid on top. However in most cases like the Petzl NEST, Ferno Excel & Paraguard and AlpDesign's Speleo there are protective 'wings' that wrap around the casualty and provide environmental protection and security which is reinforced by the usual webbing straps for torso, and legs. Arms/hands can be placed inside the 'leg-wings' if required. Most have head protection/support either in the form of a 'hood' as in the Nest or forehead straps like the Excel and/or head blocks like the SpecPac and LSC 402. Some of these have been around as long as there have been stretchers and Ferno have more models than anyone with the Paraguard as perhaps the oldest professional rescue design still in existence. This has been updated of course with the Excel version (pic left) and the similar Res-Q-Mate both of which can have extension handles not usually associated with confined space rescue. Ferno's lighter Lifesaver model (above right), which is a variation on the venerable Neil Robinson sits between the roll-up model category and the rigid platforms. Two models that deserve special mention are the AlpDesign Speleo and the Petzl NEST. These have been specifically designed for cave rescue which of course lends itself perfectly to any urban-industrial confined space rescue. They are both true multi-role stretchers and although we used the original SKED for confined space rescue and then the Traverse/Vertical from when it was first introduced in Australia there is no doubt that we would have been trying to get our hands on the Nest or Speleo.. They are rigid platforms by virtue of optional removable reinforcing 'rods' in the case of the NEST (pic right) and a full length sheet of carbon-fibre composite of Kevlar and Bakelite plastic in the case of the Speleo (top



right). You can see from the Excel and Lifesaver stretchers how wings are incorporated into strapping to provide security and protection but the NEST and Speleo both take protective wings to a new level with full body protection from water and debris (though not ingress but the Speleo's integral sheet would likely provide as good a level of protection as you could get as it is similar to the kind of protective systems you get in Mountain/Heli Rescue stretcher 'Systems' where multiple separate components are used to create the finished stretcher

3) FLEXIBLE/ROLL- UP STRETCHERS

Together with basket stretchers/litters, this category provides the largest range of options and in fact, the GUIDE in WSAR#10 that prompted this GUIDE, features solely flexible and roll-up stretchers. The venerable Neil Robertson from 100 years ago with bamboo rigid inserts, and hemp/manilla rope and canvas that is a contaminant nightmare in the modern world is still sold for some reason and even has some modern competition despite its tendency to roll during extraction- must be a nostalgia thing! Others like Kingfisher's Xtract, modify that basic concept using a full-length specialised fabric and stiffened inserts for rope or winch operations. SKEDco were the first to produce a viable modern alternative roll-up stretcher in the late 70's with the iconic orange SKED and all others are a variation on that same theme using sheet polyethylene about



3mm thick give or take a mil. We used the SKED for 30 years and can certainly attest to its versatility and ability to endure abuse. However, like so many iconic designs, SKEDco probably sat on their laurels for too long and it remained a quite basic design that was ripe for improvement. In the early nineties, Brian Joplin of South Wales Cave Rescue and a fabricator friend of ours, GEMINI in Hampshire, UK, produced the first real alternative, the Cocoon stretcher (right) which replaced the SKED's circumferential lifting slings with grommets eyelets into which carabiners for a suspension bridle could be clipped. It had integral upper body spine reinforcement with head restraints, an adjustable webbing foot strap and its second version had colour-coded straps so was decades ahead of its time. It also had a metal spreader bar inside the shell at the head end for vertical raising/lowering instead of the Sked's tedious threading of rope. The spreader needed a bit of refining but this was a great stretcher and probably too well made at that time to be economically viable but it could hold its own against all of the modern variants. In the late nineties, Australian Steve Achilles's Vertical (pic above-right) further evolved the SKED design by shrouding it in a tough Cordura skin which enabled a full internal body harness with head straps to



be added together with six side handles and two vertical lift eyelets. This was also a design element of the more substantial, Welsh-made MIBS much favoured by the UK military in the 90s. Although we maintained SKEDs operationally, unless we needed the added strength of a rigid frame for which we used the Bell Tangents and a Bell Bariatric, the Vertical stretcher was, for us, better for rope & con-space rescue with lower bulk than the MIBS and more versatile than the Troll /SAR Products Evac shown overleaf (3M/Miller bought Troll so still sell the original Evac Body Splint [not included in this GUIDE].

The Heightec Chrysalis is also based on this original Dave Allport concept). The design of the Vertical and the Evac are largely unchanged today. **The downside with integral straps, and indeed any stitched element, is that they may not be detachable enough to decontaminate an important consideration in rescue today** but our trusty Vertical enabled us to slide the poly-sheet out via a Velcro end-closure and put the straps and cover in a washing machine! Fast forward to the noughties and onwards to more recent times and



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stretcher is loaded. This situation can arise when hot-loading a casualty from a ledge for instance and is a good reason why these roll-up stretchers are best loaded while on the ground or a firm surface. The other preventive measure is to insert a spine board. The reinforcement bars of some models overcomes this problem (check the integral spineboard column which, if coloured as a black square, indicates reinforcement but not necessarily full spinal protection without further measures).

Roll-up stretchers ALL benefit from being back-rolled as soon as you take them out of the storage bag – if you roll or bend them against the direction they were rolled in, the whole thing will lay flat on the ground rather than keep curling up. This Slix XL (pic right minus additional side panels for bariatric patients) shows the stretcher laid flat and also the range of grommet attachment eyes and colour-coded securing straps.

Task, Kohlbrat-Bunz and UltraMedic have all addressed a problem we regularly saw with roll ups; the constriction of the shoulders as the straps are loaded and pull the sides together with resultant occlusion of the brachial artery causing tingling, discomfort and loss of sensation (which is why it is always a good idea to use a rescuer as your casualty during training – get to feel what the patient feels). SKED now have a shoulder board accessory to alleviate this but Task (left) the RL range and UltraRoll models above incorporate transverse spreader bar inserts at the shoulders to stop constriction. The latter two are particularly well specified and also have pelvic and thoracic reinforcement bars. This problem is largely negated in the half-size stretchers we'll mention next, because they are often cut-away at the arms with no constriction (or protection).

For raising/lowering, roll-ups will often have either specified grommet reinforced eyes like the Slix 100 and RL3000 above, the UltraRoll (top) and the Saviour *Technical* (opposite top) with its noticeably lower 'freeboard', or like the SKED, a sling that

passes around the entire underside of the stretcher. In many ways, though cumbersome, this traditional head and foot-end sling support is more full-proof than eyelets cut into the PE sheet because even if the stretcher disintegrated, the casualty would still be supported. The disadvantage is that the slings are exposed to abrasion as they rub over surfaces and the ground and need to be regularly checked and replaced if damaged. Heightc modified this with their POD having webbing that passes under the casualty on the *inside* of the shell.

Vertical lift from the head-end is more common in confined-space rescue, in fact, it is virtually the only occasion that a vertical lift of an injured person can be justified. Our definition of 'vertical' for this article refers to the 80-90 degree orientation of the stretcher into a complete head-up, feet-down position as with the Ferno *XT-Pro* half-board model pictured on the right. This orientation is required to negotiate an opening or vertical tube/passage/cave that won't allow the stretcher to be raised in the preferred horizontal orientation. Vertical lift points for a head-up extraction may use the regular head-end attachment eyes or there may be a separate

attachment above the head to ensure that any straps don't end up being loaded across the casualty's face.

The original SKED had a rather cumbersome but nonetheless foolproof rope attachment that threaded through eyes along the entire body of the stretcher and terminated in a knotted support for the feet.



See later section on suspension for details of bridles and rigging but the next category of stretchers have become masters of vertical lift and rescue from extremely confined spaces.

4) HALF SIZE/HALF-BOARD & SEAT STRETCHERS

Perhaps the best choice for extreme confined spaces which require

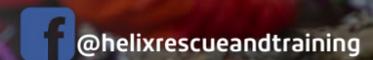


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Left-to-Right: Cresto Skopan, CMC/SKED Drag'n Lift, Ultramed Conrest, LSP-Miller, Slix-50, Ferno XT Pro, Tyromont Tyrol CS back-plate (exc stretcher harness), Kong Half Rolly & Task STR-H.
Below-Left: Yates/CMC SpecPac & F.A.S.T Fatsboard

vertical and horizontal hoisting/lowering are the models which package the upper-torso and head only, leaving the legs free to negotiate tight confines and bends. This category could be divided into rigid and roll-up as two distinct design variations. We have NOT included the many immobilisation devices like the KED and OSS which could be seen as one step removed from the half-board stretchers we HAVE included especially since Ferno sell a lifting bridle for the KED but this is presumable for short duration raising/lowering with limited exposure to fall from height. The differences are in the complexity and security of the strapping with half-stretchers like the

LSP and the Spec-Pac having full-suspension hardware and handles whereas an extrication device and most drag 'stretchers' use plastic and Velcro patient restraint straps and buckles to enable simple lifting and shifting from, for instance a car crash, to a properly configured stretcher or ambulance trolley. In the absence of anything else, an extrication device would certainly help in manoeuvring a casualty within and from a confined space but it would be more makeshift than dedicated to the task and couldn't safely be used for vertical lift/lowering unlike the models in this GUIDE. The LSP-Miller was perhaps the first model to take an extrication 'vest' and make it into very capable vertical hoisting/lowering with full strength webbing and hardware and lifting points incorporated into a rigid backboard. It took a

while for others to follow the LSP's lead but we did eventually get some quite sophisticated half-board models like the Spec-Pac by Yates/CMC and latterly Ferno's XT-Pro and Ultramedic/SKYLOTEC's Conrest. Unique in this selection is the Fastboard, a half-basket stretcher designed to scoop and package a casualty inside a minute with pre-positioned webbing and

a single – pull-to-tension and secure harness system, There are also enhanced versions of the more basic metal seats like Cresto's Skopan and the Telson which use an angled seat to better support the casualty during vertical extraction but this is impractical for traditional horizontal carrying so the other half-boards shown here, use wide, padded leg loops which work in vertical and horizontal orientation.

The Drag'n Lift that features as the main picture on our title page is a Sked/CMC collaboration is a half-sized roll-up (a variation of their basic Drag-stretcher below) with enhanced strapping to enable hoisting. It's not alone in adopting this enhancement of the most basic roll-up drag-stretchers; the Slix-50, Task STR-H and Kong Rolly are also half-sized roll-up stretchers with enhanced strapping and safety features.

DRAG-ONLY STRETCHERS

Some high-spec roll-ups like the Saviour Tactical, Slix RR and SKED-Drag and Evac-Pro are drag and carry-only, NOT lift capable and are therefore not included in this GUIDE but they do everything you might want a con-space stretcher to do. The most basic 'drag-stretchers' have limited means to secure the casualty for a complex extraction beyond transverse straps and maybe leg straps; they are simply a means of dragging and carrying a casualty for short distances quickly from a place of danger to a place of safety Compare the SKED-Drag on the right with the Drag n'Lift top-left with red and blue lifting straps and metal d-rings. Since dragging is a common part of any protracted rescue many full-spec rescue stretchers incorporate a drag handle as seen here in the Conrest, Tyromont CS and Kong Half Rolly above.. Some drag-only mats are quite complex and full length like the Albumat but this too uses Velcro securing so it is suitable for dragging or carrying down stairs and across grass and tarmac but not rocks or rubble or high angles. One or two like the Xtract stretchers are unusual because they have the low bulk and rapid deployment of a drag stretcher and easy to get into tight spaces to package the casualty but are also capable of being hoisted and have a float option. The ability to fold, roll or pack down small for entry is



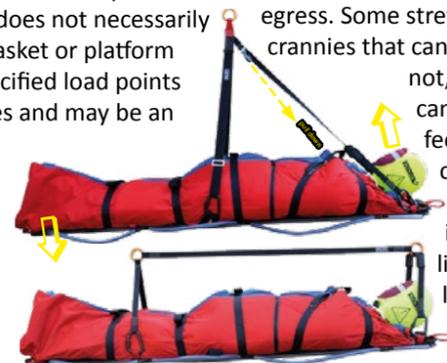
an important consideration for some types of rescue but it is wise to remember that your ease of entry and access with a packed stretcher is radically different to exiting with a deployed stretcher. Some might argue that if they take in a full length stretcher even with the access hassles, they at least know that it will fit all of the tightest spaces during egress. The full length SKED for instance rolls down into a cylindrical bag with external pockets which is about 92x23cm /9" x 36".

VACUUM MATTRESSES

We haven't included vacuum mattresses even though some perform a very capable job in a confined space. They would nearly always need some form of reinforcing to be suitable for full rope suspension and should they be punctured, all support integrity is lost. A three-day rescue of a caver in South Wales in Autumn 2021 utilised a vacuum mattress on the outside of a rigid board/stretcher because it provides excellent insulation and protection and it was dragged over some pretty rough terrain showing how resilient these things are. But again they can't be used for a hoisting unless reinforced. Some otherwise excellent multi-role stretchers like Kohlunz'e RED, Tyromont's Tyroll (not to be confused with the very different Tyroll CS in this GUIDE), Ferno's Sauerbag3 and Kong's Everest are really a system of components that combine to become an excellent all-purpose stretcher rather than being a stand-alone rescue stretcher and these are often quite bulky so are geared more towards mountain and helicopter rescue than confined spaces.

SUSPENSION, HORIZONTAL & VERTICAL LIFT

For rope and winching operations you have to be very careful to ONLY use the specified lift points – this does not necessarily mean a handle or, in the case of a metal basket or platform stretcher, anywhere along the top rail. Specified load points may be required because of the load angles and may be an isolated section of rail (Isolated Rail Eye in our tables) or an obvious eye, perhaps with a reinforced grommet or an extra reinforced weld-point on metal baskets. For horizontal lift these will be located at the strongest part of a stretcher to rule



out folding or buckling under load; roughly the ¼- ¾ length points at the shoulders to mid torso area and the lower leg to thigh area. Most of the weight is in the head and torso so you will see the roll-up stretchers in particular concentrating their load points in the upper half of the stretcher while half-boards are obviously ONLY loaded at the head and torso. Rarely, will a stretcher have horizontal suspension points at the obvious extremities – head and foot.

