

WILDERNESS SAR

PARKRANGERS, MOUNTAIN&CAVE RESCUE, WATER&HELL-OPS



ISSUE

8

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WILDERNESS SAR

CONTENTS

8

ON THE COVER



The full picture!

A rescue exercise in the Gola di San Nicola canyon in Matise Italy, conducted by the National School of Rescue Technicians of the National Alpine and Speleological Rescue Corps. The section shown here and in our ON-THE-COVER feature overleaf, is a short

distance away from the waterfall pictured left which necessitates a 37m raise or lower. The route is often tackled from the river on up because that route is much shorter and quicker than trying to evacuate downstream.
Photos by Pino Antonini

- 6 **PRODUCT INFO:** Rope, ATV & Water Stuff
- 10 **WATER RESCUE:** EMILY Drone
by Edward Lundquist
- 16 **WELL-BEING:** Stress Injury
by Laura McGladrey & Kate Dernocoeur
- 20 **SPOTLIGHT:** Micro-Blasting
by Carroll Bassett
- 26 **GUIDE to Basic Hand Ascenders**
by Ade Scott
- 36 **MOUNTAIN RESCUE:** UAVs
by Darryl Ashford-Smith
- 42 **SAR SAFETY:** Pt2 Mountain Rescue Equipment
by Greg Toman
- 54 **WATER RESCUE:** Crossline REACH
by Mitch Sasser & Sean Norman
- 58 **GUIDE to Rescue Dog (Suspension) Harnesses**
by Ade Scott
- 70 **EQUIPMENT:** SAR Pack pt1
by Roland Curll

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KONG CANYON STRETCHER & CASUALTY PROTECTION

Shown here in Blue & black is Kong's 60Lt Expedition pack, the Langtang which weighs 1.86kg/4.1lbs empty and features.....:

- adjustable shoulder straps with quick release for disengaging, with integrated daisy chain
- adjustable waist belt concealed in special bags
- practical and solid ergonomic carrying handles
- internal loops for gear holders in 2 vivid colours
- internal rings for attachment of rope-ends in 2 vivid colours
- practical bag carrying emergency rope (it can contain 60 meters of 8.5mm rope), with internal rings for rope extremities and ring for clipping to the harness
- ice axe holder for canyons with snow: very practical and rapid extraction and reinsertion of the ice axe with the worn backpack



Photo by P. Antonini



This issue's cover features a complex canyon and waterfall extraction by a *National School of Rescue Technicians* team of the National Alpine and Speleological Rescue Corps (CNSAS) in Matisse, Italy. They are using Kong's 911 Canyon stretcher with integrated Casualty Capsule, a protective packaging which is particularly important in water-intensive rescue like this where the risk

of hypothermia actually increases AFTER the initial rescue. The waterproof capsule has a clear visor, internal lexan shield (pic opposite) with cervical collar and an adjustable breathing vent which can be isolated during inundation as will have been the case just before this photo when manoeuvring through the waterfall. Inside the environmental protection the casualty is restrained with a full body and lower leg harness system. The stretcher itself is a two-piece capable of suspension in any orientation as well as having extended carry handles.
www.kong.it

The Kong Canyon Rescuer Stretcher was introduced in 2014 and is designed for canyon and river rescue, fitted with a dry-bag (watertight), wide padded internal webbing for a fast fixing of the injured, aluminium alloy frame, Kevlar cradle with holes for water discharge, head protection and Lexan visor. Fast disassembling in two pieces for an easy transportation. The stretcher includes all the accessories and suspension/carry kit. It is equipped with:

- fully waterproof bag in tri-laminate fabric
- patient immobilization straps which are fully padded and feature fast attachment hardware
- ultra-light aluminium chassis with fiberglass cradle (has holes for

- water drainage)
- Lexan visor (with integral breathing valve) to protect patient's head without restricting breathing
- two-pieces frame to facilitate transportation
- suspension kit
- fully buoyant
- Weight: 23kg / 51 lb

Cost: £6300/\$7800/€7800

CLAMPS WITH A BITE

the EDELRID CRUISER Ascender family

HAND CRUISER, CHEST CRUISER, and FOOT CRUISER—now the family is complete, and we can offer you a complete range of ascenders. Each of the ascenders (or clamps in Europe) provides comfortable and fast ascent on the rope and optimal bite, even on icy or muddy ropes. Furthermore, all three feature impressive, innovative details.

The HAND CRUISER is an ergonomically shaped hand ascender with smart features. The curved design increases comfort and reduces friction in the system. A large eyelet allows several carabiners to be attached; a smaller eyelet positioned slightly higher is ideal for setting up a directional anchor.

In addition, the secondary hand can comfortably grasp the top of the HAND CRUISER during ascent. The right/left versions are available in different colors for quick identification.

- Ergonomic head section for ambidextrous ascent
- Two-component handle for maximum comfort
- Large eyelet for up to three carabiners
- High attachment point for setting up a pulley
- Angled handle for increased comfort
- Clamp cams with cleaning holes for optimal bite on dirty ropes

The CHEST CRUISER is a compact chest ascender for efficient and fatigue-free climbing on the rope. The ascender can be opened in one simple motion.

The modular construction with a fastening plate and textile fastening loops allows for integration into different chest harness systems. It also features a safety lock for the clamping mechanism, which ensures safe and easy handling. Using a foot ascender is a



particularly efficient and low-fatigue method of climbing single ropes. However, conventional foot ascenders can accidentally disengage from the rope if it is unfavorably positioned. The FOOT CRUISER incorporates a rope clamp that prevents accidental disengagement from the climbing rope. The locking mechanism is easily operated with the other foot and can even be removed if necessary, making it quick and easy to disengage from the system in an emergency. Thanks to the low spring tension, the ascender runs extremely smoothly, making climbing easier and preventing premature fatigue. At the same time, a robust, stainless steel cam provides optimum bite, even on icy or muddy ropes. The adjustable foot strap ensures secure fixation of the foot and has an abrasion protector to prevent premature wear. The FOOT CRUISER is available in both right and left-foot versions and with a Talon version for affixing to climbing spikes.

www.edelrid.de

Article	HAND CRUISER	CHEST CRUISER	FOOT CRUISER
	88253 (left) 88254 (right)	88255	88249 (left) 88250 (right)
Photo			
Certification	EN 12841-B, EN 567	EN 12841-B EN 567	-
Weight	200 g	120 g	165 g
Certified rope diameter	8.0 to 13.0 mm	8.0 to 13.0 mm	8.0 to 13.0 mm

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ARGO +SHERP=

Pro-XTVs



ARGO, the worldwide leader for amphibious Extreme Terrain Vehicles (XTVs), is pleased to announce it has entered into a manufacturing and supply agreement with SHERP to expand its current offering of commercial amphibious XTVs. ARGO President and CEO, Brad Darling, stated, "Our current lineup of ARGO Conquest Pro Series XTVs are renowned in the commercial/industrial market. From mining to oil and gas, and from utilities to search and rescue, the commercial customer has been key to ARGO's success for over 50 years' and with the co-branding of an all-new line of SHERP machines, it will help guarantee success for the next 50 years."

The ARGO Commercial Series will now include four new XTV models arriving January 4, 2021: the ARGO Sherp Pro, ARGO Sherp Pro XT, ARGO Sherp Ark XTX and the ARGO Sherp Ark XTZ. All are built for the rugged demands of commercial operators, with extra power and capacity, greater versatility, maximized quality and safety. SHERP has done a phenomenal job in giving commercial customers an extreme terrain product, and the new ARGO Sherp positions perfectly as the next step from our ARGO Conquest Pro Series.

Regarding SHERP, Darling went on to say, "We are very excited about how this relationship has developed and the opportunities that lie ahead for both companies. Going forward we believe this partnership will provide tremendous value to ARGO, our commercial customers, and our dealers."

Yaroslav Prygara, CEO of SHERP International added, "The addition of ARGO's dealer network, infrastructure, and the strength of their entire team will enable us to provide greater service and support to our commercial customers as well as strengthen and elevate the ARGO Sherp brand across all of North America."

In addition to expanding the commercial product line, ARGO has restructured its business model to create a dedicated commercial and robotics team. This new team will be responsible for the professional XTV product line, which now includes the Conquest Pro Series and the new SHERP vehicles. This team will also have responsibility for our Xtreme Terrain Robotics (XTRs) products. Whether manned or unmanned, ARGO has a full lineup of commercial, industrial and military-ready products.

ARGO SHERP PRO XT

Bigger. Bolder. Beastier. These three powerful statements set the course for our team when designing the ARGO Sherp Pro XT. It gives you more technology, improved innovative features, and of course, an overall larger vehicle to enhance your total experience. Inch by inch, you'll see nothing was overlooked. The high-quality craftsmanship is second to none, inside and out. And if you're lucky enough to drive the ARGO Sherp Pro XT, you might never get out of the redesigned driver's seat — comfort is king.

*Models shown may include accessories.



SPECIFICATIONS

Engine Make	Doosan	Wheelbase	86" (2200 Mm)	Front Seats	2 - 3 Point Seatbelts
Displacement	1.8 L	Towing Capacity	5170 Lbs (2350 Kg)	Rear Seat option -	2 Front Facing
Fuel Type	Diesel	Dry Weight	5280 Lbs (2400 Kg)	-	4 Front Facing
Cylinder	3	Fuel Capacity -	Main 25 Gal (95 L)	-	6 Side, 1 Rear Facing
Emission Standards:	Epa, Stage 5/Tier 4 Final	Fuel Capacity -	Cannisters In Rims 15.3	Gauge	Multifunctional Digital
Doc	Doc+Dpf/Doc Only	Gal X 4 = 61.2 Gal	(58 L X 4 = 232 L)	Review Camera	Standard
Cooling System	Liquid	Interior Volume -	Overall 275.5 Ft3 (7.8 M3)	Heater	Standard
Horsepower - Max	55 Hp (41 Kw)	Interior Volume -	Front 70.5 Ft3 (2.0 M3)	Air Conditioner	Optional
Torque - Max	190 Nm	Interior Volume -	Rear 205 Ft3 (5.8 M3)	Headlights	Led - Hi/Lo Beam
Fuel Consumption	1.3 - 2.2 Gal/H (5-8 L/H)	Speed - Max Land	25 Mph (40 Km/H)	Lightbar - Rear	Optional
Voltage	12 V	Speed - Min Land	1 Mph (2 Km/H)	Lightbar - Front	Optional
Alternator Capacity	140 Amp	Speed - Water	4 Mph (6 Km/H)	Bumpers - Front	Standard
Starting	Electric	Suspension	Adjustable Pneumatic	Bumpers - Rear	Standard
Battery Type -	Main Lead Acid	Brakes	Circulating Tires	Hitch	2" Receiver -
Battery Type -	Backup Lead Acid	Parking Brakes	Dual Disc	Winch	Front And Rear
Transmission Type	6-Speed Manual	Tires	Handbrake	Bilge Pump	Optional
Final Drive	Enclosed Chains In Oil	Pressure	Tubeless, Ultra-Low	Glove Box	Standard
Steering	Two Lever Hydraulic Skid	Tire Size	Pressure	Cup Holders	Standard
Payload	2640 Lbs (1200 Kg)	Wheels	71 X 23-25	Storage Boxes -	Under Floor as Std
People Capacity	2 Standard,	Ground Pressure	(1800 X 600-635)	Lockers -	2 Pcs Optional
Climb/Descend Grade - Max	35 Degrees	Pressure Control	Aluminum Beadlock	Mirrors	Standard
Sidehill Grade -	Max 30 Degrees	Cabin	0.9 - 2.1 Psi	Window Options:	Rear Side 2 Pcs
Overall Length	156" (3984 Mm)	Frame	(0.07 - 0.15 Kg/Cm2)	-	Rear Side 4 Pcs
Overall Width	99" (2520 Mm)	Rops (Certification)	Adjustable By Exhaust Gas	Warranty	24 Months
Overall Height	112" (2846 Mm)		Aluminum Hard Top	Color	Or 1,000 Operation Hours
Ground Clearance	24" (600 Mm)		Steel Galvanized		Black

ASAP Rescue Jet-Boards

UK Designers and Engineers ASAP Water Craft's Rescue jet boards are quick launch electric jet boards that Rescuers can carry on their back or use the fold-flat optional wheels and launch almost anywhere. Search and Rescue professionals are choosing Asap's jet boards for inland and sea rescues, as an easier option to transport as well as something that can be launched by one person, to power through the water quicker.



Asap's jet boards have deceptively high torque, which in the water, translates to incredible towing power. For example the board is tested with five people hanging from the side in the water and there is barely any speed loss as everyone is returned safely to shore. In another test we tried towing a 2.5 Ton boat, which the Asap Rescue board towed with ease around the harbour then out to sea! The power and rescue towing potential of this bodyboard sized jet board should not be underestimated.

Once thrown into the water, the rescuer presses the thumb throttles, which control the speed of the electric propulsion system. This custom propulsion system was designed specifically for Asap's Rescue jet boards – a compact, light weight ducted jet system, with guards at the inlet and outlet, means you can safely roll around with the board in the water. The rescuer shifts their body weight to steer the board. On reaching the casualty, there are a number of rescue options: the removable rescue float can be passed to the casualty, or strapped around an unconscious person, or the casualty can be brought onto the jet board using the same board roll technique lifeguards use. Casualties able to swim and hold on, can easily grab any of the handles on the jet board, as the rescuer powers them safely back to shore.



Water rescue organisations in The Netherlands have been building custom water rescue trucks to house their fleets of Asap Rescue Jet boards. However, it's not just the quick launch and ease of use they prefer – much like electric cars, Asap's electric jet boards require very little maintenance/servicing. Their simplicity with just one moving part means there is little to go wrong, along with the very low running costs of charging the battery. Guide price for the Rescue 156 is £5,830. exc VAT c/w a rescue float (buoyancy for one person), one handed rescuing throttle programming, 2m tow line, standard charger and rescue colours/branding. Custom colours/branding on request.

www.asapwatercrafts.com

Model	Rescue156
Performance up to	5kW
Speed*	16km/h
Dimensions	145 x 60 x 28cm
Average runtime**	50-60mins
Charge time: Fast:	120mins to 80%
	180mins to 100%
Super Fast:	50mins to 80%
	90mins to 100%
Weight	30kgs
Battery	50V Lithium-ion
	1.46kWh 31.2Ah
Buoyancy	60kgs
Number of speeds	3
Brushless motor	4000rpm in water
Hull/body	Dense moulded foam
Steering	Body weight leaning
Stopping	Double safety off
LED display	speed & battery
*speed quoted is top possible speed, this varies depending on driver/position/conditions	
** average runtime based on how most people drive, this varies depending on driver/speeds selected/conditions	

Bestard SAR PRO Boot



- ▶ Vibram sole and reinforced toe
- ▶ Gravel gator
- ▶ Stainless steel eyelets
- ▶ Reflective strips front and rear
- ▶ Lace stash
- ▶ Optional stab proof innersole
- ▶ Comfortable and robust
- ▶ Sizes UK 6–13 (including half sizes)



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using **EMILY** Emergency Integrated Life-saving Lanyard



By Edward Lundquist

Ned is a retired U.S. Navy captain who writes on maritime, naval, defense, security, energy and transportation issues. He lives in Springfield, Va.

What's 4 ½ feet long, orange, goes faster than 25 miles per hour and saves lives? The answer is EMILY, the Emergency Integrated Life-saving Lanyard, made, ironically, in the arid state of Arizona by Hydronalix. EMILY is a remotely-controlled unmanned surface vehicle (USV) that can be sent out to people in danger of drowning and used as a flotation device for up to six people.

Like many small companies, Hydronalix started with a bright idea and a garage. CEO Tony Mulligan and his partner Bob Lautrup played around with small, remote-control surface vessels that featured a racing-boat inspired hull. Testing their designs from Zuma Beach in Malibu, California, they could see how such a vehicle could help life guards get flotation to swimmers in distress, especially those who may be far out in the water or in heavy seas. The early versions went through an evolutionary process of continuous improvement, becoming safer, more efficient and more effective.

EMILY is made of Kevlar and aircraft-grade composites and is virtually indestructible. It can handle a 30-foot wave. It can be thrown out of a helicopter or off bridges

EMILY was launched from a series of Navy-sponsored Small Business Innovation Research (SBIR) investments starting as far back as 2001. Mulligan has developed and extended the company's technology and its EMILY product line to provide multiple solutions to a wider array of problems. EMILY is a compact, battery-powered, water-jet propelled robot, and designed to assist lifeguards in the event someone is drowning or in distress. It is made to be seen, covered in bright orange and flying an orange flag. The USV is equipped with a waterproof two-way marine band radio with loudspeakers and a remote microphone. Other versions used for covert surveillance missions could be made less

obtrusive. It's small and relatively inexpensive, and is disposable if necessary. The basic vehicle can be fitted with sensors to carry out a number of other functions, such as sonar imaging or environmental sampling.

Mulligan said the boats are practically indestructible. "Emily is made out of Kevlar and aircraft-grade composites. It can handle a 30-foot wave. It can be thrown out of a helicopter or off bridges."

The USV can operate for three hours on its battery, and comes in different versions, depending on the function. The lifesaving version is remotely controlled, whereas the sonar version is autonomous, and conducts planned missions without a pilot telling it what to do, a particularly useful feature when conducting a search

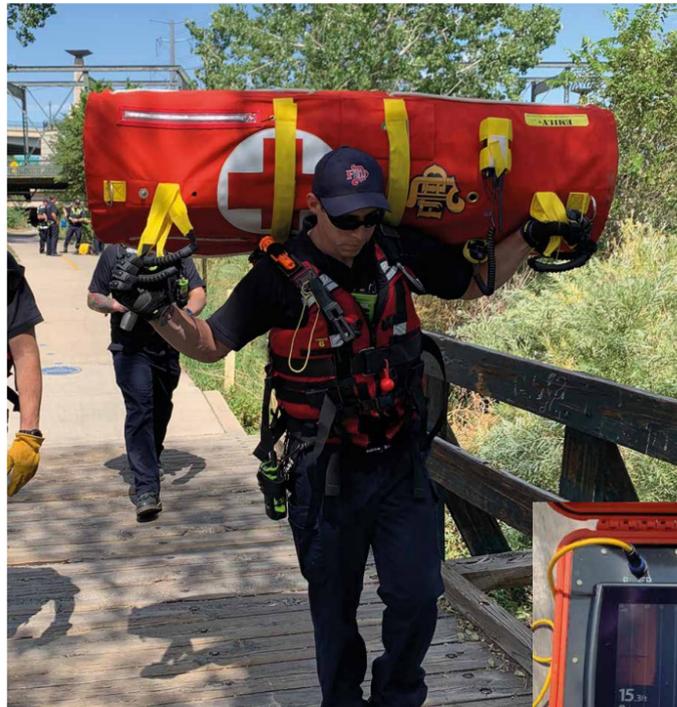
pattern for an underwater object or drowning victim. Sonar EMILY is equipped with Hummin'bird side-imaging sonar from Johnson Outdoors Marine Electronics, using SAR Hawk software from Black Laser Learning (BLL) to process the data.

MORE POWER FOR SWIFTWATER RESCUES

An upgraded rescue version called the "Swiftwater EMILY" has a bigger battery and a higher-power motor for use in fast current or very rough conditions. Scott Buccieri is the assistant chief for special operations with the Denver Fire Department, said his department has the Swiftwater version. "I believe the platform is safer and more efficient than actually putting a rescuer in the water because now there are fewer variables to deal with," he said.

"We don't have major waterways or massive bodies of waters in our jurisdiction. Our water rescue team includes divers who are trained in all forms of rescue diving, from swiftwater rescue to under-ice diving and working around and hazardous materials, but we're not dealing with water rescues every week. Our biggest waterways are the Platte and Cherry Creek Rivers. Our water levels and flow are usually low. Our main challenge is when we get thunderstorms or spring snow melt-off from the mountains. Some of our streams or creeks are usually not much more than a trickle, but they can become a torrent in a matter of minutes. We go from 'not much' to 'insanity.' For us, these are low frequency-high risk events." "We have some areas where twice a year we have continuous





EMILY and hang on while we pulled them in. But even if the victims can't hear, they intuitively grab on, and EMILY is sturdy and buoyant enough to allow us to bring them to shore."

"As a department, we don't use every tool we have all the time. And we have a lot of different training we have to perform. We can't devote a lot of training time for just one system or tool," Buccieri said. "Having something like EMILY that is fairly simple in how it's put together, and straightforward in how it works and how you use it, makes it 'firefighter-proof.'"

Buccieri said Swiftwater EMILY gives his department a tremendous amount of versatility. "It's an amazing platform. It's something that makes real sense for us." Hydronalix CEO Mulligan said "the lifesaving technology is being used in many other ways, including a water sampling system to test sewage or industrial waste for hazardous substances or to monitor natural events such as a red tide bloom. The sonar variant has sensors that can measure water depths and produce



water rescue calls, but during the rest of the year it's just dry," Buccieri said. "When there's no danger it leads to a sense of complacency for the public and our rescuers. That's really our biggest challenge."

Buccieri said he has to go outside his local area to effectively train. "We take our team up to Boulder, which is closer to the mountains, and we can train on Clear Creek, which has a pretty robust water flow. It's actually been too rough for training in the past couple of years, so we can't always practice there. This year we had to deal with the pandemic."

COVID has added some new wrinkles to rescues, such as creating opportunities to transmit the virus. "We don't want to get anything, and we don't want to give anything. If I can send EMILY on a water rescue, I don't have to put myself next to the victim. We can keep people away from each other," said Buccieri. "The tool increases our capability while keeping ourselves safe during this pandemic."

The platform is safer and more efficient than actually putting a rescuer in the water.

Scott Buccieri
Assistant chief for special operations
Denver Fire Department

Buccieri said EMILY is very simple, adaptable and efficient. "It's extremely easy to use as well as very easy to train on. When Hydronalix came to train our responders, it took much less time to train each shift than we had planned for. We were able to get all of our people to a point where we were more than comfortable. We had firefighters and police who were participating in training, serving as both responders and victims, who didn't know we were going to use EMILY in our drills. They didn't even know we had it. During the drills we were able to use the communications function to tell the 'victims' to grab

side-scan and down-scan images of bridge substructures and streambeds, as well as a topside camera to view the underside of bridges".

and camera will be used to obtain images of substructure units below water; to view the underside of bridges and performance characteristics, and to monitor the bridge for scouring. The system can operate in turbulent waters with high current near substructure units or debris.

Casey Collings, an engineer and diver with the Great Lakes Engineering Group (GLEG), a company that does bridge inspections for MDOT, and actually bought a Sonar EMILY for themselves, said Sonar EMILY provides valuable intelligence



understand what we should be seeing. With EMILY, we can make out exactly what's down there. You can't put a dollar figure on the safety value. We may still have to dive, but now we know what we're getting into. We save a lot of time. More importantly, it's really important for diver safety," says Collings.



