TECHNICAL RESCUE

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

ISSUE 74

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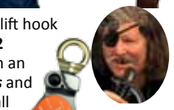
issue 74

Above: TR's resident extrication crew take a look at the practicalities of actually ***removing the casualty*** having used all the tools on the truck to create space .....or not in the case of 'MPV/Mini-vans' like this. **Page 12**

Above: A MARKET GUIDE to ***Hand-Held Search Cameras***, as exemplified by the pole-mounted LeaderCam above. SearchCam is still going strong as the 3000 and is now pressed hard by the latest models of app-driven, 360 degree cameras like the FL360 **Page 24**

Our second MARKET GUIDE this issue is ***Evacuation Triangles*** or harnesses but we tend to use 'harness' to describe encompassing webbing connected by buckles and locking clips. In this genre, ALL have eye or D-Rings connecting to a carabiner or lift hook instead of locking buckles/clips. **Page 62**



Our old pirate Reed Thorne returns with an outstanding multi-part series on ***Pulleys*** and Pulley Systems which should have you all creating systems in your sleep from old cotton reels and knicker elastic. **Page 38**

Paul O'Sullivan precedes a forthcoming article on low-head dam/weir rescue with a look at an ever-present and increasing risk - floods, looking at 6, rather than the usual 4 phases. ***The 6 Phases of Flood.*** **Page 54**

PARK**RANGER** has now changed title to **WILDERNESSSAR** Issue 5 is therefore the first under the new title but is otherwise exactly the same magazine as before in the same style and format as TECHNICAL**RESCUE**and ARB**CLIMBER**. W**SAR** concentrates on mountain, cave and remote area rescue generally using lighter equipment that the more urban and industrial-based technical rescue agencies. We have also moved offshore marine rescue and long-range SAR helicopters across to **WILDERNESSSAR** but there will always be some crossover of content between the magazines.

ACCESS&RESCUE is our FREE Bi-Monthly, digital-only (pdf) E-magazine for: TECHNICAL**RESCUE**, ARB**CLIMBER** and **WILDERNESSSAR** magazine readers. It covers Rope Rescue, SAR, USAR, Extrication, Water Rescue, Rope Access, Tree work and Tactical subjects providing SAFETY RECALLS and NOTICES, new and archive articles, Product News items plus news and events.
Get your download link via the websites:
www.rescuemagazines.com or www.arbclimber.com
Email us to receive it free, automatically every quarter.
accessandrescue@aol.com

Bluewater Ropes' Armortech Rope with a mystery piece of hardware currently under review. Armortech is a military grade rope using Technora as a tough, abrasion and heat resistant fiber in the outer of two sheaths. Cost aside, such ropes are just as applicable to rescue as they are in the tactical world. See our On-the-Cover page overleaf for details.

Bluewater (BW) Armortech Rope 7/16" 11.5mm

This issue's FRONT COVER features the Bluewater Armortech rope available in the slightly larger metric size of 11.5mm more accurately reflecting its US-made 7/16" imperial size I guess. Armortech is all about the Technora fibre but let's first mention that it has a double sheath, something we've not used much in many years. Primarily because we were put off by the immense stiffness and that handling seemed to get worse with age in those early military ropes. This isn't a review and we could simply have put some facts and figures here and left it at that but this has looked to be a far more useful rope than simply discounting it as a Special Forces or firefighting rope. For starters, even with a double sheath over-laying a nylon core it handles like a high quality nylon and seems to retain that handling even after high speed repetitive revolutions through a descender (mechanically replicated rather than continuous abseils/rappels). The second sheath is an orange dyed Polyester and when you see that orange colour show through the sand-coloured outer you know it's time to take stock because that takes some kind of abuse. We cut through a standard nylon rescue rope with a sharp blade like it wasn't even there leaving a cleanly cut fibre end. We expected Technora's resistance to be more about resisting blunt-force trauma from a concrete edge and that it too would succumb readily. But it was determined all right. Rather than slicing through we had to saw and even that initially just kicks up fluffy fibres. It will cut of course, it's not chainmail but it's amazingly resilient and so it should be at over $6. a metre. But even that price is not half bad in this now crowded specialist fibre market where you can easily pay double that for high-end aramid ropes.

Bluewater describe ArmorTech® as excelling "in harsh environments where cutting, grinding and welding take place because slag will not stick to this rope" and indeed there's little point trying to melt the fibres on the end with your lighter! Technora will withstand 934 degrees - I bet that trumps your Zippo.

You would think that the lurid green thread would be counter to the 'covert' theme of this rope but as usual the 'Sand' camo is not 'tactical', just a consequence of the natural colour of Technora and it's fastidious refusal to accept dye. Good though this rope is for the tactically inclined amongst you it is equally good for anyone requiring fantastic abrasion and heat resistance while retaining the ability to still bend the rope into party balloon animal shapes. We will try to get hold of a longer review length to verify how it stands up to using a range of different pieces of hardware but our impressions to date are that this is an excellent representative of this genre of ropes.

SPECIFICATION

Elongation:
@ 300 lbf. = 5.1%
@ 600 lbf. = 7.3%
@ 1000 lbf. = 9.8%
Diameter: 11.5mm (7/16")

Weight: 97g/m
6.5 lb/100ft
Tensile Strength: 8,500 lbf.
37.8 kN
Sheath Mass: 53%..
Cost: 100m: $631.
www.bluewaterrope.com

EMERGENCY DESCENT/ BAIL-OUT

[ED: Bail-out has been the unifying product of rope-hardware manufacturers in recent years – every company in the fire-rescue sector seems to have one. We're currently using/reviewing the CMC LEVR (which should have been in this issue but we ran out of room as usual) and so far is another excellent option. The Deus 3100 too may be pretty good justifying their claim to be the most 'advanced' but this is a market crowded with new and very functional products so it's a claim worth checking out]

The DEUS 3100 is quite simply the most advanced personal rescue system available for fire and rescue. It is a whole new breed of hands-free technology designed and built to the highest standard of all. The DEUS 3100 delivers easier, safer, more practical and completely hands freebail-out. The DEUS 3100 is available as part of a kit, or can be combined with kits for a wide array of emergency and training uses and include accessories like the Deus Fire Escape Anchor ($85) with an interior contour lined with grip-tight "teeth" rounded to protect hands and rope.

SPECIFICATIONS

STD DUES 3100

Descent height	30.4 m (100 ft)max
Load Rating	136 kg (300 lb)max
Descent rate	3 m/sec max
Weight	0.9 kg (plus rope)
Dimensions	13 x 9 x 5 cm 5.3 x 3.5 x 2.1 in
Operation	Hands-free or manual
Construction	Aluminum, stainless steel, brass
Standard	NFPA 1983 (06-ED)

EscapeDEUS 3100 features a rock-solid case, professional grade construction and quadruple-redundant safety with four brakes:

- a hands-free figure-8
- a drum brake
- a manual friction brake for precise control
- an automatic centrifugal brake to protect from free fall

Hands Free. Escape3100 operates fully hands free, stop or go, while protecting you from free fall. It limits descent speed to a safe 3 meters/second maximum, about the same speed as jumping off a chair. It is lightweight and portable; pocket-sized and just 0.9 kg (plus the rope).

Proven Reliable. Firefighter tested and certified to meet NFPA standards.

Simple Operation: the oversized control knob is all you need for complete control, even with heavy gloves. Stop or go and change speed any time during descent.

Uses Quality DEUS Rope. The DEUS 3100 is certified for use only with 7.5mm DEUS ropes. These NFPA-certified fire and cut-resistant kernmantle technical ropes are specifically designed for the DEUS 3100. Use it for personal rescue, 2-person rescue, heavy rescue, vertical positioning, confined space rescue, hauling and lifting, and more. The DEUS 3100 is available in a variety of complete kits from $ 1,304.00

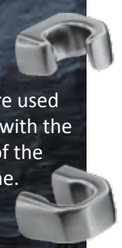
www.deusrescue.com

I'D PETZL EVAC

[ED: If you're not busy rescuing yourself by bailing out with that 3100 opposite, you'll hopefully be rescuing someone else and this new variant of Petzl's market-leading autolock, the I'D, could be just the thing. I thought it did this anyway but the new version takes away some niggles with the handle and autolock when using the I'D upside-down. It has an extra friction post if you want to use it, max working load of 250kg for 10mm-11.5mm ropes a hole in the handle for cord so you can use it remotely and weighs 615g it's a tad heavier than the I'D S and L versions. There was talk of the handle being a different colour to other versions, maybe grey but the Most of the blurb is equally applicable to other ID's ....]

The I'D EVAC is a self-braking descender with anti-panic function primarily designed for lowering from an anchor. The ergonomic handle is specifically oriented for managing of a load from the anchor and offers comfortable descent control. The integrated anti-panic function and anti-error catch limit the risk of an accident due to user-error. The AUTO-LOCK system allows the rope to be automatically locked without having to manipulate the handle or tie off the device. Once locked, the rope can be taken up without having to manipulate the handle.

Auxiliary Closed and Open Brakes are accessories for I'D S, I'D L and I'D EVAC self-braking descenders. They are used to increase the friction in accordance with the weight of the load and the diameter of the rope, or to release the rope at any time. The closed version additionally provides a constant redirect of the rope. www.petzl.com



EDGE NEGOTIATION

in YOUR POCKET.....well Almost

[ED: this very slick item is the RAFA by Israeli tactical and access company Highnovate. It folds down to the 5.5kg/ paperweight you see directly above and then unfolds to release a vice-like arrangement using legs with rubberised feet (or they can have spikes) that hinge out to 90 degrees from the main spar. When you depress the black button in the centre the spar telescopes out to accommodate whatever width parapet, sill or wall you need to rig from. The inboard foot has an eccentric camming action so that once your spar is adjusted for width a handle gives you leverage to lock it firmly in place by camming a few mil out from the legs, similar to a glazing suction cup (without the suction). This also allows for easy release when you're finished. You clip your anchor carabiner into the eye you can see top left of the device.

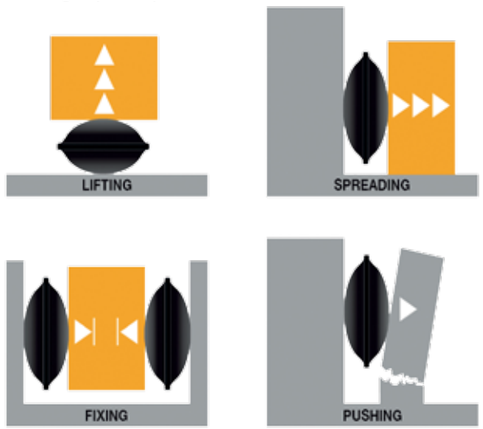
Also from Highnovate is this carrier-line mount made of tough plastic polymer, for a drone. This is something we discussed as an option about 15 years ago before drones even existed. Back then we were using remote control helicopters for surveillance but talked about using them as a delivery system for water rescue, delivering floatation (now a common drone option) and a carrier line to stranded or through-ice victims struggling to reach safety. If the carrier cord was too fine they could pull a full size line out. Drones superseded the helis and now this carrier package makes that original idea a reality and better still it can be mounted to a wide range of mid-range drones. Anything you might previously have done with a pneumatic or pyrotechnic line-launcher can now be very accurately achieved with a drone as long as the weather isn't too horrendous – then you're back to square one. You can span chasms, rivers, lakes, cliffs, ship-to-ship, shore-to-ship, building to building, ground to roof etc.

TOURNIQUET

The "PAX Limb Tourniquet" (PET) is a tourniquet system for severe bleeding on the extremities. Due to its variable length and the winch system with locking points at 90 ° per turn makes it equally applicable for arms and legs. With manual pretensioning when applying the band, only a few turns are needed to ensure bonding through the PAX limb tourniquet. On the writing surface at the end of the tape, the application time and further notes can be noted. weight: 60g
Cost: €40 **www.pax-bags.com**

MFC Pneumatic Lifting bags updated

The latest variant of ***Stak Jak*** bags from MFC International has several advantages over traditional ovoid lifting cushions including the ability to safely stack up to three cushions.
The Stak Jak is a revolutionary flat-profile lifting cushion developed for vehicle and heavy-duty lifting requirements. Primarily used in emergency rescue situations, they are also suitable for a wide range of industrial, mining and military applications.
The flat profile of the Stak Jak has several distinct advantages over traditional ovoid lifting cushions of which the most significant is the ability to safely stack up to three cushions together. This enables a greater lifting height without the risk of sudden ejection or instability that can occur when stacking ovoid mats.
Stak Jaks have a slim profile for tight space scenarios and compact storage. They are constructed from compression-moulded neoprene that is reinforced with exceptionally tough high tensile Polyaramid cord (DuPont™ Kevlar®) that provides strength and rigidity, yet are light enough to be carried by just one person. The outer, hot-vulcanised, neoprene cover features a non-slip matrix pattern on both surfaces to increase friction and holding capability.



Stak Jaks can be inflated quickly to provide an instant lift, making them ideal for use in rapid response emergency situations. They also have a controlled deflation facility if required.
Our 12 bar Stak Jaks are intended for lifting, lowering, positioning, separating and moving of loads weighing up to 90.000 kg (90.0 tonne) per bag.
Using special neoprene material allows the Stak Jak to be used within a temperature range of -30°C to +90°C.

www.mfcinternational.com

Streamlight DUALIE WAYPOINT

The Dualie Waypoint® light offers dual light technology with a forward facing spot beam and a bottom facing flood light that can be used individually or at the same time. It exhibits long runtime using 4 “C” sized alkaline batteries, high, medium and low intensity modes, and the latest in power LED technology. The spotlight provides a high powered beam for distance spotting and the bottom/downcast light for all your area lighting needs. The ergonomic handle hooks over any door, pipe, bar, cable or ladder rung for hands free operation. It also includes other innovative features like the D ring and integrated stand to make the light perfect for any lighting need. The light is sealed and floats, so it’s great for wet applications.

COST: $95 / £80
MATERIAL/LENS
- High impact polycarbonate housing
- Rubberized lens cover
- Available in yellow/black
- Unbreakable polycarbonate lens, o-ring sealed.

LIGHT SOURCE/OUTPUT:
- C4® LED with multiple lighting modes
- High Lumens 1,000
- Run Time – High 3.50 hrs, Low 125 hours
- Beam Distance 548 meters
- Max Candela 75,000

SWITCH:
- Push button switch with momentary and click on operation. Using the momentary switch function, tap once for high, twice for medium and three times for low.

BATTERY:
- Four “C” sized alkaline batteries. (not included)

DIMENSIONS:
- 6.75" x 6.5" x 3.55" / 17.14 x 16.5 x 9.0 cm

WEIGHT:
- 2.06 lbs | 934 g w/o batteries

FEATURES:
- LED Solid State Power Regulation provides maximum light output throughout battery life.
- IPX7 rated design; 2 meter impact resistance tested.
- Integrated stand and D ring for hands-free lighting.
- Approvals: Meets applicable EN directives.

WARRANTY: Limited lifetime warranty excludes rechargeable batteries, chargers, switches and electronics which have a 2 year warranty with proof of purchase. www.streamlight.com

Kent RESCUE PFD

Type V

The Kent Swift Water Rescue Vest (SRWV) is the latest in Type V personal flotation devices designed for the challenging environment of a swift water rescue. The vest is constructed with 500 denier black Cordura for durability with 400 denier hi-visibility green nylon to ensure the user is easily visible under any conditions. In addition, Solas grade reflective panels have been added to the front chest, stomach area and the back for even more visibility under low light conditions. One inch lightweight durable flotation foam provides a minimum of 22 lbs. of positive buoyancy. Three – one inch wide webbing straps with heavy duty plastic adjuster buckles provide enough flexibility to fit most rescuers. A quick release harness with a large steel D-ring on the back has been incorporated into the vest for keeping the rescuer tethered if needed. There is a sturdy grab handle sewn into the rear of the vest by the neckline to assist team members in retrieving the rescuer. For storage, the vest has a large zippered front pocket, front lash tabs, covered strap attachments and multiple lashing areas for lights, knifes and other necessary gear. A whistle with a sewn in tether is located on the left side of the vest in a pocket under the Solas reflective strip. A pair of leg straps with metal O-Rings and snap hooks are included which could be easily removed or re-installed just by clicking the snap hook back into the O-Rings if the situation requires them. Finally, a clear panel has been sewn into the upper back for a name or agency to be displayed.

- Hi-Vis yellow fabric
- Zippered front panel covers buckles to reduce snag hazards
- Grab handle to assist rescue team members retrieve the wearer
- Three encircling belts with heavy-duty buckles
- Durable 500 denier Cordura® and 400 denier hi-vis nylon
- Lightweight and durable flotation foam
- Quick-release rescue harness
- SOLAS Grade reflective material
- Large zippered pocket, front lash tabs, covered strap attachments and multiple lashing areas for lights, whistle, knife, necessary gear
- Clear panel on vest back for name badge
- Leg straps with metal D-rings and snap hook
- Minimum 22 lbs. of buoyancy
- * U.S. Coast Guard Approved Type V Life Jacket / Personal Flotation Device (PFD) ** Swift Water Rescue Vest (SWRV) Tether NOT INCLUDED **

COST $190
www.kentsafetyproducts.com / www.rocknrescue.com

Procuring an.....
Enhanced Helicopter Paramedic Helmet System

by **Cameron Edgar**
Director Helicopter Operations,
NSW Ambulance Helicopter Critical Care Paramedic, Special Casualty Access Team

Consistent and clear communications is an essential component of safe and effective aeromedical helicopter operations. Traditional down-the-Wire (DTW) helmet-based aviation communications have been limited due to the dynamic and varied operational environments for NSW Helicopter Paramedics and the technical ability of existing radio and flight helmets.

AIM

The project aimed to provide a purpose designed helmet and radio headset system that delivers improved head, eye, hearing protection and situational awareness for use across the broad range of Helicopter Paramedic missions.

BACKGROUND

Traditionally NSW Helicopter Operations have used a conventional flight helmet but it was not designed for the mission flexibility required for the broad range of environments NSW Helicopter Paramedics operate in such as cliffs, caves, canyons, offshore vessels and remote areas.

The current conventional flight helmet system is expensive, limited in operational use and requires specialist repair. As the helmets are a single unit comprising intercom, head, eye and ear protection, the need for repairs can result in the helmet being unavailable for extended periods.

METHOD

A review of safety reports and operational debriefs was undertaken in order to determine the scope of work required for an enhanced helicopter helmet system. A world-wide scan of alternative helmet system solutions was undertaken, with military special operations providing an insight into a possible solution.