BRIDLES AND SUSPENSION-POINTS

The various bridles and lift-strap options are discussed in depth in the article in WSAR#9 which is available free via our website. Here, we shall simply mention that for confined space rescue it is very useful to have a means of changing the orientation of your stretcher from horizontal to vertical in order to negotiate tight entry or egress points. This is best achieved with a bridle system like the one below that allows you to take in the tail of an adjustable sling to raise the head or with a separate mini-pulley system from the head to the collection point. You will need to ensure that any strapping can be easily secured when not in use so that it does not represent a snag hazard during egress. Some stretcher have pouches or nooks and crannies that can keep straps out of the way but if not, use some small tackle bags that can be safely stowed by the patient's feet or next to the O2 cylinder. Before we leave attachment points though, it's worth mentioning control lines and tag-lines.



limit the exposure of carabiners by placing inside the frame where possible and face gates inwards towards the casualty



MARKET GUIDE

These are ropes connected to the head and or foot-end of a stretcher to assist in positioning and direction of lift during a raising or winching operation or on a tyrolean. In general a tag-line is for orientation, positioning and obstacle negotiation while a control line maintains a constant lowering speed and/or braking action in a more horizontal plane such as a tensioned diagonal/tyrolean traverse.

HELICOPTER-USE

It's not often the case that a winch operation is required following a con-space rescue but it could be, especially from on-board a ship so you need to ensure that your stretcher is heli-compatible. LSC's 402 models (left) and Zero Height's Heli (right) are, despite their 'light' appearance, true multi-role stretchers that hoist, float (with adjuncts), slide and can get into pretty narrow spaces which is why the 402 is favoured by so many US helicopter crews. Any stretcher's aerodynamics can be altered by the way you package your casualty so even those listed in this GUIDE as Heli-compatible may be affected by rotor-wash and rotor-spin under certain conditions. What is vitally important is that only the bridles and accessories specifically made for your heli-stretcher are used – **there should be no mix and matching of slings and components from other manufacturers when it come to heli-ops.** Interestingly Peter Bell's early work with the RAF seemed to indicate that a slight tilt to head up reduced spin as it shed air more readily.



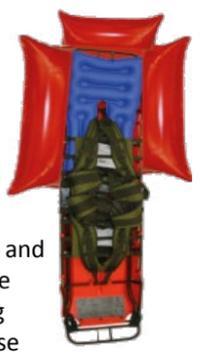
ENVIRONMENTAL PROTECTION

In most urban-industrial confined spaces, environmental protection is not quite so essential as it is in mountain and cave rescue where cold, winds and running water can conspire to kill off your casualty just as surely as the original injury. That's not to say that thermal protection in particular may not still be an essential component of your casualty packaging just that the measures can be less extensive than is required 6000m up a mountain. You may for instance wish to add a Thermo-Rest style self-inflating mattress to your stretcher accessories because it also doubles as water flotation. For the ultimate protection, Kong have an all-encompassing capsule (right) which seals like a drysuit and has a clear face shield with breathing valve.



HEAD GUARDS/FACE SHIELDS

The Kong Capsule is perfect for complete head-to toe protection from cold-water inundation but there are simpler options for head-protection like the Kong Visor (above) which attaches to their optional head-foam/cervical management system. Being strapped to a stretcher face up to negotiate a vertical face is a very scary prospect with very real dangers from falling dirt and debris. In the old days a pair of glasses or goggles were the minimalist approach but CMC broke the mould when they introduced their comprehensively protective clear Lexan Litter-Shield shown on the right in its alternative, larger, taller format that will fit most basket stretchers, not just CMC's. This thing is as good today as it was when it was introduced in the 80s able to deflect sizeable chunks of debris that might defeat lighter-weight counter-measures. Indeed Jim Frank says he knows of at least two saves from rockfall thanks to this Lexan Shield. Not cheap at \$470 but a lot cheaper than a new face! Similarly the MacInnes cover by Lyon (pic right) uses adherence to the EN Mountaineering Impact standards as the basis for design. This degree of solid protection might be bulky to store and carry were it not for the fact that both designs can simply flip over the end of the stretcher for patient access and during transport or invert inside the stretcher for storing. The simplest face visor options including Kohlbratt's build-your-own flatpack model, store flat until formed into a sturdy plastic dome or curve. Some head immobilisation measures provide a limited degree of face-protection and are shown as ● indicating partial protection. (As a side-note, a variation of the usual head immobilisation measures is LSP's Helmet Immobiliser (right) with an extended, elastic top section).

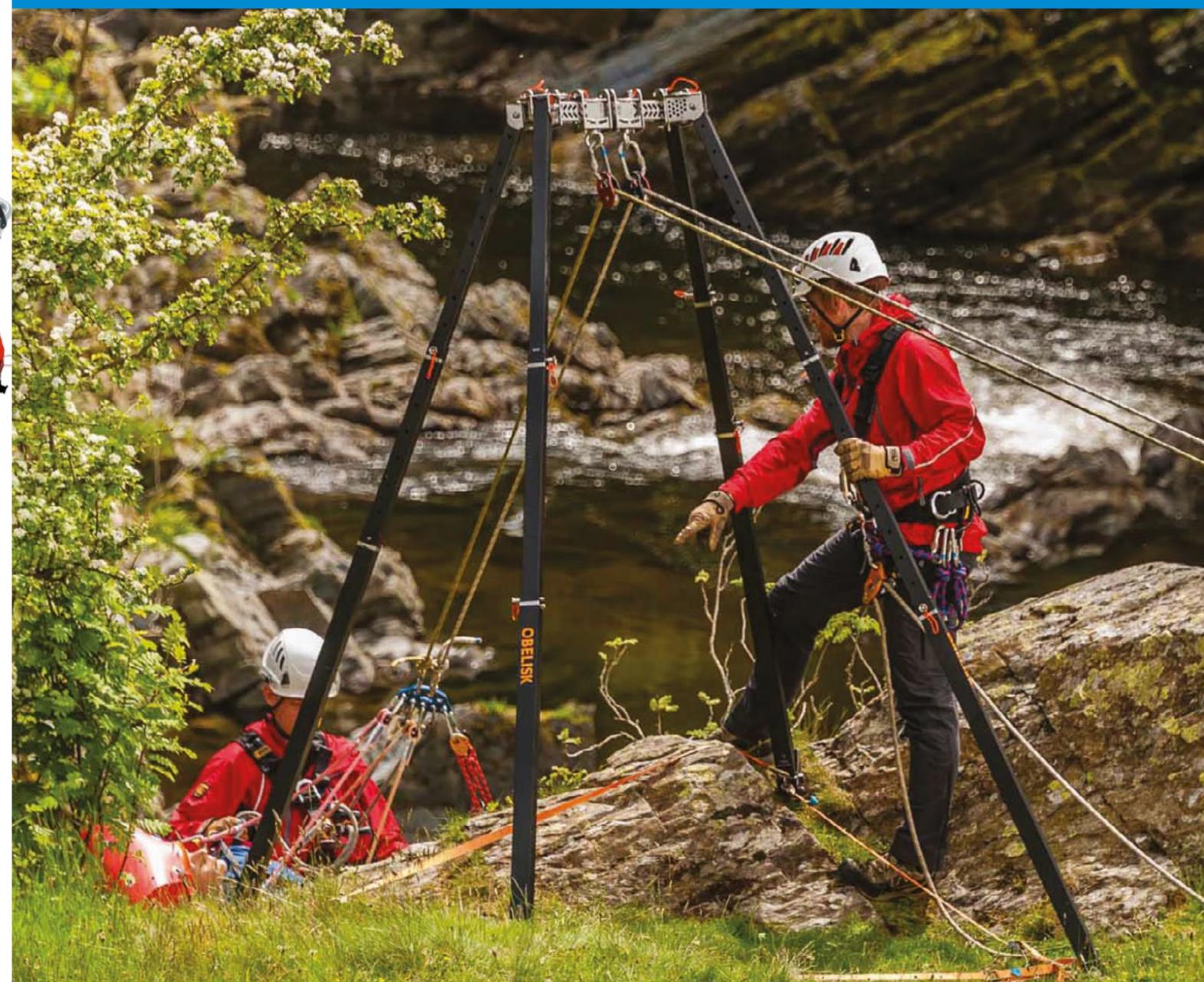


FLOTATION

Strapping a casualty into a stretcher when in or near water is a tricky decision because, with just a few exceptions, most of these stretchers will either sink like a stone or at best, remain on the edge of being neutrally buoyant so will require additional flotation in order to function safely in water or, in this case, flooded tunnels. They can be quite fiddly to fit so don't expect to rock up and deploy within a couple of minutes like water rescue teams might with pre-rigged systems. Pre-planning is necessary. Where available as an option, most use round float tubes that strap around the outside of the frame and/or have a 'thorax' pad to help float the heavy upper body. The UT200 above has foam-tube options but also offers these inflatable supports for those operating in confined spaces who don't have room for 6 cubic feet of solid foam. The UT2000 also offers an inflatable upper body 'lilo' for enhanced buoyancy at the vital head-end also providing warmth and protection as mentioned earlier with the Thermo-Rest mattress.

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IN THE FOLLOWING TABLES.....

Any use, feature, accessory or component that is inherent in the stretcher 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.

NB: we have previously used a diamond ♦ to indicate this in our GUIDES but felt a diamond ♦ was better used to show which stretchers were tapered. ALL of these stretchers can be used for short-duration carry-out with varying degrees of casualty comfort and rescuer convenience so **Long Range (LR) Carry-Out** is a separate category. Rope rescue is a feature of ALL of these stretchers but load capacity varies with only the EvacPro+ specifically designed for bariatric casualties.

ORIGIN: The 'manufacturer's country, not necessarily the country of manufacture indicated by an inset flag.

COST: a rough guide only – **includes** local taxes/VAT. Varies with exchange rates, extra taxes etc. We usually round up to the nearest Pound£/US Dollar\$/Euro€. Cost is for basic model with included accessories indicated by a solid square in the appropriate column (optional extras being an outline square).

STRETCHER TYPE

FLAT-FOLDABLE: A flat-topped stretcher with a rigid base that folds for storage. Usually has integrated straps and/or enveloping flexible 'wings' which encapsulate or partially encapsulate the casualty.

FLAT-ROLL-UP: A flexible flat sheet that rolls into a tube for storage – most halve in length for storage but some, like the Petzl Nest, halve in width.

HALF-SIZE ONLY: Half-length stretchers, seats or extrication vests with lift-capability. Some also indicated in the ROLL-UP column.

BASKET: a basin shaped stretcher with raised sides that help retain the casualty within it. May be an open weave frame of tubular metal (or carbon-fibre) or it may be a solid shell, usually some form of plastic, supported by a tubular metal frame.

RIGID: Is for stretchers that are fully rigid but are not baskets – usually a half board or platform.

SPLIT: SPLIT Refers to a two-piece stretcher that divides into two separate halves which can be carried by one or two people. Some hinge as well as splitting. Most have the provision of a ruck-sack style harness or suitably equipped carry bag which implies it can be carried by one person but some are better divided between two persons.

STRETCHER ATTRIBUTES:

TAPERED ♦ RECTANGULAR ■ The general shape. Tapered means it narrows significantly towards the leg end.

CERTIFIED: Not necessarily a specific standard as a stretcher but meets the more generic Medical Device Directives in the UK/EU and/or USA/Canada

WEIGHT: does not include bag and other options

DESIGN LOAD & MBS: Design load is the weight of person that is intended to use the stretcher akin to Working Load Limit. This may be further defined by horizontal and vertical weight limits. Minimum Breaking Strength/Load – **MBS** (in burnt orange) is generally 10 or 15 times higher than the WLL.

DIMENSIONS: Length by width with some showing a depth/height from ground. Some widths will be the sheet material opened out rather than the width of the stretcher when it is formed. Some half-size models may be wider than they are long. The stored dimensions may be the bag rather than the rolled stretcher which can be rolled tight at half the bag width.

MATERIALS: FRAME – In the case of roll-ups the main sheet material is often High/Med/Low Density Polyethylene or HDPE/

MDPE/LDPE. The **BASE LINER** or padding may not be present in rolled-sheet stretchers or may be an option in some baskets which is further indicated in the **PADDED BASE MAT** column.
SUSPENSION POINTS – indicates the number and type of specific attachments for horizontal and vertical raising/lowering. This is NOT the same as the handles/hand-holds unless indicated.

USES & FEATURES:

HORIZONTAL RAISE: Can be suspended on rope/winch cable in horizontal/prone orientation. Does NOT refer to hand-carry

VERTICAL RAISE: Suspends in head-up/standing posture

HELICOPTER: Stretcher is approved for use in/from helicopters in its own country.

SKIDS/REINFORCED: The ability to slide over hard surfaces without compressing the stretcher and adversely impacting the casualty. Some have skids, others have rigid inserts

LR GROUND-CARRY: LONG RANGE Ground Carry able to be carried for long distances over mixed terrain. Allows multi-rescuer carry. Has wide, comfortable handles. Supports and protects the casualty when slid over rocks/railings etc.

WATER-CAPABLE ■=Inherently buoyant stretcher or flotation is included in the price quoted. □=Optional flotation from the same manufacturer as the stretcher

EXTREME CONFINED SPACE: Narrow enough to be used for confined spaces and in **EXTREMELY** small spaces.

BARIATRIC: Only one model is specifically designed for bariatric but confined-space rescue by definition will hopefully preclude the largest of bariatric patients. Some may fit a very large casualty but need to be strong enough to hoist. This is indicated by a circle ● or a bariatric option in this range but not intended for conn-space rescue is indicated by □

HEAD IMMOBILISATION: Neck and head immobilisation measures but **NOT** the full protection of a cervical collar.

SPINE IMMOBILISATION: Usually a half-board covering the spine area from head to waist as an integral component. Some have reinforcing or a rigid base that resists bending but is **NOT** considered to be definitive spinal protection unless it is a specifically certified adjunct so is indicated by a circle ●.

FACE GUARD: A universal face/head guard will fit any stretcher in this GUIDE so this refers to the manufacturer's specifically supplied head/face-guard if one is available.

WEATHER PROTECTION: waterproof and/or heat-retaining cover

ADJUSTABLE FIXED LENGTH BRIDLE: A set of straps connecting harness lift points to a central collection point. Often called a bridle for horizontal lift and a yoke for vertical lift.