The Navy SBIR investment helped to fund the beta testing at Zuma Beach in Malibu, Calif., for the original EMILY. Mulligan worked with the Los Angeles County Fire Department (LACFD) Lifeguards, who were instrumental in the evaluation. LACFD now has five systems, including one Sonar EMILY. LACFD Capt. Patrick O'Neil said EMILY can not only rescue people, it can also prevent

before the divers enter the water, especially when the water visibility is low. He said the divers can encounter a lot of junk in the water, from tree branches to refrigerators to cars. "We want to get some reconnaissance of what is down there before we actually get in the water. We don't want to go in blind. If we're going into murky water with zero visibility, EMILY helps us








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incidents. "Our lifeguards are actively involved directing people away from danger, such as rip currents or obstacles. We use EMILY with a two-way speaker to warn swimmers. I've had at least 100 prevents. It's hard to estimate the value of all those rescues you didn't have to perform, and the lifeguards you didn't have to put at risk."

LACFD Lifeguard Chief Fernando Boiteux's personnel are well versed on how it works, and helped to train other agencies, such as the elite U.S. Customs and Border Protection, Border Patrol Search, Trauma and Rescue (BORSTAR) team of the United States Border Patrol's Del Rio Sector in Texas, which now has Swiftwater EMILY.

Harold Ortega, who commands BORSTAR, said all BORSTAR team members have been certified as operators. "Training with the LACFD lifeguards was very useful. We were able to ask questions to professionals that have significant experience using EMILY in real situations, and who actually use it every day."

Migrants who try to cross the Rio Grande River to enter the U.S. can find themselves in peril. "We have a lot of water rescues," said Ortega. "We're there at the border every day. The Rio Grande River can be extremely dangerous for those who attempt to traverse it. We see a lot of young children, even infants, and unaccompanied minors trying to cross the river, even in bad conditions. Our agents can also be at risk anytime they get into the water. The water might be waste deep, and two steps later they're over their heads in a strong current." Ortega said members of the BORSTAR team consist of certified EMTs and Rescue Paramedics. "We're trained in rescue techniques, boat operations and diving," Ortega said. "The hard part of the job is when we transition from lifesaving to victim recovery."

Vincent Capone, sonar instructor and CEO of BLL, which makes the software for Sonar EMILY, said Sonar EMILY is a cost-



"It's for public safety agencies." Not all police officers, firemen, fish and game wardens or park rangers are trained rescue swimmers, but they can perform a water rescue with this tool, Day said. As an example, Day points to the Rockaway Beach Volunteer Fire Department in Oregon, which has two EMILYs. They used EMILY to save an entire family—two children and two adults—caught in a rip current.

Robert (Bob) Lautrup, Hydronalix executive vice president, said EMILY doesn't replace the lifeguards. "We present Emily as a tool to help responders conduct rescues faster and safer. A single lifeguard or responder can perform a rescue that would not otherwise be too risky without waiting for backup."

www.hydronalix.com

effective underwater search and survey platform for shallow environments. It can be operated autonomously, or by remote control. "A grid search pattern may be best when searching a large area for a drowning victim or an object of interest. When working around a structure or imaging an exact location, you may want to control the vehicle yourself," Capone said.

Buccieri said his department was assisting in a search for a missing person that took four days. "If we had the Sonar EMILY, we would have found him on the first day. It wouldn't have changed the outcome, but the family was there for the four days with us. If we could have gridded out a search pattern with EMILY we would have found him right away, and his family could have had closure." Paige Day, a retired fire chief, now works for Hydronalix, understands budget constraints for small municipal service agencies. Day said the basic system is affordable, even with add-ons like loud speakers and cameras. "Beach Rescue EMILY costs about \$10,000", Day said. A Swiftwater Rescue program, which includes more specialized training, is just under \$15,000, although Day said "a new online training program will reduce travel expenses for training and bring down the system cost, and is a more practical approach during the pandemic. The sonar unit is more expensive because of the sensors, its autonomy capability, and the ability to collect, display and store data".

Day said that she and her team have trained and certificated more than 50 swift water rescue professionals at more than a dozen rescue agencies in 2020, including New York City, Austin, Texas, and Denver Fire Departments. The training package includes classroom and field operations training for Swift Water Rescue EMILY, Beach Rescue EMILY, and SONAR EMILY.

"This is not just for lifeguards," Day said.

Issue 8 WILDERNESSAR



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Stress Injury

Building Capacity for the Year Ahead

By **Laura McGladrey**
and **Kate Dernocoeur**



Laura, aka "Glad," is a family and psychiatric nurse practitioner who specializes in emergency medicine, mental health and traumatic stress, especially in the wilderness and remote parts of the world. She has been an instructor with NOLS Wilderness Medicine since 1999.

Having started her rescue career with Vail Mountain Rescue Group in Colorado in 1977, Kate has been prominent in Mountain rescue and EMS ever since and is well known from her work in JEMS magazine. An EMT/fire-fighter/paramedic Kate is currently a medical Examiner in Michigan and Medical Officer for Kent County SAR (MI). A fellow of the National College of Emergency Medical Dispatch since 1990.



Everyone knows that 2020 and 2021 are in a league of their own, unprecedented in fact. Collectively, we have already witnessed record usage of the backcountry and outdoor spaces, unrivalled wildfires, angry and unyielding social unrest, huge weather events, and, oh yeah, COVID-19. As the seasons morph into whatever comes next, it seems as if there's barely time to catch your breath. This means that before those in the emergency ranks even show up for their change-of-season jobs, many are already seriously depleted of their innate inner coping resources. It's a set-up for stress injury formation if there ever was one. (If the term "stress injury" is new to you...read on!)

In October, Stephanie Thomas, a 13-year veteran with Teton County Search & Rescue (TCSAR) in Jackson, Wyoming, made a presentation at the 2020 virtual gathering for the International Commission for Alpine Rescue (ICAR). In it, she offered a collection of recommendations about things we can do for ourselves and our teams as we head into this next round of work.

It looks like an unusually busy season ahead, populated by novices who may lack outdoor/backcountry savvy. This is evidenced, to date, by record levels of backcountry gear sales. This impending record usage of the outdoors comes with new (and shifting) COVID protocols and predictably high levels of stress for emergency workers. What to do?

In anticipation of the possibilities, the following seven tangible, practical recommendations as presented at ICAR by Thomas might help. Use them to help your team (and yourself) combat the effects of such set-ups for stress injury formation as new (and changing) COVID-19 protocol stresses, decreased spontaneous connection with your team, and pre-existing depletion.

These recommendations rely on awareness of the powerful work and new nomenclature for emergency providers regarding Stress Injury Formation and Psychological First Aid (PFA). This emerging work constitutes a revised approach to what to do about stress. They represent the next generation of the work by people such as Jeff Mitchell and the International Critical Incident Stress Foundation he helped create, plus the broad efforts, especially by the military, to address post-traumatic stress disorder (PTSD). As EMS/rescue expert Laura McGladrey, who is also an emergency and psychiatric Nurse Practitioner, says, "By nature in our profession, we have exposure after exposure (and a lot of other stressors, too). I'm not sure we could expect the human machine to undergo what we do without changes, yet when the machine does start to change, we call it a disorder? No, let's start thinking of this as a 'stress injury formation'."

Formation of stress injury occurs on a continuum," according to McGladrey. From work borrowed from the U.S. Marine Corps, she describes how this "Stress Continuum Model" works well as an operational system for managing reactions to our risky, difficult, sometimes heart-breaking world.

Viewing stress injury as a continuum takes into account that injured people don't go from being fine one minute to full-blown PTSD the next. It's a process, much like diabetes where there are early, subtle changes. In diabetes, blood sugar values start to rise. Unaddressed, these can lead to worsening injury formation, such as numbness in fingers and toes, along its continuum to diabetic ketoacidosis, and can even result in death.

In our world, we are repeatedly impacted by difficult scenes, depletion/exhaustion, and other factors. Over time, a person can go from feeling excited and happy in their work down a continuum that has identifiable and increasingly worrisome signs, some emotional, some physical. Unaddressed, that

[Stress] injured people don't go from being fine one minute to full-blown PTSD the next

person can go from a green-light state through a progression of signs and symptoms that indicate stress injury formation. View these as being like the yellow light on a stoplight. In this system, there's also an "orange" light as things worsen. Unaddressed, this can lead to a red-light that demands a person to stop. Some call it PTSD or critical incident stress, but the good news is that there are solutions that can prevent emergency responders from proceeding that far. There are answers to the pain, just the way a splint or cast can help support a fracture while it re-knits its own integrity when the broken bones heal.

When agencies and teams pay attention to the following seven recommendations, they stand a better chance of negotiating the difficult days ahead. The reward: a healthier outcome, as evidenced by greater overall wellness and (also necessary) rank retention for everyone concerned.

1. Pre-load capacity with all your might. We have to respond and adapt to what is happening in this moment. We can't be distracted by what we want it to be or what it has been in the past. A person already in a state of stress is more likely to sustain stress injuries, so a capacity for resilience matters. Those who will thrive in this season are those with the most capacity (physical, emotional, spiritual, logistical) to adapt and respond to the complexities each moment demands. Because of the nature of this beast of a year, building this capacity is more important than ever. Souls coming in, soot-faced, already depleted from fighting wildfires for the past few months cannot expect to jump right into their ski patrol roles (or whatever) without taking time to notice and address ways to build renewed capacity.

2. Write new rules for this season. This means determining your targets for the season, such as team cohesion, personal emotional survival, and having enough bandwidth to respond to complexity. It will likely require emergency providers and their leaders to change the ways things have been done traditionally. It might be a goal of simply getting through with your sanity intact! Be ready to let go of some of the higher expectations and “extras” that you are used to doing. For example, find COVID-friendly ways to accomplish group connectedness now that the familiar huddles or hugs aren’t happening.

3. Radical Prioritization. Choose your goals for the team, your family and yourself. Prioritize them. Create and use a plan that acknowledges and honors your priorities for each of the important elements of life: self, family, team. Staying connected and getting out to be with the people and in the places we love is non-negotiable for survival this season.

4. Expect low tolerance for emotional pain/stress. Stop and fix, using the self-care you need and deserve. Sometimes, our rescuer personalities cause us to limp on a blister, or tolerate a nagging dig from misplaced gear in our packs. But pushing through depletion and overload is a bad idea—especially this year. We’re already running a marathon, many of us in remote settings. Care aggressively for yourself and your team in real time. It’s unhealthy to put self-care off until after the season; this year, trying to do that could be outright impossible since our “seasons” seem to be occurring without breaks. Cut yourself some slack: allow yourself some decreased tolerance for enduring emotional pain and depletion this season.

5. Increase self and partner awareness. Make intentional use of a buddy system to check on each other. The demands of what has every indication of being an unusually busy season this year will make everyone more susceptible to depletion. Learn about the stress continuum and how to recognize those depletion levels. Plan to conduct regular check-ins with yourself and your team. Make it a team-wide effort so no one gets lost in the weeds. Remember others, too, such as dispatchers and other people who “have your back.”

6. Plan for increased exposure with more inexperienced folks and higher volumes in the backcountry. People whose emergency response experience is minimal see things (“exposures”) very differently from those with a lot of time in grade. Anyone on your wider local team (such as avalanche forecasters) who are less accustomed to responding to difficult scenes should be noticed and included in trauma mitigation. Notice those persons at a scene (such as those who called for help but are physically uninjured) who might benefit from receiving psychological first aid. It is more likely than ever to be needed, with so many inexperienced people using the backcountry. Other helpful measures to implement after the

event include “the 3-3-3”—a specific stress-injury check-in that is intentionally done after 3 days, 3 weeks, and 3 months.

7. Consider new rituals for grief this season. Emergency teams typically have well-established rituals for caring for each other after losses, especially those involving our own team members or people we know. These often involve such remedies as spontaneously gathering, sharing meals, and (of course) drinking adult beverages. All of these rituals have been affected by COVID-19. Tragically, personal and spontaneous connections have been largely lost, and substituting for them is a challenge. This year, brainstorm with your team to find substitute rituals that allow for periodic, planned check-ins. The need to connect and support one another is essential to our tribal world, especially in the initial aftermath of a significant loss.

Yes, 2020 was a beast, early 2021 may not be much better so the coming seasons will demand a lot of us. These facts mean that your team could benefit from some especially-focused planning. Include in your exposure plan ways to easily access reliable links to the professional support and other resources that are available to you (see sidebar). Know the local, established therapists who “speak” your service’s unique language, whether it’s SAR, EMS, wildland firefighter, climber, avalanche forecaster, dispatcher, or whatever.

In addition, it is helpful to any team to implement at the outset a common language for the situation. For example, does everyone know what “stress injury” is? How it forms? Signs that demonstrate movement along the stress continuum? What to do about that? (For more information, go to <https://www.responderalliance.com>) Having language in common allows everyone to begin on the same page. As the weeks and months ahead pass, this will help people monitor their well-being and that of their team and adjust as needed in real time.

None of these strategies will happen by magic. Planning and preparation for the challenging season ahead will require us all to be very intentional. A good starting point is to check your inner “batteries,” and have the “battery charge” conversation with your colleagues and team. Know from the outset what depletes you (and how to say no to it), and also what/who charges up your batteries. Take time as a team to create rules of engagement that take into account the unusual nature of this COVID-19 year. Implement whatever radical reprioritization is indicated for you and your community. And of course, be ready to lean in (hard!) to the things that connect you to one another when the going gets tough.

Take heart. Pandemics do have a finish line. We will get there. It’s the “how” of finding our way through that will define us and our teams in coming months.

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SAFETY FIRST

Micro-Blasting

How **EzeBreak** explosives can aid in clearing access/egress routes in caves and concrete

By **Carroll Bassett**

Carroll is President of West Virginia Cave Conservancy, Sub-Regional Coordinator of ERNCRC Cave Rescue and Vice President of WV Association of Cave Studies. He owns Ezebreak and BMS Rescue Equipment which makes and supplies specialist rope hardware.



GEAR SPOTLIGHT

The EZEBREAK Micro-Blaster™ is a compact powder actuated demolition system primarily used to break rock and concrete. Our systems were initially developed to allow US cave explorers to open normally inaccessible passages but the knock-on benefit has been the possibility for rescuers to more quickly clear blocked cave entrances, rockfalls, landslides and other collapses in order to effect a rescue or recovery. As a very lightweight and portable option this is particularly applicable to remote-area rescue teams but the principles are similar for USAR and heavy rescue to use in building collapses requiring clearance of concrete and stone.

I live in Greenbrier County in south eastern West Virginia, USA, which has over 1500 known caves, allowing ample opportunity for the discovery of new unexplored caves even after 70 years of active exploration. If you know where to look, and you learn techniques such as ridge-walking, finding them is generally not very difficult. However, opening these caves to passable dimensions can be a serious challenge. If the removal of the dirt and relatively small boulders filling cave entrances doesn't get you into the cave, use of the Micro-Blaster™ will help facilitate entry. Our predominant limestone here is quite hard and generally impossible to break with normal hand tools, i.e. hammers, chisels, picks, and battery powered rotary hammer drills. Most of the potential cave entrances we have worked on are also fairly remote, meaning that equipment used must be hand carried to the site, limiting the amount of available equipment.

Situations such as these called for a lightweight portable system that could be used for passage modification and also potentially as a tool to assist in cave rescue. Traditional blasting systems all require government licensing and strict observation of storage, transportation, and use requirements. We set out to see if we could eliminate these requirements. Another problem with licensed explosives is that they are overkill, with the real potential of destabilizing the passage. It quickly became obvious that a smaller explosive charge would be most appropriate for use with our systems.

Under the current regulations of the US Bureau of Alcohol, Tobacco, Firearms and Explosives, there is only one choice of energetic materials that does not automatically require a high explosives license and that is smokeless powder. Luckily smokeless powder is ideal for small scale demolition when properly "stemmed". Stemming is a blaster term referring to the packing of a material on top of the charge to maximize the energy transferred to the material being broken. Smokeless powder turned out to be optimal given its pressure dependent burn rate and the relatively high pressure attainable upon initiation. The latter characteristic is ideal in that during the initial ignition of the Micro-Blaster™ Cartridges, the burn rate increases exponentially, producing large amounts of gas at high pressure overcoming the tensile strength of the material to be broken. The moment the material is broken the pressure is released from the hole, greatly reducing gas production and to a large extent reducing fly rock, which adds to the safety of our

systems. This is not true for high explosive materials in that they consume the energetic material available once initiated.

The next problem we had to solve was to develop a stemming system that would stand repeated use and at the same time keep the energy in the hole long enough to allow the smokeless powder to develop the required pressure in order to be effective. Once we realized that the smaller the drilled hole, the easier it was to stem the hole, we determined that a 5/16 inch (8mm) diameter hole would be effective and allow sufficient diameter for high tensile steels to offer the desired durability. Given that our systems are often used in remote locations, this small but still effective diameter hole allows battery powered rotary hammer drills to drill many more holes per battery charge which adds to the efficiency of the overall operation.

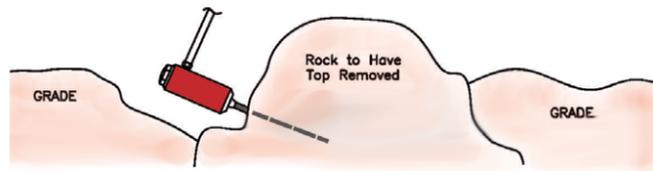
Under US ATF regulations, primers, normally used to initiate the powder in small arms cartridges, are also exempted from the blasting regulations, which made them the obvious choice to initiate our cartridges if we wanted to create a license free product.

Our next problem to solve was the need to incorporate a mechanical system to initiate a cartridge inside of the material to be broken. In order to initiate a primer, which issues a spark when struck, we needed a firing pin mechanism that would strike the primer deep inside the rock or concrete being broken. The solution was to use a hardened high alloy tube drilled to accept a long firing pin that could be incorporated into a triggering mechanism capable of generating sufficient force to initiate the primer at the end of the cartridge.

The first model of the Micro-Blaster™, the Micro-Blaster I, uses a spring-loaded hammer mechanism which initiates the cartridge remotely with a 25' (~8m) lanyard. This mechanism is housed in a rectangular steel block weighing approximately 3 lbs. which provides the necessary mass to resist the pressure from the initiated cartridge long enough to break up the material, i.e. (effective stemming). This system works well but has limitations given the requirement that the lanyard has to be pulled at right angles to the drilled hole. This makes the system less than ideal for working in ditches, holes, caves, or passages. The Micro-Blaster™ I works well when removing tops of rocks in rural roads and fields but not so well underground or in enclosed spaces. Once we recognized this limitation, we set out to develop the Micro-Blaster II system which would be more flexible in its use.

We realized we had two choices to supply the necessary power for the Micro-Blaster™ II to initiate the Micro-Blaster™ Cartridges, either pressurized gas or electricity. We eliminated the electrical route realizing that to provide the necessary mechanical energy we would most likely need to use a kind solenoid which unfortunately would probably have a limited life as a result of the extreme shocks the coils would receive on each initiation of the system. That left us with the pressurized gas option that we then developed to yield an appropriate mechanism that was robust enough to stand the

REMOVING THE TOPS OF ROCK IN ROADS AND FIELDS



1. On one side of the rock dig down below grade several inches.
2. Drill hole below grade at shallow angle into rock being careful to have bottom of the 9-10 inch deep hole in or near the middle of the mass to be broken.
3. Thoroughly clean hole and proceed as usual observing all safety precautions. On very large rocks several holes may have to be drilled and shot from different sides.

Demolition of a 3-4 ton limestone boulder. The process took about 1.5 hours.



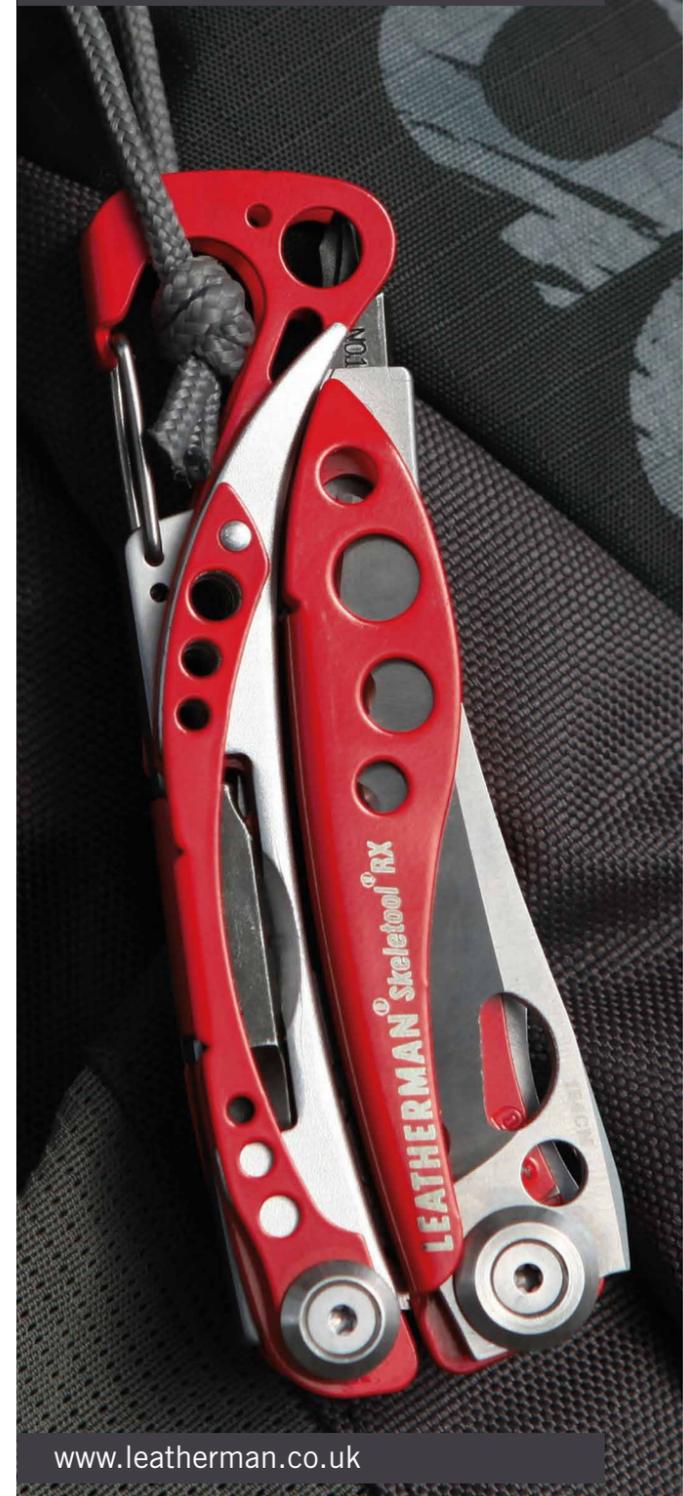
stresses of repeated shots. A machined steel cylinder was then used to house this new mechanism with a small fitting added to introduce the compressed gas to this head to then initiate the cartridge. We quickly realized that this new and improved pneumatic system could be manifolded to allow the simultaneous initiation of up to three Micro-Blaster™ units, tripling the potential capacity of the system. During a period of refinement, we realized that holes drilled deeper could accommodate more than one cartridge per hole for more than a 2x increase in effective power. (pic top) As it turns out, this works when the shock wave from the upper initiated cartridge reaches the primer of the lower cartridge thereby initiating it. The reason for the perceived 2x+ power increase by using 2 cartridges is that the upper cartridge pressurizes the hole and then initiates the primer in the second cartridge which then burns at a higher rate than the upper cartridge thereby generating gas at a much higher rate. Surprisingly, using 2 cartridges would appear to yield up to 4 times the power of a 1 cartridge shot. Drilled holes up to 16 inches (~406mm) deep can accept up to 4 Micro-Blaster™ cartridges. The magnifying effect of 2 cartridges per hole does not seem to follow with more than 2, however it does increase the reach which can be useful in breaking large boulders. We should mention that in multi-cartridge shots, especially holes containing 3-4 cartridges, not all of the cartridges may initiate. This is usually an indication that more cartridges were used than needed for that particular shot because the material broke before the lower cartridges received the shockwave to initiate them. Typically these events are only a few milliseconds in duration at most. Care should be exercised when removing "spoils" to determine that no unfired cartridges are inadvertently initiated during the cleanup of broken material.