Phase 1 included detailed discussion with a range of manufacturers. Three helmet systems were chosen for proof-of-concept testing over six months. Testing was undertaken in partnership with aviation contractors to ensure safe integration with existing airframe and communications systems. At the conclusion of the testing a single system was selected for an extended trial.


The base version of the Exfil SAR prior to NSW Heli modifications

Phase 2 involved a detailed risk assessment in conjunction with helicopter contractors, leading to a two year trial which saw selected Helicopter Paramedics fitted and trained in the trial helmet system. The goals included:

1. Identify opportunities to rationalise multiple existing helmets (flight/roping/water/road crash).
2. Validate the ability for the system to integrate with a range of operational equipment required for the full spectrum of Helicopter Paramedic operations (eg; head torches, night vision goggles, video cameras, safety eye wear etc).
3. Provide enhanced communications and situational awareness through improved aircraft intercom, ambulance radio and face-to-face communications, without the need to take the helmet off (important for canyon and cliff mission profiles).
4. Provide radio communication flexibility; can have headset turned on for aviation operations, and on or off for roping operations, as well as meet all Electro Magnetic Interference requirements.
5. Provide a modular solution that if part of the system's communications or PPE becomes unserviceable, the faulty component alone can be replaced.
6. Identify opportunities for cost savings compared to the current multi-helmet approach.

Phase 3 consisted of a formal report with recommendations and a supporting business case with detailed costing to secure funding.

Funding was provided for the rollout of the System to all 60 NSW Ambulance Helicopter Paramedics and the introduction staged over 12 months.

OUTCOMES

We went with a Team Wendy Exfil SAR helmet & a 3M Peltor Comtac headset. Eye pro is all ballistic rated, with most going for large ballistic goggles, that are fire retardant and tinted. We have the ability to mount night vision goggles and counter weights on the back (which we use regularly)

The Enhanced Helicopter Paramedic Helmet System is just completing operational rollout and is proving to have notable benefits for complex search and rescue helicopter operations, with minor adjustments being made as the system is bedded in.

The system provides increased head protection during cliff and canyon missions, as well as increased situational awareness when interacting with ground teams. It has allowed for a level of rationalisation of multiple helmets and is half the price of an off-the-shelf flight helmet.

Once the system has been well bedded a review will be conducted to identify opportunities for Helicopter Doctors.

Several other Australian state and territory ambulance services and aeromedical operators have begun early trials of similar systems to determine if they meet their local operational needs.

ED: We have active reviews going on at the moment with two Team Wendy helmets which, for those not on a tight budget, are pretty near the top of the tree in terms of build quality and performance. These reviews are due to appear in WILDERNESS SAR magazine for the Ski version of this helmet and in TECHNICAL RESCUE magazine for a full tactical version. We had no knowledge of the contenders for the NSW Heli project let alone which model was eventually chosen until Cam submitted this piece well after our own review began. Therefore, any appearances of Team Wendy having taken over the world and ownership of this magazine are purely coincidental. It is however, nice to know that our findings to date have been at least partly validated by the NSW Heli trials.

Driver Casualty Extrication

QuickCuts #11

Car-Upright, Roof OFF, Out-the-Back.....

by **Rich Denham & Nick Appleton**

TRm Extrication Editors: Veteran London Firefighters and instructors, Rich is now with Gannon Emergency Solutions in Latin America and Nick is with Babcock PLC under contract to London Fire Brigade

Extrication (noun) : Free (someone or something) from a constraint or difficulty
Oxford English Dictionary

There are many crash rescue manuals with 'Extrication' in their titles, but for the most part they concern themselves with space creation and not actual casualty extrication, so here we aim to deal purely with the removal of casualties from crashed vehicles rather than the vehicle dismantling process. It is timely that we review this process as we may soon see less emphasis on spinal immobilisation which has been the literal backbone of extrication considerations forever. It will take a serious change in mindset and procedure to have the majority of casualties 'cleared' of spinal complications by the medical attendance on their arrival. The number of roof-removals would certainly reduce. But since any change in protocol is some way off, in this enlarged article, we will look at two contemporary methods of extricating a driver-casualty.

We'll start with the 'classic', and probably the most popular training scenario, extrication of a driver casualty from an upright saloon car. With an assumption of a roof displacement to accommodate a suspected spinal injury the generally quicker option is with the roof flapped forward or the roof might be removed altogether. It should be noted that there are many variations on this theme, but the methodology demonstrated here, shows, in principle, how this extrication can be performed by just five practised rescuers who frequently change roles rather than positions:

Fig 1: Start position – Firefighter (Ff) 1 has control of the head while Ff2 and Ff3 stabilise the casualty. Note the passenger seat-back is already flat for ease of rescuer movement.

Fig 2: Ff2 has partially moved the driver's seat-back rearwards to allow the placement of the long board by Ff4.

Note that this procedure became standard for virtually ALL extrications where the mechanism of injury might cause spinal compromise. The issue of litigation is such that it was felt to always be better to err on the side of caution. Latterly this thinking has been questioned with faster clearance of possible injury and therefore more rapid self-extraction felt preferable to a protracted extrication.

Fig 3: A fifth Firefighter now enters to assist in positioning the board. Once both casualty and board are stable, the driver's seat back is moved fully down, followed by then lowering the casualty and board as one unit. The head end comes to rest on the top edge of the back seat, from which the head-rest has previously been removed. *Note that if casualty and board are lowered as a unit together with the seat back, the casualty will experience juddering which will be uncomfortable and may also make existing injuries worse.*

Fig 4: moving anti-clockwise, Ff4 has now moved around the car to take control of the head (notice top and bottom grip) from Ff1, who now moves to take control of the casualty's legs. In fig 4b below, FF1 does not release the casualty until Ff4 has properly taken control of the casualty's head. Ff3 and Ff2 are about to assist in sliding the casualty up the board. FF5 has now taken control of the head of the board.

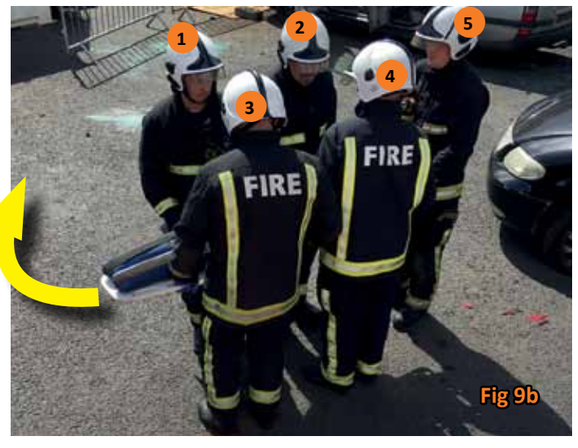
Fig 5: The casualty is slid to the top of the long board, ideally, in two purposeful slides in quick succession. No handovers.

Fig 6: The casualty and board are now level and stable and Ff4 is handing over control of the casualty's head to Ff5 – note the contrasting grips for the handover. *Also note that at this point (and at the call of the medics), the casualty can be secured to the board.*

Fig 7: Ff4 has now moved to Ff5's left side (right as you view Fig 7a) to support the top of the board on that side.

Fig 8: As the casualty and board are moved away from the car in small and distinct movements, Ff3 leaves the car to support the board next to Ff4 – note the interlocked hands and arms of the Ff's on each side of the board. *Also note that at this point a further rescuer (not shown) would be standing behind Ff5 to guide him as he temporarily walks backward*

Fig 9: Once clear of the car the board and casualty can turn in the direction of the ambulance, with Ff5 at the head of the casualty directing progress as they walk forward.



For clarity, the O2 mask, tubing and cylinder were left out of the photo sequence, although it really must be included and actively managed in all training activities, what with the tendency for the tubing to snag and the cylinder to roll off in training and operational circumstances alike. In the next section the same casualty extrication, but this time in a confined space….

Car-Upright, Roof ON, Out-the-Back.....

People-movers/MiniVans

Here, we are still assuming a prospective spinal compromise but before resorting to cutting and spreading to create space, what if there is a quicker and less traumatic way to undertake the extrication of the casualty, for instance where the fire-rescue service and medical team leaders agree that there is adequate compartment space without structural tool use. Or if there is only a limited tool inventory available and the casualty requires a quick release or you have some form of restricted external access?

Assuming that the doors will open or can be forced relatively easily, simply unbolting and removing seats (in this case the rear bank) may create sufficient safe space to rapidly remove a front seat casualty by suitably practised rescuers. Incidentally, there is a training gain here because, for the sake of exercises, the doors can simply be opened and the seats unbolted or stowed in the case of some people carriers. This is an evolution that can be continuously repeated as, after each practice, re-bolt the seats, close the doors and start again. This is a real plus in the face of austerity and (in)efficiency cuts in training budgets..... for ease of demonstration, we have used a people carrier, but with the proliferation of SUVs and 'crossovers', the technique could be used on many vehicles with a larger compartment area and can use as few as 5 rescuers:

Fig 1: The starting position of the extrication – the rear seat bench has been removed (*see previous article on Impact Wrench and unbolting in issue 70*) and the doors driver's door and rear hatch would be open. Note that the paramedic is not managing the casualty's head from the driver doorway because this space is needed for other functions, see later...

Fig 2: There are five rescuers in this photo! in addition to the Paramedic (1) holding the casualty's head from the front, a Firefighter (Ff) (2) is kneeling in the driver doorway with one hand (purple gloves)on the seat back winder and the other hand is stabilising the casualty, a Ff (3) and the Doctor (4) are prepping in the rear compartment and an Ambulance Technician (5) in the rear driver-side doorway is receiving a head hand-over briefing from the paramedic.

Fig 3: Note the blocks positioned on the compartment floor as a leveller with the casualty's seat base, so the casualty doesn't slide downwards to the head of the board when laid on it.

Fig 4: There is an intermediate hand over of the casualty's head to the Medic and the casualty is fully supported by Ff's behind the passenger seat and in the drivers doorway, before the seatback is lowered and the extrication board is placed.

Fig 5: There is a further intermediate head handover between the medic and the Doctor.

Fig 5

Fig 6: The casualty is now laid flat, the paramedic and the Ff in the driver doorway having managed the legs during this process. Note that the Doctor has the casualty's head in a top to bottom grip, so that ultimately the paramedic (who will have moved to the rear of the vehicle) can easily re-receive the head using a contrasting/complimentary side to side grip.

Fig 6

Fig 7: The view from the recently vacated driver casualty's seat shows the Doctor has transferred control of the head to the paramedic and the casualty is now ready for removal from the vehicle. On the decision of the medical team Leader the casualty could be fully secured to the board within the vehicle prior to removal the vehicle.


Fig 7

Fig 8: Casualty now removed from the vehicle, prior to transfer to the ambulance gurney.

Fig 8

Note that although this is a fairly specific circumstance, many of the casualty handling principles are common to most extrications.

Of these principles, multi-tasking is the most used. Note that control of the casualty's head is handed over no less than three times. Also that multiple tasks can be undertaken from one position, for example the Ff in the drivers doorway will first assist in stabilising the casualty, before winding the seatback down, assist in lowering the casualty onto the board and then finally assist in lifting the casualty's legs free of the footwell – all from the same position!

As previously mentioned, a top tip whenever practising casualty extrication is to always have the casualty on oxygen, as managing the accompanying 02 hose and cylinder in such circumstances is often neglected and is an art-form in itself. In conclusion and as suggested by the photo sequence, casualty extrication evolutions are most profitably practised with your local medical teams and of course using their and your local protocols.

HANDHELD Search Cameras

Aside from the use of drones as a vehicle on which to mount search cameras, there hasn't been much to get excited about in void-searching camera development in recent years. That's testament to how good and robust the existing technology is I suppose with one or two of the top models virtually unchanged since the last century.

Applications for pole-mounted search cameras began evolving about 20 years ago so that vehicle extrications in particular together with water searches became a more regular use of cameras previously marketed only at victim location in building collapse rescue. 'Pole-mounted' evolved into 'cable-lowered' and even helmet or ROV mounted. The biggest change within the market in recent years has been the purchasing of many of the main players in each sector by just three entities; *Scorpe, Savox* and *Leader Group* or *Groupe Leader* depending on which country you're in. The latter two companies dominate our sector as one-stop shops for disaster response equipment with *Delsar, Search Cam* and *Con-Space* on one side and *LeaderScan*, *LeaderCam* and *LeaderSound* (breath analysis) on the other – all are industry icons, as valuable today as they were in the 1990s.

Another legendary name from that period that seemed to disappear for a while outside of France is the Vibrascope and associated Vibraphone. This company was bought by Scorpe and added structural movement monitors to their existing range of hydraulic tools and lifting bags so they truly are a one-stop-shop.

The problem with many sectors of rescue is that the market is so specialised and financially small, that development stagnates once something is found to work well. Look at *Con-space Communications*' hard-wired system. That has hardly changed in over 30 year and is still the leading, if not sole, main contender for prospective purchasers of intrinsically safe, duplex comms. The same goes for Search Cam (both brands now being under the *Savox* umbrella). There will be changes of course; optics, acoustics and electronics are all superior now even if the outward appearance is the same. There was a period in the early 2000's when much smaller systems like Red Box began to appear aimed more specifically at vehicle extrication and even underwater search at a more affordable price. Disaster response, however, continued to specify the larger, more complex and proven robust systems so SearchCam has remained at the forefront and is now sold as the 3000 together with its smaller brother the Recon III. The visually similar *Pro-Eye* from *Yone Corp* in Japan expanded on the underwater capability with a system that has sonar as well as a camera while *Groupe Leader* augmented their *LeaderSearch* acoustic system with *Leader Cam*, a system more in tune with the proliferation of separated camera and TV systems. One notable model that piqued a lot of interest when launched a couple of years ago and the impetus for us compiling this guide is the *FirstLook360* which we have mentioned a few times in this magazine and in our Emag ***Access&Rescue***. This has taken many of the best features of current market leaders and incorporated some neat additions to set it apart. Not least is its ability to wirelessly transmit high resolution images to smartphones and tablets, doesn't everything these days? Apparently not and ironically, it's Andy Ibbetson, the son of the founder of *Con-Space Communications* Terry that has co-developed this new camera, presumably drawing on his and Terry's decades of experience in the confined space rescue sector. I say 'ironically' because, unlike the *Con-Space Comms* system, which is firmly rooted in 'old' reliable technology, *FirstLook360* embraces every element of smart technology which is why it is worlds apart from most of the others. And the same reason that *Con-Space Comms* has stood the test of time could conceivably be why the *FL360* uses direct, one-one wireless connectivity rather than relying on satellite or mobile-network-dependant connectivity.

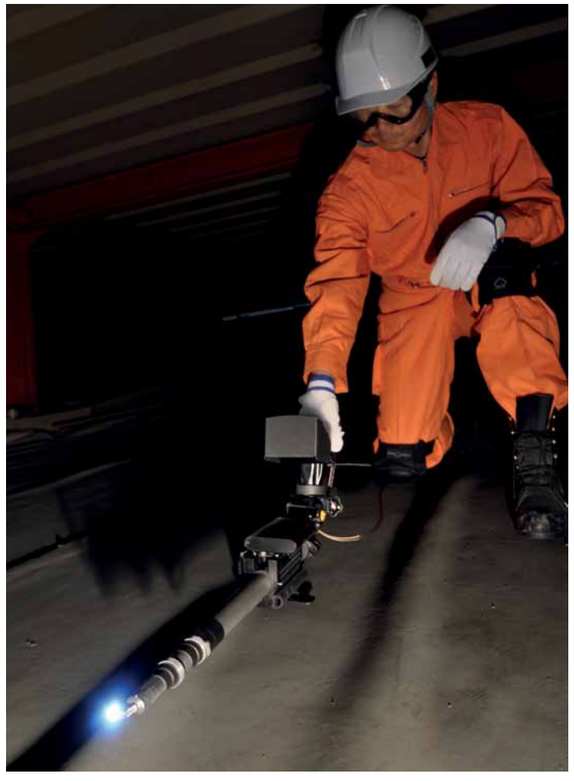
Electronic, fly-by-wire and direct transmission is far superior most of the time but when mobile WiFi and Satellite comms fail so does your camera. Close-system connectivity using a wireless signal bypasses this particular failure mode but, as with all digital transmission, can presumably be hacked or jammed in some way if anyone was desperate enough. So, just in case, systems like *FL360* can be hardwired as well. You sometimes *can* have it all ways and it has to be said that catastrophic failures predicted by the doom-merchants for fly-by-wire and satellite dependent systems when they first appeared have proven largely baseless and indeed have probably been far less that the 'mechanical' or analogue systems they replaced. One thing the *FL360* doesn't do which most of the others list as a key feature is have a mechanically articulating camera head. The *LeaderCam* left and above right (as featured on Issue 73's front cover in use with the White Helmets in Syria and here with sunlight shroud on the screen) can be made to look sideways at the flick of a toggle by the camera operator. Plus, of course, the person manipulating the camera can rotate the pole – which is a handy back-up should articulation jam. Agility Corp, the new kids on the block, thought, what's the point of all that sophisticated camera head articulation and associated telemetry? If we stitch

together the image from two wide-angle, side facing cameras to give a full 360 degree view it wouldn't need to move to look sideways. In the picture on the previous page you can see one half of the protruding 'bubble' lens at the top next to square LED lights (there's also a battery level and pairing indicator just below the 'F' of the product name.) It's like having 20x20 peripheral vision with no time-lag that you would otherwise get while articulating the camera head. Can't argue with that and so the 360 bit of the name was born. With no reliance on head manipulation there's less to go wrong. The camera head, remember, takes pretty much all of the abuse, and although they're built to be rugged with substantial protective shrouds around the hinge-points they're still vulnerable to damage and jamming when unceremoniously shoved through a small opening in dusty, dirty, sharp-edged, re-bar filled concrete.

CAMERA POLES

The original *Search Cam* now in its '*3000*' version and with a lighter, less costly variant the *Recon III* (above) had the TV screen permanently mounted at the end of the pole making the whole assembly heavier and cumbersome because it limited your ability to manoeuvre the camera and pole. Subsequent *SearchCam* models made the screen detachable and this is a standard feature of most modern camera systems which either have the screen hardwired like *Leader-Cam* or wireless like *FL360* but either way this enables much easier forward-operating of the camera by a separate person. This is not always the case, in the picture above, the operator is manoeuvring the *Tactical Electronics Core* pole while viewing a detached screen fastened to his arm – there are definitely times when it's easiest to view something by twiddling the pole yourself, and some, even the aforementioned *FL360* have the option to be mounted to the pole for single operator use. One model has been specifically downsized to be used by one operator – the Yone Nano system (right) has a teeny 7mm head on an otherwise standard looking search camera system with a toggle directed camera, on-handle screen and it runs on double AA batteries, truly light and portable. Savox had something similar with their diminutive 'Mongoose' but that seems to have now disappeared.