Adjustable straps shown as ■ or □ if it's an option.

Fixed length straps = ■ or □ if it's an option.

INTEGRAL BODY HARNESS: Enhanced strapping that restrains or wraps the foot, shoulders/chest, waist and thighs (leg-loops). Not simply transverse straps crossed over the chest. Femoral and shoulder straps are often padded in a full body harness.

EXTENSION HANDLES: are carry handles that fix to the frame but rarely used in Con-space rescue except for walk-in/walk-out.

COLOUR-CODED STRAPS: Straps are coloured in pairs to ensure correct connections especially of the body/foot harness. The integrity of semi circular roll-ups can be dependant on correct alignment of straps. Some have partial colouring with the foot and or chest straps coloured differently.

FOOT-PLATE/SUPPORT: a rigid foot plate or separate web-support strap or rope – often as a figure 8.

PADDED BASE MAT: between the casualty and the stretcher and always waterproof to allow easy cleaning of body-fluids

CARRY BAG/RUCKSACK: Protective cover, often with back-straps

COLOUR: Primary colour of shell/frame with an outline secondary colour to indicate trim colour.

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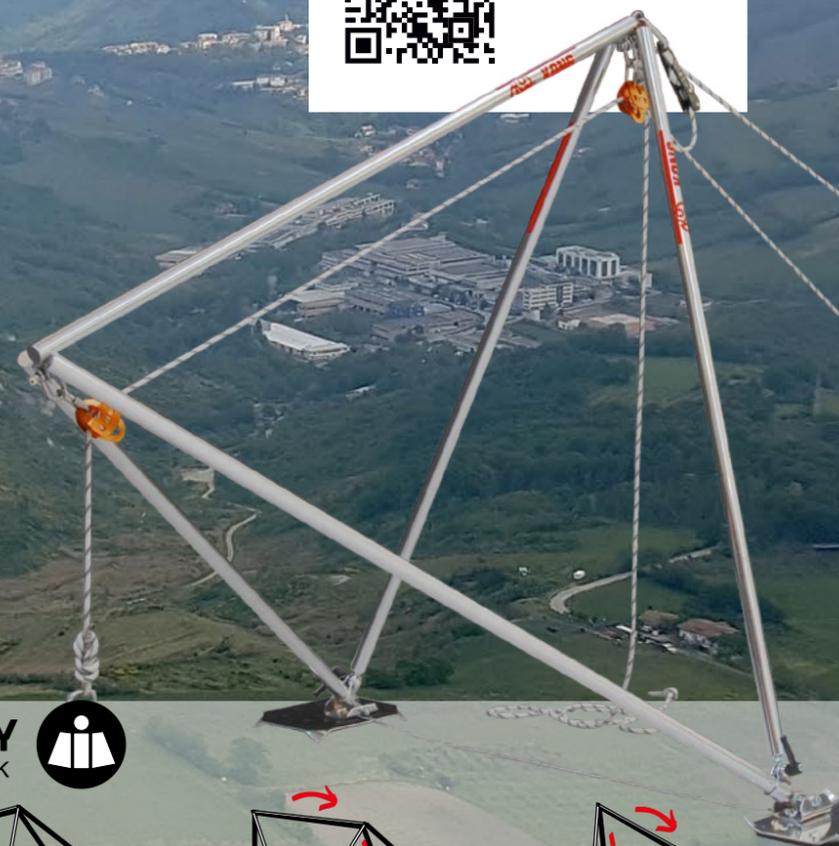
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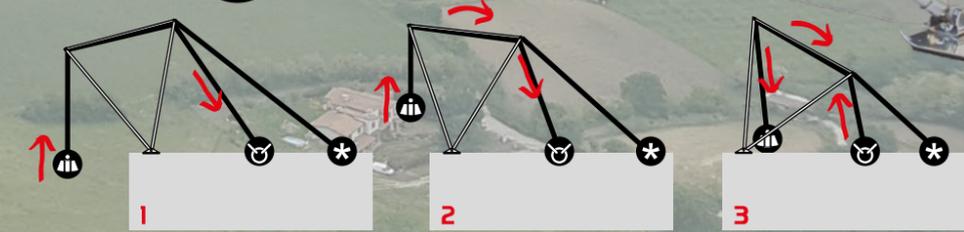




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IMAGES NOT TO SCALE	MODEL	COMPANY	ORIGIN	COST inc tax / VAT	FLAT- FOLD ABLE	FLAT- ROLL-UP	HALF-SIZE ONLY	BASKET/RIGID/SPLIT	TAPERED RECTANGULAR	CERTIFIED EU/UK USA	WEIGHT	DESIGN LOAD Hrztl/Vertical MBS	DIMENSIONS L x Wx H/D SPLIT/ROLLED LENGTH (longest section)	MATERIALS: FRAME BASE/LINER SUSPENSION POINTS	HORIZONTAL RAISE	VERTICAL RAISE	HELIX-WINCH	SKIDS/REINFORCED	LR GROUND-CARRY	IN-WATER-CAPABLE	EXTREMECONSPACE	BARIATRIC	HEAD IMMOBILISATION	SPINE IMMOBILISATION	FACE GUARD	WEATHER PROTECTION	BRIDLE ADJUSTABLE	BRIDLE FIXED LENGTH	BODY HARNESS	COLOUR-CODED STRAPS	FOOT-PLATE/SUPPORT	PADDED BASE / MAT	CARRY BAG/RUCKSACK	COLOUR OPTIONS	NOTES	WWW.					
																																					USE				
	Fladdermus FS34108	FALLSAFE		€412	-	■	-	-	■	■	6kg 13.2 lb	140kg 308 lb	200x50x30cm 79x20x12" 92x30cm 36x12"	HDPE 8 Grommet eyes	■	■	-	-	-	-	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	* fits with the Fallsafe Bo immobilisation vest/ stretcher	fallsafe-online.com				
	Fastboard	F.A.S.T Rescue Solutions		\$2450	-	-	■	■	■	■	10kg 22 lbs	25kN 2549 lbf	115x46x12cm 45x18x4.5"	Polyethylene 5 Lift-capable hand holds	■	■	-	■	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	Also available in white and with LED lights around inside of top rail.	fastrescuesolutions.com		
	Res-Q-Mate	FERNO		\$2800	■	-	-	■	■	■	17.5kg 38.5 lb	180kg 397 lb	185x28x10cm 73x11x4" 100x28cm 39.5x11"	Stainless Steel PVC 4 Web Eyes	■	■	■	-	■	-	■	●	-	■	■	■	■	■	■	■	■	■	■	■	■	■	Extension handles	ferno.com			
	Paraguard Excel	FERNO		£1950 \$2500	■	-	-	■	■	■	11.5kg 18 lb	136kg 300 lb	182x27x7.5cm 71.6x10.6x2.9" 104x27cm 41x11"	Aluminium PVC 4 Stainless D-rings	■	■	■	●	-	-	■	●	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ferno.com	
	Lifesaver	FERNO		\$900	-	■	-	■	◆	■	6.5kg 14.3 lb	160kg 350 lb	153x104/40x3cm 60x41/16x1"	Plastic Rib Inserts Ballistic Nylon/ PVC 2 metal Rings	■	■	-	■	-	-	■	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	ferno.com		
	Neil Robinson	FERNO		£530	-	■	-	●	◆	-	8kg 17.6 lb	136kg 300 lb	153x100x4cm 60x40x1.5" 150x18cm 60x7"	Bamboo Rib Inserts Treated Cotton 2 metal Rings	●	■	-	●	●	-	■	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	A classic design using traditional materials. Archaic but functional. Available in 2 lengths	ferno.com		
	XT-Pro*	FERNO		£750 \$850 €870	-	-	■	■	■	■	3.4kg 7.5 lb	160kg 352.7 lb	83x30x6cm 32.7x11.8"	Carbon Fibre 4 Web eyes 1 Head strap	■	■	■	■	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*XT- std version excludes hoist capability but can be upgraded inc floats	ferno.com			
	POD MS02	HEIGHTEC		£958	-	■	-	-	◆	■	9.5kg 21 lb	140kg 308 lb	220x90cm 87x35.4" 90x20cm 35.4x8"	LDPE 6 Grommet Eyes	■	■	-	-	-	-	■	-	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	heightec.com		
	Chrysalis	HEIGHTEC		£1158	-	■	-	-	◆	■	8.65kg 19 lb	260kg 572 lb	215x79cm 85x31" 79x22cm 31x7"	Nylon/Polyester PVC 6 Handholds for lift straps	■	■	-	-	-	-	■	●	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	heightec.com	
	Telson	HEIGHTEC		£1536	-	-	■	■	■	■	7kg 15.4 lb	140kg 308 lb	114x38x25cm 45x15x10"	Stainless Steel Foam 10 Lift-capable hand-holds	■	■	-	■	-	-	■	-	■	●	■	■	■	■	■	■	■	■	■	■	■	■	■	■	heightec.com		
	JSA300-CS	JUNKIN SAFETY		£430 \$409	-	-	-	■	■	-	10.4kg 23 lb	681kg 1500 lb	204x46.7x20cm 80.5x18.4x7.75"	5/8" top rail Steel Steel Mesh 8 Captive Rail Eyes	■	■	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	junkinsafety.com	
	UT 2000	KOHLBRAT & BUNZ		£2432	■	-	-	■	■	■	8kg 17.6 lb	160kg 352 lb	180-200*x44x12cm 71-79*x17.3x4.4" 94-104*cm/37-41"	Aluminium Plastic* All Top&Lower Rail	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	*Shell can be removed *Length with frame extenders. Extension handles option	kohlbrat-bunz.com lyonequipment.co.uk
	RollUP RL1000 RL2000	KOHLBRAT & BUNZ		£875 £1660 \$2295 €1985	-	■	-	-	◆	■	7.6 to 9.6kg 16.7 to 21.1 lb	150kg 330 lb 600kg 1320 lb	248x92cm 98x36" 92x27cm 36x11"	HDPE 30 Grommet eyes	■	■	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	■	length adjustable head and foot ends. Option of Cobra, manual feed & plastic quick release buckles. Numerous handle, strap and stiffener supports	kohlbrat-bunz.com lyonequipment.co.uk	

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IMAGES NOT TO SCALE	MODEL	COMPANY	ORIGIN	COST inc tax / VAT	FLAT- FOLD ABLE	FLAT- ROLL-UP	HALF-SIZE ONLY	BASKET/RIGID/SPLIT	TAPERED RECTANGULAR	CERTIFIED EU/UK USA	WEIGHT	DESIGN LOAD Hrztl/Vertical MBS	DIMENSIONS L x Wx H/D SPLIT/ROLLED LENGTH (longest section)	MATERIALS: FRAME BASE/LINER SUSPENSION POINTS	HORIZONTAL RAISE	VERTICAL RAISE	HELIX-WINCH	SKIDS/REINFORCED	LR GROUND-CARRY	IN-WATER-CAPABLE	EXTREMECONSPACE	BARIATRIC	HEAD IMMOBILISATION	SPINE IMMOBILISATION	FACE GUARD	WEATHER PROTECTION	BRIDLE ADJUSTABLE	BRIDLE FIXED LENGTH	BODY HARNESS	COLOUR-CODED STRAPS	FOOT-PLATE/SUPPORT	PADDED BASE /MAT	CARRY BAG/RUCKSACK	COLOUR OPTIONS	NOTES	WWW.		
																																					USES	
	Total	SPENCER		€530	-	■	-	◆	■		6kg* 13.2 lb	200kg 440 lb	243x92x3cm 96x36.2x1.2" 95x38cm 37.4x15"	HDPE 10 Web slots inc 4 for lifting slings 18 grommet eyes for head rope*	■	■	-	-	-	-	■	□	■	■	■	■	■	■	■	■	■	■	■	■	■	*weight excludes rope and straps. *Rope fed thru round eye to create anchor eyes at head and foot	spencer.it	
	STR Wind	TASK		\$825	-	■	-	◆	-		9.2kg 20.25 lb	120kg 265 lb	200x90x0.5cm 78x36x0.25" 90x25cm 35x10"	HDPE Foam pad 12 Web eyes 1 Head strap + D-ring	■	■	-	■	●	-	■	-	■	□	■	■	■	■	■	■	■	■	■	■	■	■	anti-constriction shoulder bar	task.br
	STR Plus II	TASK		\$950	-	■	-	◆	-		11.2kg 24.6 lb	120kg 265 lb	240x90x0.5cm 95x36x0.25" 90x32cm 35x12.5"	HDPE Foam pad 12 Web eyes 1 Head strap + D-ring	■	■	■	■	●	-	■	●	■	□	■	■	■	■	■	■	■	■	■	■	■	■	anti-constriction shoulder bar	task.br
	H-STR-II	TASK		\$750	-	■	■	◆	-		6.7kg 14.75 lb	120kg 265 lb	120x82x0.5cm 47x32.5x0.25" 90x20cm 35x8"	HDPE 10 Web eyes	■	■	-	●	●	-	■	●	■	□	■	■	■	■	■	■	■	■	■	■	■	■	anti-constriction shoulder bar	task.br
	Gazelle Con-Space 0107	TRAVERSE/ FERNO		£363 \$475	-	-	-	■	■	■	14kg 31 lb	408kg 900 lb	210x46.4x18cm 82.5x18.25x7"	Carbon-Steel HDPE Mesh 8 Captive Rail Eyes	■	■	■	■	■	■	■	■	-	-	-	■	■	■	■	■	■	■	■	■	■	ideal commercial/ training stretcher	traverserescue.ca	
	TRS/VRS 19-0100/SL TRA19-0100	TRAVERSE/ FERNO		£1186 \$982 €2125	-	■	-	◆	■	■	8kg 18 lb	250/350kg 550/771 lb	202x84cm 79.5x33" 84x25cm 33x10"	MDPE Cordura 3 Web eyes + 7 independently lift-rated handles	■	■	■	-	●	■	■	-	-	-	■	■	■	■	■	■	■	■	■	■	■	■		traverserescue.ca
	Titan Pinnacle Con-Space 11-4000/0153254	TRAVERSE/ FERNO		£1082 \$750	-	-	-	■	■	■	6.5kg 14.3 lb	408kg 900 lb	209.5x48.3x18cm 83.5x19x7.25"	25mm/1" top rail Titanium HDPE mesh 4 Strat-points	■	■	■	■	■	■	■	-	■	-	-	■	■	■	■	■	■	■	■	■	■		traverserescue.ca	
	Titan Pinnacle Split Con-Space 11-4001/0153255	TRAVERSE/ FERNO		£1282 \$1335	-	-	-	■	■	■	7.5kg 16.5 lb	408kg 900 lb	209.5x49.5x19cm 83.5x19.5 x7.7" 106.7x49.5cm 42x19.5"	25mm/1" top rail Titanium HDPE mesh 4 Strat-points	■	■	■	■	■	■	■	-	■	-	-	■	■	■	■	■	■	■	■	■	■		traverserescue.ca	
	Tyroll CS	TYROMONT		€1500	-	■	■	◆	■	■	7.1kg 15.6 lb	150kg 330 lb	107x32cm 42x13"	Polyethylene/ Carbon Fibre Cordura/PVC 3 web eyes*	■	●	-	■	-	-	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	*Top handle is drag-only	tyromont.com	
	Conrest SAN9100	ULTRAMEDIC/ SKYLOTEC		£1950 €1965	-	-	■	■	■	■	8/9.1*kg 17.6/20lb	150kg 331 lb	102x24x8cm 40x9.4x3"	Aluminium Polyester 5 handle/eyes	■	■	-	■	-	-	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	The orange straps in this image are the chest harness <i>not</i> lift bridle. *Optional separate foot-support	ultramedic.de	
	UltraRoll SAN-9000 SAN9001	ULTRAMEDIC		£1396 €1180*	-	■	-	◆	■	■	7.3kg 16 lb	300kg 660 lb	254x92x30cm 100x36x12" 92x27cm 36x11"	HDPE 30 Grommet eyes	■	■	■	■	■	■	■	-	■	-	■	■	■	■	■	■	■	■	■	■	■	*Specific to Bell UH-1D / NH90/Sea King Mk. 41 *Military version €1380 *Shoulder, thoracic and pelvic rigid supports	ultramedic.de	
	UltraMining	ULTRAMEDIC		€2010	-	-	-	■	■	■	20kg 44 lb	200kg 441 lb	200x55x30cm 78.7x21.6x11.8"	V2A Stainless Steel 6 Handle/Rail Eyes	■	■	■	■	●	-	■	-	■	■	■	■	■	■	■	■	■	■	■	■	■	■		ultramedic.de
	Heli RHOOWA	ZERO HEIGHT SAFETY		£1715	■	-	-	■	-	■	6.2kg 13.6 lb	300kg 660 lb 5kN	195x40x10cm 90x40x15cm	Aluminium Polyester/Canvas 4 Metal D-rings on fixed straps	■	■	■	-	-	-	■	-	■	-	■	■	■	■	■	■	■	■	■	■	■	Zero also has close copy of the SKED which we have not included	zeroheightsafety.com	