Further research into the designing process informed us that there were a few accessory items that should be added to the Micro-Blaster™ Kits. We noticed that rocks that we had cracked were occasionally hard to separate into pieces so we included two tapered pins that can be driven into the blast hole to separate the cracked material. We also included a telescoping magnet to help retrieve cartridges in the event of a misfire, a

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Cavers removing part of a Micro-Blasted rock from an cave entrance dig.



disassembly tool for field service, manuals, a wire cleaning brush, and a manual "hole blower" to clean out the drilled holes before introducing the Micro-Blaster™

Given the very large variety and types of rock it will be useful for the end user to understand a few guiding principles in determining technique. Experience has taught us that our systems are most effective in the hardest of rock. Effectiveness is reduced as the material becomes softer. Granite and hard limestones break surprisingly well while softer rock, such as sandstones, generally need more power to break successfully. This is also true of concrete in that the higher PSI mixes break with fewer cartridges per volume (CPV) than the lower PSI mixes. Free standing boulders will have low CPV requirements while bedrock will generally require more. Users should be aware that large free-standing boulders, up to 1000 lbs. (~500kg) can be broken with 1 or 2 Micro-Blaster™ Cartridges. Bedrock or boulders embedded in heavy soil will be more difficult to break.

Now that you have a sense of what our systems are, how, and why they work, we should discuss who is having success with our systems. Our first customers were local contractors and excavators who had heard rumors about the development of

our systems and started calling before we were ready to go to market. We rushed to get a few units in their hands and luckily our design was mature so their feedback was almost entirely positive. We learned at this point however that the Micro-Blaster™ I had some limitations, as previously mentioned. Feedback was quite positive so we pressed on with marketing to discover that there were people all over the country and the world that needed this capability. Among other inquiries, the US Forest Service had been looking for an alternative to high explosives to build and repair trails. After successful testing at their facility in Missoula, Montana, US they released a bulletin recommending our products to all of their facilities and also to many of the National Park Service offices around the country. These relationships led to working with the US Professional Trail Builders Association which gave us further reach into the industry of private trail building companies. The launch of our website brought in lots of inquiries from people struggling with rock or concrete problems and sales started to ramp up almost immediately. US FEMA purchased a few systems with the intention of using them to deal with building and bridge collapse rescue scenarios. We also began getting orders from artisanal gold and gem miners which has in turn become a significant market segment for us. Ezebreak, LLC currently has many dealers in the US and distribution in Canada, Australia, and Norway (for Europe). One challenge that our offshore customers face is the high cost of shipping our Micro-Blaster™ cartridges, which are classified as Dangerous Goods. We set up our offshore distributors to buy in volume thereby reducing costs to end users.

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BASIC HAND ASCENDERS



Petzl Basic HAND ascender 2021

This is the first of four GUIDES to ascenders & rope grabs modified from our epic all-in-one 30+ page GUIDE in ArbClimber#18. Hand ascenders are probably the *least* used type of ascender and are best defined by what they are NOT and what will be in the other three GUIDES- they're not Chest Ascenders, Lever Rope Grabs (9) or Handled Ascenders. That said, the distinction between a hand ascender intended to be grasped in the palm, and a similarly moved Rope Grab or a chest ascender directly attached between a sit harness and a chest harness/strap is not only subtle, in some models they try to be one and the same like the Rock Empire Chest-up (4), Xinda (5) and Heightec Twist

Clog HAND ascender 1960s



Petzl Croll CHEST ascender 2021



(Clog)/ Wild Country Ropeman 2021

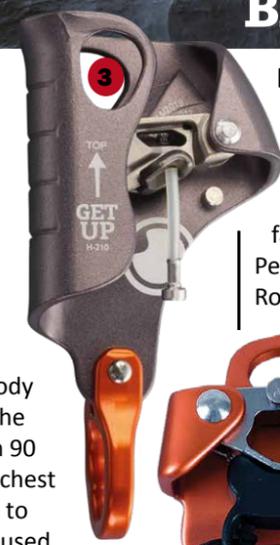


(7). Having listed ascenders in the ARBCLIMBER article as they were described by the manufacturer we now think the XInda is an outright chest ascender and the Chest-Up swivel might allow a carabiner to lay flat but the swivel itself still protrudes. Skylotec's Hoist (8) and Kratos Safety's Ventral have a webbing slot as well as an eye so are entirely able to be used as a chest and hand ascender. Heightec's Twist was listed only as a chest ascender but we think it deserves mention as both because it has movement limiting eyes, but it's a fine line. Generally, a chest ascender has a bottom eye that is twisted or offset to allow a carabiner to sit flat on your chest and a top eye that is similarly offset and/or is wide enough to directly attach a tape harness. If you look at (1) and (2) above the Petzl Basic ascender on the left is designed to be grasped in the palm of the hand and has a 'comfort' grip on the shoulder. The Croll on the right is Petzl's smaller model with a reinforced cam-enclosure to improve wear. [NB: an early report from Italian and UK cavers indicating that the reinforcement wear could cause

rope damage was investigated and dealt with- see Emag#28]. The cam safeties are different because the hand is in a different position on each during use. Both clip onto the frame out of way during rope installation (CAM-PARK in our tables).The key difference is in attachment eyes. When you connect a carabiner into either the top or bottom eye of the Basic ascender (1) it orientates at 90 degrees to the eye and would protrude uncomfortably into your body if used as a chest ascender. A carabiner in the yellow Croll (2) can pretty much move from 90 to 0 degrees and sit sideways or flat to the chest in either eye with the top still wide enough to accept tape without bunching it up. We've used the term 'BASIC' Hand ascender to distinguish this selection from chest ascenders and lever-cam rope grabs. Many would argue that a chest ascender can do both jobs but having a wide top and/or bottom eye allows a carabiner to move or slide which it won't in a hand ascender's round or shaped eye. That is the criterion by which we have included a hand ascender in this guide – unlike a Chest ascender, **the top and bottom eye on these BASIC models must retain the carabiner in one position and not allow it to move sideways. That will either mean a round eye or a directional curve into which the carabiner sits when under load.**

HISTORY

While the most basic of hand ascenders existed from the 60's, in the form of devices like Denny Moorehouse's 'Clogger' hand ascender, Petzl's first entry into the rope ascender market wasn't until 1975 with Croll chest ascender. This was a direct evolution of the mountaineering Jumar rather than handle-less Clogger and was intended, by inventor Dressler, to be specifically for use in caving. Fernand Petzl had been one of the world's leading cavers since the 30's and was already producing kit like caving ladders, mountaineering bivi platforms and of course his revolutionary electric headlamps, but it was actually other luminaries of the 60's like Moorhouse, Dressler, Jusi and Marbach who came up with ascender and descender designs which Fernand Petzl was able to refine and bring to production before beginning his own prolific rope hardware inventing.



EXCLUSIONS

We HAVE included ultralight hand ascenders exemplified by the Wild Country Ropeman. Wild Country can trace its lineage back to Clog and a certain Denny Moorhouse also of DMM and ISC fame. We have also included smaller PCDs like the Petzl Micro-Traxion, Kong Duck (6), Edelrid Spoc and CT RollINLock but not the larger dedicated Progress Capture Devices like the Petzl ProTraxion or SMC Advanced HX. These PCDs all meet EN567 as an ascender but also function as a pulley. All of these mini-ascenders may be deemed to be 'emergency' ascenders, especially in rescue but they do function well across a variety of tasks. We have NOT included, Fall arresters like the Rockers, UAscend, CAMP Lift etc. even though they will function well as an ascender because we have to draw the line somewhere and, in reality, if we were to include ALL devices that can function as an ascender that would include all cam descenders and hybrids! The ultimate emergency ascenders, the Petzl Tibloc (top right) and Skylotec Ringo are included in the GUIDE to Rope Grabs because they load directly through the cam rather than the frame. PCDs have a separate GUIDE in TECHNICAL RESCUE #73.

It's important to note that we consider ANY toothed cam ascender, which is necessarily aggressive in order to grip even a wet or icy rope during ascending, to be best used ONLY for ascending/rope climbing. When you ascend you regularly generate 2kN of load simply because of the 'bounce' and dynamic activity of moving so it wouldn't take much of a harsh sit-back to start pushing 4 or 5kN. If you can generate such forces in ascending, anything more in activities that can or do accumulate extra force is likely to be too close for comfort so why take the chance? Ascenders for ascending and rope grabs (9)with their more rope-friendly cams for all the other jobs (including ascending in most cases!). As an aside, the Wild Country Ropeman 1 (pic right), and four other ultralights – the Kong Duck, CT RollIN'Lock, Beal Tract Up/Edelweiss Micro-B DO NOT have toothed cams.

MODERN DESIGN

There have been some developments and improvements in cam design and safety and as far as the frame is concerned perhaps the most obvious new features are the incorporation of a swivel-eye in the Czech, Rock Empire Chest Up (4) and Skylotec's Get Up (3). Skylotec's is a 180° integral shackle bolted to the frame while Rock Empire's is a 360° swivel incorporated 'within' the frame with the



addition of a bolt-on retainer. It will be interesting to see how this stands up to prolonged wear. These models and a few others also exhibit the modern trend towards a 'tab' on the safety cam to enable easier manipulation of the cam for large or gloved hands.

USE of BASIC HAND ASCENDERS

Some folk prefer a non-handled ascender as their top ascender instead of the much bulkier handled models and old-hands in particular like the ease of movement of the ascender afforded by simply grasping the frame rather than inserting into a handle particularly with gloved hands. This Modular ascender from Kong is unusual in being a hand ascender that converts to a handled or even double handled ascender. However, for rope climbing, the hand or basic ascenders are most often seen as a knee or floating cam between a foot ascender and the chest and/or top (handled) ascender. While the four types of ascenders in our four GUIDES are largely interchangeable for many tasks, some are better at one or more tasks than others. The commonest uses for all ascenders and rope grabs are:

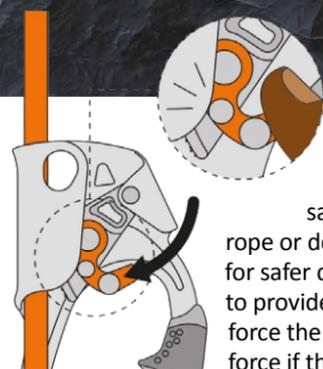
- Ascending/Rope-climbing
- Self-belay/back-up during climbing and this is a use that may increase if two-rope systems are mandated NB: this is largely for dedicated fall-arresters but also smooth cam and some ribbed cam devices – **there are huge risks to using toothed cams for self-belay even where it is implied or stated as an acceptable use for any given device**
- Lanyard & flip-line/pole strap rope length adjustment
- Direct hauling and progress capture in a haul /raising system *but monitor your input forces and loads carefully.*

OTHER FEATURES...

WEB EYE: At least 6 models have a wide enough bottom eye to accept webbing. Two have a web slot and round eye.

TOP EYE: The top eye can be used for:
1) to clip a carabiner around the rope during ascending/hauling thus ensuring the ascender cannot detach completely
2) as a hauling aid or to anchor for hauling – in this function the little man symbol or 'UP' arrows should be upside down!

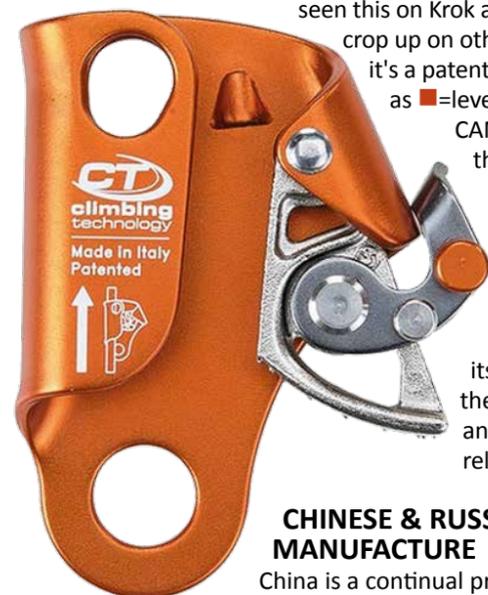
SAFETY CATCH: If the safety catch clicks to the disengaged position too easily during use you could be in for a scary drop. You never downclimb by releasing the cam via the safety catch and should instead press or 'thumb' the actual cam where sideways and/or downward pressure from your thumb or finger on the cam itself is enough to release the rope but will then enable it to re-engage the second you removed your thumb. For this reason some cams have a more pronounced bottom edge while others have an opening or additional material to facilitate better thumb purchase.



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RELEASABLE CAM UNDER LOAD

(right): Climbing Technology now has an additional pillar on their safety catch which, in the event of a rope or debris-jam halting your progress, or for safer downclimbing, acts as a pivot-post to provide leverage against the frame and force the cam off the rope. This takes some force if the cam is under load so cannot be released by accident. We have previously seen this on Krok ascenders and will crop up on others but we're told it's a patented CT design. Shown as ■=leverage cam in the



CAM-PARK column the tables. Also note in this picture, the Anti-Cam-Invert. This protrudes inside the frame and stops the cam being able to force its way out through the top under high load and catastrophically release the rope.

CHINESE & RUSSIAN MANUFACTURE

China is a continual problem for us because, in between counterfeits, so many prominent companies (even manufacturers) in the access and rescue sectors buy in Chinese products to rebadge as their own. We have only recently included Chinese companies under their own names because some have transparent and comprehensive websites and can be contacted for information, most notably Anpen. But no sooner had we included Xinda products in a previous guide than they were seriously called out by trading standards in the US and Europe for having helmets mislabelled as meeting standards that they absolutely did not. We can be fairly sure that European companies rebadging products have satisfied themselves of standards adherence but we remain a little bit sceptical because companies like Lixada, Magideal, GM, New Doar, SUT, Camnal, Leopard, Tupa and Yundxi are difficult to pin down or tell their products apart. You **will** find models on Amazon etc that look identical but have different specification. We can only quote the data supplied to us but we often double-check by scaling the image. We've cautiously included Xinda and SE Peak but **don't** take that as an endorsement. SE Peak is a German brand used by Shanghai Liedell and maybe also Taiwan's NalHon which seems to have identical products! We had to delete Taiwanese company Adela for lack of data and responses. It's even harder to track down Russian companies which often develop their own unique and interesting products but unfortunately also make close copies. As do KROK but we've stuck with them as the sole Russian entry because they have a comprehensive website and answer emails.

www.rescuemagazines.com

IN THE FOLLOWING TABLES:

ORIGIN: The country selling the product but this is not always the same as the country of manufacture. Where we know, there is an inset flag to show where it is made.

COST: approximate, rounded up and inclusive of local taxes which are generally from 10% and more often 20% in Europe. Often priced much lower locally or online.

WEIGHT: for a single ascender/cam without a carabiner

DIMENSIONS: Width x Height x Depth/thickness but this last one is not always given – the depth is dictated by the cam enclosure but in lever cams this is also increased by the length of the axle pin which may have a locking nut or spring-release mechanism (pip-pin). Even for hand and chest ascenders the depth may vary from reality if the quoted measurements don't include protruding rivet heads etc.

MATERIALS: When we say 'Alloy' we mean Aluminium Alloy unless otherwise specified. These are practically all alloy so we've differentiated the construction rather than the material. Most are shown as 'Stamped' meaning that a flat plate of metal is cut to shape then forcibly stamped and rolled into form. Extrusion forces heated metal through a die to create the shape, hot-forged too takes heated metal and forces it into shape like a smithy making a sword or horseshoe. Milled takes a solid lump of alloy and carves/mills it away to create the desired shape, like a sculpture.

STANDARDS: for CE these fall into two categories EN 567 (rope clamp Ø 8 – 11mm) for sport use and EN 12841 B (rope adjustment device Ø 10-13mm) for professional use. EN567 (ascenders) is still the most common standard in this list but is generally for ropes up to 13mm rather than the original 11mm sport limit. EN12841 for rope adjusters takes in ascenders (-B) hybrids and descenders (C) and fall arrest devices (A) which can all act as ascenders. These require a slightly larger diameter rope so the lower limit is higher – usually around 10mm rather than 8mm. The Mini PCD's may also have EN12278 for pulleys. UIAA is the mountaineering standard with some enhanced testing and EAC applies to Russia and its southern satellite states.

ROPE DIAM RANGE: It is best to always use the millimetre sizes in ALL of our MARKET GUIDES because the fractional inch equivalents are less specific. 1/2" for instance can be anywhere from 12 to 13mm. Fatter ropes make progress harder but too thin a rope can be positively dangerous as it can jam between the cam and enclosure. **It's best to ignore the lowest and highest rope diameter claims.** Remember that a rope will often get fatter with age so if it was a tight fit with a new rope it may become too large with use and stress the cam enclosure if heavily loaded. The rope range quoted uses the lower limit for EN567 up to the sometimes higher limit for EN12841- B. More often than not EN12841-B starts at 10mm rather than 8mm.

WLL(SWL): is the weight of person actually climbing or the weight that can be pulled/hailed before either the rope begins to tear or the cam enclosure unfolds. A small button or 'crease' in the frame on most models stops the cam from flipping upwards under high load if the cam enclosure starts

to unfold/bend resulting in an unstoppable downward slide – this is why both ascenders in a Texas-rig-style, two-ascender system, should have direct connection to the harness. Having just a foot ascender doesn't constitute a safe back-up, it's really a third ascender to improve climbing efficiency because if your top ascender were to fail/slip/be accidentally removed, the foot ascender is unlikely to hold you upright unless you had spookily anticipated the precise moment of top-ascender failure! Some WLL figures quoted are suspiciously high and are more likely simply to be an extrapolation of the MBS. Where we see 4kN quoted it is likely to be a re-interpretation of EN567's requirement for a 4kN load to be held at 5 different spots along a fixed rope of minimum and maximum diameters within the ascenders rope range. Most will quote a WLL based entirely on the standards they have met even though their actual capability may be much higher – 100kg for EN567 or 120/140kg for EN12841-B etc.

The **MBS** figure is largely irrelevant as it refers to the strength of the frame, or to be more exact, the ascender's connection eye(s) and even this will vary with rope size. 4kN is usually the lower limit for what may range up to and beyond 12kN for larger rope. For lever cams there is no end-to-end connection and an MBS is often not given because the rope will slip through or perhaps fail before the cam enclosure. If you were to use the framed ascenders as a carabiner or a link in a hauling system rather than as the means to exert the pull this might come into play as you try to stretch the frame end to end, otherwise, for operational use, don't worry about it because the failure mode, if you overload the ascender, will be the cam or the rope, probably the rope.

(Bottom) EYE DIAM: Not necessarily the actual size of connector/carabiner you can get into the bottom eye. Round eyes tend to be a true diameter in which case your carabiner/ bar would need to be slightly smaller than this figure.

CAM-PARK: This applies to virtually all handled ascenders and is the ability to hold the cam off the rope completely, generally by clipping the safety catch onto the opposite part of the frame. This facilitates easier rope installation/removal.

■='leverage cam' extra post to release cam under load see p28
ANTI CAM-INVERT: This is now a custom-incorporated pinch in the frame material or a 'knob' to stop the cam rotating too far and releasing out of the top of the frame under high load. This was originally mitigated by clipping a carabiner through the top eye and is still used as such by many.

COLOURS: the colour of the frame or cam enclosure. Different model colour options are separated by a comma. A forward slash/ indicates two (or more) colours on one model which, for Rope Grabs may be a cam-colour. Unlike the handled ascenders, there are not many left AND right hand models. Left-hand model colours are shown in burnt orange.