Most companies in this sector are first and foremost search camera specialists using or designing the pole or delivery system for that camera. One company however, is a pole specialist that has had a camera designed to utilise their poles. *Reach and Rescue* in he UK have an enormous telescopic pole that can reach up to 55ft/17m indeed, they have a pole adapted specifically to fit the FL360 in addition to its standard pole offerings. This is currently the longest pole in the search camera sector and while it would be outstanding in large void searches, it might have limited applications in regular building collapse where the spectre of 'making progress' rears its head. Actually getting a rigid pole into a space to search can be problematic so camera heads have become compact so that a single manageable bore hole can be drilled in slabs or through brickwork to allow initial entry of the camera and pole.



A much easier device to get into limited spaces is the endoscope-type camera also called a borescope or fiberscope, that has mostly migrated across to rescue from 'inspection' in other sectors. These use a flexible tube from the screen or relay to the camera. The tube can be 'bent' into shape to ease entry into spaces and such cameras have proven particularly useful in vehicle crashes where the rescuers are able to identify specific foot and limb entrapment points before they commence metal relocation. I remember attending an incident many years ago where the first-arriving crew commenced a dash-roll only to find that an extraneous bolt on the old van's steering servo had penetrated the casualty's knee which was now being pulled off along with the steering wheel and dash! Had they existed at the time, a quick look with a flexible camera system would have identified this and enabled an alternative course of action. Since they have evolved from endoscope systems some of these systems can still marry back to an endoscope system ie. have a regular or magnifying eye piece connected to the end of the tube instead of, or as well, as a screen to aid clearer imaging of what the camera is looking at. The downside to these semi-flexible tube systems like *SnakeCam* above and *Unifire*'s (top) is that they are not usually capable of having the camera detached and used separate from the pole/tube and screen. The *Core* system (right) aimed more at tactical users but equally applicable to rescue, offers a number of camera options including this borescope/endoscope-style camera which uses an eyepiece *and* monitor option with wireless transmission.

REMOTE OPERATION

The ''remote probe' idea, where the camera head is detached and lowered into a void was really pioneered by Con Space with their audio-only attachment to the hard-wired *Con-Space Communications* system so its no surprise that *Con-Space*'s second cousin once removed, the *FL360* also has this option with a metal eye that can be screwed in to the camera head as the most robust of lowering attachments. Leadercam has a variant, the RD90 which attaches to a 90m cable and, unlike their standard camera head listed in the following table, is waterproof to the full 90m of the cable.

Many of the cameras have a two-way mic so that the operator can listen for, or communicate directly with the victim with the added huge advantage of full visual acuity of the victim and surroundings thanks to either on-board lighting or an infra-red camera (an option for some) or both. *FL360*'s 'probe' head pictured on page 25 deserves special mention because it is so efficient as a probe with all-around vision and lighting and because it has, along with the Tactical Electronics Core systems, the ability to transmit wirelessly to any android mobile device, be it tablet or smart-phone they have, you guessed it, an app for that. Both systems are app-driven

allowing for updates and ad-ons.
You would think that in this day and age of remote operated everything and drones in particular, that wireless would be standard in rescue but as we mentioned before, this is too specialist an area to attract much funding for development so most of the old stalwarts are updated as best they can be and continue to be sold. There is not necessarily anything wrong with that, look how many wood-burning *Aga* or Range cookers are increasingly sold today in preference to modern alternatives and yet your average Victorian cook would be entirely familiar with it. It's solid and reliable even in the midst of Armageddon, much like some of these cameras! One area that can drive development is the military and one of the few ruggedised, wireless camera systems in this list is from *Tactical Electronics* with one of the most comprehensive range of camera head options in this list. The *Core* (right) also has an encrypted signal partially negating our hacking concern mentioned earlier.

CAMERAS, SCREENS & ELECTRONICS

Quality of electronics and optical components are obviously key to the best systems. You want to be able to see what the camera sees and hear with as much clarity as possible. Headphones, as shown by the *Leader Cam* in our title picture, accentuate and concentrate the mind to listen for relevant sounds cutting out extraneous noise that might otherwise inhibit your ability to hear the faint signs of life coming from an external screen speaker. At least three systems here, the *Savox*, *Leader Group* and *Scorpe* systems allow integration of other assets such as acoustic monitoring, structural movement, breath analysis and even radar in the case of *LeaderScan.* The optics themselves don't necessarily make things easier when you're exploring a monotone dusty void where even exposed skin looks like concrete dust. It can even be the case that enhanced resolution just confuses things as it shows up every grain of dust. This is where infra-red and thermal imaging stand out as invaluable tools but we have yet to see a system with multiple camera systems on one head and the ability to switch seamlessly between them. Thermal imaging can offer the best option for live-person recovery as shown by the *Core* system screen (above) and *Leader Group* now has a thermal imaging camera option for its system which replaces the existing standard camera head when you need it. The TI camera head (below-right) simply replaces the standard camera above it by screwing onto and plugging back into the pole of the LeaderCam. Thermal imaging effectiveness becomes marginal for hypothermic or near-death victims with little surface temperature to detect or paradoxically in very hot environments where masonry retains and emits heat long after the collapse and can mask the bodies diminishing thermal signature.

Modern cameras are pretty much all daylight colour with LED illumination with some switching to infrared in low light which can accentuate and contrast skin tones more easily. Unless everything is covered in dust or is the same colour in which case camera orientation can be a real problem. Without wishing to sound like a rep for the *FirstLook360*, its modernity means it has a useful handle on 'spatial orientation' in environments that are otherwise incredibly difficult to reconcile with what you think you should be seeing. This is to be expected for the newest camera on the market and similarly it has a higher resolution screen than most because it's the newest and is using easily upgradeable technology. Touch-screen overlays on the tablet(s) it's transmitting to show the camera's real-time orientation – effectively an artificial horizon and depth perception indication because, don't forget, it has that 360 degree view – like two bubble observation ports stitched together back-to-back or the product images you see online where you can navigate all around them, back, front, top, bottom. It's not 3D but it is virtual 3D. This system and the Tacical Core models allow video snapshots to be taken of the entire void which is relayed back to larger screens (which might be on the other side of the world!) and enable support personnel to examine for clues in greater detail and report back to the frontline operators if they spot anything worth checking out. With some, like the FL360, images are GPS tagged so the operator knows exactly where to go even if frontline rescuers have long since moved on to another search area.
As mentioned earlier, screens have mostly become a detached component, no longer firmly fastened to the telescopic pole but handheld and most often used by a second rescuer while the first manoeuvres the camera. We will probably see more systems becoming wifi compatible and using apps so that regular tablets and smart phones can be used instead of a dedicated screen. The FL360 for instance uses a *Samsung S2* tablet, albeit the top-end LTE version costing $850 but you can get lesser S2 models for about $300 and the incredibly versatile Tactical Electronics Core systems use virtually anything including radio networks so you can see how replacement and augmentation will become cheaper and easier in the future. However, there is something to be said for the simplicity of a screen with a handful of colour-coded buttons with icons as exemplified by the *Search Cam* screen above. When rain and dust are hindering the use of touch-screens, more conventional button screens will keep working.

UNDERWATER USE

A number of the cameras in this list will operate underwater or at least under the surface of the water, in other words you can break the plane of the surface to get a much clearer view underwater without going too deep – similar to a periscope of a glass bottom boat. Some however, are designed to be used underwater and have attributes that lend themselves to dive team searches or perhaps in place of a dive team search. The Reach&Rescue Underwater, Yone ProEye 751 SNR with Sonar and the JW Fishers models are clearly designed with an aquatic environment in mind but don't forget some of the regular models like the LeaderCam in it's RD90 variant, the Red Box Snake eye and even the venerable SearchCam 3000 which have camera heads that will all go beyond 20m/60 feet in depth.

It's true that these will mostly be involved in body or evidence searches rather than rescue but as has been proven time and time again with cold-water drowning victims, they're not dead until they're warm and dead. Assets like underwater cameras can be the difference between being just-in-time or having not-much-hope-in-the first-place. It could be argued that any team or agency with available cameras AND with bodies of water on their response patch should leave the cameras packaged to be able to search underwater straight from the box since a change to structural collapse mode (if a change is even required) will never be as time sensitive as a drowning victim. It may be that the regular set up using a telescopic pole is your best approach to shallow water searches, particularly for victims that have fallen through ice where a pole can search an area in a radius of several metres from the entry hole or flow-predicted search hole. Cold, deep open water on the other hand will generally benefit from a cable-lowered camera worked in a pre-determined search pattern via boat. Remember that many camera systems offer cable lengths that are far in excess of the camera's depth-rating. This is not an oversight, this is because your camera may be operating LATERALLY from the screen rather than straight down – you may for instance be using a crew on the bank/shore rather than in a boat so that the camera head may be hundreds of feet away and only a few feet deep rather than being hundreds of feet deep. Or you may be search a well or liquid storage tank with a large void before reaching the water. This all sounds obvious but you may want to mark your cables with a maximum depth indication for those occasions when you ARE sending the camera straight down into water.

Another option is a rescue swimmer using a handheld camera like the Fishers CHV-2 or CM-1 with pistol grip (option). This is effectively a hard-wired dive camera capable of working the deepest of all the models in our guide. Nevertheless, it is prospectively still immensely useful even if used at the surface as a sub-water periscope or slightly deeper by a duck-diving rescuer without full scuba because surface monitoring of the screen by attentive observers may spot something the swimmer doesn't. In the case of the MC-2 Mini camera this can be mounted on a pole or even on a helmet (pic above) but is otherwise a fully functioning dive camera which have no lens or camera movement other than being pointed in a particular direction by the rescuer.

Finally mention should be made of Yone's Pro Eye variant with sonar (right) This adds a whole new tool to your array because it is a colour camera on a cable which extends out from a sonar sensor sitting just below the water surface. Once a target is identified the camera can be lowered to visualise the sonar's detection. You don't have to use sonar since the camera can still operate as a stand-alone device but

HANDHELD SEARCH CAMERAS


Red Box Snake Eye


Agility Corp First Look 360


Reach&Rescue


Tactical Electronics Core


ProEye 751 SNR


Leader Group LeaderCam

Scorpe Vibrascope


Savox SearchCam Recon III

there is a gunwale clamp on the camera mount and two different screens in the system case – one for sonar and one for simultaneously colour imaging. The Yone cameras are also oddly unique in using propriety power tool 12v batteries that are easily obtainable from DIY stores, which is a useful option.

IN THE FOLLOWING TABLES.....

We have included ONLY cameras that are actively marketed to and for rescuers even though there are a number of inspection cameras from other industries that might be viable. The majority of these are pole cameras which helps to narrow the field but there are a couple of flexible wire cameras because they are specifically sold to rescuers.

COST: Very approximate. Some manufacturers are oddly reticent to provide a price. We get this in all of our guides and particularly for high cost item which always makes us suspicious that there is differential pricing going on or they feel that a higher cost comparison counts against them.

WEIGHT: There are 2 weights given, the first is the complete system including a case if that is how the system is sold. This is an important figure because it affects the overall shipping limits when moving equipment into a disaster zone. The second figure (in burnt orange) is the weight of the camera unit plus pole as it feels to the person holding and/or controlling it. For some cameras this may include the display screen because it is permanently attached. If not, the display screen is given as a separate weight in green in the SCREEN column.

MIN to MAX LENGTH: the length of pole from shortest extension to longest. A single figure is the MAX extension. Many have extension or longer pole options and some, like the Reach&Rescue and JWFishers don't fit the pole in the case so you would need to factor in that extra weight to the system total.

SUPPLIED CABLE: refers to a camera extension cable to enable the camera to be clipped on and lowered or used remote from the operator. Most kits are supplied with a minimum length so you will again need to factor in the weight of longer lengths if purchased extra to the kit (in terms of air transport for overseas deployments). Cable lengths are shown in burnt orange and in brackets for optional lengths.

SCREEN RESOLUTION, SIZE, WEIGHT: We often see a screen resolution AND a camera resolution but if one is substantially lower than the other you will presumably not be seeing the image to best advantage. Screen or Monitor resolution is usually in Pixels and is shown in burnt orange
Size and weight of the screen as distinct from the whole kit is important where the screen is fully detached and may be hand-held or worn on the sleeve. For some it remains 'embedded' in the carry case (eg. the ProEye Sonar, Reach & Rescue and JW Fishers models) which is sat on the ground or a stand so weight isn't such an issue.

CAMERA RESOLUTION (in burnt orange) for the camera may be given in a number of scales including TVL, lux (for the light-source operating limit rather than resolution) and Pixels.

ADJ RANGE (in black) refers to the articulation angle of the camera head. Some can be controlled by the operator to rotate through as much as 240 degrees (Recon III above right). The FL360 on the other hand doesn't articulate at all but has taken the more obvious option of a camera head that already sees a 360 degree view of the space. Reach&Rescue's camera head is a flexible but stiff articuqaltion that is adjusted manually but normally views in the direction of the pole.

FIELD OF VIEW (in green) is what the camera actually sees or rather the view you see from peripheries to straight in front. In the case of the FL360 you see the entire 360 degree view but for most the view is dependant on how wide-angle the lens is. Endoscope style cameras tend to be quite narrow while larger lenses on SearchCam and ProEye give up to 260 degrees of view. Wide angle can sometimes lead to distortion at the peripheries.

COLUMNS

CAMERA DETACH refers to the ability to remove the camera from its pole or mount and attach it to a cable for lowering.

COLOUR / B&W CAMERA refers to the output to your screen being in full colour (in burnt orange) which may convert to Infra-Red in low light, or Black and White which is the minority of cameras in our Guide here even the Mini JWFishers has a colour option.

THERMAL / IR CAMERA refers to thermal imaging in burnt orange and/or Infra Red (IR) in black. Options are shown in an outline box ☐.

IP RATING is an internationally recognised ingress protection figure for water, dust and gas – none of which is necessarily the same, ie. just because a product is waterproof doesn't mean it's intrinsically safe. The first figure is solids (dust) where 6 is the highest/best. The second figure is for liquids where 8 is the highest/best meaning waterproof beyond 1m and 7 is waterproof up to 1m below water. IP68 is therefore the best.

JW Fishers VRM 2 Monitor

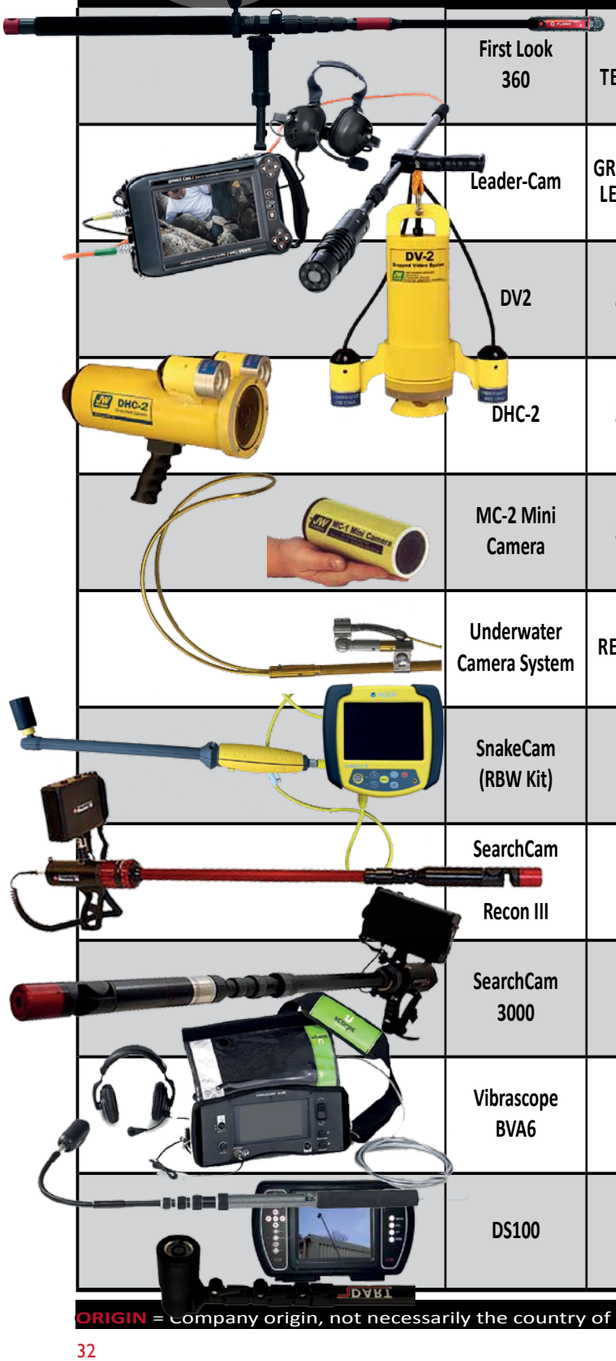
CAMERA IMMERSION is further qualification of the IP Rating to show the actual depth capability of the camera – remember NOT to use cable longer than your camera's depth rating if lowering straight down into water.

DATA STORAGE may be to a hard drive (in black) generally the case with laptops and tablets, SD card in burnt orange for transfer to other devices for manipulation or USB in green which is again normally only with a laptop option as with JW Fishers.

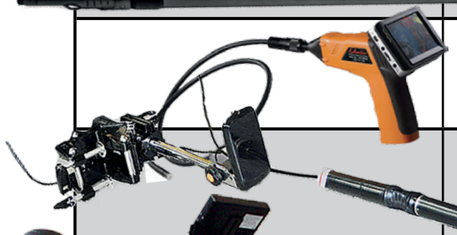
IMAGE/VIDEO CAPTURE refers to either *still images* or *video* in burnt orange.

GPS/GPSIMAGE TRACK this may be on-board GPS to indicate the location of the camera and operator (black square) or it might be an image tracking GPS (in burnt orange) which shows where any given image is taken so that search teams can return to the spot.

HD CARRY CASE: The HD in burnt orange refers to a heavy duty, waterproof, shockproof case like the Peli, Explorer, Storm, Hardigge, IMPH or Otter. The cases pictured here are all toughened, waterproof cases. A case listed as a black square will be a more standard hard carrying case, not necessarily waterproof or shock proof but well up to transporting the camera system. An outline square indicates a soft pack option – maybe a back pack or a fabric carry bag.