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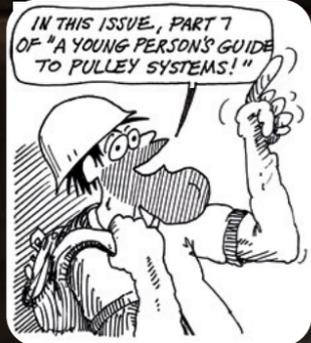


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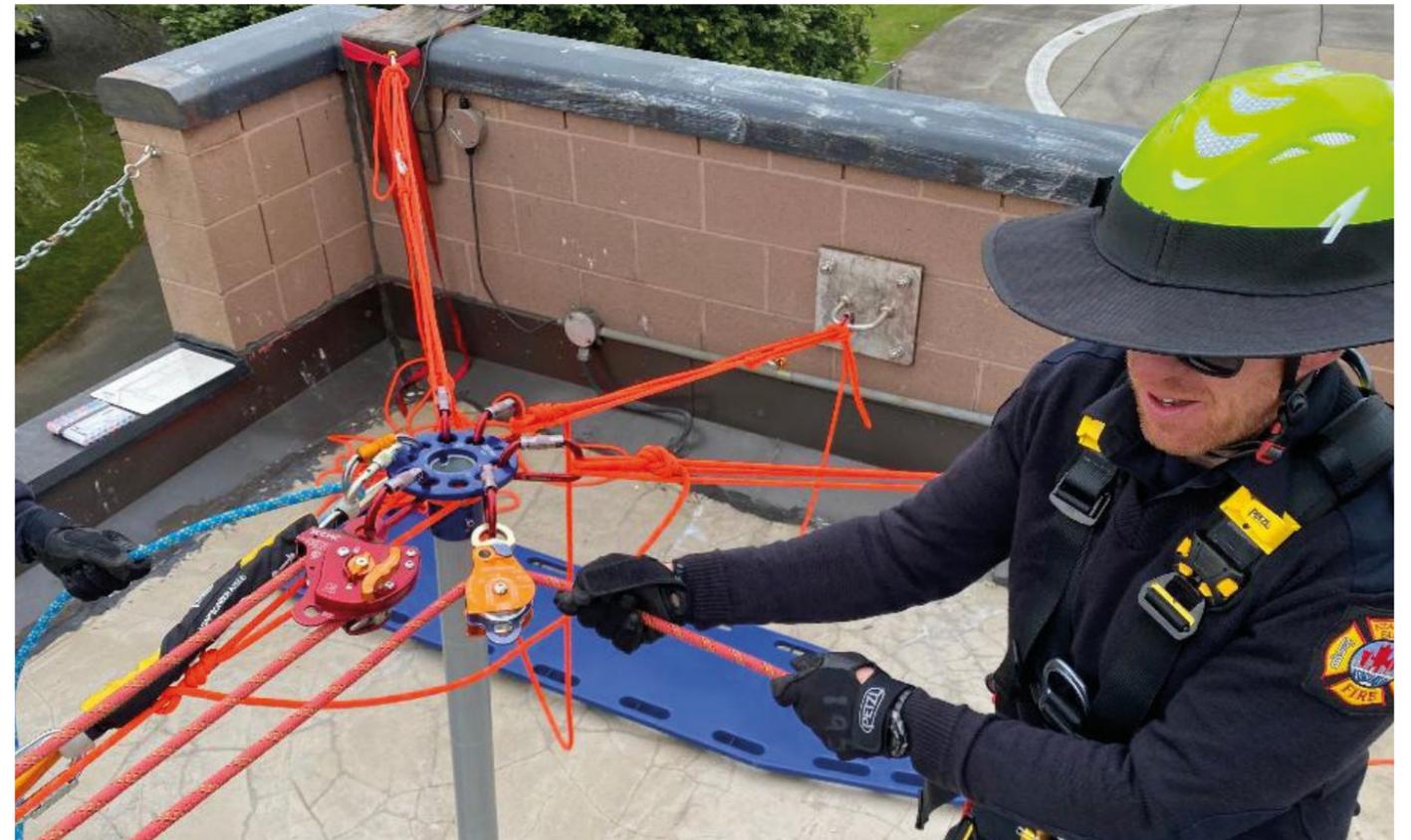
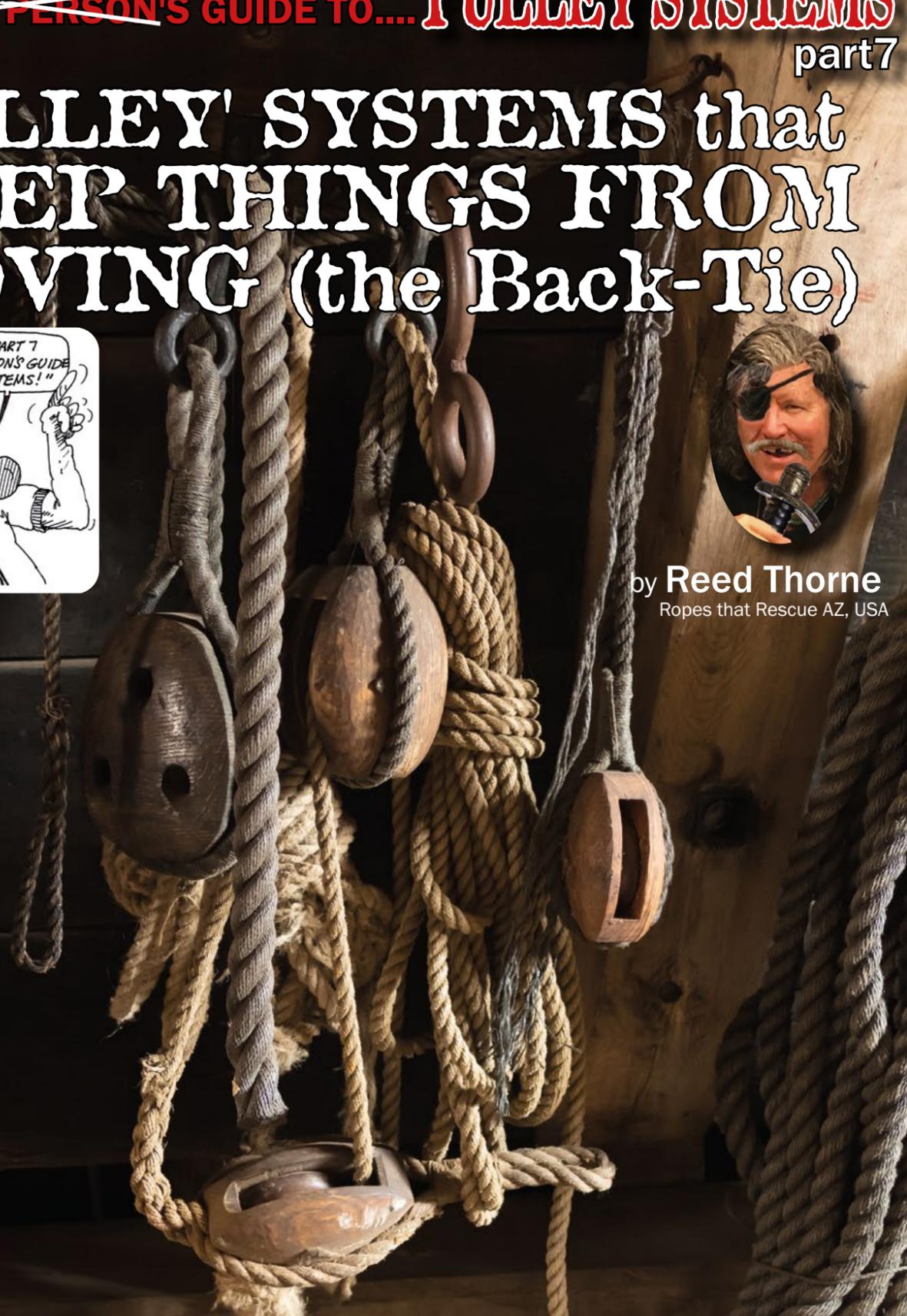
PIRATE'S
A YOUNG PERSON'S GUIDE TO.... PULLEY SYSTEMS

part 7

PULLEY SYSTEMS that
KEEP THINGS FROM
MOVING (the Back-Tie)



by Reed Thorne
Ropes that Rescue AZ, USA



Members of the Niagara Falls Fire Dept. (Ontario, Canada) prepare a three backtie rigging pod for an operation through a lazy-leg Sideways A-Frame. The three backties are built from one orange rope (including the opposition out the distal side) and all tied off at the anchors. The side back ties were 45 degrees off the center line back tie allowing both the main line and the belay line to be run off this pod.

Often, it is imperative to stress to those entering into this field of rescue the importance of proper planning early in the operation. With proper planning comes proper engineering. Whether we like it or not, when you endeavor to build a rope rescue 'system', you become an engineer of sorts. Maybe not the type of engineer with a much earned diploma hanging on the wall, but nonetheless an engineer of a temporary system which is being used to get the casualty(s) to the back of the ambulance and eventual medical care.

Up to this point (Parts 1 through 6) we have dissected the actual pulley systems that have pulleys in them. You know.... those round sheave devices (the better ones having a swivel on top) which reduce friction when used in class 1, class 2 and class 3 variations. These variations can be used as simple, compound and complex systems. Those systems used invariably as friction reduction items to help us in the task of getting a patient to definitive medical care. Friction therefore is our enemy if using them for a raising operation. In contrast, if lowering, friction becomes our friend (see part 1).

Imagine a pulley system with no pulleys then? There would be much more effort needed at the input of the system to overcome all the inherent friction whilst rope is being directed somewhat sharply around bare carabiners, yes? What would be the point of doing this, one might ask? Pulley systems without pulleys is the subject of Part 7 and Part 8 of this series. It is

perhaps one of the most important things we use these systems for. They will therefore be an integral component of your engineering for a rope operation.

Let's begin with a definition of rescue rigging (and rope access).