POWER ASCENDERS FOR PROFESSIONALS

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images NOT to scale	MODEL	COMPANY	ORIGIN	COST	WEIGHT	DIMENSIONS Width x Height x Depth	STANDARDS	MATERIALS ALLOY SHELL CAM	CAM	ROPE DIAM RANGE	WLL/ MBS	(Bottom) EYE DIAM	CAM-PARK	ANTI-CAM INVERT	SERIAL NO	HAND/BASIC	CHEST/offset	COLOURS RIGHT LEFT	NOTES	WWW.
	Tract Up	BEAL		£39 \$54 €36	78g 2.7oz	65x35mm 2.6x1.4"	EN567 UIAA	Stamped* Aluminium		8-11mm 5/16 - 7/16"	2kN 450lbf	19mm 0.8"	■	■	■			GREEN	*Stainless steel eye/pulley	pro.beal-planet.com
	Solo 2	CAMP		£55 \$70 €50	95g 3.4oz	95x57x24mm 3.7x2.2x0.9"	EN567 EN12841B	Stamped HardenedSteel		8-13mm 5/16 - 1/2"	140kg 308lb	14mm 0.55"	■	■	■	■		BLACK, SILVER GREEN		camp.it
	Nahuel 2020	CLIMAX		£36 €33	122g 4.3oz	110x68mm 4.3x2.5"	EN567 EN12841B	Stamped StainlessSteel		8-13mm 5/16 - 1/2"	100kg 220lb 4kN 900lbf	*15mm 0.6"	■	■	■	■		BLACK	*29x15mm	productosclimax.com
	Ascender Simple +	CLIMBING TECHNOLOGY		£42 \$54 €48	150g 5.3oz	110x74x28mm 4.3x2.9x1.1"	EN567 EN12841B UIAA	Stamped StainlessSteel		8-13mm 5/16 - 1/2"	140kg 308lb	18.5mm 0.7"	■	■	■	■		ORANGE	■=leverage cam	climbingtechnology.com
	RollinLock	CLIMBING TECHNOLOGY		£70 \$81 €83	80g 2.8oz	68x35x24mm 2.7x1.4x1"	EN567 EN12278 UIAA	Stamped Alloy		8-13mm* 5/16 - 1/2"*	4kN 900lbf	18mm 0.7"	■	■	■	■		ORANGE	*Also 10-16mm web in exceptional circumstances	climbingtechnology.com
	SPOC	EDELRID		£60 \$53 €65	60g 2.1oz	60x50x10mm 3.4x2x0.4"	EN567 EN12278	Stamped Aluminium		7-11mm 3/32 - 7/16"	15kN 1686lbf	18mm 0.7"	■			■		GREEN		edelrid.de
	Micro B	EDELWEISS		£36 \$55 €39	78g 2.7oz	65x35mm 2.6x1.4"	EN567 UIAA	Stamped* Aluminium		8-11mm 5/16 - 7/16"	2kN 450lbf	19mm 0.8"	■		■	■		RED	*Stainless steel eye/pulley	edelweiss-ropes.com
	Compact D41	HEIGHTEC		£46 \$68	160g 5.6oz	115x75x23mm 4.5x3x0.9"	EN567 EN12841B	Stamped HardenedSteel		9-13mm 3/8 - 1/2"	125kg 275lb	15mm 0.6"	■	■	■	■		GREEN		heightec.com
	Twist D42	HEIGHTEC/ PMI		£46 \$68 €49	150g 5.3oz	105x70x35mm 4.1x2.75x1.4"	EN567 EN12841B	Stamped HardenedSteel		10-13mm 3/8 - 1/2"	125kg 275lb	16mm 0.6"	■	■	■	□	■	GREEN		heightec.com
	Duck	KONG		£45 \$76 €47	70g 2.5oz	63x31x22mm 2.5x1.2x0.9"	EN567	Stamped# Aluminium		8-13mm* 5/16 - 1/2"*	100kg 220lb	18mm 0.7"				■		GREEN, BLACK, RED, BLUE	#Eye/pulley is stainless steel * Also operates on 10-15mm webbing	kong.it
	Modular	KONG		£40 \$66 €41	170g 6oz	114x78x25mm 4.5x3x1"	NFPA-L EN567 UIAA	Stamped HardenedSteel		11-13mm 7/16 - 1/2"	100kg 220lb	14mm 0.55"	■	■		■		BLACK, BLACK, RED, BLUE	can be retrofitted to Kong winches and with a handle etc.	kong.it
	Ventral FA7001500	KRATOS SAFETY		£41 €40	160g 5.6oz	115x75x21mm 4.5x3x0.8"	EN567	Stamped Aluminium		10-12mm 3/8 - 1/2"	4kN 899lbf 15kN 1686lbf	13mm 0.5"	■			■	■	BLACK		kratossafety.com

NOTES COST: Approx & inc local tax/VAT * excludes duty/import taxes & shipping WLL: Where no WLL is given by manufacturer we show a Max Load based on approx 10:1 safety ratio N/A: info Not Available/not given COLOURS: =Body colour.

images NOT to scale	MODEL	COMPANY	ORIGIN	COST	WEIGHT	DIMENSIONS Width x Height x Depth	STANDARDS	MATERIALS SHELL CAM	CAM	ROPE DIAM RANGE	WLL/ MBS	(Bottom) EYE DIAM	CAM-PARK	ANTI-CAM INVERT	SERIAL NO	HAND/BASIC CHEST/offset	COLOURS RIGHT LEFT	NOTES	WWW.
	Basic	KROK		\$25* €22*	245g 8.6oz	104x71x26mm 4x2.8x1"	EAC	Stamped Steel		8-12mm 5/16 - <1/2"	4kN 899lbf 15kN 1686lbf	15mm 0.6"	■	■			GREEN, BURGUNDY	Powder coated. ■=leverage cam Steel frame version shown +40g *excludes duty/import taxes & shipping	krok.biz
	Stregor	KROK		\$37* €37*	75g 2.6oz	63x34x31mm 2.5x1.3x1.2"	EAC	Stamped Steel		9-12mm 3/8 - <1/2"	4kN 899lbf 15kN 1686lbf	*16mm 0.6"					BLUE	*19x16mm *excludes duty/import taxes & shipping	krok.biz
	Stregor lite	KROK		\$42* €36*	49g 1.7oz	57x33x24mm 2.2x1.3x0.9"	EAC	Stamped Steel		8-12mm 5/16 - <1/2"	4kN 899lbf 15kN 1686lbf	16mm 0.6"					GREEN	*excludes duty/import taxes & shipping	krok.biz
	Basic	PETZL		£49 \$85 €51	85g 3oz	104x64x30mm 4x2.5x1.2"	EN567 EN12841B UIAA EAC	Stamped Stainless Steel		8-11mm 5/16 - 7/16"	140kg 308 lb	16mm* 0.6"	■		■		SILVER	*28 x 16mm	petzl.com
	Micro-Traxion P53	PETZL		£74 \$130 €75	85g 3oz	65x55x24mm 2.6x2.2x1"	EN567 UIAA	Stamped Steel		8-11mm 5/16 - 7/16"	2.5kN 562lbf	18mm 0.7"	■		■		GOLD		petzl.com
	TREEUP CD201/202	PROTEKT		€47	220g 7.8oz	134x86x28mm 5.3x3.4x1.1"	EN567	Extruded Steel		8-13mm 5/16 - 1/2"	100kg 220 lb	20mm* 0.8"	■				BLUE RED	*27x20mm Also badged (made by?) GT	protekt.pl
	Chest Up	ROCK EMPIRE		€54	118g 4.2oz	99x62x30mm 3.9x2.4x1.2"	EN567 EN12841B	Hot-Forged? Aluminium		8-11mm 5/16 - 7/16"	4kN 899lbf	16mm 0.6"	■	■		■	ORANGE, BLACK	Swivel eye	rockempire.cz
	S-206	S.E.PEAK Shanghai Leidell Ind Co Ltd/NalHon		£36 €33	122g 4.3oz	110x68mm 4.3x2.5"	EN567 EN12841B	Stamped StainlessSteel		8-13mm 5/16 - 1/2"	100kg 220lb 4kN 900lbf	*15mm 0.6"	■	■	■		BLACK, BLUE, PINK	*29x15mm	en.sepeak.net
	Hoist (AB20)	SKYLOTEC (ANTHRON)		£62 \$70 €67	150g 5.3oz	104x75x30mm 4.1x3x1.2"	EN567 EN12841B UIAA	Stamped StainlessSteel		9-13mm 3/8 - 1/2"	4kN 899lbf 14kN 3147lbf	13mm 0.5"	■	■	■	■	BLACK	Skylotec Germany owns Anthon Slovenia. Anthon brand-name being phased out. Also rebadged by 'Skalt'	skylotec.com (anthon.si)
	Get Up H-210	SKYLOTEC		£90 €87	123g 4.3oz	129x122x66mm 5x4.8x2.6"	EN567 EN12841B UIAA	Stamped StainlessSteel		8-13mm 5/16 - 1/2"	140kg 308 lb	13mm 0.5"	■		■	■	GREY/ Orange	Integral shackle-eye	skylotec.com
	Ropeman 1	WILD COUNTRY		£45 \$50 €50	62g 2.2oz	55x36x31mm 2.1x1.4x1.2"	EN567 UIAA	Hot-Forged Aluminium		10-13mm 3/8 - 1/2"	400kg 880lbf	13mm 0.5"	■				ORANGE, BLUE		wildcountry.com
	Ropeman 2	WILD COUNTRY		£50 \$55 €55	92g 3.25oz	55x36x31mm 2.1x1.4x1.2"	EN567 UIAA	Hot-Forged StainlessSteel		8-13mm 5/16 - 1/2"	400kg 880lbf	13mm 0.5"	■				BLACK, GOLD	There was also a Ropeman mk3, narrower than the mk1/2 but was discontinued	wildcountry.com

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Looking into the abyss



Search Strategies for Small Unmanned Aircraft used in rural and mountain environments

by **Darryl Ashford-Smith**

Darryl is a Scottish Mountain Rescue Training Officer. A veteran of USAR in London Fire Brigade for over 21 years, Darryl has served as a member of RAF Mountain Rescue and is now resident in Scotland

As the technology accelerates rapidly and knowledge increases in Unmanned Aerial Systems (UAS) search and rescue methods, using them in rural and mountainous environments still pose difficulties and require the pilot to work hard to produce positive results. The use of mission planning software to enable an effective search is available however, it can be expensive and may not be suitable for all environments (most account for a search flight path at a set height above the ground and not following the contours or taking into account dead or difficult ground). Also, planning software does not take away the requirement of the pilot to plan the search and have a viable strategy.

The cost of small, line of sight, off-the-shelf unmanned Aircraft (UA) enables search and rescue teams to have an enhanced, safe, capability for search and rescue and safety without the expense of additional software or additional time training and remaining proficient in its use particularly with volunteer teams. For teams with limited funds and those in developing countries, it may be the only option. Also, with teams working within areas where a long walk-in may be necessary, weight and size are an issue where team rescue equipment must be prioritised.

This two-part article sets out to discuss the difficulties and solutions that the recently formed Search & Rescue Aerial Association – Scotland (SARAA-Scotland) have been working through to enable them to deploy effectively in support of mountain rescue events in Scotland. It may go without saying that the terrain and environment in Scotland is challenging whereby a long walk-in or waiting for a break in the weather is probable. SARAA-Scotland currently utilise off-the-shelf UAS' in conjunction with high-definition goggles to facilitate two-person teams with the pilot flying the UAS while the sensor operator carries out the observation of the search using the goggles. Sadly, the goggles that have been proven to be so successful to our operations to date have been withdrawn from the market and now an alternative option is being sought. The team would welcome any feedback or enhancements on the article content.



The Search & Rescue Aerial Association-Scotland are made up entirely from volunteers and rely on donations to fund equipment. The team can be found on social media sites by using @SARAAScotland

ON ARRIVAL

Before the search commences, the Pilot must gather any information relevant to the task, the casualty and safety. The type of task should be established as to whether it is a search, communications relay or perhaps for safety or situational awareness. Dropping items from the UA is currently prohibited within the boundaries of current aircraft capabilities and our pilot training however, the options are endless. The point last seen, and limits/boundaries of a search area should be known so that no time is wasted searching areas that do not have to be searched and to ensure that one search area is overlapped onto another. The direction the casualty/missing person (MISPER) may travel (if mobile) will have a bearing on the search direction. Full information (colour of clothing/age/sex/activity etc.) on the casualty/MISPER should be obtained to identify them in the search and to potentially exclude other persons in the area that may not be involved.

Certain categories of missing persons may exhibit specific behavioural patterns according to their condition. For an example, a person with mild dementia may have a tendency to travel further distances and with severe dementia may tend to travel shorter distances and follow roads/tracks wherever they lead. The search implications for each type of condition should be taken into account. The actions on finding the casualty should be discussed and agreed with the Search Manager.

SETTING UP AND POSITIONING

The pilot should consider anything that may have an effect such as the weather, the position of the sun, terrain, GPS signal, the potential direction of the casualty, the type of ground or the feature(s) involved and suitable drop-off location to deliver an efficient search. Each position, in readiness for operating will be different however, there are some standard positions that may be used according to the type of search or feature. Once at the location, a risk assessment and any pre-flight checks and procedures should be carried out.

The temperature and in particular cold environments should be considered as the UAS Team will be static for some considerable time. The batteries should be kept warm during mobilisation, on the way to the drop off point or location and particularly



just prior to use. The controller/tablet can also be affected very quickly by the cold so should also be kept warm prior to, and in between flights. Giving a clear and structured brief to the UAS operation is not only critical for safety but intrinsic to an efficient and effective search.

The landing site should be in a location where the team can use the UA for the search/observation in clear sky. The UA is flown within line of sight of the pilot with clear sky behind. By operating in this way, the pilot will know that the UA will not impact anything as otherwise, it is extremely difficult to judge how close a UA is to the hillside or any other obstructions. To aid in making the UA visible, a bright coloured skin can be applied.



A strobe light can also be fitted which further increases visibility. The strobe light enhances visibility particularly well in dusk/low-light conditions and when the UA is against a dark background.



INCIDENT ASSESSMENT CONSIDERATIONS

When used for scene assessment, the UAS Team should ensure that information is gathered in an effective way. Considering that the scene assessment could be of a range of incident types such as heavy transport (rail/aircraft), avalanche, wildfire or a water related incident, the incident commander/team leader

will require a range of views to obtain critical information and situational awareness. An overall view will be required of the whole of the incident scene from above and each side along with close up views of specific areas of interest. It may be the case if on scene early enough, that there may be little information gathered, particularly in remote or difficult areas to reach by vehicle or on foot. A structured way of reporting incident information is highly beneficial such as the METHANE report for example, as the right resources will be able to be facilitated.

When used for the monitoring of the scene of operations or for high-risk areas/operations, the UAS Pilot must coordinate with on scene key personnel to ensure that the flights are coordinated with periods within operations where the higher risk activities may be taking place. As flight time is limited, to observe a scene with little activity may waste valuable flight time when needed. Ensuring clear communications with the command station is vital, especially if other airborne assets are expected to be taking part. Technology can assist in this regard, but again as more technology is added to the aircraft cost and weight tend to increase.

Knowing whether there is going to be data connectivity at the area of search is important if a live feed from the UA or operator is expected. Being reliant on a 4G/5G signal in the wilds of Scotland or the foothills of Nepal cannot be assumed, and so methods of relaying areas searched, finds and progress need to be agreed prior to departing to the search area.

SEARCH CONSIDERATIONS

Search with a UA can be difficult, complex and has many variables such as environmental conditions, the weather, the ground and the experience of the UAS Team. There is no substitute for training and maintaining a standardised, structured approach for each type of flight, search method or search pattern. The following principles are common to all UAS search methodologies:

- Only the sensor operator should search, not the Pilot. The pilot's primary responsibility is ensuring safe flight closely followed by flying a suitable search pattern
- Large search areas should be broken down into smaller areas taking into account line of sight restrictions and battery duration
- The search should always commence prior to the search start point or should overlap the boundaries of a search segment and the whole search area (see image below)
- The height, speed and camera angle may differ for each search
- For any search with the UA in motion, the UA should be held static from time to time as any movement from the target may be the only thing that gives its position away
- A search, with the camera inclined forwards, is likely to have areas obscured from the field of view. A search should be carried out from the opposite/another direction to cover as much ground as possible
- It is rare that a search area can be declared as 100% clear and the probability of the casualty/MISPER moving into the area after it has been searched should be considered. In the image

below, two search segments have been identified (white lines show the search segment boundary). The search should always extend past the boundary so that all search segments and areas overlap (overlap in yellow).



When carrying out a search pattern at a set height, it must be understood that areas may be missed as when the height of the ground changes (in relation to the UA), the field of view of the camera will change also. In the image below, the UA is searching with the camera facing forwards and at a depressed angle. In this configuration, a target may be obscured behind a feature like a stone wall or behind vegetation. Even folds of ground can cause a target to not be within the cameras field of view. For these reasons and those above, a search from other directions should be carried out.



The Pilot will have to establish at what height the UA will fly at, at what speed and at what camera angle. This will be determined by:

- Safety
- Type of search (e.g., rapid/efficient/thorough)
- What is being searched for and size, colour etc.
- The weather/environment
- The nature of ground and the thickness of vegetation or spacing of trees for example.



As an example, the settings below detail which will allow the Goggle/tablet operator 7 seconds from a target coming into the field of view to assess and react, even if just to call a halt:

- 70m height
- 9m/s speed
- -40deg depression angle

THERMAL IMAGERY

The effectiveness of a thermal image camera will depend on the thermal contrast between objects. This is the difference in temperature between the casualty and the surrounding ground or vegetation. If the temperature is similar to the surroundings, it will be difficult to distinguish between them. The temperature of the ground is more dependent on the amount of sunlight it receives rather than the temperature of the air. A person's surface temperature is dependent on whether they are warm or cool which will depend on the temperature of their surroundings. Clothing will reduce the amount of heat detected by the camera, as would a casualty wrapping themselves in a thermal blanket.

Thermal image cameras can see in total darkness and light fog however, in fog the effectiveness may be reduced as the infrared signal is diminished as the radiation is scattered. They are not fully capable of seeing through water and may only detect some residual heat.

When searching a wooded/vegetated area, the thermal image camera cannot see through them however, it may still pick up enough heat from a person between the foliage to be detected which may prove more successful than relying on trying to detect them with a non-thermal camera. In open ground with minimal other heat sources and a good temperature difference, thermal image cameras can prove to be very efficient. It must be stressed however thermal cameras are expensive and sensitive. From flight trials we conducted, when there was a significant temperature differential (human body at 37°C, ground temperature at 0°C) the subject was quite clear (in open ground). However, when the temperature differential was reduced to within 20°C (a summer's day) the sensitivity of the thermal camera was not enough to be able to differentiate between the objects. There is a real challenge for industry to increase sensitivity whilst trying to maintain a portable aircraft at an affordable price for charities and the humanitarian sector.

GROUND/WEATHER FEATURES AFFECTING FLIGHT

Certain ground/mountain features can affect a UAS flight adversely which the pilot must take account of:

- Mountain passes may be prone to funnelling and the wind may become stronger as it passes over and descends which may push the UA downwards even though joystick input is for ascent
- An effect may occur where the heating from the sun can cause upwards air movement on the side exposed to the sun, and a downwards air movement on the shaded side
- Wind can travel up a face and over a cliff top causing turbulence
- A similar feature may occur when the air current runs over the top of a feature and causes eddies on the lee side
- If two air masses or winds at different speeds meet, turbulence may be also created causing instability to the UA.

FAMILIARISATION OF THE TARGET

It is very important to gather information from the search manager about the casualty profile and the colour of clothing the casualty may be wearing. Once in mind, the UAS Team can focus on that to give them the best chance of a find. Like physical search, it is beneficial to have a pre-search procedure to familiarise the searchers with something similar to how the casualty might look. If the colour of clothing the casualty is wearing is known and the team have clothing of a similar colour, a team member wearing the clothing can be placed in a position on similar ground/vegetation so that the sensor operator can familiarise with how they might look. Like the Northumbrian Raindance method of target familiarisation, this gives a benchmark and a formal method of making the search as effective as possible. The UAS is positioned at a height and camera angle that will be used during the search, then the sensor operator views the casualty from different angles and zoom.

There is a misconception that wearing bright coloured clothing in the hills will instantly enable a person to stand out well among the background. Below shows a red jacket against a dark background but at a reasonably close distance.



It does help on certain backgrounds and if close however, wearing bright colours to be visible is not as effective as one would have thought. The below image shows clothing that is a different colour to the surroundings. Six waterproof jackets have been folded into a rectangle (approx. 70cm x 40cm) and have all been placed on ground of a similar colour (rocks). The colour of jackets from left to right (in-line with yellow arrows) are orange, red, black, lime green, purple and fluorescent yellow. The UA was at a height of approximately 40m. Red is a very common colour of jacket but does not stand out that well with a dark background. Lime green is becoming more popular and stands out well behind dark backgrounds but less well on snow.





The image below shows a bright orange two-person emergency shelter among a very dark background which ordinarily would be expected to stand out. The UA was no more than 150-200m away.



Until the UAS is close or zoom is used, the target may be missed very easily.



CAMERA CONSIDERATIONS

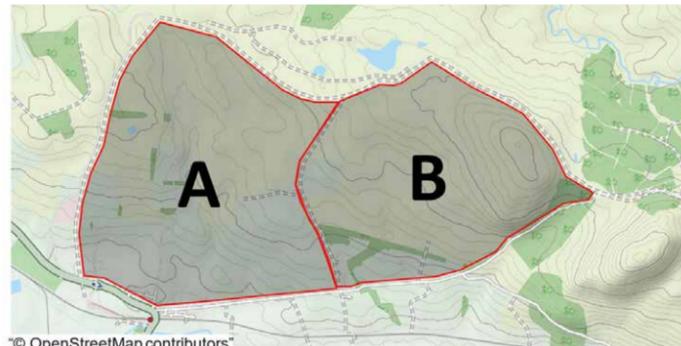
With a bright background, the image from the camera darkens the foreground. Keep the camera angled down to limit the amount of bright sky being in frame. Even small downward movements of the camera can make a significant difference.



When carrying out a search, the use of a head tracking gimbal (if available) on the goggles should be considered. The head tracking gimbal allows the sensor operator freedom of movement with the gimbal which will allow them to search independently of the flight path. The use of the head tracking gimbal should be especially considered when carrying out a rapid search as a wider area may be covered between each UA flight track.

SEARCH STRATEGY

The search strategy should be in place to ensure that a plan of action is in place to achieve the overall aim of the search which will ensure a methodical, simple, common sense system of work to identify an efficient and effective plan capable of yielding positive results. No single search method is likely to be sufficient on its own. To ensure that an effective search has been conducted, a combination of methods will likely be required. The boundary of the whole search area should be identified and if a considerable size should be broken down into search segments. Each segment should be identified to avoid confusion. Identification can simply be letters or numbers.



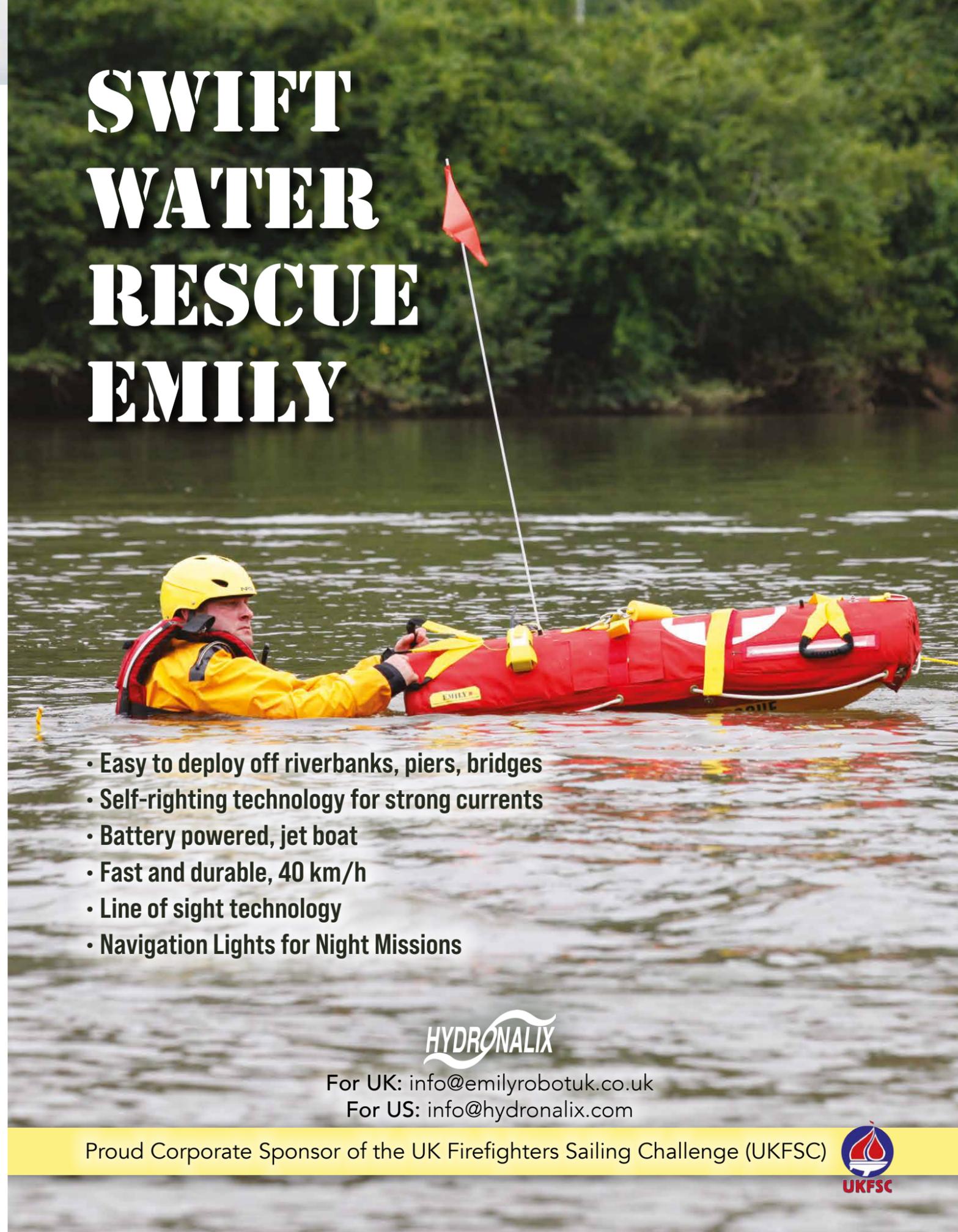
In the search areas, the UA Team may wish to conduct a rapid linear search along all prominent tracks and a point of interest search on any key features as a priority before conducting an area search in each segment for example. Having linear boundaries is extremely useful as when a search pattern such as the parallel line search is being used, the feature can be used as an edge to ensure there is a demarcation line for areas to overlap and to aid in the flight path.