IMAGES NOT TO SCALE	MODEL	COMPANY	ORIGIN	COST Basic System excluding accessories	WEIGHT PACKAGE TOTAL IN HAND	LENGTH MIN to MAX SUPPLIED CABLE	SCREEN RESOLUTION SIZE WEIGHT	CAMERA Diameter	CAMERA RESOLUTION ADJ RANGE FIELD OF VIEW	LIGHTS	BATTERY DURATION RECHARGE	OPERATING TEMP	TWO-WAY MIC	CAMERA DETACH	COLOUR/B&W CAMERA	THERMAL / IR CAMERA	IP RATING	CAMERA IMMERSION	DATA STORE SD USB	WIRELESS STREAMING	IMAGE VIDEOCAPTURE	MAINS/12v CHARGER	GPS/GPS IMAGE TRACK	HeavyDutyCARRY CASE	NOTES	WWW.
	First Look 360	AGILITY TECHNOLOGIES		N/A	15.5kg/34.2 lb 1.4kg / 3 lb	3m 9.8ft	2048 x 1536 246mm /9.7" 0.39kg /0.9 lb	49.5mm 1.95"	1920 x 960 - 360°	6 x wide-angle LED	Li-Ion* 3-5 hrs 1.5 hrs	-10 to 60C 14 to140F	■	■	■	□#	68	3m 10ft	■	■	■ ■	■ ■	■	■	*WIll also operate using 4x CR123A cells # IR version/option in 2019	agilitycorp.com
	Leader-Cam	GROUPE LEADER/ LEADER GROUP		N/A	14kg / 31 lb 2.78kg/6 lb	2.4 - 3.4m* 7.8 - 11ft (1x25m or 2x90m cable options)	800 x 480 178mm / 7" 1.38kg /3 lb	47mm 1.85"	700 x 480 0-170° 260°	8 x LED	NiMH or 10x AA 2.3 hrs 3.3 hrs	-10 to 60C 14 to 140F	■	■	■	■ □	54	2m# 6.5ft	■	NO	■ ■	■	□	■	* figures for Std kit. Option fpr Poles up to 5.66m/18.6' Batteries compatible with Leader Scan, Hasty & Search #RD90 version waterproof to 90m. GPS in 2019.	leader-group.eu
	DV2	JW FISHERS		$3295 +$3195*	27kg / 59 lb 6.8kg / 15 lb	No Pole 50m / 150ft (300m/1000ft option)	* 264mm/10.4" 10.9kg/24 lb*	127mm 5"	0.8 lux /480L NO 170°	2 x 1500 lumen LED	Marine, AC-mains or 12v DC	-25 to 60C -14 to 140F	□	■	■ □		-	150m# 500ft	■ ■ □	NO	■	■ ■	NO	□	*For VRM-2 screen module. Camera can be linked to any suitable laptop/display. #300m/1000' housing available. *exc cable, add 9kg/20lb /150ft *Wt includes integral case	jwfishers.com
	DHC-2	JW FISHERS		$3795 + $3195*	23kg / 51 lb 3.2kg / 7 lbs *	No Pole 50m / 150ft (300m/1000ft option)	800 x 600 * 264mm/10.4" 10.9kg/24 lb*	114mm 4.5"	0.8 lux /480L NO 170°	2 x 1500 lumen LED	Marine, AC-mains or 12v DC	-25 to 60C -14 to 140F	□	■	■ □		-	150m 500ft	■ ■ □	NO	■	■ ■	NO	□	*For VRM-2 screen module. Camera can be linked to any suitable laptop/display. #300m/1000' housing available. *exc cable, add 9kg/20lb /150ft *Wt includes integral case	jwfishers.com
	MC-2 Mini Camera	JW FISHERS		$2095 + $3195*	15.4kg / 34 lb 0.45kg / 1 lb*	Pole adapter=$225 50m / 150ft (300m/1000ft option)	800 x 600 * 264mm/10.4" 10.9kg/24 lb*	60mm 2.375"	NO 50°	Halogen or 12 x LED option	Marine, AC-mains or 12v DC	-25 to 60C -14 to 140F	□	■	■ □		-	150m 500ft	■ ■ □	NO	■	■ ■	NO	□	*For VRM-2 screen module & exc lights.Camera can be linked to any suitable laptop/display. Camera is B&W as standard but colour and EuroPAL options. *exc cable, add 4kg/9lb /150ft	jwfishers.com
	Underwater Camera System	REACH&RESCUE		£2014	10.2kg /22.5 lb exc pole	*5m 16.4ft 20 m / 65ft (30 & 40m options)	800 x 480 178mm / 7"	23mm 0.9"	480 TVL 360° (manual) 120°	12 x LED	Li Ion 6-8 hrs 8 hrs	-10C to 50C 14 to 122 F	NO	■	■		68	30m 100ft	■	NO	■ ■	■ ■	NO	■	*Poles can be 5m, 9m 13m or 17m/55ft long. Pole can be simultaeously fitted with rescue aids and body recovery hook (shown).	reachandrescue.com
	SnakeCam (RBW Kit)	RED BOX AVIATION		£4500	1.4kg / 3 lb	0.45m 1.5ft 9.25m* / 30ft (500m option)	640 x 480* 127mm / 5"	30mm 1.2"	512 x 492 90° 46°	4 x LED 1 XeNon	6v NiMH 35mins x 2 (6hr option)	0 to 50C -32 to 122F	NO	■	□	□	68	30m 100ft	■ * ■ *	NO	■ *	■	NO	■ ■	*Basic kit uses a lower res screen with no audio-visual record capability. * Up to 500m cable available + 1.2-7.8m Pole option	redboxaviation.com
	SearchCam Recon III	SAVOX		$9000	18kg/40lb*	1.09-1.43m 3.5 - 4.7ft	640 x 480 146mm / 5.75"	47mm 1.85"	811 x 507 0-240° 289°	16 x LED	Li Ion 2 hrs	-10 to 60C 14 to 140F	■		■	NO	68	23m	■	NO	NO	■	NO	■	*weight is for Hasty kit including Recon III *and* Delsar sensors and accessories	savox.com
	SearchCam 3000	SAVOX		>$15000	4kg/8.8 lb	1.04 -2.34m 3.4 - 7.6ft	640 x 480 146mm / 5.75"	47mm 1.85"	811 x 507 0-240° 289°	16 x LED	Li Ion 2 hrs	-10 to 60C 14 to 140F	□	■	■	NO	68	23m	■	NO	■ ■	■	NO	■	Pole options up to 6m/19ft	savox.com
	Vibrascope BVA6	SCORPE		€12000	13.2kg/29 lb 6.4kg/14 lb	0.5 - 2m 1.6 - 6.6ft 5m /16.4ft (100m/330ft option)	178mm / 7"	39mm 1.5"	0.5 lux 0-360°	6 x LED	12v NiMH 4.5 Ah 4-5 hrs 4 hrs	-20 to 50C -4 to 122F	■	■	□ ■	□	67	100m	■	NO	■	■ ■	NO	■	Data for waterproof camera, more basic camera available.	scorpe.eu
	DS100	SECA		£1890	7kg/15.4 lb 3.5kg/7.7 lb	1.2 - 4m 3.9 - 13ft	640x480 127mm / 5" 3.5kg	65mm 2.56"	420 TVL 0-110° 90°	36 x LEDs	11.1v Li 7hrs 4.5 hrs	-20 to 55C -4 to 131F	■	■	■ ■	■	67	Yes	■	□	■	■ ■	NO	□	DM version has wireless AND wired camera	dartsystems.co.uk

ORIGIN = Company origin, not necessarily the country of manufacture COST: INCLUDES local taxes/VAT . DUTY: HD Heavy Duty, STD Standard Duty, LD Light Duty. ADJUSTMENT: Black box= Standard feature. White (black or orange outline) Box □=Option

IMAGES NOT TO SCALE	MODEL	COMPANY	ORIGIN	COST Basic System excluding accessories	WEIGHT PACKAGE TOTAL IN HAND	LENGTH MIN to MAX SUPPLIED CABLE	SCREEN RESOLUTION SIZE WEIGHT	CAMERA Diameter	CAMERA RESOLUTION ADJ RANGE FIELD OF VIEW	LIGHTS	BATTERY DURATION RECHARGE	OPERATING TEMP	TWO-WAY MIC	CAMERA DETACH	COLOUR/B&W CAMERA	THERMAL / IR CAMERA	IP RATING	CAMERA IMMERSION	DATA STORE SD USB	WIRELESS STREAMING	IMAGE VIDEOCAPTURE	mains/12v CHARGER	GPS/GPS IMAGE TRACK	HeavyDutyCARRY CASE	NOTES	WWW.
	CORE POLE CAMERA	TACTICAL ELECTRONICS		$8623	1.56kg/3.4 lb	0.6-3.2m 4-10ft (5.3m/17ft option)	1280x720 127mm / 5" 0.4kg / 0.85 lb	42mm 1.65"	1280x720 0-360° (manual) 70°	4 x LED	3xCR123 2.5hrs	-20 to 50C -4 to 122F	■	NO	■ ■	■ ■	-	NO	■	■	■ ■		■	■	Hardwire option. 4 different camera head options -Fixed, Flexible, Flat/Under door and small-bore endoscope as well as a K9 camera.	tacticalelectronics.com
	WSC4926	UNIFIRE		$600	0.67kg/1.5 lb	0.9m* 3ft	712 x 486 60mm / 2.36" 5oz	41mm 1.61"	320 x 240 0-360° (manual) 45°	4 x LED	4 x AA 2hrs	-10 to 50C 14 to 122F	NO	NO	■ □	NO	-	NO	NO	NO	■		NO	■	*Cable availbale in 3ft lengths up to 12ft	unifireusa.com
	Pro Eye 751 SNR	YONE CORPORATION		N/A	19kg/42 lb 8.5kg/18.7 lb	2.4m 7.8ft 10m* 33ft	795x595 142mm / 5.6"	36mm 1.4"	811 x 507** 0-180° 231°	12 x LED	12v NiMH (Li-Ion option) 3-6hrs 5 hrs	N/A	■ □	■	■	■	67	50m	□	NO	■	■ ■	■	■	DSX version without sonar. SNR=SONAR & Colour visual cameras 3, 5 & 6m pole options. **PAL version = 795 x 595 *4,20,30 & 50m cable options	yone-co.co.jp
	ProEye 951 S-IR	YONE CORPORATION		N/A	19kg/42 lb	(20m / 65ft option)	177mm / 7"	32mm 1.25"	450TVL 0-180° 270°	12 x LED	12v NiMH 3-4hrs 3hrs	N/A	■ □	■	■	■ ■	67	50m	□*	NO	■ ■	■	■	■	Standard version with colour camera. Second camera interchangeable with IR/TiC *OPTION with 8gb or 4gb SD Casualty temperature monitor	yone-co.co.jp
	ProEye 991 NH Nno-Cam (Handy)	YONE CORPORATION		N/A	15kg/33 lb 3.3kg/7.3 lb	0.7-1.7m 2.3-5.6ft 3m (5m option) 10ft (16ft option)	9cm / 3.5"*	6.9mm 0.27"	0-360° 72°	4 x LED 8 Auxilliary	6xAA NiMH	N/A	■	■	■	NO	67	10m	■	NO	■ ■	■	NO	■	*Standard model has 2.5" screen	yone-co.co.jp

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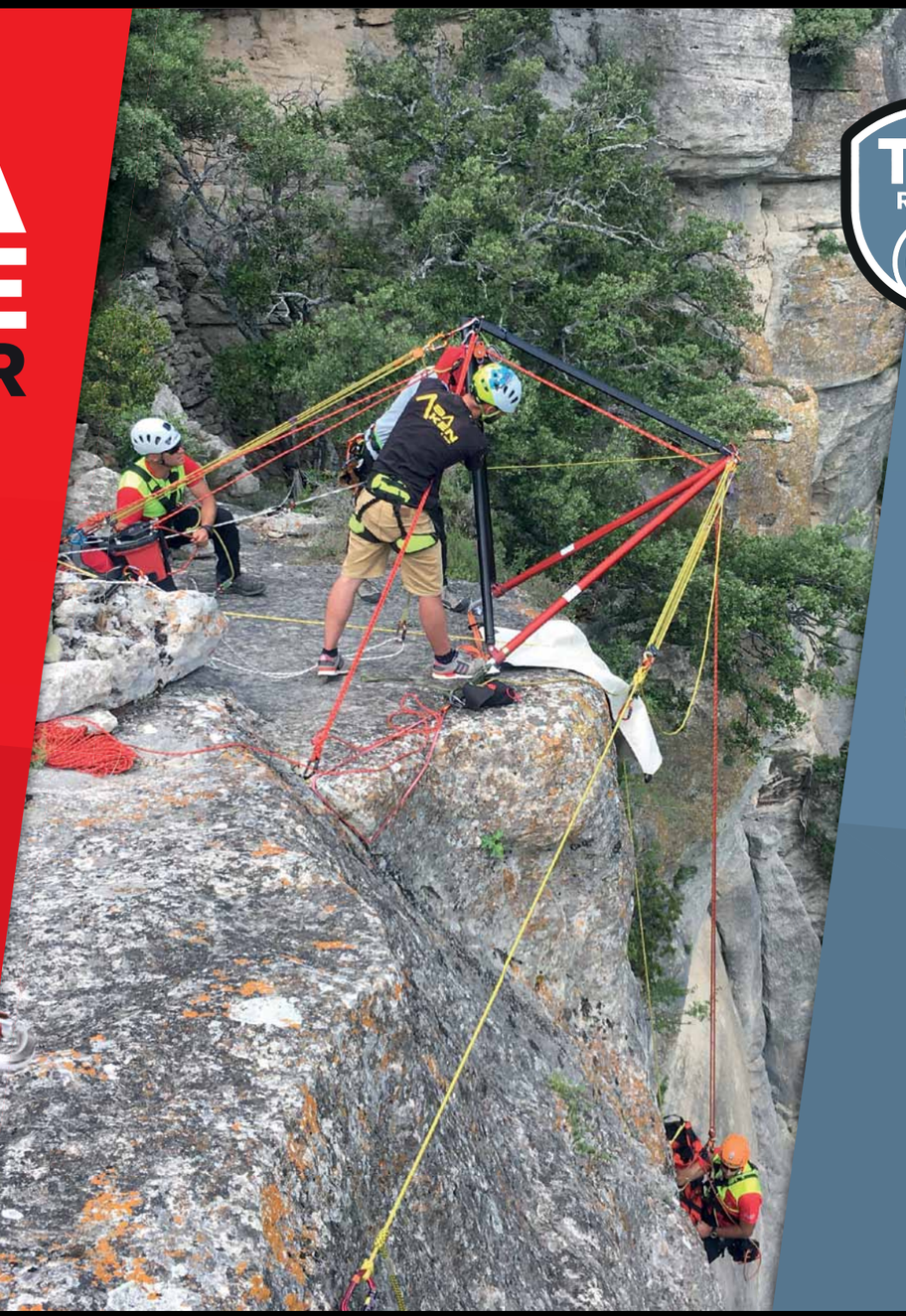

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A ~~YOUNG PERSONS~~ PIRATES GUIDE TO .....

PULLEY SYSTEMS

part1

by Reed Thorne
Ropes that Rescue AZ, USA

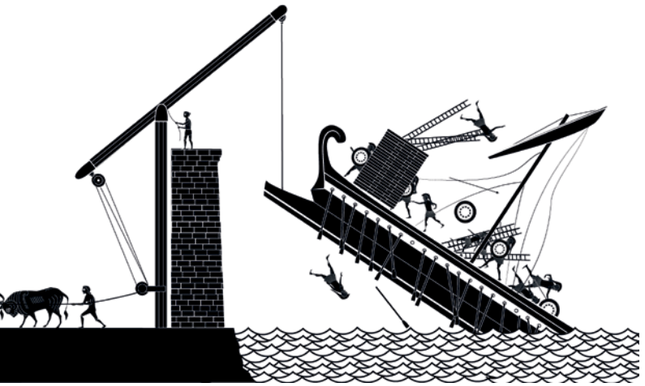
INTRODUCTION

A few days ago, after a somewhat brutal day behind the computer in my basement man cave preparing this article, I was fortunate enough to visit the renowned Oak Creek Brewing Company in Sedona, Arizona where they serve a rather delicious hoppy India Pale Ale (IPA). The German-trained brewmaster, a good friend of mine, was happily about his craft in the adjoining room where the massive stainless steel fermenters, mash vats , boilers and the like line the walls. It's an impressive set up with the smells of the process, particularly those of the massive amounts of hops used in good IPA. On this particular day, an Archimedes' screw (a long auger) was in use to bring the enormous amount of grain from the outside storage bin to the mill and eventual mash tun.

The Archimedes' screw is just one of the inventions of this brilliant mathematician/engineer/physicist of ancient Greece. Archimedes of Syracuse (287 BC – 212 BC) first introduced the ratio of circumference/diameter in pi in the western tradition (3.14159.)… He was also credited with creating the first pulley system, although not the lever, which pulleys certainly are. He apparently said "Give me a lever long enough and a place to stand, and I will move the world". With pulleys being levers, as we will see in this first TRm installment, Archimedes was able to accomplish many heavy lifting tasks. He single-handedly blew everyone's mind at the time, by moving a heavy sailing vessel to ground using the first "block and tackle" system called the

This is one of Rock Exotica's 'Omni' range, a state of the art pulley circa 2019. It's slick and efficient but a 17th Century sailor would recognise it and be able to use it to good effect. Building MA systems is an ancient skill as relevant now as it was then.

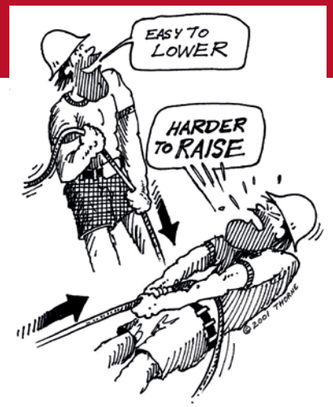
Title pic by Reinhardt

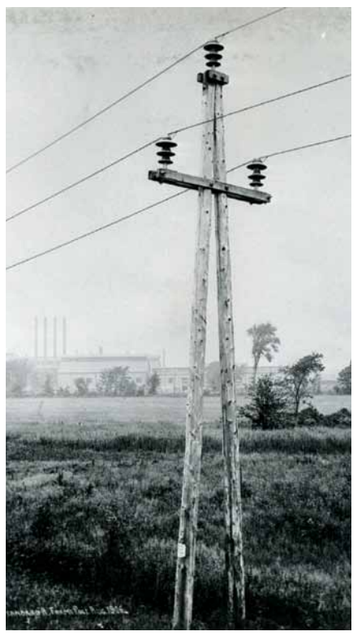


'Claw' (above)combining pulleys with leverage.