"Rigging" consists of carefully placed anchors allowing loads to be either held in place and kept from moving, or by where loads are meant to be moved through the use of compression and tension. These use both controlled friction and mechanical advantage at times it is needed"

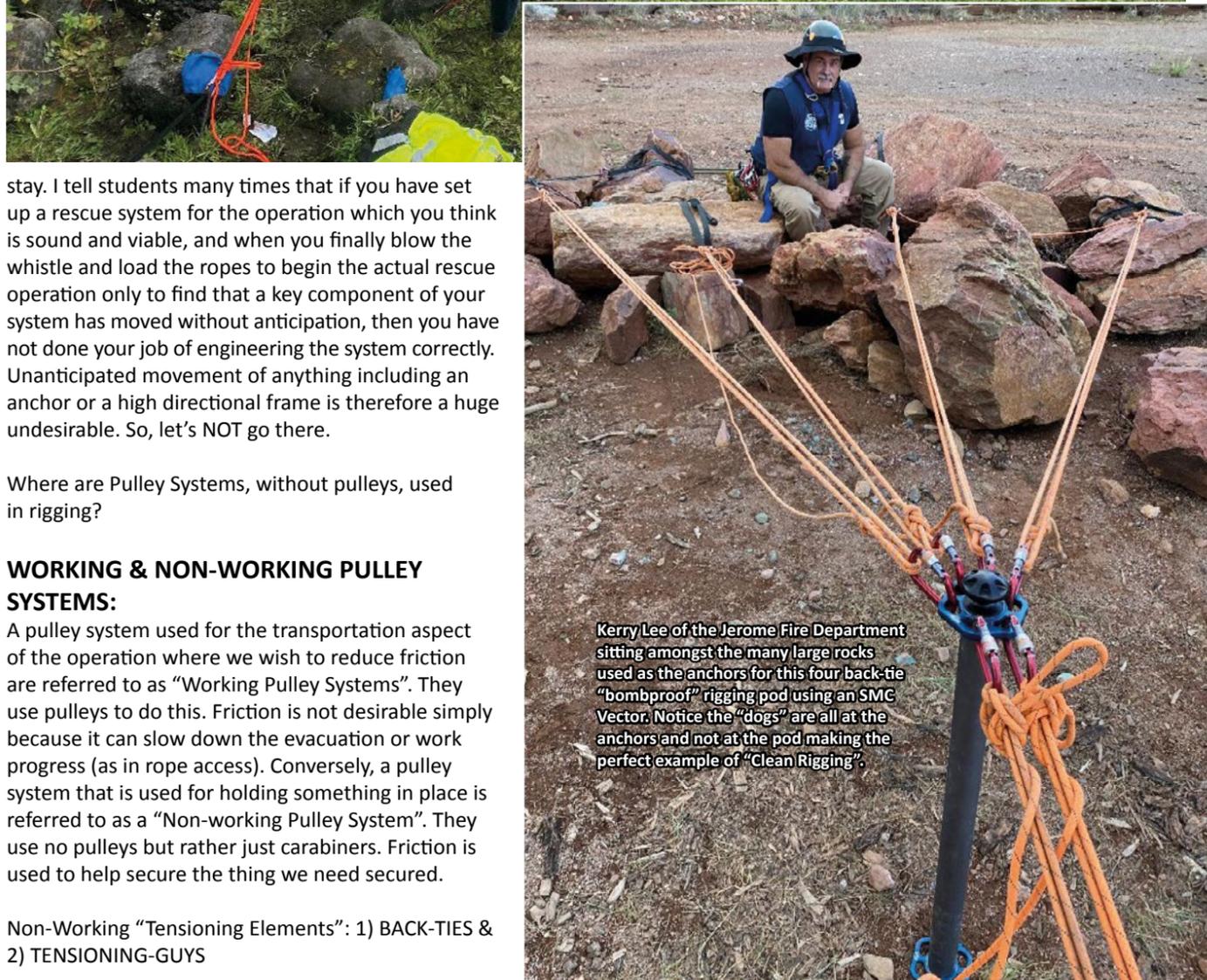
So, really we can boil this down to two basic things. As this basic definition above indicates, we have two tasks that pulley systems perform for us. They are:

- 1) holding fast something we engineer not allowing it to move and;
- 2) the transportation part of this engineering: MOVING the victim or casualty to safety and to the back of the ambulance.

So make no mistake, the "transportation" part of this is extremely important if we are to be ultimately successful. However, if something you have set up or installed as part of your system moves or falls over during that transportation portion of your rescue, that can severely negatively impact your good rope rescue intentions leading to a horrible outcome. All will hinge on things staying where they were intended to



Members of the Niagara Falls Fire Dept. (Ontario, Canada) work along the Canadian side of Horseshoe Falls and prepare to do a litter operation over the precipice. The three back tie rigging pod (called a "beachhead" anchor) to the left of the frame (again back-tied with a single orange rope) supports the operation and protects those working near the dangerous edge to set up the Arizona Vortex.



Kerry Lee of the Jerome Fire Department sitting amongst the many large rocks used as the anchors for this four back-tie "bombproof" rigging pod using an SMC Vector. Notice the "dogs" are all at the anchors and not at the pod making the perfect example of "Clean Rigging".

stay. I tell students many times that if you have set up a rescue system for the operation which you think is sound and viable, and when you finally blow the whistle and load the ropes to begin the actual rescue operation only to find that a key component of your system has moved without anticipation, then you have not done your job of engineering the system correctly. Unanticipated movement of anything including an anchor or a high directional frame is therefore a huge undesirable. So, let's NOT go there.

Where are Pulley Systems, without pulleys, used in rigging?

WORKING & NON-WORKING PULLEY SYSTEMS:

A pulley system used for the transportation aspect of the operation where we wish to reduce friction are referred to as "Working Pulley Systems". They use pulleys to do this. Friction is not desirable simply because it can slow down the evacuation or work progress (as in rope access). Conversely, a pulley system that is used for holding something in place is referred to as a "Non-working Pulley System". They use no pulleys but rather just carabiners. Friction is used to help secure the thing we need secured.

Non-Working "Tensioning Elements": 1) BACK-TIES & 2) TENSIONING-GUYS

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ABOVE: Members of the Niagara Falls Fire Dept. (Ontario, Canada) work from what is referred to as a “beachhead” anchor using four back-ties from one orange rope where all the “dogs” were done at the anchors. The term “beachhead” comes from the Normandy Beach Invasion in WWII June 6, 1944 and is placed in seemingly hostile territory where no suitable anchors exist upon arrival. This small rigging pod is proximal to the edge and positioned in such a way that it protects all those working on this cliff prow. The photo illustrates a symbiosis of compression (using Vortex legs and a cut log) and tension (using pre-tensioned back-ties and Spanish windlasses on trees to the right).

BELOW: A “bombproof” focused anchor on a tree using one rope with all dogging done at the anchors only. Note the capstan winch also attached to the bottom of the tree. Both main and belay were run off this anchorage.



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Are there names associated with these? The common nomenclature used for these tensioning elements since I have been in this field has been well established (at least in English-speaking countries). There are therefore addressed in the next two parts of this series.

- BACK-TIES (Part 7 of this AYPGTPS series)
- TENSIONING GUYS (Part 8 of this AYPGTPS series)



ABOVE: Members of the Los Alamos, New Mexico Fire Department employing a 'beachhead' anchor (AZORP) near the edge from which to protect rescuers and also to belay from.

The non-working Back-Tie and the non-working Tensioning-Guy are of the general class of "Anchoring Systems" referred to as "Linear Anchors". (Take note: This will be a NEW series in **TECHNICALRESCUE** Magazine on *Rigging!*)

Linear anchor DEFINITION:

Linear rope systems between single anchor points which either apply tension as in a pre-tensioned back-tie (or front-tie which will be discussed later after these concepts are learned). Remember that these non-working pulley systems (again, without pulleys) are used to anchor something down to keep it from moving so the term "linear anchor" fits them perfectly. So the back-tie or tensioning guy are linear anchors in the they are tensioned and set and "tied off" (not moving).

Pre-Tensioned Back Tie DEFINITION:

Those linear anchors consisting of pre-tensioned, non-working pulley systems which focus another point-anchor and hold back away, oppositely, from the intended applied force. We will shorten that here to **PtBt**.

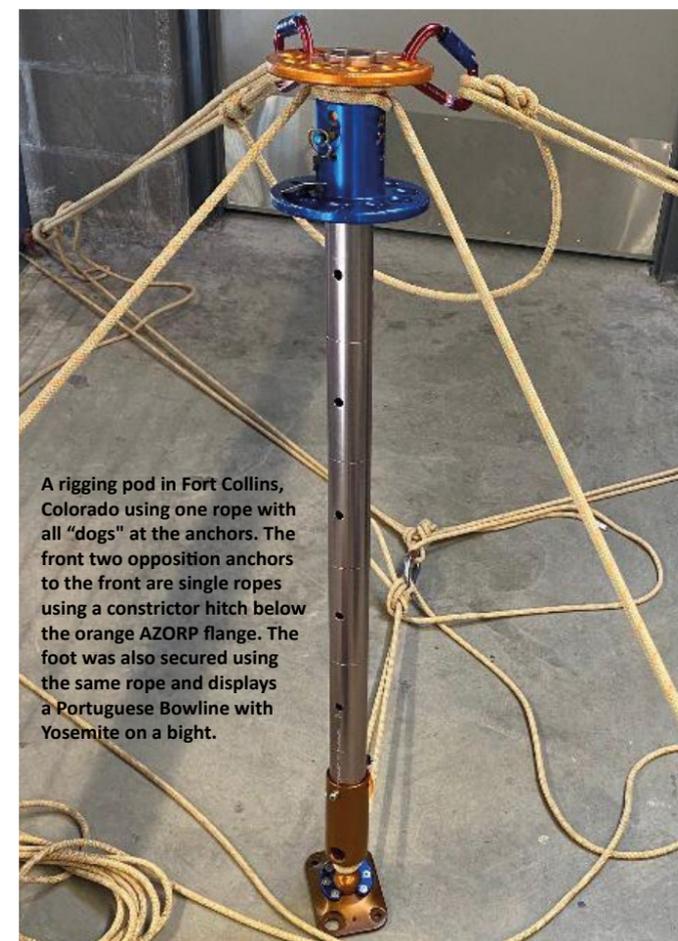
CONSTRUCTION OF THE BACK -TIE:

So the very useful pre-tensioned back-tie is used for all types of rigging, rescue and otherwise. As an example, it is the core element in many sophisticated rope access jobs. It holds the "focus" on a focused anchor or focused floating anchor. There can be several PtBt holding one anchoring plate or pod. We will be delving into "substantial focused" and so-called "bombproof focused" anchors in the next series. (Including "substantial focused floating" and so-called "bombproof focused floating" anchors)

The PtBt is usually constructed in the form of a simple 3:1w/cd but many variations exist which depend on manpower to do the tensioning. For instance, if we have 4 or 5 personnel who can do this task of tensioning we usually run with a lesser mechanical advantage (MA), but never less than a simple 3:1. The simple reason for never less is that we wish to have at minimum, three ropes of smaller diameter holding the intended force. Never one rope as this will often stretch where three or more will not.

If we have fewer than three people tensioning, we generally up the MA. There are variations of simple 4:1w/cd and also the 9:1 compound. All of these can certainly be constructed from larger ropes (like 7/16" or 11.1mm rope), but this becomes very inefficient due to size so our preference is to use 7mm, 8mm or up to 9mm smaller ropes for the purpose of back tying (or guying as you will see in the next instalment – Part 8). Remember that these non-working pulley systems are bundled ropes, so you are not therefore relying on only one of these smaller ropes to do the heavy lifting (again, remember that one single rope will stretch). There are usually a bundle of three minimum **all the easy** from the load to the anchor with no single rope segment (Note: any single rope segment, even if only a few inches, becomes a weakness in the back-tie). These rope bundles add up to the same strength or exceed the strength of some of the main ropes you are rigging with for the main or belay.

Another thing we try to do is get the least stretchy rope we can. That usually means if I am purchasing smaller diameter ropes for the back ties (or guying), we shy away from nylon because if its higher elongation compared to polyester. Nylon also keeps stretching given time and you will come back after having tensioned it to full value and you will notice it is loose



A rigging pod in Fort Collins, Colorado using one rope with all "dogs" at the anchors. The front two opposition anchors to the front are single ropes using a constrictor hitch below the orange AZORP flange. The foot was also secured using the same rope and displays a Portuguese Bowline with Yosemite on a bight.

again later. One of our favorite back tie ropes is *Bluewater "Canyon Extreme"* as it has a very tough Technora sheath which canyoneers love. Also, for those on a budget, the *Sterling HTP* (High Tenacity Polyester) in 3/8" diameter is great because it is fairly abrasion resistant sheath and is less expensive. The slightly larger rope in the *HTP* also assists in the gripping ability for tensioning, especially with gloves on which some are required to wear while rigging. Smaller diameter ropes are hard to grip with gloves and in general.

While friction actually helps in holding something in place, the argument that less friction to tension the back tie element can also be made. If one was going to make the latter argument and stand by it, they would have to have more than a few dozen pulleys hidden away in their pack. Using multiple pulleys in a back tie or guy is not practical. I think the many photos here clearly show that they are not needed. I prefer to use the smaller diameter rope on simple carabiners and allow the friction to be overcome by the tensioning team with whatever MA they choose and hold that tension until it can be tied off. That leads us to "the Dog".

TYING OFF THE BACK-TIE: "THE DOG"

The important part to remember about any back-tie (or tensioning guy for that matter) is that all the strands of the non-working pulley system should be under tension equally. This again differs from a working pulley system in that with them

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only the one rope coming from the rescue load or mass will be in tension leading up to the progress capture device (PCD). This allows us to reset the pulley system once we have reached two block (chock-o-block). With the non-working pulley system pre-tensioned back-tie, there is no resetting at all. Once you pull it up to full tension, you tie it off and leave it alone until the operation reaches conclusion. As for how much tension to put on the back-tie, this will depend on what you are trying to hold. But as a general rule, we try and attain at least 225 lbf to 300 lbf (1 kN to 1.4kN) of force on most back-ties. When your team

practices this, do so with a small dynamometer to read what you end up with after tying off.

The tie-offs, called a "dog", are usually two half hitches on a bight (which if you analyze is really a clove hitch on a bight). These half hitches are both pulled back towards the carabiner to tighten. Never away from it which creates space. We do not use an overhand on a bight in the tie-off process as it is pulled away from the anchor to tighten and this creates a small gap leading to the tie-off being loose.

On the simple basic 3:1w/cd we tie off at the anchor only (called the "Anchor Dog Technique") by "dogging" the bight of rope (you normally will not have the bitter end of the rope but rather a bight) with the customary two half hitches described above. The reader will notice that there is a lack of "dogging" at the rigging plate, or rigging pod, bipod or tripod. We just find it more prudent to dog at the anchor only and this requires discipline. It is what we call "The ART of Clean Rigging". The term "dog" and "dogging" probably comes from the power delivery field, or power transmission line work, at least in North America, and is not to be confused with any other colloquial definitions!