In the absence of linear features in a search area, other landmarks/features may be used to form an imaginary line. In the image below, the tracks at the bottom and two sides have been used as search area boundaries (in white). For the last remaining search boundary which has no linear feature, an imaginary line (yellow) has been created using the corners of two the wooded areas.



The search strategy comprises of many different things as discussed, but if a system is established and practised, will prove highly beneficial. In part two we will look at search types, flight patterns and the search of specific mountain features.

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SAR SAFETY

PART 2 Mountain Rescue Equipment

By Greg Toman



Greg was awarded a Churchill Fellowship for this research in 2019. He is currently leading the development of the remote rescue capability for the Queensland Fire & Emergency Service in Australia. Outside of the Fire Service, Greg's background includes a Diploma in Outdoor Education, outdoor pursuits instructor (rock climbing and whitewater kayaking), rafting guide, and instruction in advanced swiftwater rescue and high angle rescue internationally.



Photo by P. Vidi

Enhancing the overall safety of rescuers and those requiring rescue in mountainous and austere environments

The aim of this research project was to investigate equipment and techniques used by mountain rescue teams internationally... in order to obtain a more global view, this research involved rescue teams and organisations from Canada, USA, UK, Austria, France and Italy. There were many consistencies between rescue teams and between the countries. Teams generally broke the equipment down into operational or specific kits, for example:

- Personal Technical Rescue Kit
- Anchor Kit
- Rigging Kit
- Stretcher Kit
- First Aid Kit
- Patient Packaging Kit
- Casualty PPE Kit
- Deceased Person Kit
- Shelter Kit

In principle, the contents of these kits were very similar between rescue teams and countries.

PERSONAL TECHNICAL RESCUE KITS

Personal Technical Rescue Kits consist of equipment that give the rescuer the ability to:

- Safeguard themselves
- Build an anchor
- Belay a rescuer
- Abseil or rappel
- Lower a person
- Raise a person or equipment
- Ascend a rope
- Bypass a knot or obstruction
- Improvise a seat harness or chest harness

The following are examples of Personal Technical Rescue Kits recommended by rescue teams:

YOSEMITE SEARCH AND RESCUE – USA

- 1 Backpack or Haul Bag
- 1 Helmet
- 1 Headlamp
- 1 Black Diamond Big Gun Harness
- 1 Pair of leather gloves
- 1 Knife (personal item)
- 1 ATC with locking carabiner
- 1 Gri Gri with locking carabiner
- 1 Pair of Jumars with non-locking

MOUNTAIN RESCUE EQUIPMENT



Personal Technical Rescue Kit – RMRG

- 1 120cm sling
 - 1 240cm sling
 - 2 Sewn prusik
 - 1 ATC
 - 1 Personal prusik
 - 1 Prusik Minding Pulley (PMP) min. 30kN
 - 1 Petzl Connect Lanyard or Purcell Prusik
 - 1 Pulley (optional)
- carabiner
- 1 Pair of Aiders with non-locking carabiner
 - 2 Nylon daisy chain, with locking carabiner
 - 1 Set of Purcell Prusik with locking carabiner
 - 1 VT Prusik with locking carabiner
 - 2 6mm personal prusik (short) with non-locking carabiner
 - 5 Locking carabiner (free on harness)
 - 4 Non-locking carabiner (on harness)
 - 1 10m x 8mm accessory cord with non-locking carabiner
 - 2 60cm Dyneema sling with locking carabiner
 - 2 120cm Dyneema sling with locking carabiner
 - 1 3.5m x 25mm webbing

OGWEN VALLEY MOUNTAIN RESCUE ORGANISATION – UK



- 1 Backpack
- 1 Helmet
- 1 Harness
- 1 Headlamp
- 6 DMM locking carabiner
- 1 10m Low stretch kernmantle
- 1 Qty – 25mm webbing

- 1 120cm sling
- 1 240cm sling
- 2 Sewn prusik
- 1 ATC
- 1 Personal prusik
- 1 Prusik Minding Pulley (PMP) min. 30kN
- 1 Petzl Connect Lanyard or Purcell Prusik
- 1 Pulley (optional)

CANADIAN AIR DIVISION – SAR TECH Canada (MINIMUM PERSONAL EQUIPMENT)

- 1 UIAA certified helmet
- 1 UIAA certified harness
- 1 Belay gloves
- 4 Locking carabiner
- 4 Non-locking carabiner
- 1 Pear shaped tri-action auto locking carabiner
- 2 Prusik minding pulley
- 1 Auto braking belay device
- 1 6m x 7mm static cordelette
- 2 60cm sewn sling
- 2 120cm sewn sling
- 3 Purcell prusik (short, medium, long)
- 1 Short prusik
- 1 UIAA certified stainless steel quick-link

BRD MOUNTAIN RESCUE SERVICE – Italy

- 1 Rucksack
- 1 Radio helmet
- 1 Radio including spare battery
- 1 Headlamp
- 1 Mobile phone and powerbank
- 1 Harness including Personal Anchor System
- 1 Rescue harness
- 1 Single rope (50m or 30m rope & 30m Kevlar rope)
- 3 HMS carabiner
- 2 Locking carabiner
- 3 Via Ferrata carabiner
- 1 or 2 Pulleys (can be a Petzl Microtraxion)
- 1 Combined abseil and belay device (e.g. tube or reverso)
- 2 120cm sling
- 1 Kevlar sling 350 – 400cm
- 1 Kevlar sling 150cm
- 1 Short Kevlar prusik
- 1 Hammer & 3 pitons / pegs or 3 Friends
- 1 Scissors & Knife
- 1 Sun glasses / Ski goggles
- 1 Notepad and pencil
- 1 First aid kit

ANCHOR KITS

Anchor Kits vary depending on what the terrain offers in the way of natural anchors or placement for climbing protection. Anchor kits may include some, or all of the following:

- Drill and bolting kit (fixed or removable bolts)
- Hammer and pitons / pegs



Drill & Bolting Kit – Kananaskis Public Safety

- Pickets and ground anchors
- Traditional climbing protection (nuts, hexes, cams)
- Slings, cordelette, webbing & rope
- Carabiners and rigging plate

RIGGING KITS

Rigging Kits were a reflection of the rescue systems the team or organisation adopted. For the majority of teams / organisations involved in this research project, a two-rope rescue system was the optimal system, especially for a rescue load. There were some rescue teams transitioning to a Dual-Capability Two Tensioned Rope System (DCTTRS)



Climbing Protection – Dieter Demetz, CNSAS

from the Single Main – Separate Belay Rope System (SMSB), and there were “hybrid” versions of these. Rigging Kits generally included:

- Ropes suitable for the terrain and pitch lengths (length, diameter and material)
- Descent control devices suitable for the rope diameter, the load and forces
- Rigging plates for master points
- Edge or rope protectors
- Equipment to construct mechanical advantage
- Equipment for redirects
- Equipment for bypassing knots or obstructions



Rigging Kit – Rocky Mountain Fire

The following are examples of Rigging Kits recommended by rescue teams:

YOSEMITE SEARCH AND RESCUE – USA

- 1 Backpack or Haul Bag
- 2 15m x 11mm low stretch anchor rope
- 8 Prusik Minding Pulley (PMP) on 4 x non-locking carabiner
- 2 Rigging plates on a non-locking carabiner
- 10 Locking carabiner
- 5 Non-locking carabiner
- 2 Conterra Scarab, each on a locking carabiner
- 4 Short 8mm prusik on non-locking carabiner
- 4 Long 8mm prusik on non-locking carabiner
- 2 SMC “egg crate” rope protector
- 2 Fire hose rope protector
- 1 Pruning saw



Rigging Equipment – Kananaskis Public Safety

- 1 Bean bag throwbag
- 2 VT prusik
- 4 14’ webbing (grey)
- 2 10’ webbing (yellow)
- 2 6’ webbing (red)
- 1 4:1 Jigger Kit (2 x locking carabiner, 2 mini double sheave pulley, 1 x 6mm prusik)
- 1 10m x 8mm accessory cord

LLANBERIS MOUNTAIN RESCUE TEAM – UK

- 1 Bag
- 11 Locking carabiner
- 3 150cm sling
- 1 Lanyard (Petzl Connect Duo and locking carabiner)
- 1 Rope grab (Petzl)
- 1 Petzl ID
- 1 Pulley
- 1 Rigging plate
- 2 Prusik
- 1 Set of wired stoppers (sizes 4 – 11)
- 2 Hexes (sizes 3 & 4)
- 1 10m cord / rope

Small Kit Bag

- 5 Locking carabiner
- 3 Slings
- 1 Bandoleer

Small Kit Bag

- 1 Hammer
- 1 Set of pegs / pitons

OGWEN VALLEY MOUNTAIN RESCUE ORGANISATION – UK HALF RIGGING KIT

- 1 Haul bag
- 1 Set of wired stoppers (sizes 1 – 10) on non-locking carabiner
- 1 Set of hexes (sizes 1-4) on non-locking carabiner
- 1 240cm Dyneema sling on a locking carabiner
- 2 120cm Dyneema sling on a locking carabiner
- 1 60cm Dyneema sling on a locking carabiner
- 1 Nut key
- 1 ATC and locking carabiner
- 1 MPD and locking carabiner
- 2 PMP and 2 x locking carabiner
- 2 Sewn prusik
- 4 Locking carabiner (free)

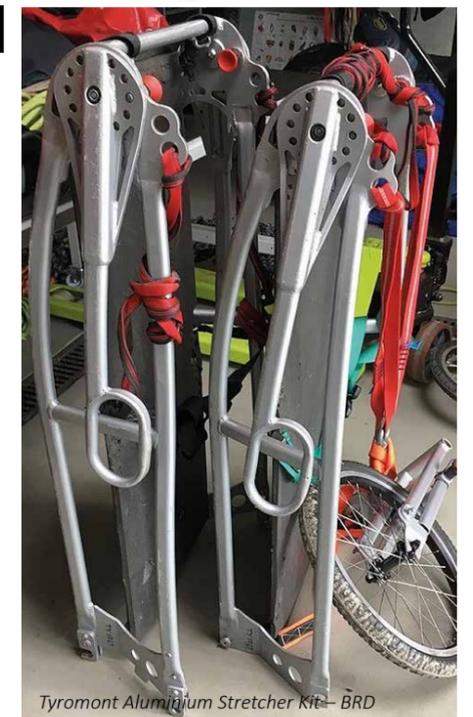
ANCHOR KIT

- 1 50m Powercord (5.9mm Technora core / Nylon sheath)
- 1 Locking carabiner
- 1 Petzl Paw rigging plate

STRETCHER KITS

Stretchers used within the international mountain rescue community did vary to a degree in their overall design. Stretchers used in Italy and Austria had a unique design compared to those used in the USA, Canada and Australia.

European manufacturer, Tyromont has been constructing mountain rescue stretchers for more than 65 years. Their unique stretcher design incorporates a curved frame which provides more space for the rescuers legs when the stretcher is being raised or lowered. The curved ends assist with negotiating obstructions such as a 90 degree ledge or void on a scree slope during a lower. The mountain rescue stretcher incorporates four individually adjustable handles, which enable each rescuer to select a handle position optimal to their carrying height and the gradient of the terrain they are travelling. The patient “bedding” area is impact and puncture resistant, providing additional protection to the casualty. The stretchers are of



Tyromont Aluminium Stretcher Kit – BRD

2-piece construction, enabling them to be carried on a backpack and they can be fitted with a single wheel attachment to take the weight of the casualty and

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Tyromont Steel Stretcher – BRD

assist with transportation. The Tyromont mountain rescue stretchers come in steel and aluminium models and vary significantly in overall weight. The steel model weighs a total of 24kgs (Stretcher 16kgs, Handles 5kgs, Wheel 3kgs) and the aluminium model a total of 18kgs (Stretcher & Handles 15kgs, Wheel 3kgs).

The more commonly used stretcher design for technical rope rescue environments in the USA and Canada (as well as Australia) is the basket stretcher. Compared to the Tyromont designed stretcher, the basket stretcher would be considered a more “all-round” rescue stretcher, which is used by many industries and rescue groups.

An example of a commonly used basket stretcher in mountain rescue is the Traverse Titan 2-piece stretcher which comes in a stainless steel or titanium model. The stainless steel stretcher weighs in at 15kgs and the titanium version only 7.5kg, making them lighter than their Tyromont counterparts. This is partially due to lighter weight components being used for the patient ‘bedding’ area, where a high density Polyethylene mesh and a plastic back support is used instead of a sheet of aluminium and foam padding.



Tyromont Steel Stretcher with wheel

HANDLES & WHEELS

Companies such as Traverse Rescue, Cascade and CMC are now offering adjustable stretcher handles and wheel attachment systems that can be fitted to their stretchers, when required. The 2-piece stretcher can be carried by the rescue team to the casualty by either:

- Tying sections to a rescuer’s backpack

experiment with tyre inflation pressures, as this impacts on what the casualty feels through the stretcher

- Incorporating a backpack harness to the dismantled stretcher. The concept of mounting a wheel underneath the stretcher, to take the load off the rescuers and to assist with

movement, has been used around the world for many years. These systems were often developed and produced by individual rescue teams ... there are actually stretchers being used today by rescue teams involved in this research, that were designed and made by team members. Stretcher manufacturers are now offering a wide range of wheel options from mountain bike wheels with disc brakes, to ‘fat’ bike wheels, to over-sized all-terrain wheels. The selection of wheel type may be governed by the make and model of the stretcher used, however factors like the terrain to be covered, wheel and frame weight, and ability to carry the wheel components were all factors for consideration.



2-piece Stretcher – Yosemite Search & Rescue



Photo courtesy of Alpine Rescue Team – 2-piece Stretcher Carry



Photo courtesy of Charles Farabee – YOSAR Stretcher Carry

An important piece of advice provided by experienced rescuers was for teams to experiment with tyre inflation pressures, as this impacts on what the casualty feels through the stretcher.

SECURING THE CASUALTY

A number of options were presented for securing the casualty in the stretcher, depending on how the stretcher was being transported, for example: carried by rescuers, on a trolley system, raised or lowered by rope, or hoisted by helicopter.



Pike & Pivot Stretcher Bridle – MRA Conference 2019

These generally included a combination of the following uses:

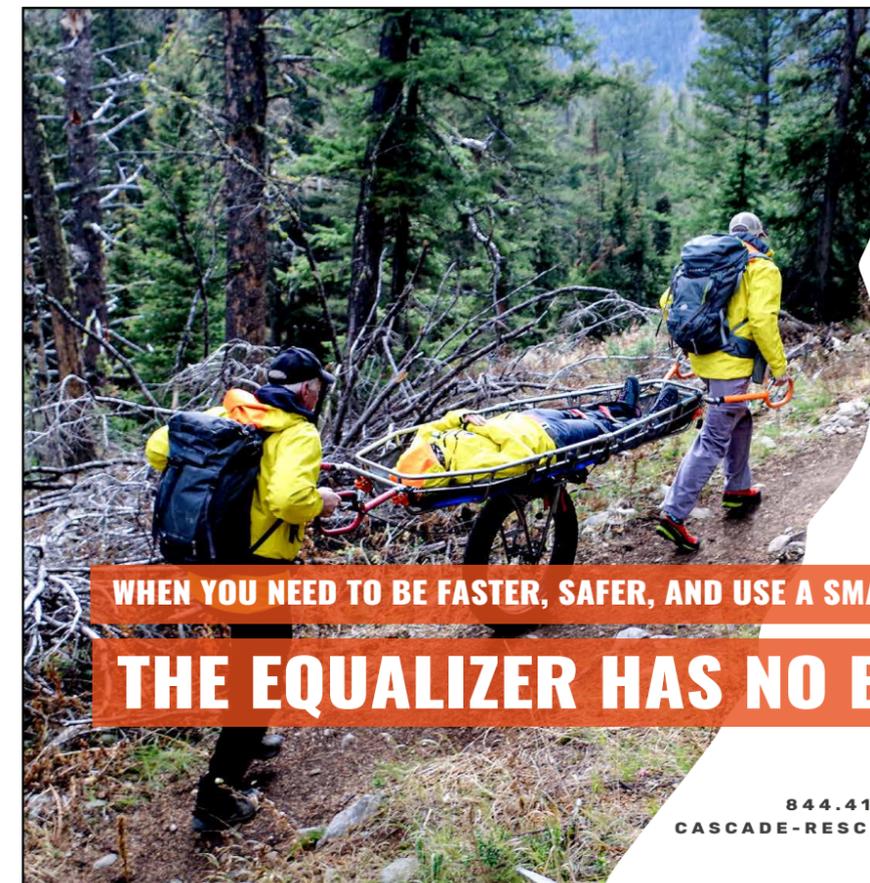
- Commercial ‘seat belt’ webbing straps supplied with the stretcher
- 25mm webbing to lash the casualty into the stretcher
- Low profile multi-fit seat harness for the casualty (secured with webbing)
- Two Purcell prusiks, basket hitched to the harness belay loop. One Purcell prusik for the torso end, and one for the leg end

STRETCHER BRIDLES

Stretcher bridles also varied between rescue teams, and in some cases this was due to requirements for use with winch or short haul helicopter operations. Where this was not a requirement, hybrid bridle systems could be used. Bridle systems were also developed to overcome obstacles often encountered in the field, where the orientation of the stretcher

has to be adjusted. An example of this is when negotiating a 90 degree edge transition with no high directional, and adjusting the stretcher bridle to perform a Pike & Pivot maneuver. Common variations in stretcher bridles included:

- Manufactured versus constructed by rescue team
- Fixed length versus adjustable (mechanical / soft rope grab, mechanical advantage kit, cam buckles)



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10 point bridle connection – StableFlight Hell bag

- 3-point versus 4-point versus 6-point connection
- Webbing versus static rope versus Technora or Kevlar Cord
- Single focal point connection or dual focal point connection

ATTENDANT POSITION

It is widely accepted that the litter or stretcher attendant should maintain two points of connection to ensure their safety. Apart from looking after the casualty during the technical stretcher phase of rescue, the litter attendant plays an important role in manoeuvring and positioning the stretcher to avoid any hazards, and to reduce friction by keeping the stretcher off the rock. To do this effectively, they must have the ability to adjust their position up or down in relation to the stretcher, while maintaining two points of connection.

Some of the equipment used by rescuers to adjust their position included:

- Handle or chest ascenders
- Belay devices such as Petzl Gri Gri, Petzl Rig, Petzl ID or ISC D4 in conjunction with an ascender, leg prusik or etrier
- Petzl Grillion or similar
- Pre-rigged mechanical advantage such as AZTEK or Petzl Jigger

FIRST AID KITS

Selecting the contents of a first aid kit was in many ways similar to selecting personal protective equipment and technical rescue equipment. The contents are generally a reflection of the types of injuries and illnesses commonly encountered in a rescue team's response area. Consideration is given to including items that may be multi-functional or light-weight, and training would include learning how to do more with less in a wilderness setting.



First Aid Kit – BRD

RMRG Boulder Colorado USA – Basic Life Support Kit			
1	Moleskin	2	Lubrication Jelly Pack
5	Band-Aids	Qty	1" and 2" Tape
1	Space Blanket	5	Gloves of each SM/MD/LG
1	Ace Wrap	1	Trauma Shears
12	Sterile 4 x 4" Gauze Pad	1	Hemostat
2	Sterile 5 x 9" Abd. Pad	4	Vionex Wipe
1	Tourniquet with Sharpie	2	SAM Splints
6	Kerlix Roll	1	Hot Pack & Cold Pack
Qty	OPA (SM/MD/LG)	1	500ml Bag of Saline
Qty	NPA (SM/MD/LG)	2	IV Angiocaths 20/18/16/14g
		2	IV Start Kit
		1	Extension Set
		2	Alcohol Pad
		1	Sharp Shuttle
		2	Op Sites
		2	Saline Preload Syringe
		2	3ml Syringe w. Needle
		1	Turkey Baster Suction
		1	Pocket Mask
		1	Blood Pressure Cuff Bag

Parks Canada – Jasper NP British Columbia CANADA			
WOUND MANAGEMENT		SPLINTING	
4	Absorbent Pad – 5 x 9"	2	SAM Splints
2	Absorbent Pad – 12 x 16"	1	Wire Splint Frame
2	Absorbent Pad – 10 x 30"	1	Finger Splint
2	Quikclot	8	Triangular Bandage
Qty	Sterile Pad – 4 x 4"	3	Tensor Bandage
3	Large Sterile Pad	1	Donut Dressing
2	Large Pressure Bandage	1	White Tape
3	Sterile Pressure Bandage	AIRWAY MANAGEMENT	
Qty	Non-sterile Gauze	1	Oxygen w.Reg (1800lbs)
3	Gauze Bandage Roll	2	Adult: Non-Rebreather
3	Abd. Pad (SM)	1	Child: Non-Rebreather
2	Chest Seal	2	Nasal Cannula
Qty	Band-Aids	1	Set of 8 OPA's
Qty	Alcohol & Iodine Wipes	1	Adult BVM
1	Tourniquet	1	V-Vac Suction
2	Bum Dressing	1	Set of 5 NPA's + lube
1	White Tape	PPE	
3	Saline Solution	3	Gloves of each S/M/L/XL
SPLINTS		TEMPERATURE MANAGEMENT	
1	C-Collar - Adult	1	Pocket Mask
1	C-Collar - Child	2	Safety Glasses
1	Speed Splint	3	Face Mask
1	Pelvic Binder	3	Cold Packs
		1	Salbutamol
		1	Spacer
		1	Benedryl
		1	ASA
		1	Glucose

Llanberis MRT Wales UNITED KINGDOM			
1	Torch	1	Waterproof Plasters (pk)
3	Pair of Gloves	1	Tourniquet
1	Stethoscope	1	Roll of Tape
1	Pocket Bag Valve Mask	1	Piece of Netlast
1	Suction Tube	1	Needle Protector Pad
1	Cannula	8	Wound Cleansing Wipes
2	Jelly Satchels	1	GTN Pump Spray
3	Nasal Airways	1	Blue Inhaler
6	OP Airways	1	Adrenaline
1	T6 Trauma Dressing	1	Drugs Crib Sheet
2	Low Adherent Dressing	1	Strip of Paracetamol
2	Non-woven Swabs	1	Strip of Ibuprofen
1	Celox Gauze	1	Strip of Aspirin
1	Vet Wrap	1	Strip of Buccastem
		1	Blood Glucose Monitor
		1	Pulse Oximeter
		1	Ear Attachment
		1	Finger Attachment
		1	Cervical Collar
		1	Splint Kit
		1	O2 Kit
		6	Finger Lancets
		1	T-Pod
		1	Shears
		3	Casualty Cards
		2	Pencils
		1	Pen
		2	Spare AAA Batteries

In general, most first aid kits covered items for PPE, trauma (bleeding, wounds & fractures), exposure, breathing, airway, diagnostics, medications and pain management. Many also incorporated intravenous fluid (IV), oxygen and automated external defibrillators (AED). First aid kits were organised into modules or sub kits for ease of identification and access. This also assisted with inventory checks and replenishment



First Aid Kit – BRD

of contents. While not listed in their modules or sub kits, the following are examples of the items included in mountain rescue team first aid kits from the USA, Canada and UK.