Since that time, men have been using the pulley system for just about everything imaginable. Many cultures used the technology of pulleys or pulley systems to perform various difficult tasks. Our forefathers used pulley systems on a daily basis to earn their wages. History books are filled with examples of how they were used to construct a modern infrastructure raising ships' masts and sails in the days of tall ships to turn-of-the century power lines and railroad bridges and onwards to skyscrapers, dams and pretty much anything that needed to go up. After the industrial revolution, the introduction of steam power employed pulley systems to lift, build and even clear stumps from fields for agriculture (called the “pig rig” or “piggyback rig”). In more modern times, hydraulics have been used with pulley systems on cranes and other such machines. Elevators of any significance all use pulley systems. They are everywhere but nowhere in so pure a form as specialist rope rescue. While more generic rescue agencies for whom rope rescue is only one small part of their work, can get away with pre-rigged systems, more specialist teams working remote from vehicles may have to raise loads great distances as quickly and safely as possible. An ability to construct systems from scratch is vital and it is done in much the same way as we have for hundreds of years albeit with lightweight alloys and high efficiency bearings instead of wooden blocks and pig fat for lubrication.

These articles are an attempt to disseminate a portion of material learned from history and over many years as a mason, lineman, climber, and rescue instructor to any who needs it to perform their craft more effectively in the vertical realm. First off, I don’t pretend to be the utmost authority on the subject, rather only a purveyor of the information borrowed from those who came before me. And there were plenty of them. One need only look at old black and white, grainy photographs like this one from the US in `1906, of structures built by men working with their hands and using basic principles of physics. How did they raise such a huge pole? Take a look at the last page of this article. Much of it was done with simple, compound and complex pulley systems rigged by workers and craftsmen who understood the principles now long lost to most outside of rescue, through time, dust and ignorance. Today, builders use a hydraulic crane or an electric winch and would be entirely unaware of how to proceed if these things failed. In terms of pulley systems, many rescuers today know what they believe, but not *why* they believe it. Personally, I would like to see more educators in this field teaching understanding. And not just for its own sake but for the rich rewards in rigging that unfold to those involved in saving a life.





This series then is an attempt to raise the understanding of a subject that is not, by any means, rocket science. In all, we have tried to communicate this simply. American theologian, Donald Grey Barnhouse (1895-1960) said about the communication of a difficult theological subject matter ,“Get the hay down out of the loft onto the barn floor where the cows can get at it.” It doesn’t do any of us much good as rescuers beating the bushes to approach this subject with science books and calculators if we are not able to communicate it to the troops. And then we can put it into solid action. I am reminded as an apprentice of an old mason who, while moving efficiently without a wasted motion, outperformed the young strong apprentices who were “thrashing the mortar on the wall”. Finesse, economy of movement and understanding... well, what else is there?

In rope rescue, these pulleys systems are like the hammer to the carpenter or the trowel to the mason. They are used for all kinds of tasks including holding something in place and keeping it from moving (like an A frame at an edge), and also lifting the person being rescued to the ambulance door for transport to the hospital. In each case, these unilateral, often tangential abilities are essential to the rescue chore for any rescue team. In this series of articles, we will investigate all the idiosyncrasies in a comprehensive treatment. Many of the illustrations are from Ropes That Rescue slide shows by the author as are the cartoons.

PART 1: HOW THEY WORK AS LEVERS

In the field of rescue, many victims of mishap are found above or below where they want to be, be it up a mountain, cliff, man-made structure or down a shaft. Obviously, in the case of being trapped at height, the need to get the victim down is of paramount importance if the rescue is to be viewed as successful. To do this, rescuers have for years simply lowered off a victim to safety and/or to the medical team waiting at the bottom. This is fairly usual stuff, it seems—very little stress, struggling or other "weeping or gnashing of teeth," as it were. What makes it so easy is that we are using the force of gravity to do the work for us. We regulate this force using friction on the rope which is, once again, often taken for granted without a full understanding of the physics involved. Have you ever wondered where we would be without friction? For instance, friction is the only thing which holds a nail in place. The use of gravitational force along with friction to control the descent are all things great and timely rope rescues are made of. Very little manpower, equipment, and rope is needed in these cases. Things can move quickly and we are down at the bottom expeditiously, revelling in our accomplishments at a later time (at the Oak Creek Brewery?)

Unfortunately, we all know that what might be optimum is not always the case. While it stands to reason that lowering won't work in the case of shaft, cave and gulley rescues it's also not so clear cut in height-to-ground rescues. Speaking of our area, similar to the Grand Canyon, on the rugged Mogollon Rim in the "Highlands" of Arizona, it is certainly NOT best to lower the victim down. The reason is simple. This creates, in most cases, a horrendous evacuation from the bottom of the cliff to the medical team waiting at the nearest road head. Several miles of scree slopes, up and down low angle carries, and the like, not to mention encounters with every conceivable animal, insect or vegetation designed to prick, bite or sting along the way (Arizona can be a formidable place). So... If we have someone on a cliff needing rescue we may attack the situation from above, and we may elect to bring the victim up rather than be held captive by what lies below; "The carry out from hell" as many view it. In these cases, don't the forces of gravity become our enemy? Doesn't friction also work against us when we switch to this mode? Unfortunately, yes. It is still considered easier to evacuate the patient upward to the top where a helicopter could perhaps make the pick up or such. Indeed, my team will many times opt for this trade-off in difficulty.

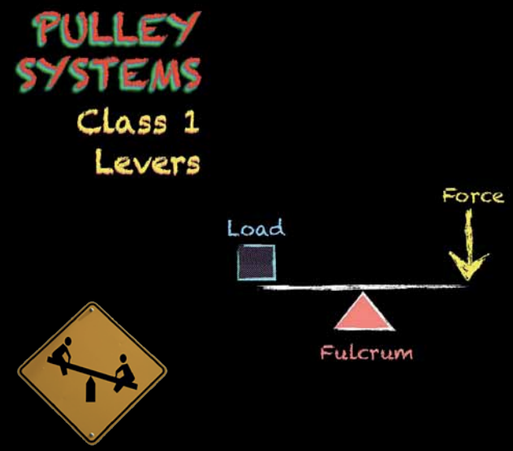
UP and OVERCOMING....Friction, that is

The question is: How do we overcome these seemingly negative physical properties in an immensely physical rope rescue environment? Many teams will build assemblages of ropes and pulleys (referred to as "pulley systems") to counteract the forces of gravity and overcome friction. Pulley systems are used by most teams, particularly those that must carry the equipment to build the pulley system to the top of whatever to begin the rescue. In doing this, we always run the risk of variables in the operation that we did not plan on. Things like: Who makes it to the top to do the lifting? How heavy is the load? How much equipment, or rope, do we have to construct this system? How much friction can we expect? Where will the haul team stand or run out? The list goes on and on. Failure to correctly assess the load being hauled and apply appropriate mechanical advantage can lead to a grunt-fest as this training exercise (left) proved. Carry a bagged 3:1 & 4:1 or only learn pulley systems by rote and the improvisation of building lifting or tensioning systems in the field is severely limited. This is why I personally believe and preach that a cracker jack rescue team must understand the principles of pulley systems and mechanical advantage and be able to build such systems virtually with their eyes shut even if they regularly use pre-rigged systems. Some believe that a rescue instructor worth their salt should have a thorough background in formal college physics.

"Engineering" the pulleys system is where we begin.....

HOW DO THEY WORK?

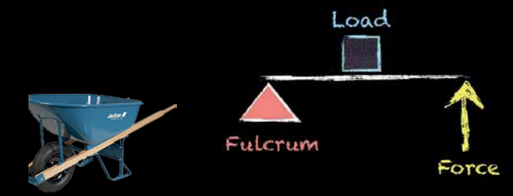
Archimedes tells us that pulleys are actually levers. There are three different types of levers: Class 1, class 2 and class 3. So, we can also call our pulleys used in rescue work class 1 pulleys, class 2 pulleys and class 3 pulleys.



CLASS 1 LEVERS:

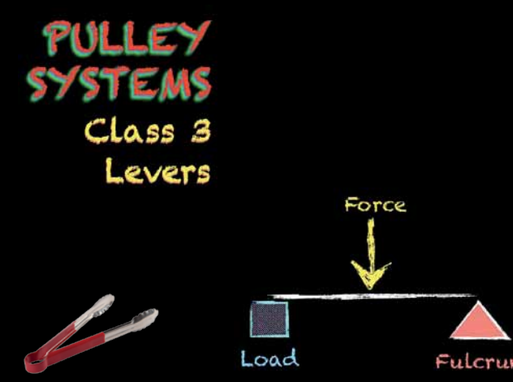
In class 1 levers, the fulcrum is always in the middle between the load and the force applied. A good example of this might be a teeter-totter (see-saw) where the fulcrum is exactly centered. If we move the fulcrum to the left, we gain mechanical advantage and if we move it to the right, we have a mechanical dis-advantage. Moving the fulcrum left is like a set of pliers or wire cutters. To the right, a pair of scissors. Maybe hedge trimmers if the blades are longer than the handles.

The mechanical advantage of this class 1 lever is 1 to 1, or more properly written, 1:1.



CLASS 2 LEVERS:

In class 2 levers, the fulcrum is moved to one end (in this case left) and the load is in the middle and the force applied at the opposite end (in this case, on the right). A good example of a class 2 lever is a wheelbarrow. Again, moving the load closer to the fulcrum will increase the mechanical advantage and moving it to the right will decrease it.
The mechanical advantage of this lever if the load is directly in the middle is a 2 to 1, or 2:1.



CLASS 3 LEVERS:

In class 3 levers, the fulcrum is moved to the opposite side from the class 2 lever. The load is on the opposite side and the force is applied in the middle. This often produces a mechanical disadvantage. The meat tongs that the cook uses at your neighbourhood barbecue are good examples of class 3 levers. Salad tongs and tweezers are another.

The mechanical advantage of the class 3 lever shown here if the force is applied direct try in the middle is a 1/2 to 1, or 1/2:1.

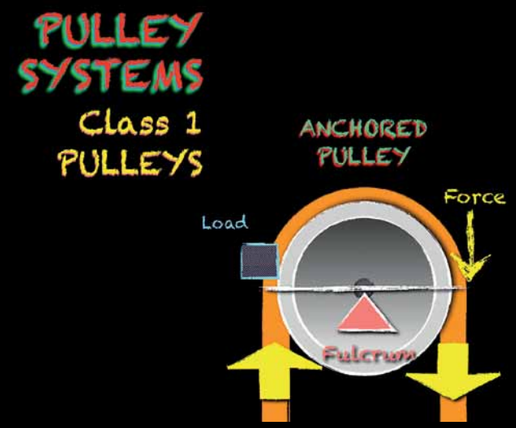
PULLEYS AS LEVERS

Relating each of the 3 levers to pulleys within a pulley system is quite easy. Looking at the previous page with all three levers illustrated show how they superimpose over our pulley.

CLASS 1 PULLEYS: MA is 1:1

In the class 1 pulley, you can see the same relationship that the teeter totter (see-saw) shows. The load on the left, the fulcrum in the center, and the force on the opposite side.

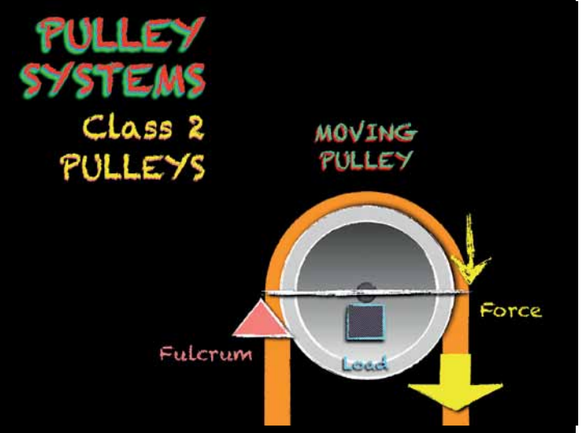
So, any pulley that is ANCHORED is a class 1 pulley. It provides NO mechanical advantage.



CLASS 2 PULLEYS: MA is 2:1

In class 2 pulleys, we see the relationship change as it did between the class 1 and 2 levers. Similar to a wheelbarrow, except that this time we are pulling the load along instead of lifting it, but the MA stays the same: 2:1.

So any pulley that is moving is considered a class 2 pulley. The mechanical advantage is doubled at this point.

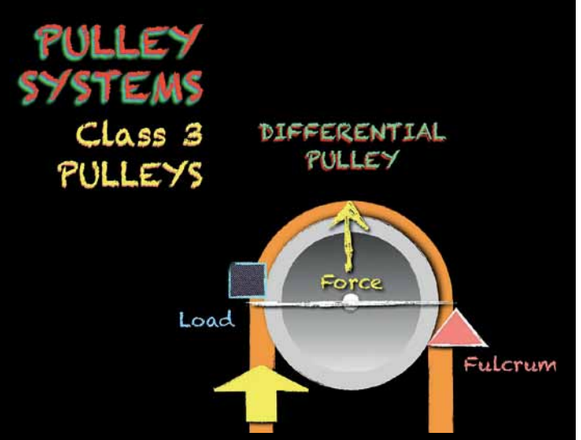


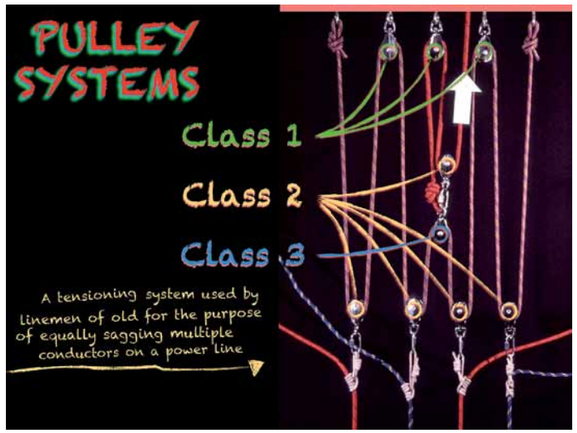
CLASS 3 PULLEY: MA is 1/2:1

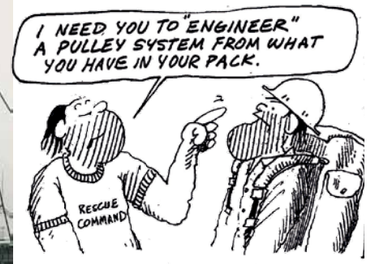
With the class 3 pulley, again we can superimpose the lever over our pulley to see what is happening. The force is applied in the middle so this produces a mechanical disadvantage. If force is applied in the center, then the MA is a 1/2 to 1 or 1/2:1.

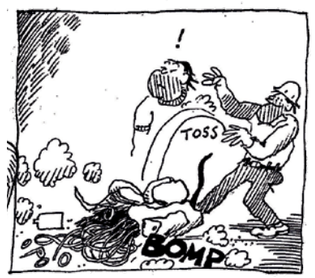
Any pulley that is moving and also providing as a differential or equalizer (like the rear axle of your car where you also have a differential) is referred to as a class 3 pulley. These are used commonly in advanced technical rope rescue for specific jobs.

Notice that the force here is pulling upward. In the illustration at the bottom of page 43, it is pushing down like you would when using salad tongs or tweezers. Both are class 3 pulley levers regardless of which way the force is applied.









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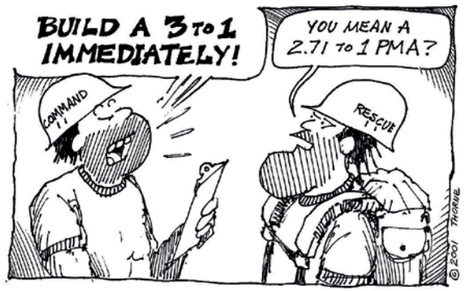

PUTTING IT ALL TOGETHER

In the illustrations above & above left, you can see a very old tensioning system used by line workers before 1900 where multiple conductors on a power line needed to have identical tension or "sag". With this one system you can see all classes of pulleys including three pulleys which are class 1, five that are class 2, and one class 3. There were these types of tensioning systems for two, three, four (shown) or any number of conductors on power lines. Today, modern stringing equipment makes this impractical but ship builders and mast repair teams would use something very similar to raise a new ship's mast. In rescue work, we use identical systems for tensioning a quad (4) trackline highline where we cannot afford any sag because it's above, say, a river or some other mid span obstruction. So, happily, these are still in use today for saving people. We will end up at this level in this series of articles, but there is much to get through first.

CONCLUSION:

Pulleys systems are so much a part of our rope rescue incidents and training that it is difficult to imagine our team without them. Imagine a craftsman without their tools. They are part of, literally, everything we do in the mountains and within industry. We take these principles many times for granted, but they are what allows the finesse I talked about earlier.

Next is Part 2: Ideal and Practical Mechanical Advantage.

PURPOSE-BUILT DESIGN

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KIT (Health) CHECK

by Andy Elwood

ED: Unlike their female colleagues, male rescuers are still reticent to address or even recognise mental health problems that can stem from the stress and trauma of the job. From his background in the military and SAR helicopters (this pic and opposite) , Andy Elwood has been instrumental in the UK in helping to 'normalise' and improve well-being of emergency services personnel and men in particular with his blogs, presentations and road-show. If you have the slightest inkling of a problem, get in touch..... www.andyelwood.com

During my 18 year career as a Winchman Paramedic on Search and Rescue Helicopters in the RAF and Coastguard, it has always been an essential routine to check kit on the aircraft, in medical bags and personal PPE to be ready for a Callout 24/7.

As a 'Dope-on-a-rope' hanging under a helicopter on a wire thinner than a pencil, attached to a hook clipped onto a Quick Release Box, which is attached to my harness, I realise exactly how important checking your kit is in order to be safe on rescues and in training.

But could we be even safer by checking on our own well-being and that of our team mates more often? If 16% of our equipment were not functioning correctly, we'd be doing something about it wouldn't we? One in six workers (16%) have some form of mental health issue according to figures from *Mind.* Simple checks and maintenance often sort issues out with our kit before they affect performance or safety. "A stitch in time saves nine" as my Granny would have said. The same is true regarding our own well-being, let me explain more. I have three examples during my time in SAR, when talking about how I felt made a major difference to my mindset and subsequently improved my performance at work. By talking about it, I was able to feel better and do better.