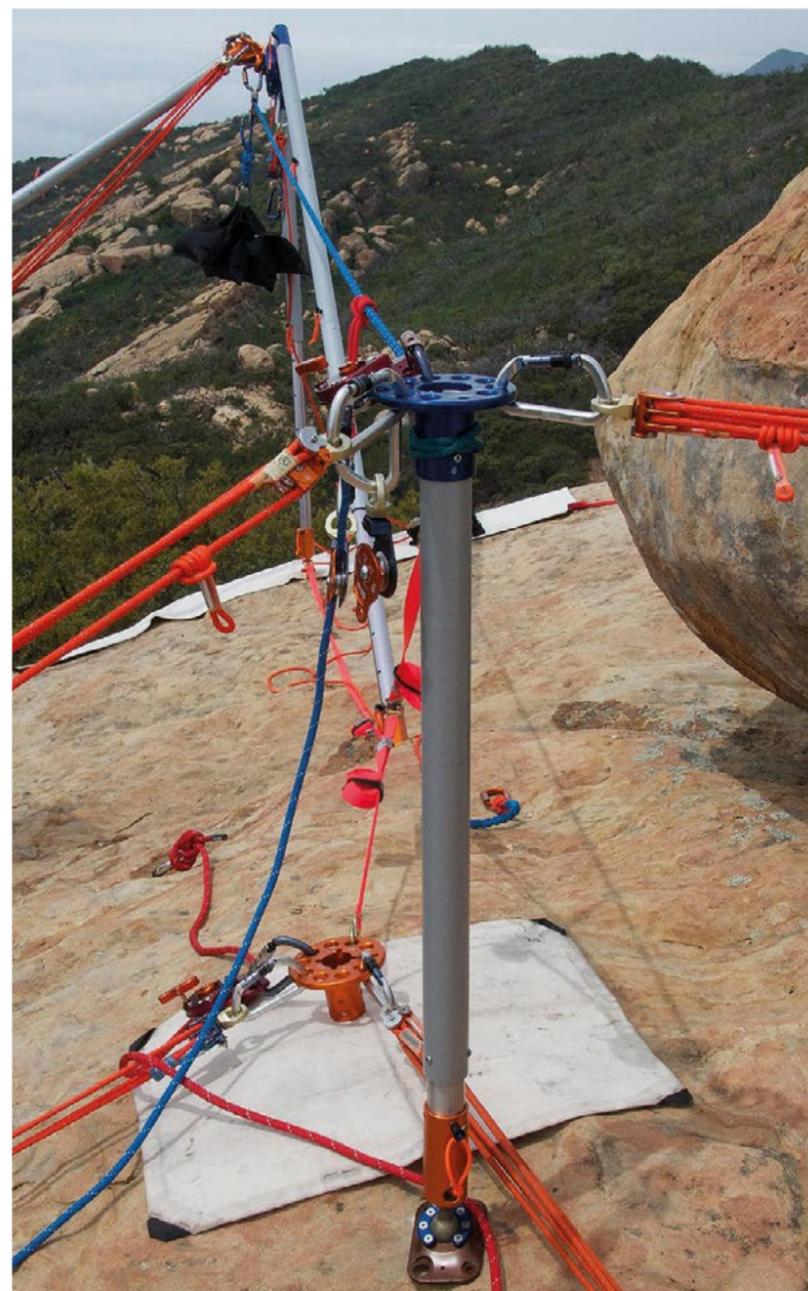
THE ART OF CLEAN RIGGING

With multiple back-ties, it is tempting to get lazy and use separate ropes for this purpose, or, as is many times the case, each end of the same rope are used, leaving a huge chunk of unused rope in between. This means more rope has to be carried whereas a smarter approach is to use every foot of the same rope for multiple backties. Once again, this requires discipline to know how to make this happen. Many of the photos shown here display just such a discipline which makes for the best use of backtie rope but also the best photograph.

CONCLUSION

There is so much to get to in this first instalment of the non-working pulley system. I considered doing the whole affair in one article but it was a daunting proposition indeed. I need to address several more issues with this in Part 8 which will be next. I simply cannot address them adequately in only Part 7. There may be a Part 9 as well.... That will remain a secret for now.

So, remember this. Holding things and keeping them from moving is an absolutely essential element of your engineered rope system whether rope rescue or rope access. You should become a master of the back-tie.



ABOVE: A Vortex set up in California at the edge called a "lazy leg" Sideways A-frame. Proximal to this frame are two focused floating anchors both secured using two each AZTEK set-of-four jiggers: Both are identical but one (with blue head) for the main line is used with a compression member (one Vortex leg) making it a "rigging pod". The lower AZORP (orange) is for the belay. Using pre-made AZTEKs is the easiest method for getting the back-ties in place, but several are needed as you can see here.



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SPECIFICATIONS

APEX 1.5 Single Swivel Pulley

Model #:	NFPA165120
Material:	Aluminum, Stainless Steel
Finish:	Anodized, Blue/Grey
Dimensions:	5.8" x 2.9"
Weight:	10.8oz (306g)
MBS:	38kN
WLL:	9.4kN
Rope size:	up to 13mm
Sheave Major Diameter:	2.0"
Sheave Tread Diameter:	1.5"
*NFPA-G Certified	



CAR ON SIDE OCCUPANTS TRAPPED

Photo by Lane Erickson

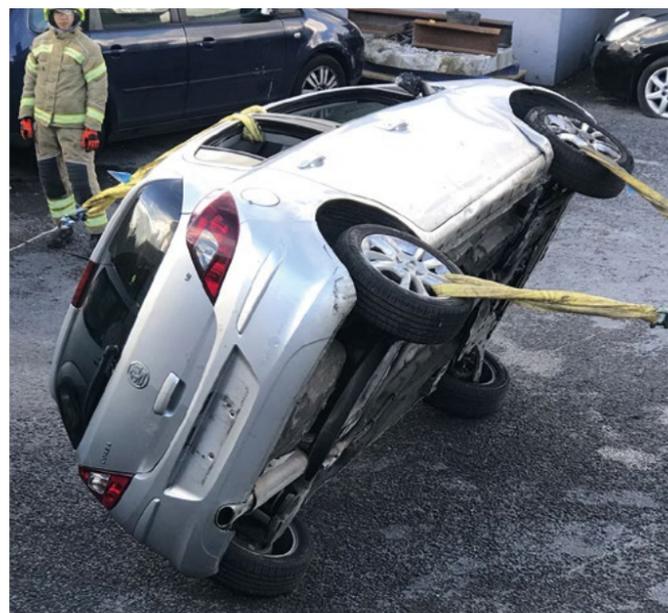
by Rich Denham & Nick Appleton



TRM 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

This article will look at the pro's, con's and process of taking a vehicle on its side and by use of two opposed winches, righting it so that its comes to rest upright on all four wheels.

The assessment as to whether to undertake – or rule-out – this vehicle re-orientation technique is a multi-agency process, based on information gathered by both the fire and medical services during their initial safety and scene assessment. The subsequent yes/no decision is based on simple and functional criteria – will it increase safety and/or reduce the extrication time ?



CONTEXT

A driver casualty is trapped within a car on its side with restricted rescuer and tool access to the roof side and the restricting object cannot be moved.

SPACE CREATION CIRCUMSTANCES AND OPTIONS

The number one option will always be to stabilise the vehicle in-situ and then flap down the roof to create sufficient space to extricate the casualty in a safe and controlled manner. However due to the positioning of the vehicle it may not be an option to carry out this evolution as sufficient space may not be available on the external roof side to allow the roof to be flapped down.

If this is the case then the likely fall-back option is tunnelling out through the rear of the vehicle. However, although this may be fine in a large SUV with a high-roofed passenger compartment, in a saloon car with a much lower roof and correspondingly less space and/or with a large heavy casualty, this may prove to be extremely difficult to achieve. Additionally manoeuvring the casualty in such a tight space may potentially cause further medical problems for them and significant manual handling issues for the rescuers.

POTENTIAL SOLUTION

However there is a third option which nowadays should also be practiced and considered, which is to very slowly and carefully move the vehicle back down onto its wheels by the controlled use of two opposing winches, to give better rescuer and tool access and improved casualty handling options.

TERMINOLOGY

HOLDING WINCH

The winch that prevents the car from dropping in an unrestrained fashion onto its wheels, in this articles images, it is positioned in direct line with the roof and is secured around the top of the B-post where it meets the roof. This may not be a 'wire-rope winch' at all and in fact may be better controlled with a heavy duty lowering device like the MPD or even a pulley system using low-elongation rope probably 13mm/1/2" or above- your services protocols will dictate what type of equipment you use. Crews with rope rescue training might use a specialist rope-based system and hardware or a capstan-lowering winch while vehicle rescue and USAR crews will likely use a wire rope Tirfor as we have in these pictures.

PULLING WINCH

The winch that is applying the force to bring the car horizontal, again ideally positioned in line with the upper B-post, but this time on the opposite floor-pan side of the car. This will be a mechanical advantage winch like the Tirfor that is capable of incremental, gradual loading to ensure that the load transfer to the lowering device is gentle but it could also be a heavy duty pulley system.

SHOCK LOADING

Where slack cable is allowed on the *Holding Winch* cable and the load then tips, applying a shock load to this un-tensioned cable. If inadvertent dynamic energy is introduced into the system and the anchor this is a VERY bad thing for all involved – the equipment, the rescue crews and especially the casualty(ies). This may occur if the tyres/wheels slip during winching/lowering which could be mitigated by a second restraint rope attached to both sides of the car at the bottom. A greater shock load may occur if the winching phase is too fast and gets ahead of the lowering operation such that slack is developed in the lowering line (wire or rope) just as load transfer occurs. This would mean the car can fall towards the winching anchor for a few inches or feet before being aggressively arrested by the lowering line. All your load

calculations that were well within limits in a controlled lowering have now gone out the window with several hundred kg/lbs of pivoted load falling even a few inches before being held. If the lowering line is a rope there will be some dynamic load absorbency that will protect the anchor to some extent but if the line is wire rope with absolutely no dynamic absorbency all of the shock load will be transmitted direct to the anchor and anchor attachments.

ANCHOR LOADS

While your winch straps/slings, chains, hooks and wire rope or rope may be rated well beyond your calculated maximum load potential, there is one element that may be outside of absolute control. The anchor. A pivoted load is obviously much less than a free-lifted dead-weight and in a clean on-road scenario such as we've shown in these images with a very small car you are unlikely to tax your winch and components. But the load on the anchor can be substantially higher than your projection of the vehicle weight alone. There might be obstructions like entanglement in fencing/vegetation or another vehicle that resists the winching effort and increases loads dramatically. The vehicle itself could be heavily loaded with people or contents that take it well over the basic vehicle weight and there may be mud, water, snow or ice wedged into wheel wells, bumpers etc. that also add to the weight. Add to this the resistance of an opposing winch at the apex of the lowering/winching phase and a much larger/heavier vehicle and you can see that your anchors can potentially be easily overwhelmed. And it won't be a gradual process, it's likely that your anchor and components will be solid one minute and catastrophically fail in the blink of an eye. Occasionally you may get some warning of impending doom due to bending or creaking but not often and that requires a person dedicated to monitoring the anchors which is actually a very good idea if you can spare the personnel. If using a vehicle as an anchor, ensure that it is chocked against forward movement or better still, side-on to the direction of load. All other types of anchor – from Armco barrier posts to bollards would require standard integrity assessment protocols.



ABOVE: Car-on-Side stabilisation courtesy of a Mexican Fire Dept. Struts on the underside of the chassis and blocks (in this case wood) on the roof-side. Note also that the rear screen glass on this old vehicle has been covered in Packex Film.



On the roof side, attach sling(s) to the top of the B-post once windows have been wound into door. Some vehicles may allow two wider-spaced points of attachment eg. B and C or B and D-posts

PROCESS

1. Stabilise in position found whilst decision-making is in progress. In the title shot, a stabilisation strut has been placed. Had the second crashed vehicle not acted as a support a second strut would have been placed here. On the opposite side, a short block and wedge tower should be placed between the B post and the road surface, also similar at the base of the lower A and C posts.
2. Open uppermost rear door and hold in position whilst medic enters the vehicle by carefully lowering themselves down through the door and then make a functional assessment of the casualty to enable necessary rapid interventions and also to aid subsequent decision making.
3. Decision made to winch vehicle back into an upright posture on all four wheels because insufficient space available for a roof flap down to be performed.
4. Medic to support and reassure casualty during winching operations and explain the movement that is occurring
5. Carefully close uppermost rear door
6. If glass is still intact and before battery is disconnected, power down both uppermost door windows to ensure that the Holding Winch stop can be attached around the top of the uppermost B post.
7. Suitably position and anchor the Holding Winch on the roof side of vehicle and connect its cable via correctly rated straps to uppermost B post
8. Secure Pulling Winch from opposite side of vehicle via correctly rated strops to both uppermost wheels
9. Gently tension both winches before removing the struts 'n' blocks, so that the vehicle is mechanically stabilised throughout this transition phase
10. One person will oversee the winching operations and have direct line of sight and communications with both winch operators, as the operators cannot see each other and effectively coordinate their actions. Then in small alternating increments the *Holding Winch* first lets out, then the *Pulling Winch* takes in, in order to slowly and carefully lower the vehicle to the ground in a controlled manner.



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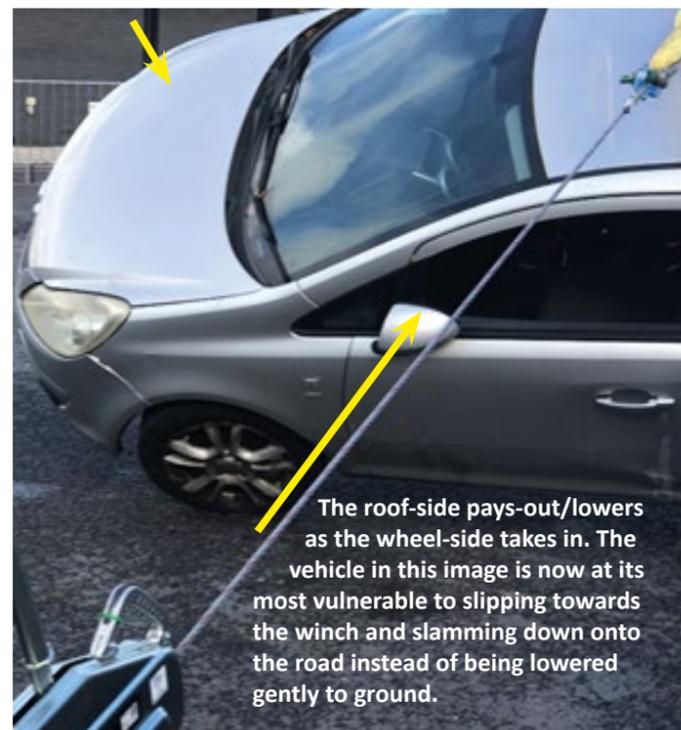
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Carefully take in slack on wheels side and roof side simultaneously. Do not over tension. Both sides should begin with equal load prior to commencing lowering of the car. The winches or lowering devices need to be securely anchored and capable of handling at least half a metric tonne even though it will hopefully never get near this degree of dead-weight-load. Notice also that soft round slings have been bundled up and wedged close to the wheels to help provide traction during the lower.