PATIENT PACKAGING KITS

Consistently, the primary piece of equipment that made up the patient packaging kit was the full body vacuum immobilisation mattress. The vacuum mattress provides immobilisation of suspected vertebra, pelvis or limb trauma. By extracting the air from the mattress with the pump, the mattress containing multi-chambers filled with beads becomes hard, and when initially moulded around the casualty's body allows full body immobilisation without pressure points. This improves comfort and reduces the risk of additional trauma. Handles located on the mattress assist rescuers with the movement of the casualty over short distances, and can assist with limiting the unintentional movement of the casualty when transported in a basket stretcher.

Many models of vacuum mattresses are X-ray translucent and therefore can remain supporting the casualty while undergoing an X-ray.

SAFE USE OF VACUUM MATTRESSES

Rescue teams that used a vacuum mattress extensively offered the following advice:

- In an outdoor environment, vacuum mattresses are susceptible to puncture. Even a very small pin size hole can result in a significant reduction in the immobilisation of the casualty over time. Where possible be selective where you position it on the ground or try to protect the mattress from sharp objects (rocks, sticks, thorns, glass etc).
- It is a compromise between 'packed' size and weight of the mattress, and the durability and rigidity

provided by the mattress. The heavier duty the mattress material, the heavier and bulkier the mattress. The more chambers and beads, the heavier and more bulky the mattress.



RedVac vacuum mattress – YOSAR



Vacuum mattress in basket stretcher – RMRG



FERNO RESCUE

FERNO RESCUE

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For additional information:
Brent Fairweather | Rescue Group Director
b.fairweather@ferno.com

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SAR SAFETY

- Vacuum mattresses come in a variety of lengths and widths, and this will also impact on the packed size and weight of the mattress.
- Some brands of mattress appear to be more prone to acquiring a leak (after a few uses) than others. It was noted that the RedVac brand of mattress was well supported.
- Ensure that you have a spare valve, and a good quality small aluminium pump is best.
- If the casualty requires a harness while being transported in a basket stretcher, fit the harness before packaging the casualty in the vacuum mattress.
- If a casualty is packaged in a vacuum mattress and cannot be accompanied by a rescuer or medic, then consider orientating the casualty (after immobilising) in the lateral position in case they vomit. Place them to one side of the stretcher and pack out the other side to keep them in place. Secure them in the stretcher in this orientation utilising the vacuum mattress handles to anchor in place.
- Make sure the vacuum mattress has a return address and contact details clearly marked, and clear instructions 'Do Not Cut'.

CASUALTY PPE

Casualty Personal Protective Equipment (PPE)

- Harness that can be quickly and efficiently fitted, such as a seat harness, like the Cascade Rikki-Tik (far right) with Cobra buckles for rapid donning or triangle rescue harness. These range from the simple triangle of material (below) to quite complex and adjustable triangles like the Kong (right) and the fully encompassing CMC Helitak (below-right) with an integral harness.
- Helmet with adjustable fit
 - Headlamp fitted to helmet
 - Chest harness option for use with seat harness



Next issue pt3 includes Ropes & Webbing, Hardware and Systems

WILDERNESSAR Issue 8

DECEASED PERSON KIT

Rescue teams are often involved in the recovery of deceased persons in austere and mountainous environments. Apart from fatal accidents resulting from outdoor adventure activities, rescue teams may also respond to suicides. Sadly, some rescue teams had locations in their response area that were 'popular' with those attempting suicide. In the absence of the relevant authority, rescue teams may be required to confirm death, establish a secure scene, gather and record evidence, and recover the deceased. Rescue teams generally had a specific kit for this purpose. An example of this, is the Llanberis Mountain Rescue Team – Major Incident Kit.



Alison Sheets (MD), RMRG Medical Director indicated that 'double bagging' the body is important in warm environments... however it is suitable to use a single bag in cold conditions and / or with frozen bodies.

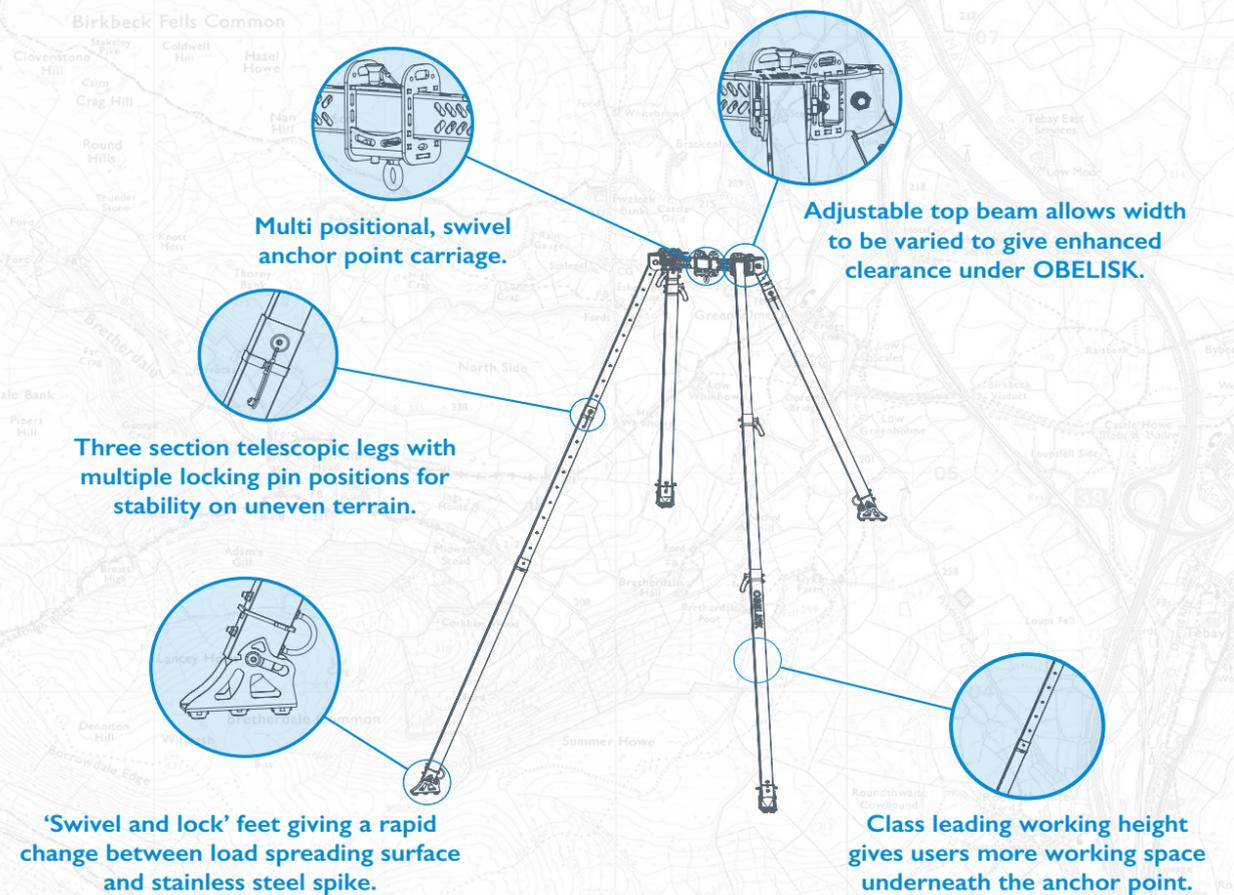
Llanberis Mountain Rescue Team, Wales-UK

- 1 Heavy duty body bag
- Qty Tags / labels / pens
- 2 Sharps container
- Qty Evidence labels & pegs (numbered)
- 10 Pairs of disposable gloves
- Qty Police evidence collection bags
- Qty Long sleeve rubber gloves
- 2 Large clinical waste bags
- Qty Cordon (demarkation) tape
- 2 Face mask
- 1 Digital camera & new SD card

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OBELISK



Designed and manufactured by Lyon specifically for emergency service work, the OBELISK incorporates a wealth of features that make it ideal for the varied and challenging situations teams have to operate in.

- Stainless steel and anodised aluminium alloy construction combines strength and lightness.
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- 'Push pin' locking on top beam, carriage and legs allow for tool-less adjustment.
- Swivel feet for maximum grip on any surface.
- Adjustable top beam with option for twin anchor point carriages allows for twin rope working without crowding.
- Weight Inc. all accessories: 22Kg.
- Guying points for additional security.
- EN795:2012, PD CEN/TS 16415:2013
- Product Code: LPP0003



For the latest information on the Lyon OBELISK specifications and availability, please contact us at work.rescue@lyon.co.uk or on +44 (0) 1539 624 040





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SafeGuard™ Rope Protector

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The SafeGuard is designed to protect ropes on sharp, jagged edges or over especially rough surfaces. It allows ropes to move freely while avoiding abrasion or cutting damage and has been thoroughly tested in industrial and outdoor rescue setups.



Green



Red



White



Blue



Black

11 mm (7/16") WorkPro™

Our low-elongation, dual-certified, static rope is light, easy to work with, and significantly stronger than other similarly constructed ropes. With a pre-steamed nylon core and 32-carrier polyester sheath, the WorkPro gets its strength from the balanced core and sheath that share loads evenly.

EN 1891: Type A & NFPA 1983: Technical

MBS: 8,092 lb



Orange



Red



White



Blue



Black



Yellow

11 mm (7/16") SuperStatic2™

Our do-it-all static rope is 100% nylon, with a core specifically engineered for more flexibility and better handling. The SuperStatic2 is compatible with a broad range of gear and hardware, making it the ideal rope for all types of high-angle rescue scenarios.

NFPA 1983: Technical

MBS: 6,519 lb

Reach

improving rescuer safety and efficiency

By Mitch Sasser & Sean Norman

www.rescuemagazines.com

We use the device in our role as swiftwater rescue instructors during training for SAR Groups, Swiftwater Teams and Whitewater professionals through our program. We strongly recommend the device be introduced early on in any Swiftwater rescue training program as it helps create a mind-set and clear understanding that with skilled use, it speeds deployment of all traditional rope-based systems used in moving water. Many new, remote based solutions are simply not possible without it. It's important to recognize that its value goes beyond just line capture. Its role has expanded considerably

from a form of remote anchor protection adding critical fast access capabilities where none existed prior to its introduction. We believe strongly that all students training to be first line rescuers in moving water be trained in its field use after thorough dry land exposure to the basics of throwing and retrieving and repetitive accuracy training. The student realizes that the risk of injury or death is present in performing a wading crossing or a strong swimmer live-bait for that matter opting for the safer and faster alternative of working remotely from a distance. I can honestly tell you the most valuable player on any swiftwater rescue team is going to be the one that masters the use of a Reach for accuracy and distance and these skills can be developed on dry land, on a dried up creek bed, at the base or station, or at home with a set-up, mocked up example of anything from a vehicle to rocks or brush that simulate the type of anchors we routinely now use to establish first-crosser protection. Then pull test trying to disengage from the arc of a pendulum, that which a swimmer or crosser would experience if the current were to blow you downstream. We refer to this as Reach first-crosser. I've done hundreds of these types of crossings and spent several months in the California Sierras over three summers with Croslin testing this form of stream crossing and I can tell you from the first to the last, we never blew out an anchor and none of the crossings could have been performed by any of the techniques currently taught in swiftwater programs. All were tension diagonals or simple pendulum belays. This is critically

Mitch is the CEO of training company Tandem Rescate in Chile formed 20 years ago. He was originally trained by Jim Segerstrom, Mike Croslin and Jim Lavalley, and, together with this formidable group, pioneered the inland water rescue programs that became the core of every established and recognized training program in the world.

Sean has been employed with CAL FIRE for 29 years, the last 20 in Butte County, N. California. He began teaching water rescue in 1997 and sat on the working group for California's State Fire Training helping rewrite the River and Flood and Boat Rescue Technician curriculum's. He is an avid kayaker and rafter in the Sierra Nevada Mnts.

[ED: The Cross Line Reach is a grappling hook with hinged arms and carabiner-style wire gates to trap any rope that is hooked. We used it from 2005 and it featured on the cover and inside issue 63 of TECHNICAL RESCUE in 2012. Despite being an, as yet, unsurpassed device lauded by Jim Segerstrom, the Reach is still not as widely used as it could be almost 20 years after its invention by swiftwater rescue guru Dr Mike Croslin. So it seems odd to almost be running this article as if it were the introduction of a new device but some things never get old. This is the kind of mechanical art-form that will still have a place in your rescue packs in 2150 when you're using drones and tractor beams to perform in-water rescue. Sooner or later, technology breaks down and you have to revert to the old ways of the early 2000's. Get it (cost is around \$140/, www.crosslinereach.com) practice with it and know that you will always have a viable rescue/recovery option.]



Just before Jim Segerstrom passed away in 2007, Croslin, Lavalley and a cadre of recognized swiftwater rescue experts convened in California to review and field test the first REACH prototype in the field and their feedback was thorough and convincing, recommending only a slight increase in its weight for longer throws which the second prototype was created by Rock Exotica. It was distributed by Steve Hudson at PMI. When Steve passed away a few years later, PMI and Croslin agreed to move production back to Bentannis Custom Manufacturing in Sonora closer to Mike's home. The first Reach prototypes were designed together with Tony Bentannini and Reach is now on version 3 which has proven to be a near indestructible, dependable ally to rescuers worldwide.



important: why would you risk a single rescuer or two or three or more in a multi rescuer stability creation...line astern, line abreast, triangle or any other technique that risks multiple rescuers blown downstream? This is not logical and yet remains the standard way to teach "shallow water crossing". Croslin admits that the multiplayer crossing techniques work to add stability, but the consequence of a blowout is extreme.

SAR groups working at night under very tricky conditions will greatly benefit if every member on the team has the ability to remotely and securely capture a line thrown to them. They can remotely anchor the device by chocking it between obstacles on the far side of the current and at the same time acknowledge that if in trouble they can lower out a tag line from their position improving their visibility at night, around a blind corner or when in need of assistance from entrapment or too strong of current to proceed. Lowering a tag line out downstream of your position increases the visibility of your position and the range of line capture to that line for fast hauling to shore.

These are the skill sets that you need to have:

- Be able to manage the device well in the water and out.
- Know how to rig the device from one rescue line to the next.
- After one evolution is done, know when to retrieve your reach
- Keep it with you on your PFD or in a waist belt throw bag system as protection for yourself and your team.

All teams should work towards developing these team-based protection strategies that prevent unnecessary technical swims. Swimming lines is no longer the high-risk solution to be falling back on. Be intelligent and make a free swim with minimal gear to the far side instead of a tethered swim.

Do Not Swim Lines anymore!

It is very dangerous and we will all be a lot safer if we approach this from a safe and efficient application.

Any line thrown short is no longer out of reach. There is no need to work off short tethers while wading into the swollen river to try and catch the bag thrown to you from the far side. Just toss the Reach out and cross clip the line thrown and its done! This does not remove the need to be a strong swimmer for swiftwater rescue, it only aids in keeping you and your team safe.

The Reach is not just a capture device. This device can help deal with boat wraps, pins, entrapments, room of doom type eddies, isolation of rescuers around blind corners, or steep cataracts which often create near impossible escapes in a timely manner. The capability of attaching to a floating line released into the current and the capture of the bitter end with a Reach cross clip gives teams a real and routine solution to establishing an



Here a throwline has been thrown on the upstream side of the mid-stream anchor rock with the bag and tail carried downstream. The Reach is then thrown to capture the tail and bring to shore allowing rescuers to either clip the tail back to the line and cinch it up onto the anchor rock or create an endless running loop around the rock. In the inset pic above the Reach can hook a throwline and slide back to the throwbag to pull it in.

immediate connection to a team member in trouble. This alone in our view raises the Reach from a piece of specialty gear to an essential piece of PPE that should be worn, closed in a pocket of every rescuer PFD. Along with a waist worn throw bag this is now considered a recognized piece of PPE.

It's important to emphasize it is now often possible to complete an entire rope-based evolution to evacuate from a midstream obstacle, a car, rock, tree or an entire small isle or outcropping without putting a single rescuer in the water, and when necessary to send a rescuer this rescuer should be ideally belayed or attached via remote anchoring to the object midstream...even if the current velocity or gradient is so severe a swim would be impossible. This is now realistic, proven and within reach. Amazingly good news that presents an aggressive fast attack option to well-trained swiftwater teams. With the additional advancement of using ascending devices to move up fixed lines in strong current it's astonishing how aggressive pendulum belays moving across unswimmable current channels into eddies behind midstream obstacles in steep gradient rivers has progressed.

Apart from trying to spread the word about the use of the REACH and make water rescue MUCH safer, we consider ourselves serious environmental stewards, we have found the Reach to be an excellent way to remove lost fishing tackle, barbed wire and any other rope like hazard at any teaching site that is heavily used or fished, including lost throw bags or lines that block navigation. Reach is capable of ripping out some real river monsters. The hinged arms exert at around 850lbs by design and can be replaced easily. These are beefy units that if mindful and vigilant of its trajectory and fast return will only function better as they age. They are built to be able to hand over to the next generation.



Swift water rescue generally constitutes a "high-risk, low-frequency" event. So every advantage that mitigate the risks should be taken and for my team, one solution has been the Cross Line Reach Device. The CAL FIRE/Butte County water rescue team is a Type 1 Team with 24 members responding to an average of thirty to forty incidents a year. These range from irrigation canals in the Sacramento Valley, to large mainstem rivers to class 5 water in the Sierra Nevada Foothills. Everything from personal protective equipment, to boats to rescue practices has come from the boating community. As rescue has progressed, we have seen a shift to purpose-built equipment for the job we do. The Cross Line Reach Device represented the first real innovation in specialty equipment for our industry. The brilliance behind the tool is evident in its design and I believe we have still only scratched the surface of what the tool is capable of.

The Crossline Reach Device was a game changer in a technical water rescue environment, it truly allows the operator to extend their reach out into the middle of the river. When you consider the options from that point, it is easy to see the potential to accomplish tasks from a much safer environment. As a leader of an organization where normal operations occur in a risk-filled environment, we are always seeking to find methods to reduce risk to our personnel. When we look at the water rescue environment we can talk about risk mitigation, but if you look at the methods that we have been utilizing, it really boils down to layers of downstream rescuers, and while they may be in place to recover a fellow rescuer or victim who has flushed during an operation, we have done little to reduce the risk to the rescuer and the victim during the rescue. By integrating the Cross Line device into your rescue package, you can dramatically reduce that risk to your personnel. The Cross Line Reach all but eliminates the need to swim a line that has been tethered to your release harness. This alone represents a huge reduction in the risk algorithm. Anytime that we are connecting a line to ourselves, even on a release harness and swimming in dynamic water, we are facing a significant amount of risk. Since we have had our Reach devices, I do not remember the last time that we had to swim a line across a body of water. By reducing the time that it takes to get a line established across a river or stream, we reduce our operating time and increase the survivability of a victim.

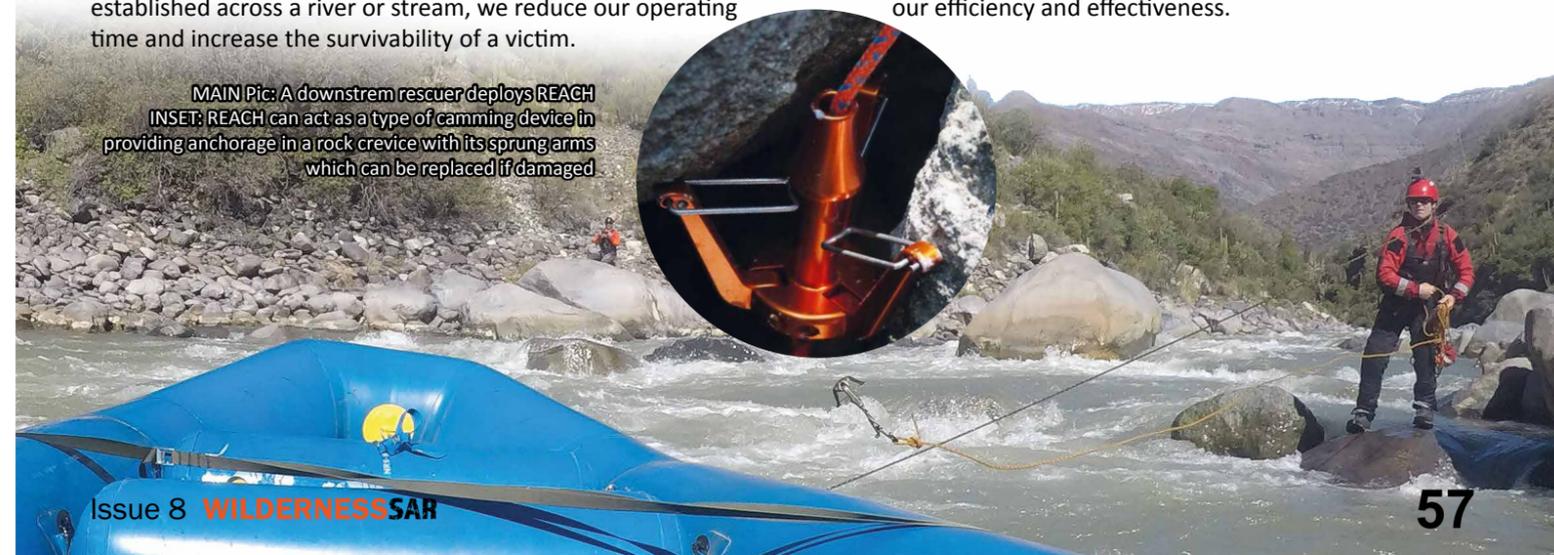
We have been able to successfully establish a tensioned diagonal in flood conditions to a center channel entrapment point, without ever putting a rescuer in the water, utilizing our Reach devices. This represents a huge risk reduction for our team when operating in that environment.

We have incorporated a Reach device into a Rapid Intervention Kit that we built after we had an accident while training where one of our team members found themselves in a tough spot. We built the kit to be deployed with us while we are training, and in the kit are critical tools that are only used when one of our team members is in trouble. We all agreed that the Reach Device was one of those critical tools. We do issue a Reach Device to each of our team members, and they wear them in conjunction with a waist mounted throw bag. This allows the waist mounted throw bag to be used as either a basic throw bag, or a Reach device to capture another line. Even with each of our team members having a personal Reach, we still felt it was critical enough that we placed one into our Rapid Intervention Kit.

We have been able to experiment with our Reach devices and have found many uses for them from quickly establishing an airway line while pairing it with a throw bag, to rescue of our personnel by using the device to make a quick connection to a deployed throw bag and to recover a rescuer. As you gain confidence with the Reach, you will begin to see a world of uses with it. You gain a 360 degree access to any point in the river and the ability to apply a vector pull in ways that was not possible before we had the Reach.