In this article, I argue that it is as important to check rescuer well-being, as it is to check technical rescue kit and I'll offer a chance to get involved in some initiatives, which promote rescuer well-being amongst your colleagues and friends, eg: 'Chinwag Curry Club' – who doesn't love a good curry?

The key takeaway from my own experience is that talking is incredibly helpful. This was the basis of my 2016 online campaign called #itsoktotalk which saw 45,000 views so there must be an appetite for this? During this campaign I travelled around the UK and promoted the idea of talking about mental health in the emergency services. So many guys opened up to me about their own struggles or how someone close to them had died by suicide. This was because I was open to listen and outside their normal sphere of colleagues or friends ie: they knew it was 'safe' to tell me about it.

This idea is core to many responder programmes in use already, eg: UKSAR's Peer Support Volunteer programme and also Mental Health First Aid principles, as taught by MHFA England. Often the person, who wants to talk doesn't need advice, they just need to off-load through talking and feel like they have been listened to.

I consider 2018 to have been a landmark year in the Emergency Services World regarding attitudes to responder well-being and mental health. We have seen a move from focusing on breaking the stigma to co-ordinating strategy and developing well-being policy for emergency services personnel.

Mental health was a major theme at the inaugural UKSAR Conference in Feb 2018 at the NEC. I am pleased that my *Mental Health Workshop,* which was attended by The Duke of Cambridge, played a significant part in the momentum to form a National Working Group within UKSAR to co-ordinate a well-being strategy for all personnel, including our volunteer organisations. I also sit on the recently formed National '*Paramedic Mental Health and Wellbeing Steering Group*' for the College of Paramedics and I am aware of the Police advances with *Oscar Kilo* and *Backup Buddy* apps. The Fire and Rescue Service has been ahead of the rest of us in this area for a while, but we are catching up slowly. However, I'm also aware that the Uk Fire & Rescue Service landscape is changing with the prevalence of their attendance at cardiac arrest incidents, as first responders. These incidents are very different to what many firemen joined up to do and I understand how they struggle with poor patient outcomes at these calls.

More recently, the corporate world have realised that their duty of care for personnel includes mental wellbeing and more importantly that happy and healthy employees perform more efficiently and more safely at work. In addition, this approach is more cost effective, as sickness & premature ill-health retirement costs are also reduced.

Surely this is essential for our emergency services family to embrace for the business of saving lives?

Here are two examples of how talking to different people after two very different incidents helped me. Firstly, I saw a psychiatrist following a rescue, when a patient vomited blood into my eyes and mouth. I had lost my confidence completely, but after a short 'chat', I felt like my old self again and was ready to get back to work and be winched. The 'shrink' was so relaxed it just felt like a chat and he just normalized everything for me. I was having a normal reaction to an extra-ordinary event.

Secondly, one morning on holiday whilst in the shower, I had a flashback to a patient trapped in a Land Rover after an IED attack in Afghanistan. My wife changed my life that day because she did 3 simple things (just like the psychiatrist):

- Created safety & trust
- Listened carefully
- Didn't judge

However, it's important to note that often stress and anxiety can lead to poor mental health building up over a long period of cumulative events, rather than just from one traumatic incident. The highest risk group for male suicide is 45-49 years old. Why is this?

Well, it's often when our parents and partners become ill or die, we may have greater financial pressure, we may become disillusioned at work, we might be having a mid-life crisis….. and we have bottled up all the trauma and emotions in our lives to date – that's a lot of crap to be hiding away and ignoring for a long, long time. Finally, one thing can make it all too much for one brain and body to cover up and contain – 'the straw that broke the camel's back.'

During my *Peer Trauma Support* volunteer training in UKSAR, I realised that I was showing symptoms of grief, burnout or stress. This presented primarily by not sleeping well over an extended period. I knew it was good to talk, so I spoke to one of the trainers and we had a chat to explore my issues. These stemmed from an intense three-year period of caring for and losing my father & my mother-in-law, moving house, setting up a company, changing job, lots of travelling and getting a promotion in UKSAR.

How many of us are going through similar pressures and demands in 21st Century life?

When he suggested to me that, as well as grieving, I might have temporary depression, I realized that, despite my own campaigning for mental health, that I still carried a stigma for mental health myself. He asked me what was so terrible about admitting that I might have temporary depression. After a short time (it felt like a long silence), I couldn't think of anything actually and I agreed it was possible and that there was nothing bad about admitting this. I felt slightly better afterwards, as I understood that perhaps there was a reason for all these feelings I'd been having of low mood and low self-esteem. This illustrated to me more than ever though, how deeply instilled the stigma can be around mental health.

This was the first step in me feeling better and turning my life around. But it has taken time and quite a few changes in my life.

I realised that it was essential for me to decide what was really important to me and what wasn't. A therapist would say this was all to do with my values and boundaries. More simply, in man-speak, for me it was about "Do what you like, Like what you do". I became comfortable putting myself first, which made a lot of decisions easier and you know what – the people who I really cared about and the ones who really cared about me were OK with that. They supported me and only had love and support for me. I have learned this is usually the case for other guys too, in similar circumstances. Currently, I have never felt better or stronger because I have opened up about my feelings (supposed weaknesses). However, doing this has actually made me feel strong again and helped me find the purpose for the rest of my life.
I believe I'll save more lives supporting others through Wellbeing campaigning and mental health first aid training, than I would dangling under a SAR Helicopter.

I have supported the *#CallingOutTheMen* campaign through Movember, which focused on men's mental health and specifically that it was OK for men to show their emotions in order to *Feel Better - Do Better*.

My favourite day of the month was the inaugural *#MenDoLunchDay* on 14th Movember last year. I hosted a lunch in Covent Garden, London and had an open invite on social media for men to come and talk about how they were feeling over some food. If you couldn't be in London, the idea was that you should invite a man you care about out for lunch and ask him how he was doing. I asked guys to take a selfie and tag the picture on social media. The response was amazing. This year we hope that you will get involved too.

The response has been so positive that a new all-male pilot programme of '*Calling Out The Men*' was launched in January. This is predominately a corporate programme, providing learning solutions and support networks through group, 121 and online sessions. Men will improve their outlook through straight talking to identify where they are on our scale. By 'owning' this position, they can then take baby steps to improve their position through challenge and support.

It's the least 'pink and fluffy bullsh*t' you've ever experienced!

I am proud to say that we will provide free online courses to male veterans and men in emergency services starting in 2019. We are using plain speaking and real examples to bust the myth that men shouldn't talk about how they feel, something our female colleagues are far better at doing. There may be something there to suit you. Check out the details at: *www.callingoutthemen.com*

Another initiative has hatched from our lunch day format of food & fun with your mates. My first podcast called 'Chinwag Curry Club' was in Jan 2019. This gets some men together to have a good chat over a curry – we have some fun and chat about all sorts of things and issues which are going on in men's lives. We discuss 'wellbeing' and how guys are feeling, what coping strategies, ways forward and resources are helping individuals. We aim to break down the stigma surrounding men's mental health and demonstrate that it's OK for men to show their feelings and talk about their emotions. All this whilst we enjoy a good curry. What's not to like?

Here's a quick summary of what I realised this year. Read it in a few seconds & save yourself four months off work – perhaps food for thought in your own life?

I do better when I have a balance of the following in my life:

- **Sleep**
- **Diet & Exercise**
- **Quality time alone**
- **Social time with others**
- **Purpose**

Organising my life to include these elements in balance leaves more capacity in my stress bucket for other major life inputs, which are outside my control.

So next time you are doing kit/ gear/ equipment checks – why not have a think about your own well-being and ask the colleague you are doing the checks with how he or she is? Sometimes you need to ask twice to find out how they really are and then, listen to what they say. Perhaps you will help turn their life around - at best reducing suicide statistics and at worse help hem feel better, to do better at work & at home. Plus, this way hey will be fully focused on doing their job, looking after you and rest of your team on the next callout you attend together.

andy@CallingOutTheMen.com

AQUATIC

Understanding the Life Cycle of a Flood

by Paul O'Sullivan

The Six Phases of Flooding

Flood events have a predictable lifecycle and an appreciation of this is essential to anyone planning or managing the emergency response to a major flooding incident. For a number of years flood rescue agencies and those teaching management of flood incidents have used the 'Four Phases of a Flood' model to describe this flood life-cycle and to provide a tool for managers to appreciate where they are within the flood life-cycle as the flood event occurs.

Whilst a useful model, I would suggest that there are a couple of shortcomings with the four phases model, namely:

- The language used is very much associated with river (fluvial) flooding and is not as applicable to other flooding causations such as coastal, surface water (pluvial) or infrastructure flooding.

- Much work has been done in recent years to develop flood prediction and warning systems and as such, key elements to modern flood response and rescue planning include actions and decisions which are made when flood warnings are issued, which is not highlighted in the current four phase model.

I would therefore suggest that an updated and improved tool would be a 'Six Phases of a Flood' model with the phases being;

- Phase 1 – Pre-Flood
- Phase 2 – Flood Warnings
- Phase 3 – Initial Inundation
- Phase 4 – Lateral Expansion
- Phase 5 – Initial Recovery
- Phase 6 – Long Term Recovery

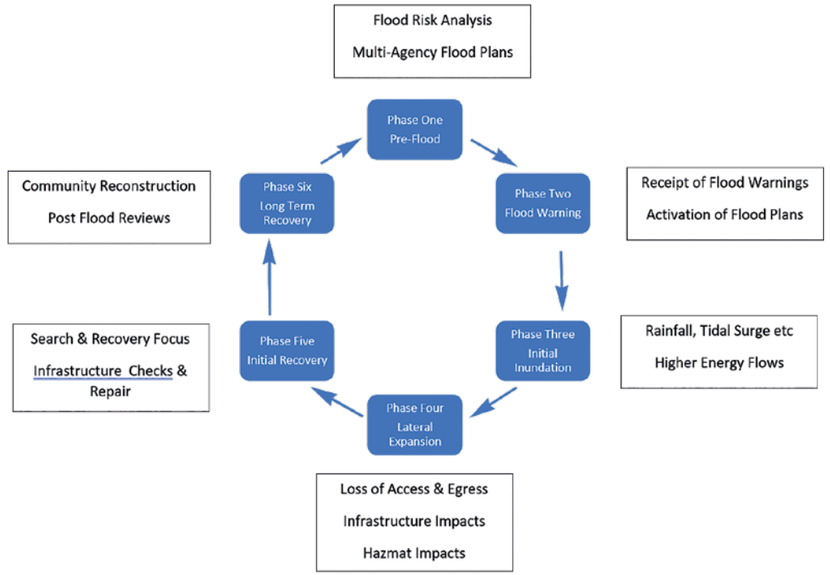
Phase 1 PRE-FLOOD

Development of comprehensive multi-agency flood rescue and response plans based upon local flood risk assessments are critical to any successful response to a flood event. In addition these plans need to be tested and response capability and capacity confirmed prior to any flood event. Subsequently, if a flood does occur this should ensure there are suitable plans to activate and flood managers have access to sufficient numbers of trained and equipped responders (or know how and where to request them) to cope with the flood.

Access to historic flood records and flood prediction information is critical to understanding the size, nature and likely duration of future flood events and these combined with a clear understanding of community geography and infrastructure should allow for the development of comprehensive flood response plans with clear triggers and actions.

Paul O'Sullivan is the Managing Director of R3 Safety and Rescue – a specialist rescue training and equipment supply business based in North Wales, UK. He's been delivering swiftwater and flood rescue training for over 20 years and teaching Rescues from Vehicles in Water classes since 2004. He sits on the UK's National Fire Chief's Council Inland Water Technical Response Group.

Main Pic: Flooding in Kiev, Ukraine quickly brings traffic to a halt and gridlocks the city. Drivers under-estimate the force of water and don't appreciate that water depth and water speed may increase rapidly, even as they wait to ford. Smaller, lighter vehicles are the first to falter. Photo by Ruslan Dvoinichkov



Phase 2

FLOOD WARNINGS

Whilst not every flood event will be preceded with a flood warning, much work has been done in recent years to improve flood warning systems including fluvial, coastal and pluvial flooding causations. Emergency and community managers now have access to a growing number of severe weather and flood warning information systems. Deciding who is responsible for acting upon information received, needs to be part of any flood response organisations strategy.

The accuracy and lead time on flood warnings will vary greatly depending upon several factors such as flood type and river catchment size. Flood warning information will change as confidence in the likelihood and severity of the predicted flood develops as we get closer to the event. Warning maps are rarely as detailed as the one on the right, often simply showing an exclamation label over a large, vague area.

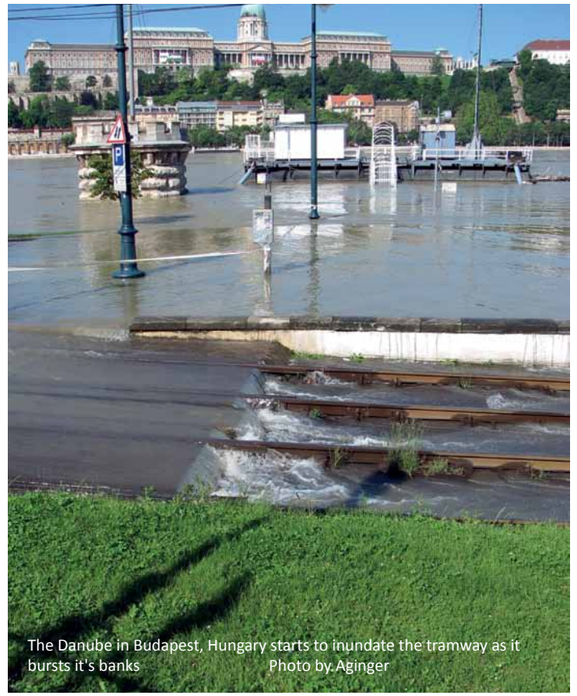
The receipt of flood warning information should be a critical stage in response to a predicted flood event. It is a time when we need to develop a suitable response to the predicted flood event based on the existing multi-agency flood plans already developed in Phase One. Warning and informing the community, initiation of evacuation plans and preparing emergency responders for the predicted event are all key actions at this time.

Phase Three

INITIAL INUNDATION

Whilst the nature of the flood will depend on the type of flooding, there is normally an initial impact where large amounts of water begin to affect areas outside normal watercourses. This can vary from large amounts of surface water flowing down streets and roads following a localised heavy rainfall event, or water breaking through or over a flood defence. This initial inundation phase of the flood is generally associated with higher energy constricted flow and this combined with the density of water generates a great ability to cause significant damage to property and infrastructure as well as risk to lives.

This phase is also when members of public first begin to experience the effects of the flood and we see people attempting to travel through flood water to get home etc. Incidents involving vehicles in water are common during this time and as water energy can be high, these incidents can pose significant levels of risk for those involved, including rescuers. Numerous international studies have cited vehicle related drowning as a key causation of deaths during floods.



The Danube in Budapest, Hungary starts to inundate the tramway as it bursts it's banks Photo by Aginger

Pumping operations try to alleviate lateral spread of flooding in the Somerset Levels, UK cutting off roads and entire villages. Before mans' building aspirations superseded nature this is exactly what a flood plain is supposed to do. Similar problems exist along the Mississippi. Photo by Jez James

Rescuers from North Yorkshire Fire & Rescue Service (UK) use wading poles to check for underwtaer obstacles, drains and holes. Photo by Steve Allen

Once the floodwater subside the real work has to begin and the true cost of damage to infrastructure can be gauged. Mud and contaminants like oil are the most difficult to clear up even if there is no physical or structural damage. This flood is in central Brazil. Photo by Paura

Phase Four
LATERAL EXPANSION

As the flood develops it has the potential to spread laterally from the areas of initial inundation. Examples of this include the spread of water from overloaded river channels across the valley floor or the penetration of sea water inland from a tidal surge or coastal defence breach. The extent of the area of expansion and water speed associated with the flood event are largely determined by the topography of the area and the volume of the flood water. Relatively narrow and steep river valleys (e.g 2004 Boscastle flood in the UK) are associated with limited lateral expansion and high velocity flood waters. By contrast, wider flatter river valleys and coastal plains have a greater ability to dissipate the flood waters over a wide area and as such, water speeds are relatively low.

This lateral spread creates significant impacts including: -

- **LOSS OF ACCESS AND EGRESS**

As water extends laterally, land is submerged by flood water and access and egress routes are compromised. Knowing which access/egress routes can be maintained the longest and at what point they will be lost is key for successful deployment of rescue and welfare resources and community evacuation plans.

- **EFFECTS ON INFRASTRUCTURE**

Lateral expansion of flood water will impact upon transport, utility, communication and medical infrastructure as well as housing. Areas of the community not directly affected by the flood water can suffer loss of key services such as water, electricity, telephone etc.

- **INTERACTION WITH HAZARDOUS MATERIALS**

As water moves from the sea, rivers, lakes and streams where it is normally contained onto flooded land, it will interact and become contaminated by a vast array of hazardous material (haz-mat) sources including, water treatment works, fuel storage/distribution facilities, domestic and industrial chemicals, agricultural waste, dead and decaying animals etc. Thus, flood events by their very nature must be treated as haz-mat events with appropriate personal protective equipment for responders and robust decontamination procedures in place.