N.B. It is essential to ensure there is no significant slack cable on the Holding Winch during the lowering operations or at some point this winch cable will become shock loaded causing a large uncontrolled movement of the vehicle with potential serious repercussions for the casualty.



The roof-side pays-out/lowers as the wheel-side takes in. The vehicle in this image is now at its most vulnerable to slipping towards the winch and slamming down onto the road instead of being lowered gently to ground.

ADVANTAGES

- On completion allows better access for rapid space creation, safer moving and handling postures for rescuers and a correspondingly safer extrication for the casualty.
- For a bariatric casualty, this may well be the safest and fastest extrication option.
- A potentially high training frequency is available as the evolution can be practised repeatedly – as long as you have access to two winches (may need a second from stores or another station – joint training exercise?), making minimal material difference to the car for subsequent alternate training purposes. Indeed for this reason it can be undertaken before the start of all training evolutions.

POTENTIAL PROBLEMS TO BE ASSESSED AND MANAGED:

- Wet road surface, reduces traction of tyre edges as the car pivots
- Insufficient anchor point for either or both winches
- Time – do you have two winches available and how long to get them if not?

- Has your team practiced this evolution? This is not the time for a first attempt at a complex manoeuvre.
- The Plan B option for this evolution– how to rapidly extricate the casualty if the medic calls for it – is minimal. Initially it would be robustly dragging the casualty through a space created at the rear of the vehicle, but once the controlled roll is in motion, it is likely safer and more efficient to fully right the car and undertake an immediate extrication through a the side of the vehicle, as the circumstances dictate.



CONCLUSIONS

This would be a rarely used technique but one which would require practice and familiarity to allow its selection at an incident, where a knowledgeable and confident fire service officer in charge can concisely explain its pro's and con's and process to the medical attendance, to inform their final decision. However, such regular training on this evolution would indeed be available with every scrap car used – and it provides a good general winch learning opportunity too – so it should be planned into the first phase of all RTC training events.



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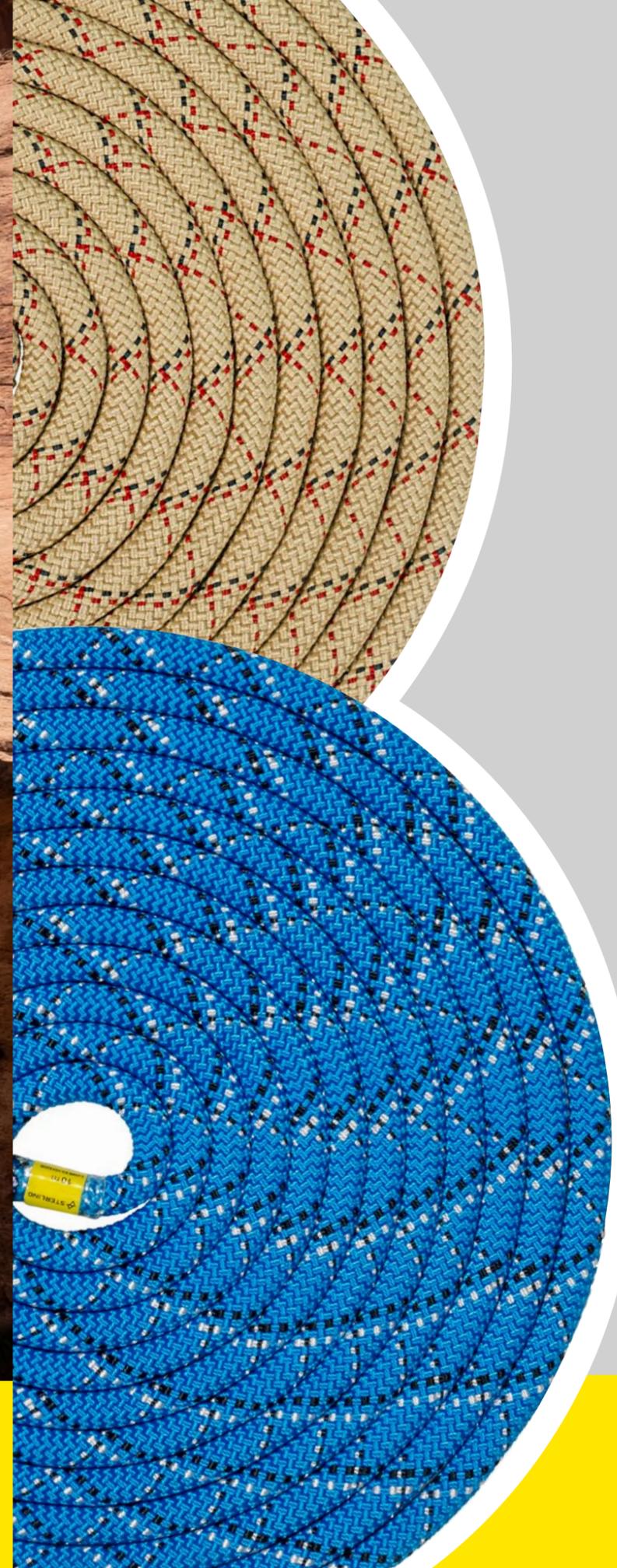
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NFPA 1983 Rating: General

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TEAM

PROTECTION

Upstream, downstream, mid-stream and pinned underwater.

By Dr Michael Croslin
& Mitch Sasser

Mike Croslin is co-founder of the world's first swiftwater rescue program, indeed co-inventor of the very term 'swiftwater rescue' along with fellow water rescue legends Jim Segerstrom, Warren Berg and Barr Edwards. They went on to form Rescue3.

Mitch is the CEO of training company Tandem Rescate in Chile formed 20 years ago. He was originally trained by Jim Segerstrom, Mike Croslin and Jim Lavalley

www.rescuemagazines.com

A new strategic paradigm for Swiftwater Rescue

Trust the source. I'm the one that baked a fundamental mistake into the original swiftwater rescue training cake all those years ago so if I now tell you that there are certain aspects of that cake that need to be improved you should want to hear my confession and act upon it to rectify any further propagation of mistakes.

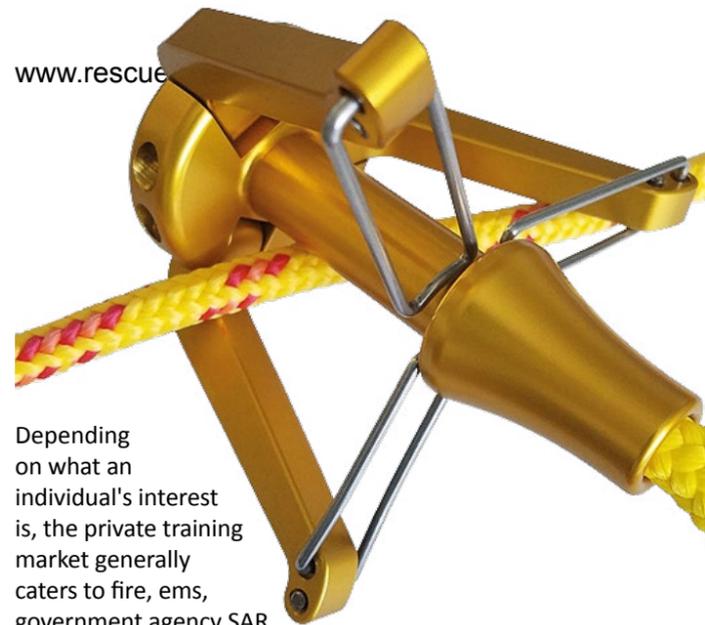
Dr Michael Croslin

INTRODUCTION

A history of modern swiftwater rescue

Team leaders must ask the question, "How do I define competency in Swiftwater rescue to protect my team members? This requires a strong level of independence on each team member's part. They must be able to self-rescue and handle their own weight in the water, always be looking for solutions to help, and most importantly should know their PPE and how to use it. This instinct is to be of service to others, to develop ourselves in such a manner that we stand beside a group of like-minded individuals with vigilance and trust in each others skill-sets. Swiftwater incidents should involve the least amount of risk to you, your teammates and those you serve. In that order.

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Depending on what an individual's interest is, the private training market generally caters to fire, ems, government agency SAR groups, Special operation groups on training rotations as a team. Each getting introduced or refreshed at different levels based on experience, or past certifications. The standard today is SRT 2-3 and 4(Advanced) or some equivalent similar iteration thereof, or in-house agency program some of which are excellent. A top-tier example is CalFire in California who does their own training roughly copied with some improvements from what Jim Segerstrom and Michael Croslin taught them in the early days of Rescue3 at the inception of developing a national standard for NFPA. These refinements learned over time as their lead instructors grew their programs throughout the state. For 24/7 OES and local area coverage, these teams are required to train year-round and have more Swiftwater experience than any other SAR group in the state. Sean Norman brought his team for a weeks training in the central Sierra to get introduced to the Reach line capture capabilities and experience first-hand a series of exercises that frankly astonished them and opened their minds to a new way of looking at Technical Swiftwater training and establishment of standard protocols within their program. Cal-Fire's area of operations included the very technically difficult Feather River Canyon with a highway running right next to the river and all the motorists, tourists, boaters, swimmers etc that get in trouble, and the flood plain below it and beyond. This Team immediately adopted and grew to a standard of competency that made it clear to us all that the Reach device is PPE for each team member not simply a piece of team equipment. If one person could speed up and simplify an evolution with such impressive accuracy and precision, the versatility of the entire team utilizing the same would exponentially increase the safety between members and that of the rescue operation.

That was 15 years ago and it's the longest-running team-based test of the REACH's value as a trusted and essential tool in public service. Mitch Sasser and I worked together to transmit the same level of competency in Chile at Tandem Rescate where his crew and students took development even further as a test-bed for big volume applications and remote anchoring. We obviously have a vested interest in propagating use of the Reach system but somebody would have come up with a

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Learning the ropes.....literally. Team members should become intimately familiar with the correct way to stow, coil and throw the Reach device in all of your most likely incident spots and in ideal conditions before training in a whole host of unfamiliar situations in uncomfortable circumstances; difficult stances in inclement weather and poor light.

similar design sooner or later and we would have been happy to promote whatever was on the market of high enough quality to do this job. We're very thankful that we are again working with trusted friends to evolve specific methods to gain mastery over the use of the REACH device as PPE in combination with a waist-worn throwbag. Jim Lavalley of *Rescue Canada* helped with testing and validation and teaches and utilizes it in their programs. ACA instructors teach it in their programs and their instructors were involved in testing. These changes all make you safer and more effective at doing your job. We don't make these suggestions to boost anything but your effectiveness and survivability under harsh conditions and because I firmly believe that water rescue needs to be safer for the rescuer. There will be those whose only motivation in joining a swiftwater team is the adrenaline rush of an epic battle with fast moving water and there will be times when this might be sufficient to pull off a 'heroic' rescue. But the wants of the individual need to be weighed against the needs of the team.

...Turn off the lights and roll the projector showing how easy it is to die trying to be a hero to your teammate who made a rookie error of missing a throwbag toss in a choppy set of haystacks. The bag was only 6 inches from your teammate's head but in a trough behind him as he peaks on the wave with a great view of his impending death. You struggle to open a second bag and toss it nervously, but on target, to your teammate just as he accelerates into the sieve. You and your other teammates will be spending the next three days trying to extract your

dear friend from the belly of the river monster you all tried to mitigate against with standard protocols for down stream protection. You learned these in your SRT program taught by a very reputable Instructor from a training program that pioneered and created the SRT programs that the entire planet has emulated with amazing results. They did what they were taught but, in this case, it did not work.

Things are changing rapidly in the world and as we know, climate change will require some serious increases in our preparation and operational tempo and response. There will be more to do with less time to do it in conditions that put rescuers at greater risk. We train during the day with repetition to prepare for the night calls during more powerful and unpredictable weather-related/flood-related events. Regardless of what progress is made against climate change, there is no possible way for us to alter this reality, and Swiftwater teams will benefit greatly from the less role-based protection. Downstream protection will be put to the test and teams with big exposure in their areas of operation will appreciate the protocols we are suggesting in this article and most recertification of students should focus on team-based protection to enhance the safety of everyone on the water. We are suggesting a more team-based awareness and remote capture upgrade. Strategic protection awareness and efficiency that can be provided by the Reach and constant carry throw bag combination and it is strongly recommended that teams learn to integrate this into every aspect of their programs.

The REACH SYSTEM as PERSONAL ISSUE.....

On every evolution where a rescuer must cross pushy high-velocity channels, a rescuer must know how to place a remote anchor with a Reach by snagging in the brush, chocking between rocks, or snagging preset natural anchors at recurrent Swiftwater incident sites. By doing so.....

no one should ever need to swim a line

let the rope pendulum the rescuer, and the channel flow does the heavy hauling. Once anchored on the far shore the rescuer now has a fixed line to manage and give stability to a wading crossing. Rescuers need small micro ascending and progress capture devices added to their PPE set-up that enable them to have a better grip (Jumar type handle) on the line while crossing and apply ascent and descent capabilities. This greatly increases mobility and confidence. Even with a traditional throw bag, it is a method that has been proven to be added safety for wading crossings where the final section of the crossing must be done by a pendulum floating swing into shore. If a fall occurs the angle is already set for the line to pendulum the rescuer, and let the flow do the heavy hauling.