I have been in the fire service for more than 35 years, and I can always tell the tools that work, because they are the first ones that the firefighters grab, not matter the incident. I have watched our team adopt the Reach as a first line rescue tool, that they know and trust. This is evident when no matter the incident type- from a basic shallow water crossing in flood water to a vehicle or a body pinned in class IV whitewater, the Reach device is always a part of the compliment of tools that our team members grab while deploying.

The Reach device for us has been a force multiplier and allowed us to reduce the risk to our team members, while increasing our efficiency and effectiveness.



MAIN Pic: A downstream rescuer deploys REACH
INSET: REACH can act as a type of camming device in providing anchorage in a rock crevice with its sprung arms which can be replaced if damaged

RESCUE DOG HARNESES

For VERTICAL SUSPENSION



TITLE PICTURE: Canadian Avalanche Rescue Dog Association dog and handler preparing for a short-haul using a K9 Storm harness. Photo by CARDA

LEFT: Not a headless rescuer, he's leaning back, looking up! Good support of the dog with a padded harness and leg loops and by the handler with soothing words and a comforting arm hence being trusting enough not to use a muzzle on his K9 colleague. Photo by Lebele Hut

SIZING: Inevitably varies from company to company but as an idea, this is PMI's guide:
SMALL – Max Girth 79cm/31" – Small Border Collies, Labs or Golden Retrievers.
MEDIUM – Max Girth 89cm/35" – Small Shepherds, Large Border Collies, Large Labs or Golden Retrievers
LARGE – Max Girth 102cm/40" – Large Shepherds, Rottweilers, Bloodhounds

There are many, many dog harnesses but this dog harness is mine..... It's actually Wilson's but he never seems to be very grateful when he notices that it's the winch harness and not his walkies harness. When we say 'winch' we really mean all vertical or rope activities. We were going to call them 'lift-capable' but that would include most harnesses with a top handle which can be used to help lift a dog over an obstacle but NOT for suspension for an extended period of

time. We've limited this GUIDE to companies in the rescue sector with two exceptions The first are two 'civilian' companies, Julius-K9 and Ruffwear. These are quality high street brands that specialise in dog products so, while they may not be intimately familiar with the minimum breaking strength of an ISC Fast buckle or Teufelberger webbing, they do know dogs and dog anatomy better than any of our rescue companies so they are worth looking at. The second group of companies are military/tactical manufacturers. Ray Allen, Elite K9 and K9 Storm are specialist K9 companies but ALL Tac companies seem to include dog harnesses in their product range. In fact, there are far more tactical supply companies than are required to service the entire global professional military forces. This can be put down to:
 1) The rise of Call of Duty, Halo etc breeding a whole new generation of military wannabe lookalikes,

2) Painballing breeding a whole new generation of military wannabe lookalikes and 3) Amateur militia groups expanding an existing generation of military wannabe lookalikes. What they all have in common is a desire to have their dogs look the same as them. In most cases this means a black or camo body harness with Molle fittings and some mean looking hardware. But the vast majority are not up to the task of abseiling/rappelling or winching into a helicopter. Some aren't even up to the task of walking the dog so we've avoided most of them and may have missed one or two good ones as a consequence. For dedicated rescue harnesses we can be a little more accurate. The same handful of companies that made them 25 years ago, make them today even though designs may have evolved a little. The market remains proportionally very small and probably hardly worth the expense of manufacture but our rescue companies are very good at being one-stop shops. Remember, these are NOT harnesses simply for ground-work. They're not even one of the handful of 'rescue-your-own-dog' harnesses designed to let you back carry your injured or geriatric pet. The harnesses in this GUIDE are for rescuers and all are capable of properly supporting a dog while it is being vertically winched, hauled and/or lowered either direct to the winch hook/ lowering carabiner or connected to a handler. Some may also be capable of being carried rucksack style, on the handler's back and some can be clipped direct to a parachute rig. Unlike 'patrol' or tracking harnesses and even some tactical Fast-rope harnesses, the winch-capable harnesses in this GUIDE provide support for the rear as well as the front and will not allow the dog to slip or wriggle out. A dog should never be subjected to a sustained off-the-ground lift using just a front/chest harness and it's no coincidence that, with two exceptions, ALL of the harnesses in this GUIDE have support BEHIND the backlegs, not just in front of them. Many 'ground-use' harnesses have a full body-length jacket that might look like you could abseil/rappel with them but you'll see that the body straps pass in front of the rear legs. EliteK9's Special Ops is one of the exceptions with no leg loops but it loads front and back simultaneously to keep the dog level during suspension.

To make it truly 'lift-capable' for longer than a minute or two, it should have rear leg loops or the ability to retrofit what some describe as a 'Swiss Seat' often sold as an accessory to the jacket harness. The tried and tested SAR Dog harness by SAR Products (right) is one of the very original designs by Dave Allport of TROLL and the first properly manufactured dog harness we used for our own dogs. It has changed relatively little in 35+ years and is a two-piece harness that links together at the suspension point via a maillon or carabiner. The load bearing elements are all double thickness webbing and full 'human'-quality stitching. The rear leg loops go around each back leg so if your dog's rear end doesn't look something like this or the Ray Allen Sling harness above right, don't subject him or her to a winch or rope operation. There are some tactical harnesses that purport to enable rappelling *without* leg-loops but they mean military fast-rope where the dog is online for mere seconds and it's virtually impossible to become unexpectedly stranded on the rope as might be the case in winching, hauling or abseiling/rappelling. In the inset picture at the top you can see the consequences of lifting with only a chest-section, not only in physiological stress on the diaphragm, brachial and thoracic arteries and maybe neck/throat but in some designs there is a very real danger of the dog wriggling out backwards from the harness. We've been testing forward loading lately (on the ground!) and it's frightening how easy even



Dog whispering: learn to read the signs that your dog is not overjoyed about the task you have in mind for him

a large dog can pull backwards out of a harness if there are no supplemental sternal straps. Of course, once leg loops are introduced it's a wholly different matter. It's very difficult to pull backwards when your rear end is connected to your front end via a firmly secured piece of webbing. The second exception we mentioned earlier is another cantilever-style loading achieved by Petzl with a webbing pattern that supports the entire belly without 'wrapping' the rear legs. Elite K9 and K9 Storm achieves this too but K9 Storm still offers leg loops. When loaded, the webbing is angled to provide a mystical level of front-to-back support. We'd still prefer to see a back leg strap though. Having a 2-piece harness with threaded buckles is more fiddly than bulkier quick-release buckles but any 2-piece allows the front section to be used separately as a ground search/lead harness like this Ray Allen Nomad and SAR Products minus their leg loops which is much lighter and less cumbersome for the dog. There are four distinct design types:

- **WEBBING-ONLY** like the afore-mentioned SAR Products and Nomad (shell -only shown above) harnesses and the Alp Design 273 right (which might have just enough of a panel to stray into the next category). These are minimalist and ultralight. Easy to carry in a small pouch and light and unencumbering for the dog to use for ground work.

- **ENHANCED WEBBING** where relatively simple webbing has more padding and a small section of 'jacket' incorporated into the chest section to enhance visibility and provide a platform for wider grab handles and/or pouches and accessory attachment points like the Modern Icon on the right which has chest padding, insulated buckles (to stop them digging in) with the 'insulation' provided by a small mesh panel with Velcro. The webbing and buckles on this model are so substantial that it moves well beyond the 'stuff-it-in-a-pouch' criterion of a webbing-only harness. The CAMP Kronos on the right incorporates a high vis panel on the top with a large pouch and a belly-pad that has pouch for a transceiver or similar. The Ruffwear DoubleBack -below might be argued to be closer to being in the next category – Jacket harnesses.. since it has a padded top and bottom section – sometimes it's a fine line between categories.

- **JACKET** with a 'jacket' covering the top of the body like the CMC K9 Pro Series Rappel and the red ALP 278 right which is a buoyancy vest with lift-capability that may only just make it into this jacket category since the jacket, in this case foam, doesn't run all around the torso, unlike the more tactically oriented, yellow K9 Storm from Canada with its integral 2-point lifting yoke and kevlar belly protection to stop rough terrain and spiky plants from intruding into your dog (pic opposite -top-left). The grey version of the Ray Allen Icon has an array of lifting and attachment



- **SLING HARNESSES** have a full enclosure for the body, usually with 4 holes for the legs and maybe a 'relief' slot for male dogs like the orange Laika above right with integral lift straps and the grey PMI (right) with clip on bridle and shoulder straps. Full wrap harnesses tend to be used only for vertical work and NOT be used for walking any distance as they can be cumbersome (and hot) for the dog. They do however provide the greatest degree of support, remain secure if put on the wrong way round and,



points plus quick (but safe) release Cobra buckles. 'Jackets' is a large category and offers further enhancements over the two previous webbing categories enabling an even larger surface for incorporation of high-visibility panels, wider grab handles and/or storage pouches/pockets. These can more readily be used for both lift and ground work and are often (though not always) faster to don with quick release buckles that pass around the dog's body. This category can therefore be easier to put on a scared 'victim' dog or a rescue dog in an unsafe location than the sling models below that need the dog to step through leg holes. This category can also contain further enhancements like flotation, stab or bullet protection like the SOS Ballistic and Nomad or extra cooling or insulation.

if padded like the Petzl and Julius-K9 (pic bottom-left), provide protection, warmth and possibly some buoyancy in water. Some back straps are quite light and simple for short carries like the PMI/RnR but others are more complex. The Julius-K9 and Tyromont (pics-bottom) have padded back-carry straps and sternum strap as well as lift points and it's no coincidence that most of the back-carry harnesses are in this 'sling' category because they are the most secure. The dog on the right in an SOS Marine harness couldn't afford to be in an insecure harness! Once loaded it's virtually impossible for a dog to wriggle out of a sling harness. There are a number of pet-shop sling harnesses designed to aid in lifting but are NOT for winching into a helicopter. The K9Redline model (top-right) appears to be discontinued but some still sell it at around \$199. It uses brass eyes to create an artificial spreader bar enabling you to vary the carry angle depending on

the dog. Spreader bars are often used for animal winching to separate the front-to-back loading and not only make it a more level lift but improve animal comfort. Large animal rescue in particular uses this feature. It's not so common for dogs since they are much lighter but there's no doubt that spreading the load using either stretcher style straps or a spreader bar improves comfort as it reduces the pull on the chest and haunches that you might get with some lower, central tie-in-points. Two of the three SOS Marine models, including the yellow one above, has an integral spreader bar. The ForDogTrainers model below has fur/fleece comfort padding and a spreader bar fit for an elephant but these straps would usually be attached to a rigging plate.



ACCOMPANIED-DOG POSITIONING

Considerations for where the dog is positioned during a winching or abseil/ rappel are the same as a human rescue. Handlers very familiar with their dogs are happy for them to be close during transit as with our USAF ParaRescuer here, Jason Fischman. This reassures the dog, allows you to easily talk them through the operation and restrain or control any adverse motion. On the other hand, having the dog underslung beneath the handler or rescuer keeps them well away from bite-able faces – just make sure that they are underslung enough not to be near any other bite-able objects. For most dogs, but in particular, novice dogs, dogs that don't particularly like being suspended and 'victim' dogs being rescued, it is best to use a muzzle because even the most placid and well-trained dog might experience fear or an extremely uncomfortable harness 'adjustment' that can cause him/her to squirm and wriggle or even lash out. We've been using dog suspension harnesses since the very first web models and one particular early back-carry model was nearly catastrophic when one of our dogs, having been trained on 20-30 foot walls for which he showed great aptitude and enthusiasm took exception to being abseiled down an exposed sea cliff. He not only managed to semi-aggressively nibble ears and hair, he proceeded to wriggle halfway out and had to be held in place with one hand while trying to abseil with the other (on an autolock with trail rope passed around a leg!). We learnt a lot from that experience, not the least of which is that, except for the very best trained service dogs, the most compliant and capable dog can become uncontrollable at ANY time. Harnesses with stiffer padding on the chest section may not cinch up sufficiently to contain a dog's escape attempt. Needless to say, that harness design no longer exists.



D-RINGS/ROUND EYES/SEWN EYES

D-rings and V-Rings are familiar to rescuers and inspire confidence in loading as do reinforced webbing eyes but ensure that the sewn interfaces use strengthened bar-tack or similar stitching to resist loading at right-angles to the direction of pull during a vertical lift or you may see stitching tear out progressively from one end. Rescue/Climbing manufacturers know this – some pet and 'tactical' manufacturers may not.

TOP, REAR, FRONT AND SIDE HANDLES

Handles may be simple flattened webbing or reinforced with an ergonomic tactile plastic/rubber grip. For the most part, these are NOT for vertical winching but for simple lift-and shift manoeuvres, control and restraint of your dog. Commonly placed above the main centre of mass over the shoulders but there may also be one on the front chest, the rear and even the sides. The 738 has two at the shoulders which may be to allow them to be held from either side when in the water with the dog.

QUICK RELEASE & DOUBLE-D BUCKLES: What we've generically called 'Clips' to save space are quick-release Cobra (1) or Cobra-style buckles that click to release only when both sides are pressed simultaneously and then simply push in to lock. These are very convenient, very strong, very safe, adjustable AND can be unclipped completely so they make for quick donning or removal and don't require the dog to step through. Plastic Fastex or Nexus style buckles (2) have the same convenience and are lighter and cheaper but are not as strong. Both are bulkier than traditional 3-bar or Double-D buckles and Cobra, as the clear market leader is certainly more expensive. The

German K9 harness uses custom plastic clips with metal tensioners and web-ends secured by velcro – (3) very tidy and very strong. Double-D is a two plated buckle that can be threaded and separated and 3-bar buckles are threaded. They allow adjustment and lay flat to the harness, are simple, light and cheap but slow to adjust and slow to release the threaded webbing.

METAL VS PLASTIC: Metal is stronger and more durable, no doubt. Plastic quick-release are much lighter and Fastex/Nexus style clips are extremely common on load-bearing elements securing jackets as well as on accessory webbing because none but the very heaviest of dogs will tax a plastic quick-release. Ray

Allen's Icon Air uses Polymer GT Cobra buckles rated to over 227kg/500lbs each while the metal versions are a whopping 900+kg/2000+lbs.

SPECIAL PURPOSES

You might think that being able to vertically lift your precious pooch is 'special' enough but some harnesses are designed for other things as well. **CMC's Lifesaver** (above-left) will

unfortunately soon be discontinued (probably too small a market) but it was designed in conjunction with San Francisco Fire Dept to be used to rescue dogs rather than for the rescue dog. It uses quick release buckles all around so that it can be easily positioned and strapped to a nervous dog in a precarious position on a cliff ledge for instance. It has more colour coordination in the straps than rescue dog harnesses because it may be donned in dark and or stormy conditions by rescuers who are probably not dog-handlers. It has a large top-handle to facilitate manoeuvring (as do many rescue dog harnesses) and packs away into itself....(the integral red zip pouch on the back). Italian Caving specialists ALP DESIGN have no less than 4 models, two of which are buoyancy jackets with lift capability. It's surprising that there aren't more of these designs because it seems remarkably useful for dogs unexpectedly working around water. Buoyancy doubles as thermal protection for ground work in colder climates but is otherwise a cumbersome prospect for a non-water dog. Perhaps the most versatile is **Ray Allen's Nomad** which is a modular mesh 'shell' into which you can swap jackets for keeping the dog cool (or warm), stab/bullet protection and/or kevlar belly shield against sharp terrain.

IN THE FOLLOWING TABLES.....

A diamond ♦ in the 'USE' columns indicates that the feature is OK for that purpose but not ideal. **COST:** a rough guide only – includes local taxes. Varies with exchange rates, extra taxes etc. We usually round up to the nearest Pound£/US Dollar\$/Euro€. Larger sizes often cost more. **SIZING:** This can range from vague to incredibly precise. In fact, most companies give quite good indications of sizing on their websites if they have a range. Some might describe this in dog breed terms – Collie, Malinois, Newfoundland etc. most as S, M L etc. but many are universally adjustable. Two-piece refers to a harness comprising a front section and removable leg loops – it does not take into account separate shoulder straps or lift risers which are indicated in the images. **USES:** All of these harnesses can be used for **ABSEIL/RAPPELLING** with your dog but the means of attachment vary as does the carry position. **WINCH/LOWERING** allows for the dog's weight to be well spread front to back and often uses risers as a stretcher-style yoke connecting to four top-mounted eyes. **PARACHUTE** indicates direct connection to the rig via two top-mounted D rings. **GROUND** refers to long-duration search, patrol and/or tracking which does not require 'lift' other than manoeuvring over boulders etc but does need freedom of movement and no heavy panels that might rub against legs. These are often thorax-only jackets but may be full body including rear legs if the webbing is light and comfortable enough. This will be apparent by the dog's agitation with specific sections of webbing or even thinning of fur though this would be a late (some might say negligent) sign. **BUOYANCY:** any harness with comfort foam will provide some floatation but not all foam retains air in the presence of water – think of a sponge! Some 'padding' is more accurately described as thick reinforcement and won't aid floatation. Two of our selection are dedicated floatation aids with full lift capability but the vast majority of float harnesses are NOT lift-capable despite appearances. **BACK-CARRY** is the incorporation of rucksack straps to allow you to carry the dog on your back during an abseil or winching. They can also assist in ground negotiation of awkward or injurious terrain and for evacuation of an injured dog. Most back-straps are stored separately

HARDWARE

LIFT CRADLE/TOP EYE(S)

We've already mentioned the advantages of distributing load more evenly using four adjustable straps akin to a stretcher bridle but this generally requires these to be carried as an extra like the PMI / RnR harness rather than being integral to the harness like the Singing Rock Laika. Some lifting straps can double as rucksack straps but the more comfortable rucksack straps are specialist items like the Julius-K9 and Petzl. A single load point makes the harness less bulky but can be more uncomfortable as it cinches in fore and aft like the SAR Products. Two top eyes allows some separation of loading and is often seen on more substantial jacket harnesses. Having separated top eyes is also good for clipping directly into the two risers on a parachute rig.



MATERIALS: The fabric body panel is shown in black. Ballistic nylon doesn't mean bulletproof it's simply the toughened nylon exemplified by the brand Cordura. Rather than a solid, protective 'jacket' some models have a mesh panel to save weight, keep the dog cooler and drain water. Webbing type is shown in green and the fittings (buckles and D rings) are shown in burnt orange.

DESIGN LOAD & MBS: Design load is the weight of dog that is intended to use the harness. The heaviest dog in the world was about 340lb/155kg/24 stone so while you're unlikely to get a rescue dog of that weight it does illustrate that you can be talking human weights especially when the dog is soaking wet. The design load is more about the comfort of the dog than the likelihood of it breaking but there is a huge difference between the quality of components in a pet-shop dog harness and a specialist lift harness. The Minimum Breaking Strength/Load – MBS (in burnt orange) is therefore given by some and is at least an indication of the quality of components.

COMFORT PAD- CHEST BODY: Indicates that the chest section at the front (an orange square ■) or the body section around the belly (black square ■) has padding. This may just be covering the webbing and buckle(s) or it may be more comprehensive. Any measures other than the webbing will help spread the load during lift and make the harness more comfortable but will always add weight, bulk and cost.

GIRTH ADJUSTMENT: distance around the body just behind the front legs and/or the belly. Adjust at the side or across the top.

LENGTH ADJUSTMENT: refers to adjustment for length from front to back and is usually a buckle on the top at the shoulders or on the back near the back legs.

CHEST ADJUSTMENT: indicates that the front (chest) or breast strap can be adjusted for size.

COLOUR: Primary colour of Jacket or panel or webbing if it's a web-only harness. Secondary or web colours are shown in the square's frame.

ADJ VERTICAL LIFT STRAPS: A set of 2, 4 or 6 straps connecting harness lift points to a central collection point as with a stretcher bridle. Adjustable straps shown as a burnt orange square ■. If either type of strap is an optional extra it is shown as an outline square □ □ NB:strap-clips/rings are not included in the harness hardware column unless integral.

POUCH. VELCRO. LIGHT ATTACH: A pouch or pocket which can be for accessories like lift straps or dog supplies or the harness itself when not in use. **VELCRO** refers to strips of loop velcro onto which you can add badges, reflection, panniers etc. A key feature of 'tactical' harnesses. **LIGHT ATTACH** refers to elastic or velcro-secured straps intended to hold a chemical light stick or a strobe or torch.

FRONT EYE. FRONT HANDLE: A sewn eye or metal eye/D-Ring on the front (NOT for lifting and often a pull-resistant connection point for lead work.) **FRONT HANDLES** are for control or manoeuvring of the dog.

TOP EYE. TOP HANDLE: Mostly a load bearing D-ring but can be a reinforced sewn eye. This is the main connection point for both lead work an vertical lift/support. Often a second eye towards the back and maybe four in total if a suspension cradle is used. We have not included any side-mounted eyes lower down the jacket on one side which are intended to be used for rucksack straps. Their presence will be indicated by a black square in the **BACK-CARRY** column and in the hardware list in the **MATERIALS** column.