Phase Five
INITIAL RECOVERY

As water levels begin to subside the flood event will begin to move into an initial recovery phase. Flood water hazards will change as water levels drop. In particular: -

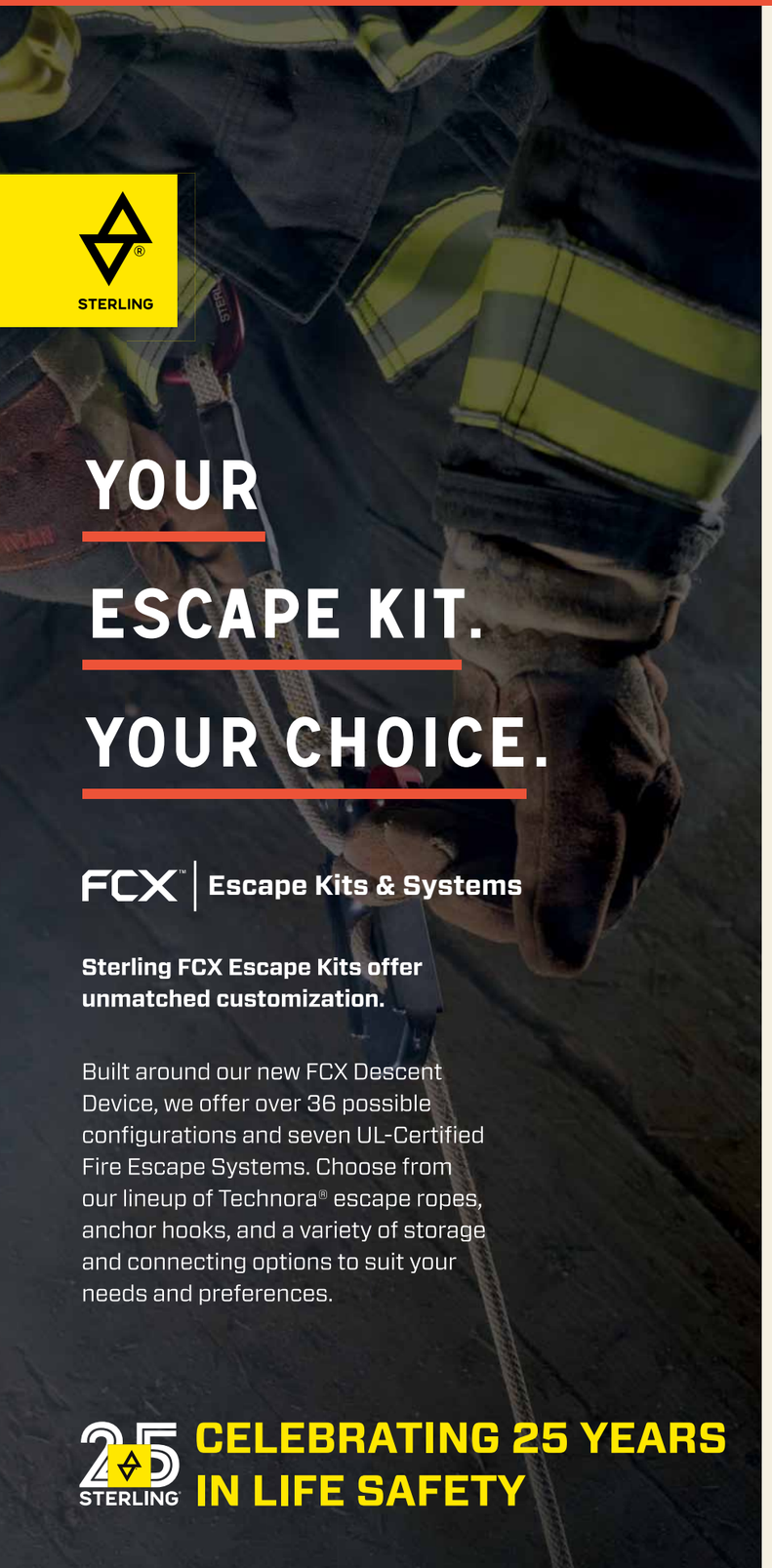
- As previously overloaded water drainage systems begin to function again, inspection lids and grids removed by the flood can create significant siphon hazards.
- Previously submerged hazards (fences, walls, vehicles, debris piles etc) will begin to emerge and can damage boats and engines etc.
- As water levels recede this can lead to an increased level of hazardous material in the remaining flood waters.

Activity focus will also change as we move into the initial recovery phase. Rescue operations will see a move towards search and recovery and there will be significant activity within the utility, communications, highways, local authority etc. sectors as these systems are inspected, cleared and repaired, in an effort to return key services to the community.

Phase Six
LONG TERM RECOVERY

This is generally the longest duration phase of any flood and the phase with the least emergency service involvement. The post flood recovery and rebuilding of a community can last for a significant time and there are numerous examples where it has been many years before all residents are back living in their homes. Major floods will have long terms economic, medical and social consequences on effected communities.

This long-term recovery phase is also the time for post flood de-brief and investigation where lessons can be learned and these in turn used to inform, review and revise multi-agency flood response plans. Thus, phase six of the flood event directly links into phase one of any future flood event. Whilst the physical and human geography of the flood effected area, combined with the causation factors of the flood (rainfall, snow-melt, tidal surge level etc) will determine the exact impact, speed and duration of any flood event the 'Six Phases of Flood' model provides a good 'broad-brush' overview of the life-cycle of a flood that can be used to provide structure to our flood response planning and management which is equally applicable to all types of flood causation.



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FCX™
NFPA 1983: Escape Descent Device

2. Choose a Rope

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FireTech2™
NFPA 1983: Fire Escape

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NFPA 1983: Fire Escape

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Hooks have become a popular choice for anchors because they can be placed remotely or secured at a window sill in situations where a remote anchor is not feasible. We offer two versions of our lightweight, machined aluminum Lightning™ hooks and the classic steel Crosby® hook.

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NFPA 1983:
Escape Anchor

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New FCX FireTech2 Escape System with Lightning Hook.

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Rapid Donning

RESCUE HARNESSES/ EVACUATION TRIANGLES

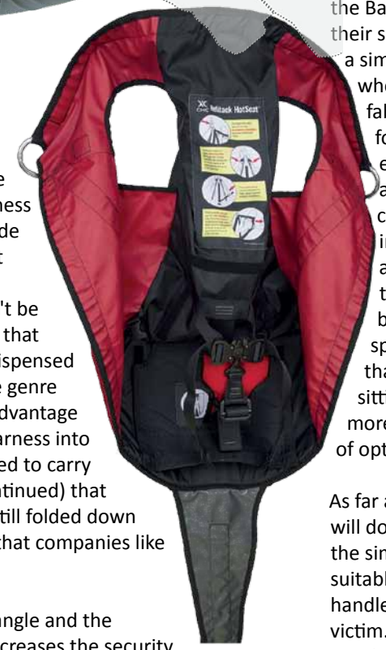
Primarily intended for uninjured victims this is the most fundamental of rope rescue devices and such a simple design that every man and his dog with a sewing machine can produce one and often does. Even we had some made up by a sail-maker in the mid-80s but that was because we wanted to make them personal issue for every rope team member and we're cheapskates. The first commercial model we can remember is the Petzl Evacuation Triangle aimed at ski-lift rescue but there was a Rollglis model at that time with more webbing than fabric support that might lay claim. In reality I expect there are merchant and naval sail makers from the mid 1600s that might lay claim to the design but we're only interested in models specifically made for rescue and made by companies in the rescue and access industries. For the purposes of this Guide we are including 'Nappy' or 'daiper' -style models with and without shoulder straps and the Screamer Suit style which is more complex, effectively extending the 'nappy' section upwards to include shoulder straps and head and/or neck support. The Bauman Screamer Suit started this alarmingly named design with an industry classic that is now discontinued but the concept has been picked up by CMC, Cascade Rescue, Yates, Traverse Rescue and Rescutech designs.

There are two things that set this Guide's 'harnesses' apart from all other harnesses:

1) A panel of material, more or less triangular in shape to support and protect the torso and sitting just under the armpits instead of at the waist (even though we refer to the top edge and fittings as 'waist'!)

2) Only D-Rings and/or sewn eyes connected together by a carabiner or hook – there is no permanent fixing buckle or clip other than adjustment so even if it's the wrong size initially it is quick to put on and secure your victim. A regular harness would involve stepping through leg loops and/or a waist belt and/or securing a buckle or clip before it is safe to load.

A rescue or evacuation triangle is a triangular panel of robust material like PVC or Cordura reinforced with webbing along all the edges that enables the waist to be passed around a victim and joined together with the third corner of the triangle as a crotch strap providing the real security for the wearer. PMI's Hasty X is unique in using two crotch straps rather than one. The basic 3-connection-point triangle can then be further enhanced to better fit different sized adults and children with the addition of adjustment buckles or fixed eyes at intervals that allow the shortening of each side when connected together. Adjustment buckles provide finite rather than fixed adjustment and are the best option but are one of the features that increase cost and maybe bulk. We say '*maybe*' because some of the fixed adjustment options using reinforced soft eyes in the webbing might end up being bulkier than the two or three buckles needed to make the things fully adjustable. At this point we should also mention that you can get evacuation harnesses without the fabric panel, just the webbing, and these are the lightest possible option for an emergency harness other than an 8 foot sling made into a Dufler seat. We haven't included non-panel triangles because there simply wouldn't be space but aside from the fact that comfort and protection are dispensed with, the basic security of the genre is still there with the added advantage that you can fit a web-only harness into a coat or overalls pocket. I used to carry an Edelrid model (now discontinued) that had three metal D-rings but still folded down to about 4" x 3" and I notice that companies like Protekta still produce these.



Moving on from the basic triangle and the addition of shoulder straps increases the security and perception of security by ensuring that the victim can't invert and fall out of the nappy. Even the crotch strap is no firm indication of security because smaller individuals and kids in particular can conceivably bend one leg enough to end up falling through the opposite leg hole. This is why so few triangles can deal with kids less than about 6 or 7 years old or, as Tractel put it, 30kg and none of the basic triangles can other than, possibly, the Kong Pegasus which can cinch down pretty small on all edges. Nevertheless, if you want to be sure about security for the smallest ambulatory kids the best current option is probably also the newest, the CMC Helitack Hot-Seat (pics left and below left) which actually has a mini harness system built into what would be the location of your average large adult's rump. The Helitack is one of a group of specialist evac harnesses that evolved from the Bauman Screamer suit for helicopter rescue which, as mentioned earlier, is no longer made because, after sterling service to the rescue industry the Bauman's have now retired but will continue to service their suits until around 2022. These are more expansive than a simple triangle of material and are more akin to a jacket where the shoulder straps have been incorporated into the fabric panel and consequently provide much more support for the head and neck and much more protection from the elements. It still doesn't suit spinally compromised victims any more than the regular triangles but that particular concern is slowly being more eroded in the rescue psyche in favour of the greater danger from not being rescued at all! The Cascade model has a reinforced neck support and the RescueTech DeLuxe has a padded and hard-reinforced back section so while it's not a replacement for proper spinal management it does provide a little more protection than most. Some models have side buckles that allow the sitting angle of the victim to be altered from more prone to more upright including the Yates ARV which comes in a range of options including full camo (pic top).

As far as helicopter evacuation goes, any of these harnesses will do the job as a last resort, they are after all, superior to the simplest under-arm strop but our 'Heli' column indicating suitable uses refers only to models that can be properly handled by winchmen and provide suitable protection for the victim. These will always feature at least one handle on the rear to make it easier to pull the victim into the heli's cabin (pic top left). It's possible that some models which don't cinch up enough at the 'waist' could actually present a hazard by ballooning out in the helicopter's downdraft and potentially widening the leg openings or even inverting the casualty and if there is one issue to watch out for with an evac triangle with no shoulder straps it is inverting the casualty because then there is nothing to stop him/her sliding out!

The iconic Bauman Screamer Suit is no longer made

Our go-to man on kit Paul Witheridge had this to add....

"One of the biggest issues with Triangles we see from any rescue organisation is incorrect fitting. So many people treat them as a sit harness and place the top edge of the harness at just above waist height. This reduces the security of the casualty (and their comfort) as their centre of gravity is way higher than the design expects. Rather than enveloping the casualty in a supportive 'bucket' with a sternal attachment they end up perched in a sit harness that places pressure in the small of their back from what is effectively a ventral connection.

You are right to bring up the kids sizing thing as this is another situation where too often the rescuer is not prepared to deal with a casualty that does not fit the 'standard' size. There have been two cases in the past year in the UK where fire & rescue found an extraction of a child more challenging because the rescuer was not sure how, or if, there was a way to reduce the triangle size. A lot of products do provide instruction on resizing, often simply a fold over of the top edge, some even have pictograms on the fabric, but not everyone seems to pick this up in training. Using one full size on a child can create a situation where the child can duck under the top edge and come out through the side of the Triangle".

The UK Coastguard model (right) doesn't meet our 'fabric panel' criterion for this guide but is worth a look. There are number of products of this nature that are a cross between an adjustable under-arm strop and a nappy, as was Troll's more basic, but decades old RS4 model. This was designed to address many of the issues/features that this article mentions such as fabric triangles being awkward if they are not packaged or contained effectively and end up billowing around. This model addressed a need for simple size adjustment for children/small adults, under arm comfort if used as an initial 'capture strop' and reduced windage if emergency hoist extraction by helo is needed. Paul contends that it's highly likely that the Coastguard model probably sees more rescues per year in the UK than any other, if not all others combined!

Models *not* included in our guide because of insufficient data but may be worth chasing down are Kaya's 3Ta (left) but that may be discontinued, Sala's hard to find AG501, Miller/Honeywell's Rescue Triangle (top-right) and the Xinda XD D9311 (right) which we have plenty of details on but no viable company contact and as yet unverifiable standards and copyright compliance.

IN THE FOLLOWING TABLES.....

Dark Orange squares ■ and text indicates the current gold standard for adjustment or a feature. A solid black square ■ indicates a standard feature that is present. An outline square □ indicates that the feature is adequate or just about up to the task but not ideal.

COST: a rough guide only – includes local taxes but will vary with exchange rates, extra taxes etc. We sually round up to the nearest Pound£, US Dollar$ or Euro€.

PACKED/UNPACKED DIMENSIONS: 'Packed' is not given by many manufacturers because you could try to squash any harness into a matchbox. However, some have a prescribed way to fold or roll like the Rock Empire above which folds into its own pocket and the Edelweiss Delta (right) which rolls up. The Unpacked dimensions are approximate and are width by height but some like C.A.M.P. include the shoulder straps especially if they are a fixed size. If there is one figure only (in black) it will be the width of the waist section which can be amazingly long often longer than the height.

USES: INFANT, CHILD, ADULT, HELI It may be possible to jerry-rig most of these to accommodate a larger size but not so easy to downsize for small children who risk falling out. Any can be used for helo rescue but some are specifically designed and operator-approved for use on helicopters.

MATERIALS: The fabric panel is shown in black. Connection eyes are shown in green and adjustment buckles are shown in burnt orange. Some models like the Rescue Technology and Yates ARV are suitable for water rescue because they have a mesh panel to drain water.

STANDARDS: EN1497 is for rescue harnesses NOT intended for fall arrest and EN1498 is basically an under arm rescue sling or with the additional 'B' as a seat or 'nappy'.

INFINITE WAIST ADJUSTMENT: An orange square ■ indicates that the waist adjusts via a buckle and therefore has infinite adjustment within its length. A number in this column indicates fixed connection points to provide waist adjustment. Bear in mind that eyes situated mid way up the triangle such as you find on the CT, Singing Rock, Anpen, PMI and Protekt (pic right) models are listed as waist adjustment particularly for children but will obviously adjust the crotch length as well. When using the these intermediate eyes the entire top half can be folded down out of the way but this negates use of shoulder straps.

INFINITE CROTCH ADJUSTMENT: An orange square ■ indicates that the crotch or nappy/daiper section adjusts via a buckle and therefore has infinite adjustment. A number indicates fixed connection points on the crotch section to provide size adjustment. As noted above, some models have a pair of eyes part way up the triangle which will also adjust the crotch length – see pic right of the Protekt DX301 probably the least expensive models in our list.

INFINITE SHOULDER STRAPS: an orange square ■ indicates that shoulder straps are present and adjust via a buckle providing infinite adjustment. A solid black square indicates that shoulder straps are present but not adjustable. The Heli style harnesses typically have fixed shoulder panels since they are a jacket.

HEAD/NECK SUPPORT refers only to the 'Screamer Suit' style harnesses because they have material that encloses the head – it is NOT an indication of integral spinal management measures.

REAR EYE/HANDLE is not a load-bearing eye but rather a tagline or control line eye/ring for manoeuvring the casualty and/or a handle for dragging inwards from the edge/drop.

COLOUR: Panel colour. Secondary or web colours in lower case.

images NOT to scale	MODEL	COMPANY	ORIGIN	COST inc tax/VAT	WT	APPROX PACKED DIMENSIONS Waist &/or Height	SUITABLE FOR: INFANT <3	CHILD	ADULT	HELI	MATERIALS: SEAT / D-RINGS/SOFT EYES / LOCK/ADJ BUCKLES	STANDARDS	MAX LOAD	INFINITE WAIST ADJUSTMENT	INFINITE CROTCH ADJUSTMENT	ADJ SHOULDER STRAPS	HEAD/NECK SUPPORT	REAR EYE/ HANDLE	GRAB HANDLES (inc rear)	HI-VIZ/ REFLECTIVE	COLOURS	NOTES	WWW.
	Wildfire	**AGILITE**		$200	860g 1.9 lb	114 x 47cm 45 x 58"		■	■		TT Polyester 1x Steel 5x Soft eyes 2xAlloy	EN 1497		2	■	■	NO	NO	0	NO	BLACK, RED/ black	Waist adj by using different eye combinations. Can invert from sitting to prone.	agilitegear.com
	Triangle (S30 & S304)	**ANPEN**		$75	810g 1.8 lb	15 x 20cm 5.91 x 7.87" 125 x 130cm 49 x 51"		■	■		Nylon or PVC 3x Alloy 3x Soft eyes	-	150kg 330 lb	2	2	NO	NO	NO	0	■ □	ORANGE/ flouro ylw. ORANGE/ grey.	Lighter-weight soft eye version with shoulder straps (straps not shown) in green or orange wt 395g	en.anpen.net
	Angel (2050)	**C.A.M.P.**		$100 €99	550g 1.2 lb	26 x 15cm 10.2 x 6" 140 x 120cm 55 x47"	□	■	■	■	Cordura 12 12xSoft eyes 3xPlastic	EN 1498	100kg 220 lb	4	4	■	NO	■	5*	NO	BLACK	*4x Crotch adjustment eyes are configured as handles. Shoulder straps are removable	camp.it
	Stable Seat Aerial Rescue Vest	**CASCADE RESCUE**		$450	2270g 5lb	46 x 18cm 18 x 7" 178 x 102cm 70 x 40"			■	■	1000D Cordura 2xSteel 1xSoft eye 1xAlloy	-	500 lb	■*	NO	NO	■	■	4	■	ORANGE/ black/blue	*Internal patient restraint strap. Steel D-s kept together with powerful magnets. Mesh for water-draining	cascade-rescue.com
	Rescue Triangle	**CLIMBING TECHNOLOGY**		€80	1150g 2.5 lb	120 x 120cm 47 x 47"		■	■		PVC 4xGalv Steel 2xSoft eyes 2xAlloy	EN 1497 EN 1498-B	150kg 330 lb	2	2	■	NO	NO	0	□	YELLOW/ black/orange		climbingtechnology.com
	Helitack Hotseat	**CMC PRO**		$645	2210g 4.9 lb	48 x 24cm 19 x 9.5" 138cm 54"	■	■	■	■	1000 D Cordura 2x Steel 1xSoft eyes 2xAlloy	NFPA class3	227kg 600 lbf	NO	■	■	■	■	3	■	RED/ grey/black,	Integrated infant harness. Quick-detachable storage bag can also store a victim helmet	cmcpro
	Evacuation Triangle	**COURANT**		€98	820g 1.8 lb	14 x 26cm 5.5 x10.25" 147 x 112cm 58 x 44"		■	■	□	Vinyl-coated Polyester 10x Soft eyes 2 x Alloy	EN 1497 EN 1498-B	150kg 330 lb	3	3	■	NO	■	0	□	YELLOW/ red/blue		mycourant.com
	Rapid Evacuation Triangle (TC022)	**DELTA PLUS**		£85	n/a	122 x 132cm 48 x 52"		■	■		Polyester 12x Soft eyes 3xPlastic	EN 1498-B	n/a	4	4	■	NO	■	0	NO	BLACK/ orange/grey	Padded waist belt	deltaplus.eu
	Fast Saver	**EDELRID**		€140	800g 1.76 lb	30 x 20cm 12 x 7.9" 130cm 51"		■	■		PVC 1x Soft eye 3xAlloy	EN 1498-B	150kg 330 lb	■	■	■	NO	NO	0	□	RED/ yellow	Replaces Delta & Delta Vario Plus. Includes RFID Chip. Special Helo version available (Bergwacht)	edelrid.de
	Delta 2	**EDELWEISS**		$80	745g 1.6 lb	6 x 28cm 2.4 x 1" 165 x 134cm 65 x 53"		■	■		PVC 10x Soft eyes 2 Alloy	EN1497 EN1498	100kg 220 lb	3	3	■	NO	■	3*	□	YELLOW/ black/orange	*3x Crotch adjustment eyes an be used as handles.	edelweiss.com
	X-it (H41)	**HEIGHTEC**		£170	1200g 2.6 lb	152cm 60"		■	■	■	PVC 1x Steel 2xAlloy Hooks 2x Alloy	EN1498A-B	125kg 275 lb	■	■	NO	NO	■	1	NO	RED/black	Can be used as an underarm sling	heightec.com
	Delta (H43)	**HEIGHTEC**		£56 €60	340g 0.75 lb	95cm 37"		■	■		PVC 4x Soft eyes	EN1498-B	125kg 275 lb	1	2	NO	NO	NO	0	NO	RED/black		heightec.com
	Pegasus	**KONG**		$185	690g 1.6 lb	23 x 13cm 9 x 5" 107 x 134cm 42 x 53"	□	■	■	■	Cordura 1x Steel 13x Soft eyes 2xAlloy	EN 1497	200kg 440 lb	5	5	■	NO	■	1	□	ORANGE/ black	C/W storage bag. Detachable shoulder straps. Padded Shoulder carrying straps also available	kong.it kongusa.com