Jim Lavalley on WADING

I began teaching wading techniques quite different that what was first demonstrated as possible wading techniques for rescuers and teams. Line A-Stern and The Wedge are techniques that ergonomically do not favor the human body while crossing fast moving water while facing upstream. This is due to the form of the human leg and articulation of movements prone to wash-out while taking a step. Canadian Wildlife and Fisheries and combined knowledge from Fly-Fishing Guides who spend time in rivers wading up to 40hrs a week proved to have developed techniques that are mechanically better and actually flow with the push of the current saving energy and improving progress towards shore. Enter the river facing the opposite shore. Your upper leg should incline upstream while your back leg anchors directly behind in a triangle supporting your upstream leg. The body is more narrow standing sideways to the current and your back leg is in the eddy of the front. Sliding your foot across the bottom of the river is more secure while lifting your foot off the bottom can cause a wash-out difficult to recover from resulting in a fall. Wading Staffs at 2mts in length also support this wading technique in a downstream support forming a tripod of contacts to stabilize with while crossing. Using the same positioning for crossing as a pair your wading partner will have their back to the far shore. Work in unison sliding the feet across the bottom, inclining the body and upstream leg towards the current for better stabilization. Fly fisherman care for a unique group of clients, many of whom are older in age. Outdoor educators, Guides and all rescuers should know how to wade downstream at 45 or greater to the current for easy go with the flow stream or channel crossings. The forward downstream progression in shallower water is best done with a wading staff for better stability but when the channel is up to your waist the is a forward downstream hop-skip and float a bit type of fast crossing. Jim is a Higgins and Langly Life-time Achievement Award Recipient and Founder of Rescue Canada



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Each Rescuer should always carry with them a waist belt throw bag system. If you can, carry a second bag down to the edge of the river with you for an immediate extra extension. One length of lightweight webbing, 3 HMS manual locking carabiners, 1 mini progress capture device (eg. Wild Country Rope Man), 1 light weight pulley, 40mts of nylon or Dyneema 2.5mm(in pouch, cutting device, whistle, 1 REACH, 2 mini (but rated) carabiners (eg. Metolius, Black Diamond).Helmet, Thermal protection, PFD, Good shoes, emergency lighting.

If it's a wide channel beyond 70ft it is already protocol to have a rescue swimmer cross the channel **without** towing a line. Instead the rescuer should carry a waist-mounted Reach system. This should be the case for ALL crossings. Once across, she takes off her waist-worn throw bag and attaches a reach and gets positioned to cross clip a 75ft throw bag thrown from her teammate, each having 60ft of deployable rope to create 120ft of remote crossing power in strong turbulent water. This is a religious experience – when a throw bag is tossed halfway across a big, fast-moving, turbulent channel and a rescuer from a safe place tosses a reach and hauls that rope in like magic. Team members quickly learn that chasing after lines thrown short, running high-risk sprints along the shore to manage lines, going after lost throw bags during training, and clearing channels of wire/fishing tackle are all potentially high-risk activities. Without use of the Reach System, this is the current state of the art in Swiftwater Emergency Response.

Checks and operational considerations for night ops means you must have DAY-TIME training methods wired to the core. Are you training daytime protocols with night ops in mind? Many do not know how to do this in an effective way that builds confidence in operations involving distances more than 15mts from your position.

Muscle memory and brain function memory when using the rescue throw bag combined with remote rescue, expanded range contact and self-rescue methods are the highest level of proficiency an individual can achieve. A team of these like-minded pro-active rescuers can cover and contain twice the radius that teams without the device can reasonably control. When we teach students to manage rescue lines we get down to details that matter when a successful throw is of vital importance. The trained rescuer will know how to pack

the bag in seconds, mount each coil correctly in hand avoiding overlaps and entanglement, and count coils, your coils! Your working arm is the fixed measurement that combines length and weight calculations used for accuracy and memorizing distances. Eliminate the doubt in your head. These practices almost completely eliminate questionable throws of throw bags, cross clips for line capture and remote anchoring because, before performing the technique, the rescuer already has the knowledge and skill-set to accomplish the task.

At night, if you can hear your teammate over the rush of the water, your senses will kick in to determine the gap between you. Voice contact generally falls within the 30-40mt range so repeated success when performed in day-time training, perhaps using sight-limiting props covering your eyes, can be modified to be performed at night with limited visibility but allowing for a small increase in sound travel. Repetitive day-time training in likely and historical rescue locations will also help when it comes to tackling the same locations in the dark. External lighting can be of great help but should be set-up as background lighting that frames a silhouette of what we are aiming for with the Reach.

Working with Chem-Lights in night conditions will also help with accuracy and distances. There are a few throw bags on the market today that include an attachment for chem lights. Attaching one to the end of a Reach is simple and huge addition to clipping lines at night or even remote anchoring to. When performing line capture at night, focus on the position of the bag deployed into the water knowing the effective range of getting a secure clip in relation to the deployment of the Reach. When performing line capture it is best to cross-clip at moments when the line in the water is as straight as possible. Avoid throwing the Reach into the pendulum downstream belly of the line to be captured.

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If the two rescuers are directly across from each other the cross-clip angle is best achieved downstream of the rescuers. A straight throw at an angle downstream of your partner who will deploy the Reach for capture, will suit best for execution. This is especially true in high-velocity flows. The deployed bag into the river must be a low-angle arc over the water that allows the reach to come into play in some cases only a half-second after the deployment of the bag into the water.

If you are having trouble clipping a line in high velocity flows your position or cross-clip angle may need to be improved. This is most often achieved from an upstream position deploying the Reach downstream across the opposing line. This also helps in keeping the Reach off the bottom of the river by using the current speed to keep it up close to the surface much like a fishing lure.

If a throw of the Reach misses, no worries. Just coil back into your hand with the Reach hanging just below your coils to avoid entanglement and you are ready for the second throw in a matter of seconds. Train fast current line-capture from the best angle of interception from steep upstream angles projected downstream that have a higher rate of success when capturing pendulum bags deployed with the intention to connect the two and progress onto the next evolution or to connect and rescue quickly.

Train fast current line-capture from the best angle of interception from steep upstream angles projected downstream that have a higher rate of success when capturing pendulum bags deployed with the intention to connect the two and progress onto the next evolution or to connect and rescue quickly. This training is unique, especially for night ops. We like to call it PPE training and what it does is strain your ability to perform within the comfort zone of contact with a partner or shoreline. This training method will push you to use your PPE in a way that enables seamless communication in an expanded range of options that can only be achieved if the Reach is included in your PPE. When team members train to the limits of length of their throw bag they understand how important a role this device makes in all of the floating rescue line rescue methods established to date.

If you are still wondering why you have not been able to get up to par it may be a lack of instructor knowledge specifically

on the use of the Reach device. In other words, your team should be looking for training programs that include more than just line capture with the reach but also remote anchoring to rocks and boulders or trees and brush for stream crossings on a tension diagonal, pendulum swings, gear retrieval. There must be a focus on access and egress including the use of the Reach. As many know and others will learn, the game has changed. All rescuers have now been upgraded to be able to connect and protect.

The best way to better your response under high-risk conditions is to never forget to perform your preplanning work that is so critical to success. This brings us to dryLand training and frequent historical site maintenance and improvement that rescuers need during a night ops event under stormy conditions.

Can one clip another line with the Reach on Dry-Land? Yes you can! Do not limit your imagination to the most common applications of the Reach or what have become to be known as the easiest uses of the Reach. There is so much more you can do with it. The moment the reach hits the far bank there is no need to haul in rapidly, maintain line tension if need be so the line stays out of the water. If not, manoeuvring can help situate the Reach for the cross clip on dry-land or slide into remote anchor placement.

Predictions are risky in Swiftwater. Getting out and training to the limits of your PPE will help you to be a more complete part of a connected team. This means constantly looking for solutions to keep team members out of the water or if a rescuer does end up in the water, having a layered downstream safety plan in place that can work remotely from a safe distance to enable exiting the water or arriving at the desired location. Downstream protection will be put to the test and real teams with big risks and areas of operation will appreciate the increase in protection strategies and protocols we are suggesting. Most recertification of students should focus on **team based protection** as a fundamental element.

Equipped with the Reach you are now an integrated mechanism that can perform within the dynamics of moving water because you have the ability to create and to sew technical rope-based evolutions mid-river or across the river.

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Mountain Rescue Workshop	AZ March 19-25, 2022	Mountain Rescue	Classroom & Wilderness ONLY	MRW Equip List 4/21	Saturday/ Friday 7 days	8 some hiking	No Prerequisite Prior rope rigging experience and climbing ability are strongly recommended.	Arizona USA Town of Jerome See <i>Jerome Fire MRW Flyer</i>	\$1,400 (50% off AZ Volunteer discounting available)	Reed Thorne
Personal Skills Rescue Workshop	MI April 2-8 2022	Solo-Semi Solo Rescue	Classroom Industrial & Wilderness	PSRW Equip List 4/21	Saturday/ Friday 7 days	8	No Prerequisite Good physical conditioning strongly recommended. Liaison: Michael DeGraene	Michigan USA Grand Lodge - Auburn Hill See <i>Program Flyer</i>	\$1,450	Michael DeGraene
Tactical Wilderness Rescue Wkshp	AZ April 4-8, 2022	Rapid Deployment Mnt Rescue	Classroom & Wilderness ONLY	Equip List 7/21	Monday/ Friday 5 days	5 some hiking	No Prerequisite May be ideal for Rapid Extrication Module Support (REMS) Teams	Arizona USA Town of Jerome See <i>Program Flyer</i>	\$1,100	Reed Thorne & TBA
Artificial High Directional Workshop	UT April 25-May 1, 2022	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip List 4/21	Monday/ Sunday 7 days	6 some hiking	No Prerequisite Prior rope rigging experience strongly recommended.	Clearfield, Utah <i>Book Exoticia & South Dade Metro Fire</i> See <i>Program Flyer</i>	\$1,500	Reed Thorne
Tree Rescue Workshop-Firefighter	CA May 3-9 2022	Bottom Up Tree Rescue	Classroom & Wilderness ONLY	Contact Instructors Keith/Reed Thorne	Tues/Mon 7 days	5 tree climbing required	Prerequisite: Climbing! This program is specifically designed for responding tree emergency personnel in excellent fitness	California USA Nevada City See <i>Program Flyer</i>	\$1,450	Keith Thorne & Reed Thorne
Mountain Rescue Workshop	AK June 1-7 2022	Mountain/ Glacier Rescue	Classroom and Wilderness & Glacier	TSRW Equip List 4/21	Wed/Tues 7 days	7 some hiking	Prerequisite: Working on snow and ice so need appropriate PPE. Contact <i>Travis Mead</i>	Alaska USA Juneau-Capital City Fire & Rescue See <i>Program Flyer</i>	\$1,450	Reed Thorne
Industrial Rescue Workshop	AK June 12-18, 2022	Industrial Rescue	Classroom Industrial ONLY	TSRW Equip List 4/21	Sun/Sat 7 days	7 some hiking	No Prerequisite Prior rope rigging experience recommended. Contact <i>Travis Mead</i>	Alaska USA Juneau-Capital City Fire & Rescue See <i>Program Flyer</i>	\$1,450	Reed Thorne
Team Skills Rescue Workshop	CAN June 22-28, 2022	General Team Rescue	Classroom & Wilderness ONLY	TSRW Equip list	Wed/Tues 7 days	6	No Prerequisite Prior rope rigging experience strongly recommended. Canada Liaison: <i>Tim Casavani</i> See <i>Program Flyer</i>	Jasper, Alberta CANADA Turn Around Rescue Contact <i>Tim Casavani, hullofirelogistics</i> See <i>Program Flyer</i>	\$1,450 USD	Reed Thorne
Artificial High Directional Workshop	UK July 18-24, 2022	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip list	Monday/ Sunday 7 days	4	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: <i>Paul O'Sullivan</i>	North Wales UNITED KINGDOM <i>R3 Safety and Rescue Ltd.</i>	Contact liaison	Reed Thorne
Team Skills Rescue Workshop	UK July 26 Aug 1 2022	General Team Rescue	Classroom Industrial and/or Wilderness	TSRW Equip list	Tuesday/ Monday 7 days	5	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: <i>Waldo Etherington</i>	Bristol UNITED KINGDOM <i>REMOUE ROPES LTD</i> See <i>Program Flyer</i>	\$1,450 USD	Reed Thorne
Artificial High Directional Workshop	UK Aug 6-12, 2022	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip list	Saturday/ Friday 7 days	4	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: <i>Paul O'Sullivan</i>	North Wales UNITED KINGDOM <i>R3 Safety and Rescue Ltd.</i>	Contact liaison	Reed Thorne
Offset/Highline Rescue Workshop	AZ Aug 27- Sept 2 2022	General Team Rescue	Classroom Industrial ONLY	OHRW Equip list	Saturday/ Friday 7 days	4	No Prerequisite Prior rope rigging experience strongly recommended	Arizona USA Town of Jerome See <i>Jerome Fire INFO Flyer</i>	TBA	Reed Thorne
Personal Skills Rescue Workshop	OH Sept 24-30 2022	Solo-Semi Solo Rescue	Classroom Industrial & Wilderness	PSRW Equip List 4/21	Saturday/ Friday 7 days	8	No Prerequisite Good physical conditioning strongly recommended. Liaison: <i>Michael DeGraene</i>	Ohio USA Cleveland - Independence Multiple venues See <i>Program Flyer</i>	\$1,450	Reed Thorne
Advanced Skills Rescue Workshop	OH Oct 2-8 2022	Advanced Highlines	Classroom Industrial Wilderness	General Equip list	Sunday/ Saturday 7 days	5	Prerequisite: Must have completed one program: TSRW, OHRW, IRW, AHDW from RTR (PSRW/STRW do not qualify)	Ohio USA Cleveland - Independence Multiple venues See <i>Program Flyer</i>	\$1,450	Reed Thorne
Advanced Anchoring Analysis & Beyond the Barn Floor Seminars	MD AZ Nov 2022 TBA	"Barn Floor" Physics & Adv. Rigging + Trigonometry Adv. Physics	Classroom and field testing Classroom ONLY	See AAA BTBF flyer	7 days	1 Mental 6-8 - 1 Mental 10	Past RTR Alumni Only You should have a good background in mathematics in order to fully participate in this program	Maryland USA Contact <i>Mike Green or Reed Thorne</i> for location & logistics See <i>AAA-BTBF Program Flyer</i>	TBA	Mike Green & Reed Thorne

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