HI-VIZ REFLECTIVE MOLLE: HI-VIZ is a High visibility colour option like yellow or red. **REFLECTIVE** refers to smaller panels or badges rather than the entire jacket. Often an optional badge and easily applied to harnesses with Velcro. **MOLLE** or **PALS** is the military-style attachment webbing. Any item that is an option is shown as □ □ □

images NOT to scale	MODEL	COMPANY	ORIGIN	COST inc tax/VAT	WT	SIZING	ABSEIL/RAPPEL	WINCH/LOWER	USES	PARACHUTE	GROUND	BUOYANCY	BACK-CARRY	MATERIALS: 'JACKET' WEBBING INTEGRAL HARDWARE	DESIGN LOAD MBS	COMFORT PAD CHEST BELLY	GIRTH ADJUSTMENT	LENGTH ADJUSTMENT	CHEST ADJUSTMENT	ADJUSTMENT ADJ VERTICAL LIFT STRAPS	FRONT EYE FRONT HANDLE	TOP EYE TOP HANDLE	POUCH, VELCRO LIGHT ATTACH	HI-VIZ MOULÉ REFLECTIVE	COLOURS	NOTES	WWW.
	274	ALP DESIGN		£120 \$170 €125	300-390g 11-13.7oz	4x Sizes 1-piece	■	■						Cordura Polyester 3x plastic fast clips 2x steel D-rings	n/a	-	-	-	■	4	-	-	-	■	■		alpdesign.it
	273	ALP DESIGN		£100 \$140 €120	592g 1.3 lb	UNIVERSAL 2-piece	■	■						Nylon Polyester 6x 3-bar buckles 1x double-D buckle	n/a	-	■	■	-	-	-	1	-	■	■	Previous version sold by AlpDesign partner KONG as the SMEUS (pictured with dog)	alpdesign.it
	278	ALP DESIGN		£190 \$265 €220	1.17kg 2.65lb 1.5kg 3.3 lb	M, L 1-piece	■	■						Cordura Polyester 7x double-D buckles 1x D-ring	n/a	■	■	■	■	■	-	1 4*	■	■	■	Full flotation swim harness. *2 handles mounted on flanks	alpdesign.it
	Delphinus	ALP DESIGN		£220 \$300 €250	900g 2 lb 1kg 2.2 lb 1.3kg 2.9 lb	XS, S, L 1-piece	■	■						Cordura 2x Velcro straps Polyester 7x double-D buckles 1x Ring +4x Sml Rings	20-25kg 44-55 lb 25-40kg 55-88 lb >40kg	■	■	■	■	■	-	1 6*	■	■	■	Full flotation swim harness with zipped pouch. *2 handles mounted on flanks. 2x rings on each side are options..	alpdesign.it
	Kronos	C.A.M.P.		£125 €130	410g 14.5oz	UNIVERSAL 2-piece	■	■						Nylon Nylon 7x 3-bar buckles	15-50kg 33-110 lb	■	■	■	■	-	-	1*	■	■	■	*reinforced 'soft' eye can double as a handle	camp.it
	K9 Lifesaver	CMC PRO		\$380	1.2kg 2.65lb	UNIVERSAL 1-piece	■	■						Cordura Nylon 5x Cobra clips 1x length adjuster	n/a	-	■	■	■	-	■	2* 1	■	-	■	DISCONTINUED but some stock left. Rear tail assembly can be stowed in jacket pocket. * Soft eyes	cmcpro.com
	K9 ProSeries Rappel	CMC PRO		\$398	930g 2lb	UNIVERSAL 2-piece	■	■						Cordura + breathable liner Nylon 5x Cobra clips	n/a	-	■	■	■	-	-	2 1	■	-	■	Rear tail assembly can be stowed in jacket pocket.	cmcpro.com
	K9 Rappel	CMC PRO		\$259	930g 2lb	UNIVERSAL 2-piece	■	■						Cordura + breathable liner Nylon 5x roll-bar buckles	n/a	■	■	■	■	■	-	2* 1	■	-	■	DISCONTINUED but some stock left. Rear tail assembly can be stowed in jacket pocket. * 2 soft eyes, 1 is for rear tracking lead	cmcpro.com
	SpecialOps MH025 MH020	ELITE K9		\$200 \$150	n/a	UNIVERSAL 1-piece	■	■						Cordura Nylon 3x Cobra clips or 3 plastic fast clips (Cop-Lock) 6x length adjusters	18-59kg 40-130 lb	-	■	-	■	-	-	2 2	■	■	■	MH020 = plastic fast clips, MH025 = metal Cobra clips. NB: no leg loops - loads front & back simultaneously. Elite K9 has an ultralight SAR sling the H12 \$90, similar to pet-carry models	elitek9.com
	Tactical Insertion HR1##1073 HR1 ##1057	FORDOG TRAINERS		\$99 €138	n/a	UNIVERSAL 1-piece	■	■						Nylon Nylon/Polyester 4x 3-bar buckles 4x rings, 2x roll-bar buckles, 4x tri-strap plates	n/a	■	-	-	■	4	-	2 2	■	■	■	HR1##1057 is a European variant in black with yellow lining	fordogtrainers.com

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images NOT to scale	MODEL	COMPANY	ORIGIN	COST inc tax/VAT	WT	SIZING	ABSEIL/RAPPEL	WINCH/LOWER	USES	MATERIALS: 'JACKET' WEBBING INTEGRAL HARDWARE	DESIGN LOAD MBS	COMFORT PAD CHEST BELLY	GIRTH ADJUSTMENT	LENGTH ADJUSTMENT	CHEST ADJUSTMENT	ADJUSTMENT ADJ. VERTICAL LIFT STRAPS	FRONT EYE	TOP HANDLE	POUCH, VELCRO LIGHT ATTACH	HI-VIZ MOLLE REFLECTIVE	COLOURS	NOTES	WWW.
	Smart Duty H26###1073	FORDOG TRAINERS		£95 \$99	n/a	S,M,L 1-piece	■	■	■	Ballistic Nylon Nylon 2x plastic fast clips 4x plastic 3-bar buckles 2x steel rings	n/a	-	■	-	■	-	-	2 2	■	■	■		fordogtrainers.com
 <small>dog shown suspended on handler's back</small>	Rappelling & Carrying Harness	JULIUS-K9		£255-295 \$300-350 €358-373	1.6-2.8kg 3.5-6 lb	M, L, XL 1-piece	■	■	■	600D Ballistic Nylon Nylon 6*x plastic fast clips 4x plastic 3-bar buckles 4x steel rings 6x length adjusters	15-25kg 24-40kg 40-60kg	■	■	-	■	-	-	2 2	-	■*	■	International company founded in Hungary. *reflective seams. *+1 more on the human's waist belt	julius-k9.com
 <small>dog shown suspended</small>	SAR Std/Aerial Insertion Std	K9 STORM		\$1850*	907g 2lb	Custom-Fit 2-piece#	■	■	◆	Ballistic Nylon & Kevlar Mil-Spec Nylon 3x alloy fast clips 2x plastic fast clips	11.1kN 2500 lbf	■	■	■	■	■	□	1 3	■	■	■	#1-piece jacket harness with separate leg loops for full support & Length Adjustment. 3 versions, Basic, Std & Adv (tactical). *Inc Custom badge	k9storm.com
	K9 Rappelling Harness K9RH	MODERN ICON		£250* \$549-605 €451-501	1.59kg 3.5lb	M, L, XL 2-piece	■	■	■	1000D Cordura/mesh Mil-Spec Nylon 5x Cobra Pro clips 2x V-rings. 2x 3-bar adjusters	17.9kN 4000 lbf	■	■	■	■	-	-	2 1	■	■	■	Can be used as a tracking harness (rear leg loops are quick detachable). Handle can be used as a soft clip-in option. *M-size exc. leg loops	modernicon.us
 <small>real dog (honest) shown suspended</small>	C99 H	PETZL		£463 \$650 €498	890g 2 lb	UNIVERSAL 1-piece	■	■	◆	Ballistic Nylon Nylon 5x 3-bar buckles	n/a	■	■	■	■	-	■	* *	-	-	■	**Top lifting point is two web eyes which can double as a top-handle. Removable Comfort foam for cleaning & replacement. No leg loops.	petzl.com
 <small>dog shown suspended</small>	AnExK9	PMI ROPE		\$150	693g 1.5 lb	S,M,L 1-piece	■	■	◆	Ballistic Nylon Nylon 8x large D-rings 2x small D-rings 5x plastic fast clips	150kg 330 lb	-	-	-	-	4	-	4	-	-	■	Lift straps and rucksack straps come with the harness in a storage bag.	pmirope.com
 <small>dog shown suspended</small>	Icon Icon Air	RAY ALLEN MANUFACTURING		#\$264 #€258	1.1kg 2.5 lb 907g 2 lb	S, M, L 2-piece	■	■	■	500D Cordura Mesh Mil-Spec Nylon 4x GT Cobra clips 1x Roll-bar buckle 2x V-rings 2x length adjusters	8.9kN 2000 lbf	□	■	-	■	-	-	2 +6* 3	■	■	■	#Price includes \$30 rear leg loops with pouch. *soft eyes 'G-Hooks'	rayallen.com
 <small>dog shown suspended</small>	Nomad	RAY ALLEN MANUFACTURING		#\$272+ #€350	n/a	S, M, L 2-piece	■	■	■	None or Cordura /Mesh Mil-Spec Nylon 4x GT Cobra Clips 4x Cobra metal Clips 3x roll-bar buckles 4x length adjusters 2x V-rings	8.9kN 2000 lbf	□	■	-	■	-	-	2 +6* 3	■	■	■	Modular harness with options for interchangeable cold/hot weather, ballistic stab/bullet protection & belly kevlar protection #Price=Shell inc \$73 Leg loops. *soft eyes	rayallen.com
 <small>dog shown suspended</small>	Rappel Sling	RAY ALLEN MANUFACTURING		\$170	n/a	UNIVERSAL 1-piece	■	■	■	Cordura Nylon 1x Maillon/ring	8.9kN 2000 lbf	-	-	-	-	4	-	-	-	-	■		rayallen.com
 <small>dog shown suspended</small>	RnR Dog Lift Harness	ROCKn RESCUE		\$164	851g 1.9 lb	S, M, L 1-piece	■	■	◆	1000D Cordura Nylon 8x alloy D-rings 5x plastic fast clips	150kg 330 lb	-	■	■	■	4	-	4	-	■	■	Lift straps convert to rucksack straps. Storage bag included.	rocknrescue.com

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	DoubleBack	RUFFWEAR		£180 \$125 €169	590g 1.3 lb	XS,S,M,L,XL 2-piece	■	■	◆	◆				1000D Cordura Nylon 4x 3-bar buckles 1x double-D buckle 4x length adjusters	8.9kN 2000 lbf	■	■	■	■	-	1* 2	2* 2	-	-	■	*eyes are reinforced webbing eyes	ruffwear.com
	H0015P	SAR PRODUCTS		£90	530g 1.2 lb	UNIVERSAL 2-piece	■	■		■				None Polyester 5x 3-bar buckles 1x 3-bar2-bar buckle 2x steel D-rings	13kN 2922 lbf	■	■	■	■	-	-	1	■	■	■	Ultra-lightweight	sar-products.com
	Laika	SINGING ROCK		£120 \$145 €99	780g 1.7 lb	UNIVERSAL 1-piece	■	■						500D Cordura with velcro securing strip Nylon 2x 3-bar buckles, 3x plastic fast clips	20-45kg 44-99 lb 150kg 330 lb	-	■	-	-	2 2	-	-	-	■	* this sling is NOT on back-to-front. It has a long 'relief' cut-out at the back so what looks like a 'sternum' strap around the rear can actually be released for a poo.	singingrock.com	
	K9 Abseiling harness	SPÜRHUDE SCHULE		€197*	1.1kg 2.4 lb	S,M,L,XL 2-piece	■	■		■	■	□		Cotton/Nylon Mix Nylon 8x plastic Fast Clips* 10x length adjusters* 2- Steel Rings	110kg 242 lb	■	■	■	■	-	-	2 1	-	■	*Each Fast Clip has a metal length adjuster and velcro tidy/retainer for the end of the webbing. * Price & wt shown are for Large	spuerhundeschule.de	
	EVO Dog harness TY-93267	TYROMONT		€250	2kg 4.4 lb	UNIVERSAL (M-L) 1-piece	■	■		■	■			Perlon Nylon 2x plastic fast clips 4x double D buckles 2x plastic buckles 2x length adjusters	20-45kg 44-99 lb	-	■	■	■	6	-	-	-	■			tyromont.com
	TY-93212	TYROMONT		€125	750g 1.65 lb	L-body 43cm L-body 53cm 1-piece	■	■						Perlon Nylon 5x plastic fast clips 2x roll-bar buckles		-	■	■	■	*	-	2*	-	■	* long top handles double as heli/vertical lift straps. Padded, removable back-carry straps included	tyromont.com	
	SOS Professional 5199	SOS MARINE		\$280	1kg 2.2 lb	UNIVERSAL 1-piece	■	■				◆		Nylon Mesh Nylon 1x double-D buckle 4x plastic fast clips Rigid spreader bar	20-55kg 44-121 lb	-	■	-	■	-	-	2 +1*	-	■	* Soft eye at rear	SOSmarine.com	
	SOS Ballistic 5199+5148	SOS MARINE		\$380	1.2kg 2.65 lb	UNIVERSAL 1-piece	■	■		■	■			Cordura Nylon 3x plastic fast clips 2x steel D-rings	20-55kg 44-121 lb	□	■	-	■	□	2 2	■	-	■	Rear tail assembly can be stowed in jacket pocket. NB Ballistic counter-measures to order and cost extra	SOSmarine.com	
	SOS Professional Fire 5199-5	SOS MARINE		\$398	930g 2 lb	UNIVERSAL 1-piece	■	■		■	■			Cordura Nylon 4x metal fast clips Rigid spreader bar	20-55kg 44-121 lb	■	■	-	■	□	-	2 1	■	■	Rear tail assembly can be stowed in jacket pocket. NB: not fire retardant.	SOSmarine.com	
	Special Operations	UKOM/ONIE		£225 \$301 €248	n/a	S, L 1-piece	■	■		■		■		Cordura MilSpec Nylon 3x Cobra clips 2x V-rings 6x length adjusters	18-59kg 40-130 lb	■	■	-	■	-	-	2 2	■	■	■	Leg loops & shoulder straps not shown but included in price shown.	contactleft.co.uk

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THE ACRONYMS ARE COMING.....LAST, PACE & KISS

Team equipment may only require one or two members of the team to carry; one stretcher, one sat-comms pack, one stove etc. The initial briefing is used to help make decisions about the equipment that will be carried. The main idea of the SAR pack is to be able to solve as many problems as possible with the smallest amount of equipment to achieve the aims of the **LAST** acronym: **L**ocate the patient, **A**ccess them, provide treatment to help **S**tabilise them, and then **T**ransport them to safety – **LAST**. The choice of equipment can be broken down into four groups, or four 'plans'.

- Communications Plan
- Navigation Plan
- Survival Plan
- Rescue Plan

These four plans can then be broken down further using the **PACE** acronym. **P**rimarily, **A**lternate, **C**ontingency, **E**mergency.

When discussing the Communications Plan for instance, what is the **Primary** form of communication going to be? Often it is simply handheld radios in which case these would require designated channels for the operation, extra batteries and maybe spares or accessories. For example, your briefing may indicate that reception is difficult in some of the places you are going into and therefore a longer antenna may be required. Once the **Primary** form of communications is established then an **Alternate** form of communications is also prepared for, maybe cell-phones along with a **Contingency** plan, perhaps runners or line of sight signalling and an **Emergency** plan, e.g. flares. This P.A.C.E acronym helps ensure that all the necessary equipment is being carried to address the Communications Plan for that specific mission.

The Navigation Plan not only involves mapping and locations but also provides the Search Manager with definitive details as to where the team has searched, and exactly where the additional resources need to be sent to.

The Survival Plan may sound contrary to what was already mentioned about this not being survival, but in this case it refers to the operational effectiveness of the individual SAR member; making sure you stay warm enough or cool enough, have plenty of water and food, making sure you have the adequate personal protective equipment (PPE) to safely do your job, or making sure you have the equipment to protect you from the elements. The aim is to ensure the original mission is not time or resource compromised taking care of a dehydrated or ill-equipped rescuer.

The Rescue Plan involves not only the equipment and resources required to rescue the casualty but considerations like waiting for additional resources. Will the patient need food? Water? Extra clothing? Does your team have enough equipment to look after the patient if they must spend the night? If the additional resources are unavailable and your team must affect the rescue by themselves, do they have the necessary equipment?

These four plans and the PACE sub-plans could result in a lot of equipment and resources to cover all contingencies so it's wise to also remember the ultimate acronym **KISS** – **K**eep **I**t **S**imple **S**tupid otherwise weight and bulk become prohibitive. One lightweight

personal shelter can be lighter than a tent – eg. something like the SOL Escape Bivy, and the SOL Sport Survival Blanket. These two items can provide warmth, shelter and can also be used for the patient, this is just an example of what can be done to address the issue of weight whilst still being effective in the field. Carrying the minimal amount of equipment is the preferred option, yet it needs to be enough equipment for the SAR team member to operate effectively at all times and not just 'survive'. It is advisable to take your pack(s) for a walk, when not attending a rescue, to see if the components function effectively and the pack is not too heavy when you get off the beaten track. Try using pieces of equipment that can have two or three different uses.

Assuming you are not a brand new team, incident history, experience and testing will determine what works for the majority of calls. New team member will be advised what to carry and which items offer scope for personal choice. Some items will be mandatory, some recommended, which is strongly advised but it is not mandatory or you can choose alternatives or optional, which is useful but may only be required for certain missions. Check lists at the time of an incident will invariably be for the larger conglomerate packs – sub-packs within them should already be check-listed for individual components. Further check lists might take account of things like the season/weather, the terrain, and prospectively short or likely protracted mission. These check-lists need to be reviewed every so often to keep up to date. After every mission a debrief can occur where the equipment carried can be discussed to learn more and to see if any adjustments need to be made. This will not only be for the equipment but also for training. Having the right gear for the job is one thing but being trained to know exactly how to use that equipment is essential. Training is also important because it can provide skills which can also help reduce the amount of equipment carried. This can include survival skills, improvising techniques, and how one piece of equipment can have multiple uses.

PACK or POCKET?

How all this equipment is carried can depend on several factors. There is equipment that should be carried on the person. If a team member travels a short distance without their backpack at least they have some equipment with them. At a minimum, each SAR member should have on them....

- a knife,
- a light source,
- a fire starter
- a watch and a smart phone are definitely useful items which are probably already being carried.



The radio chest harness is a popular item for SAR teams and most of them are also used for carrying equipment that is frequently accessed. For example, the Coaxsher chest harness (pic right) has a compartment for radios and a GPS, but it also has the ability for carrying other frequent items such as a notepad, pen, and a flashlight.

Some backpacks have small pouches on the waist belt or on the shoulder straps which can help with quick access. Items that are 'clipped' on the outside of the backpack should be avoided because they can get caught on things, be easily damaged, or fall off. When packing equipment into the backpack, some items, such as medical equipment, may be considered essential and need to be easily accessed, so they should be packed in a way that enables quick access without having to tip the entire pack out. Outside zip pockets for instance but medical equipment is a very involved topic and therefore is a discussion for another time.

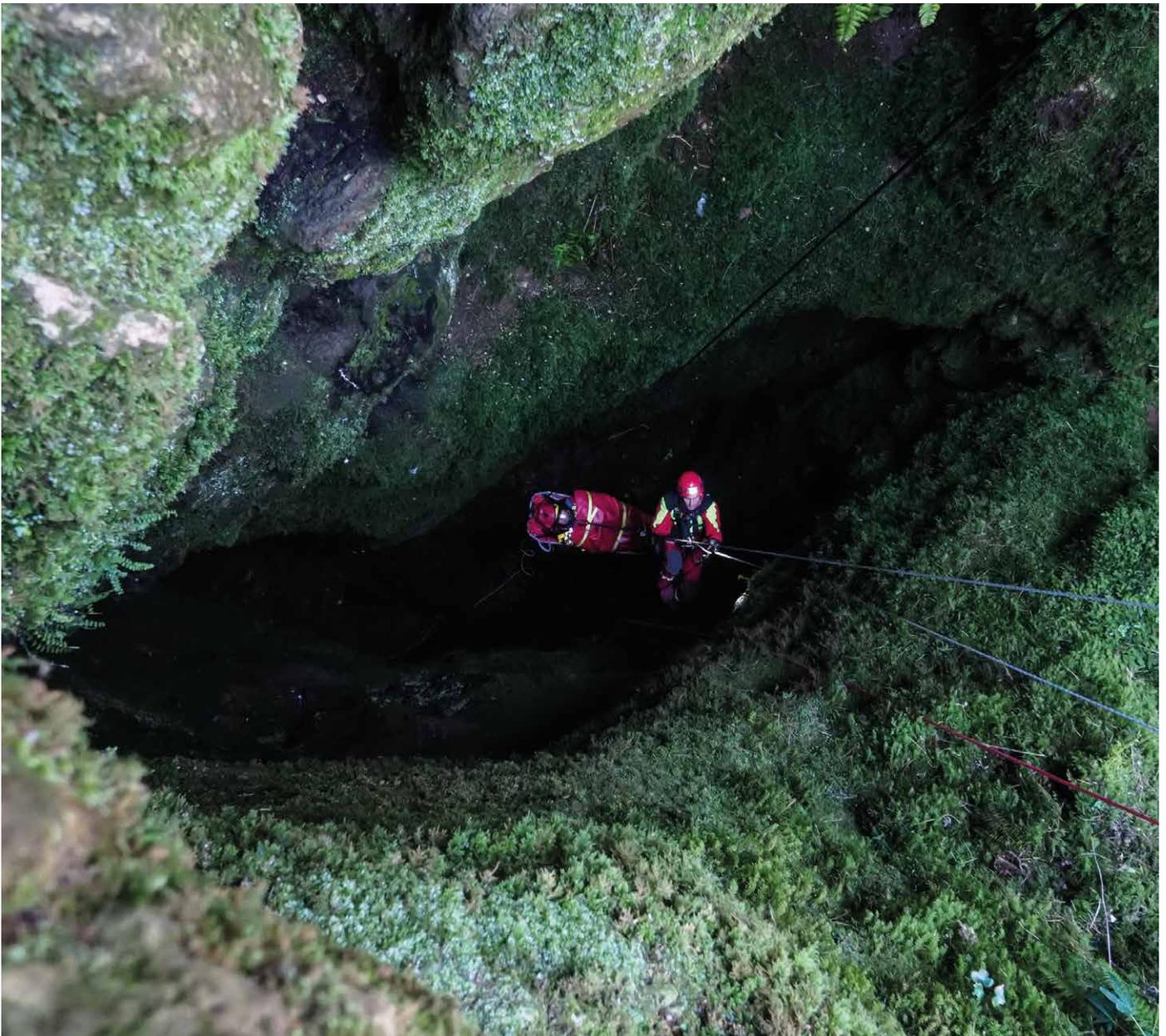
Choosing the main backpack or rucksack deserves careful consideration. The *Coaxsher Endeavour Search and Rescue Pack* (pic right), or something similar, may be a possible solution for teams that operate in lowlands, or for forest fire teams that perform search and rescue. This is a modular pack where modules can be removed from the pack so the user can modify the pack based on the task they are performing. However, for teams that operate in remote areas, or mountainous locations; the alpine style backpack seems to be the pack of choice. Some military-style packs are made of heavier gauge Cordura or similar toughened fabric for better endurance whilst sport-oriented alpine backpacks are made of a lighter material. The *Osprey Atmos* pack (pic above) and a lot of the other Osprey brand packs have an air flow system integrated into their harness to help reduce overheating and sweat building up on the users back which reduces discomfort for them. The choice of backpack should be based on how well it fits the user,



the harness system of the pack which should be top-spec. How well the pack fits the user will help to reduce unnecessary stress on the body and be less awkward for carrying heavy loads. The industry tends to describe 50-70 L packs as 'hiking' and 60-70+ as 'expedition' with SAR packs somewhere in the middle. Size of pack will often dictate the overall weight being carried depending on materials – many use sport hiking and mountaineering packs while bespoke rescue items generally demands the tougher materials, 500 to 1000 Cordura/ballistic nylon or waterproof vinyls – like modified drybags. These latter packs, as exemplified by the 60L Kong Langtan described in this issue's **ON-THE-COVER** feature (pic left), can offer the ultimate protection against water ingress but are relatively heavy even before you've loaded the equipment in. Reduced weight reduces the impact on the body. Determining how much equipment you would normally

carry will give a pretty good indication, but this would not just be individual equipment but also team equipment. A common rule of thumb is that the pack would contain the individual equipment and then leave an extra ten or twenty percent of free space in the pack for team equipment which is allocated at the command post such as advanced medical equipment, technical rescue equipment, spare batteries, or clothing for the patient. One option to insure that this free space is maintained, is for the SAR member to place their footwear and clothing (or uniform) that they wear during a SAR call-out inside the top of the of their pack; when they respond to a call they take out their clothing and footwear to change into, and now that space is free for other equipment.

Each item placed inside a SAR Pack is chosen to address the different challenges that may be faced in the field. What specific items to carry to address challenges like food, water, clothing, shelter, and staying warm (or cool) during an extended SAR operation will be further discussed in the next part of this series. The SAR Pack can be used for team equipment, personal equipment or, more often, a mixture of the two. In the end it is about being prepared for the widest range of mission options with the least amount of equipment to complete the task to a professional standard.



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