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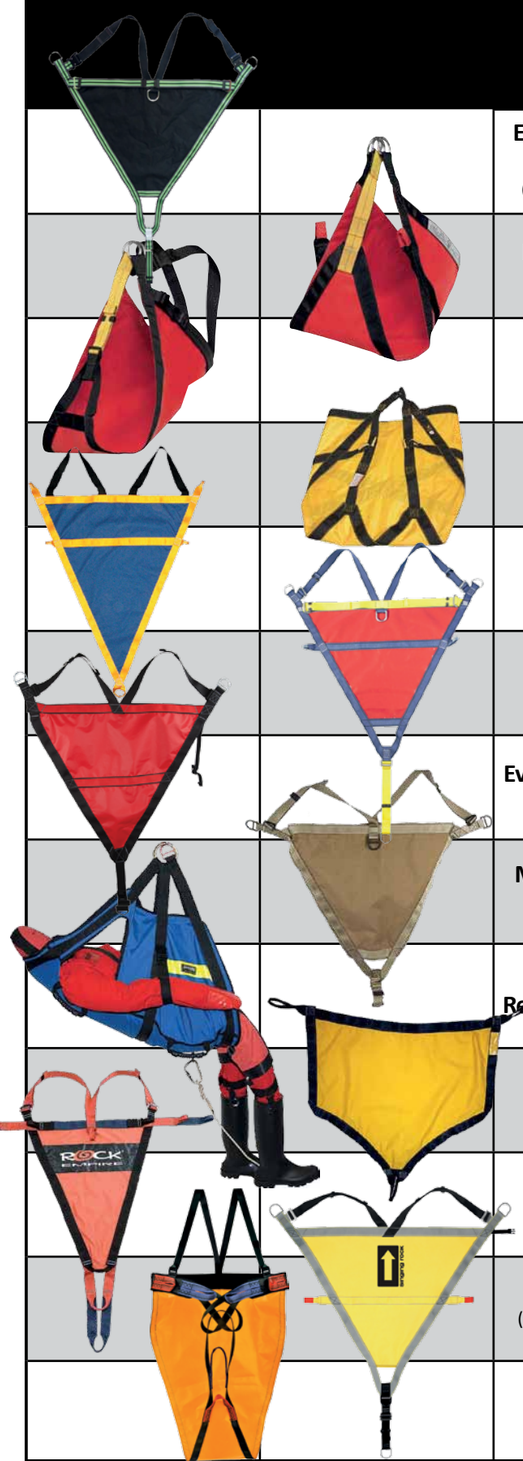

MODEL	COMPANY	ORIGIN	COST inc tax/VAT	WT	APPROX PACKED DIMENSIONS Waist &/or Height	SUITABLE FOR: INFANT <3	CHILD	ADULT	HELI	MATERIALS: SEAT / D-RINGS/SOFT EYES / LOCK/ADJ BUCKLES	STANDARDS	MAX LOAD	INFINITE WAIST ADJUSTMENT	INFINITE CROTCH ADJUSTMENT	ADJ SHOULDER STRAPS	HEAD/NECK SUPPORT	REAR EYE/ HANDLE	GRAB HANDLES (inc rear)	HI-VIZ/ REFLECTIVE	COLOURS	NOTES	WWW.
Evacuation Triangle (FA7000500)	KRATOS		€65	1090g 2.4 lb	31 x 41cm 12 x 16" 140 x 157cm 55 x 62"		■	■		PVC 4x Alloy D-Rings 5x Alloy	EN 1498-B	140kg 308 lb	■	■	■	NO	■	0	□	BLACK/ green	Adjustable shoulder straps made of elastic webbing, with auto-lock buckles.	kratossafety.com
Bermude (C85)	PETZL		£70 $140 €82	795g 1.75 lb	35 x 27cm 13.8 x 10.6" 105cm 41"		■	■		PVC 4x Alloy D-Rings 3x Soft eyes	EN 1498	140kg 308 lb	2	2	NO	NO	■	0	□	RED/ black		petzl.com
Pitagor (C60)	PETZL		£77 $160 €89	1290g 2.84 lb	35 x 37cm 13.8 x 14.6" 104 x 143cm 41 x 56.2"		■	■		PVC 4x Alloy D-Rings 5x Alloy	EN 1497 EN 1498-B	140kg 308 lb	■	■	■	NO	■	0	□	RED/ black/yellow		petzl.com
Hasty X	PMI ROPE		$280	693g 1.5 lb	38 x 30.5cm 15 x 12" 122 x 165cm 48 x 65"		■	■		PVC 8x Soft eyes	-	147kg 325 lb	NO	2	NO	NO	NO	0	□	YELLOW/ black	replaces previous , much heavier Hasty Harness	pmirope.com
Rescue Triangle (DX301)	PROTEKT		€25 $30	1250g 2.75 lb	131 x 97cm 51.5 x 38"		■	■		PVC 5x soft eyes	EN 1498-B	130kg 286 lb	2	1	■	NO	NO	0	□	BLUE/ yellow/black	Also rebranded as Blue Star in Denmark and Vertiqual *Escape* in Romania	protekt.com.pl
Rescue Triangle (DX302)	PROTEKT		€30 $40	1150g 2.5 lb	136 x 90cm 53.5 x 35.4"		■	■		PVC 4x Alloy D-Rings 2x Soft eyes 5x Alloy	EN 1497 EN 1498-B	140kg 308 lb	■	■	■	NO	■	0	□	RED/ blue/yellow		protekt.com.pl
Evac Triangle (708350)	RESCUE TECHNOLOGY		$185	1000g 2.2 lb	127 x 160cm 50 x 63"		■	■		PVC 3x Alloy D-Rings 2x Alloy	-	143kg 315 lb	NO	■	■	NO	NO	0	NO	RED/ black		rescuetech1.com
Mesh Evac Triangle	RESCUE TECHNOLOGY		$180	1300g 2.87 lb	116 x 134cm 46 x 53"		■	■		Vinyl-coated Polyester mesh 3x Alloy D-Rings 2x Alloy	-	143kg 315 lb	NO	■	■	NO	NO	0	■	TAN, BLACK/ Fluro yellow	Mesh aids draining for water rescue	rescuetech1.com
DeLuxe Victim Rescue Cradle (708353)	RESCUE TECHNOLOGY		$275	1300g 2.87 lb	177 x 210cm 70 x 83"		■	■	■	100D Ballistic Nylon 4x Steel D Ring	-	181kg 400 lb	NO	■	■	■	■ ■	4	■	BLUE/ black/yellow	Padded and polycarb supported back. Arm retention/support slings	rescuetech1.com
Rescue Triangle (RGR6)	RIDGEGEAR		£96	400g 0.9 lb	25 x 15cm 10 x 6" 90cm 35"			■		PVC 3x Soft eyes	EN 1497	136kg 300 lb	NO	NO	NO	NO	NO	0	□	YELLOW/ black	Design due to change in 2019	ridgegear.com
Alpha (CUD001)	ROCK EMPIRE		€84	870g 1.9 lb	30 x 17cm 12 x 6.7" 132 x 119cm 52 x 47"		■	■		Nylon/Polyester 9x Soft eyes 2xAlloy	EN 1497 EN 1498-B	150kg 330 lb	3	3	■	NO	■*	3**	□	ORANGE/ black/blue	*50kg limit on rear eye **3x Crotch adjustment eyes an be used as handles.	rockempire.cz
Combi II (W8211BY00)	SINGING ROCK		$100 €70	880g 1.9 lb	25 x 11cm 10 x 4.3" 125 x 123cm 50 x 49"		■	■		RipStop Nylon 4x Steel D-Rings 2x Soft eyes 2xAlloy	CE 1019 EN 1497 EN 1498-B	150kg 330 lb	NO	■	■	NO	■	0	□	YELLOW/ grey/black	New version 110g lighter than previous model. Also available without shoulder straps as SIT II for $80	singingrock.com
Resc B (G-1042-B)	SKYLOTEC		€88.10	700g 1.5 lb	23 x 34.5cm 9 x 13.6" 135cm 53"		■	■		PVC 9x Soft eyes 2x Plastic	EN 1498-B	140kg 308 lb	3	3	■	NO	NO	3*	□	ORANGE/ black/red/ blue	*3x Crotch adjustment eyes an be used as handles.	skylotec.de

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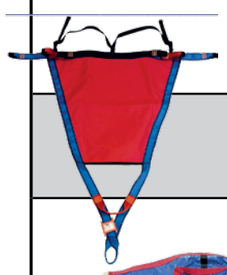
	MODEL	COMPANY	ORIGIN	COST inc tax/VAT	WT	APPROX PACKED DIMENSIONS Waist &/or Height	SUITABLE FOR: INFANT <3	CHILD	ADULT	HELI	MATERIALS: SEAT / D-RINGS/SOFT EYES / LOCK/ADJ BUCKLES	STANDARDS	MAX LOAD	INFINITE WAIST ADJUSTMENT	INFINITE CROTCH ADJUSTMENT	ADJ SHOULDER STRAPS	HEAD/NECK SUPPORT	REAR EYE/ HANDLE	GRAB HANDLES (inc rear)	HI-VIZ/ REFLECTIVE	COLOURS	NOTES	WWW.
 	**Evacuation Triangle** (TG V365054200047)	**TAGS**		**€60**	**660g 1.45 lb**	20 x 15cm 7.8 x 6" 119 x 150cm 47 x 59"		☐	■		PVC 5x soft eyes	**EN 1498-B**	**130kg 286 lb**	**2**	**1**	■	**NO**	**NO**	**0**	**NO**	**BLACK**		**tags.systems**
	**HT9**	**TRACTEL**		**£138**	**n/a**	**130 x 132cm 51 x 52"**		■	■		PVC 8x soft eyes	**EN 1497**	**150kg 330 lb**	3	**2**	■	**NO**	**NO**	**0**	**NO**	**RED/ blue**	**Min weight 30kg**	**tractel.com**
	**Evacuation Cradle/ CEVAC**	**TRAVERSE**		**$265**	**1800g 3.9 lb**	30.5 x25.4cm 12 x 10" 127 x 109cm 50 x 43"		■	■	■	1000 D Cordura 3xGalv Steel 1xWeb 2xAlloy	-	**225kg 495 lb**	■	**NO**	■	■	■	**0**	**NO**	**RED/ black**	**also branded as CEVAC by Barry Cordage**	**traverserescue.com**
	RSI Rescue Triangle (328)	**YATES/ RSI**		**$325**	**1105g 2.4lb**	**137 x 137cm 54 x 54"**	■	■	■		PVC 3xGalv Steel 1 plastic	-		■*	**NO**	**NO**	**NO**	**NO**	**0**	■	**BLUE/ red**	*This has an internal waist belt with buckle that adjusts to keep the adult or child firnly within the triangle	**yatesgear.com**
	**Air-Lift Rescue Vest (ARV)** (908)	**YATES**		**$895**	**2720g 6 lb**	**106 x 165cm 42 x 65"**		■	■	■	1000D Cordura 5x Steel 2xSteel	**NFPA**	**181 kg 400 lb**	**NO**	■	■	■	■ ■	**3**	■	**CAMO. ORANGE/ blue/red.**	**Water-draining mesh, camo ($970) and solid panel versions available. Adujustable sit-angle**	**yatesgear.com**

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LEATHERMAN ReBar MultiTool

LEATHERMAN	REBAR
ORIGIN	USA
COST	$60 £65
WEIGHT	190g / 6.7oz
LENGTH CLOSED	10.16cm / 4"
LENGTH OPEN	17.52cm / 6.9"
TOOLS	16
BLADE LOCK	YES. ALL
SHEATH/BELT CLIP	Sheath & Pull-out eye

The *ReBar* came to us last year along with a couple of other fairly nondescript looking models and at first sight we were a little underwhelmed. But after some use and abuse we ditched the other two for the time being and ended up focusing on the *ReBar* because it immediately stood out as a pretty decent player.

It's effectively a small version of the *Supertool* and you can really appreciate the more workmanlike design by comparing the pliers head with the *Wave*. The pliers head on the Wave is altogether more refined, it's a finer grip thread, smaller nose and nicely rounded with integrated wire cutter. The *ReBar*, like its big brother the *Supertool 300*, has replaceable wire cutters, a squarer head and a much coarser forward grip which really does grip more firmly if you're trying to pull something with force.

Leatherman have a '*Heritage*' version of the *ReBar* but I think that's just a cunning ploy to get rid of a load of old-style leather pouches that were still cluttering their warehouse. Otherwise this is also available in black or tan and has a similar range of tools to the *ST300*: ● Needlenose Pliers ● Regular Pliers (we count pliers as one item not two hence 16 not 17 tools) ● Premium Replaceable Wire Cutters ● Premium Replaceable Hard-wire Cutters ● Electrical Crimper ● Wire Stripper ● 420HC Knife ● 420HC Serrated Knife ● Saw ● Awl & thread loop ● Med Phillips ● Small Flat Driver, ● Med Flat Driver ● Wood/Metal File ● Tin/bottle opener ● Ruler 19cm/8"- The only obvious absence is the fattest screwdriver or pry-bar but *ReBar* still has a medium driver (called a 'Large' on the *ReBar*). The pliers are excellent, they're actually a little wider than the *ST300* we had for our original tests at 45mm rather than 40mm opening. These might be the best pliers heads we've yet come across given that they also have the replaceable wire cutters. The rest is basically the same but shorter in the case of the main blades (7.36cm/2.9" instead of 9.6cm/3.77" for the main knife blade. There are couple of differences though, *ReBar*'s 4 main blades have a rebate at the bottom which shortens the cutting or filing surface but sits snuggly into the handle ends without damaging the blades should you try and fold them down with the casing closed. There is also a curved top-edge to the file and the saw blade. We're not sure if there's any advantage beyond weight-saving but we have noticed that the file blade, while not sitting proud of the casing, does seem to be a more obvious presence to your fingers with its high-friction surface more exposed at the sides – maybe the bottom of my fingers have got more saggy with age!

One of the issues with this more traditional design of course is that you don't have access to the blades when the tool is closed so no one-handed opening. Of the remaining tools don't get me started on that awl, I know it's highly subjective with many swearing by it, I tend to swear at it finding it too fat for the 'threading' jobs I actually want it for. However, I did find a use for its sharp edge as a scraper this time around to get some melted plastic off a metal bar without having to dull the main knife blade....kinda sacrificial but easy enough to re-sharpen.

If you refer back to our *Multitool Finals* with what we considered the best 5 multitools at that time (TR issue 68) you'll see that the *Supertool 300* came in fifth after the enhanced test regime but joint top in the original tests involving 25 good tools.

We'll include the *ReBar* in a new series of back-to-back tests later this year but with *ReBar* being a slightly refined and smaller version of the Supertool it stands to reason that it would fare well in our overall results table. A quick look at the criterion we used in the regular Back-to-Back tests suggests it would get around 48 making it about joint 7th out of 26 (23 are listed in our cumulative table because two tools broke). That makes this a very creditable performer. The smaller size wins it some extra points on cost and bulk which it then cedes back on cutting and sawing prowess. Overall, if you want to shave $20 off the cost and almost 100g/3.5oz and half an inch/1cm off the closed length but retain everything you liked about the *Supertool 300*, this is your multitool. It feels as though it has a little more design finesse but when you handle it side-by-side with the more stylized models you can see that it's still pretty much the sturdy, reliable, toolbox multitool grunt of old.

www.leatherman.com

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without a blinded eye in the crowd.

Ultra-powerful, rechargeable, and waterproof headlamp equipped with an anti-glare mode.

The patented FACE2FACE anti-glare technology system automatically dims the light output when two DUO S headlamps are aimed at each other reducing the blinding effects of its powerful beam. Rechargeable, waterproof and robust for extreme uses like caving. The DUO S makes uses in groups much more “eye friendly”. Maximum brightness: 1100 lumens (BOOST mode).

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