



# TECHNICAL RESCUE

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

ISSUE  
77

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Medical • Aquatic • Tactical
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### WILDERNESS SAR

incorporating **PARKRANGER**  
Same style and format as  
**TECHNICALRESCUE** and  
**ARBCLIMBER**.

**WSAR** concentrates on  
mountain, cave and remote  
area rescue generally using  
lighter equipment that the  
more urban and industrial-  
based technical rescue agencies.

We have also moved offshore  
marine rescue and long-range SAR helicopters across  
to **WILDERNESS SAR** but there will always be some  
crossover of content between the magazines.



### ACCESS & RESCUE

is our FREE, digital-only (pdf)  
E-magazine for:  
**TECHNICALRESCUE**,  
**ARBCLIMBER** and  
**WILDERNESS SAR** magazine  
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SAR, USAR, Extrication, Water  
Rescue, Rope Access, Tree work  
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## CONTENTS



Above: Reed Thorne continues to confuse his viking heritage with British pirates in his multi-part series on **Pulleys and Pulley Systems**. this issue he is looking at Simple and Compound systems. **Page 16**



Above: Josh O'Brien begins a two-part look at inflatable paddle boats and how they can be used to best effect in flooding and swiftwater incidents. **Paddle Boat Handling for First Responders** is on **page 26**



We begin a huge series on **Waterproof Cases** with **part 1 - Wheeled Cases** from companies AtoG. **Page 36**



Right: An old favourite in this issue's **SPACE CREATION** with a dynamic twist on an old favourite, we present the **Assisted Dash Roll** on **page 58**

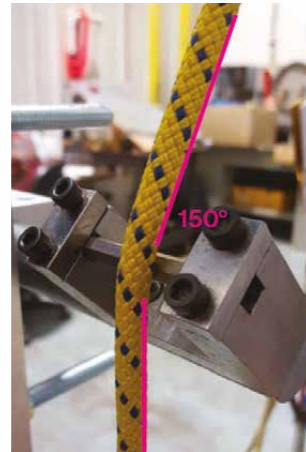


### FRONT COVER:

The now iconic AZTEK mini pulley system by Rock Exotica uses Sterling Rope for its sewn eye prusik and, in this version the main rope. This ties in nicely with Reed's pulley article on **Page 16** which looks at compound systems. AZTEK by itself

is not a compound system but an AZTEK pulling on another AZTEK would be! More on this Sterling Ropes cover image on **page 2**

# STERLING ROPES



constant improvement, we sought to better it. We've received feedback from users that they were looking for increased performance in some specific categories. We set out with these goals for improving the ropes for the AZTEK:

1. Increased durability and abrasion resistance
2. Increased strength
3. Increased cut resistance
4. Arc Flash resistance

Using Aramid fibers such as Technora® seemed the obvious choice due to their

This issue's cover features the Aztek mini pulley system reeved with Sterling Rope. The cover and this page are two of Joe Klementovitch's excellent shots taken at the 700ft Cathedral Ledge in Hew Hampshire during testing of the Aztek using Sterling Rope and featured in a detailed test article in WILDERNESS SAR issue 7. But the Aztek is one of many items of equipment that is equally at home in an urban industrial rescue kit as it is in a mountain rescue kit. The hardware from Rock Exotica is pretty bombproof but it's the rope that gets all the abuse and the component most likely to fail if you don't get the choice right. It's no surprise that Sterling was chosen to provide the sewn prusiks that provide progress capture for the Aztek as well as the main rope in kits sold by Rock Exotica and of course Sterling Rope.

In this case, here is a snippet from the introduction to that test article in WSAR#7 which describes the choice of rope for Aztek and the testing undertaken by Sterling to ensure it was the best 'fit-for-purpose' possible. Above is their bespoke abrasion testing rig: The AZTEK was created by Technical Rescue magazine's venerable Rope Editor, Reed Thorne of Ropes that Rescue with Sterling developing the sewn cord components. The Kit has evolved through the years and in pursuit of

strength and performance in thermal and abrasive environments. Having both passed the NFPA Elevated Temperature test, SafeTech™ and FireTech2™ were our top candidates for the host rope in the Aramid AZTEK in terms of thermal resistance. These ropes have also proven to be very durable and abrasion resistant in the field. However, aramid fibers are more susceptible to the effects of flex fatigue, requiring the Sterling Engineering Team to do some investigating. To be thorough, we also wanted to quantify abrasion resistance. Thus, our Rube Goldberg-esque cycle tester was devised, which is capable of subjecting rope samples to repeatable and consistent cycling over an object.

Check out the full article in WILDERNESS SAR# 7.



## PRODUCTS – ROPE STUFF

www.rescuemagazines.com

# GET UP & GET DOWN

The Skylotec *Get Up* combines progress capture cam and a hand ascender in one. The design is characterized by great ergonomics. Thanks to the two carabiner eyes, the Skylotec *Get Up* can be used faster and with less equipment. Operation can be left, right or ambidextrous. The ascender complies with the standards EN 567 and EN 12841. It can be used in combination with foot slings or cowtails as well as part of a pulley system as a progress capture cam. An innovative and alternative safety catch prevents accidental opening of the ascender, it also makes it easier to operate with one hand, even with thick gloves.

- Suitable for ropes from 8 to 13 mm
- Dimensions 129 x 122 x 66 mm (L x W x D)
- Weight 120 g
- Cost: £/€90 inc VAT

SKYLOTEC's new SIRIUS descender has a compact design that makes it fit perfectly in the hand. It also has a lever with a small arc of motion that saves time when working because quick and accurate movements are possible. Additionally, the lever closes automatically. As soon as it is released, it blocks the rope in the device. It can only be reopened by pressing a button. The automatically self-blocking lever reduces errors when getting into the work position. An unintended opening of the lever is not possible. Another benefit is that to insert and remove the rope, 'Sirius' does not need to be removed from the carabiner that connects the device to the harness. This increases safety for the user because the descender always remains attached to the harness, and rope insertion can be done intuitively and securely with a connected carabiner. A small eyelet in the lever makes it possible to operate the descender with an accessory cord in an emergency – which means simultaneous rescues can be executed. If one person falls or has a sudden medical issue, such as dizziness or a heart attack, an accessory cord can be attached in the lever eyelet of the other person. The user can then operate both his own as well as the descender of the victim and rappel both persons to safety on the ground

STANDARD: ANSI Z359.4:2013, DIN EN 12841-C:2006, DIN EN 341-2A:2011

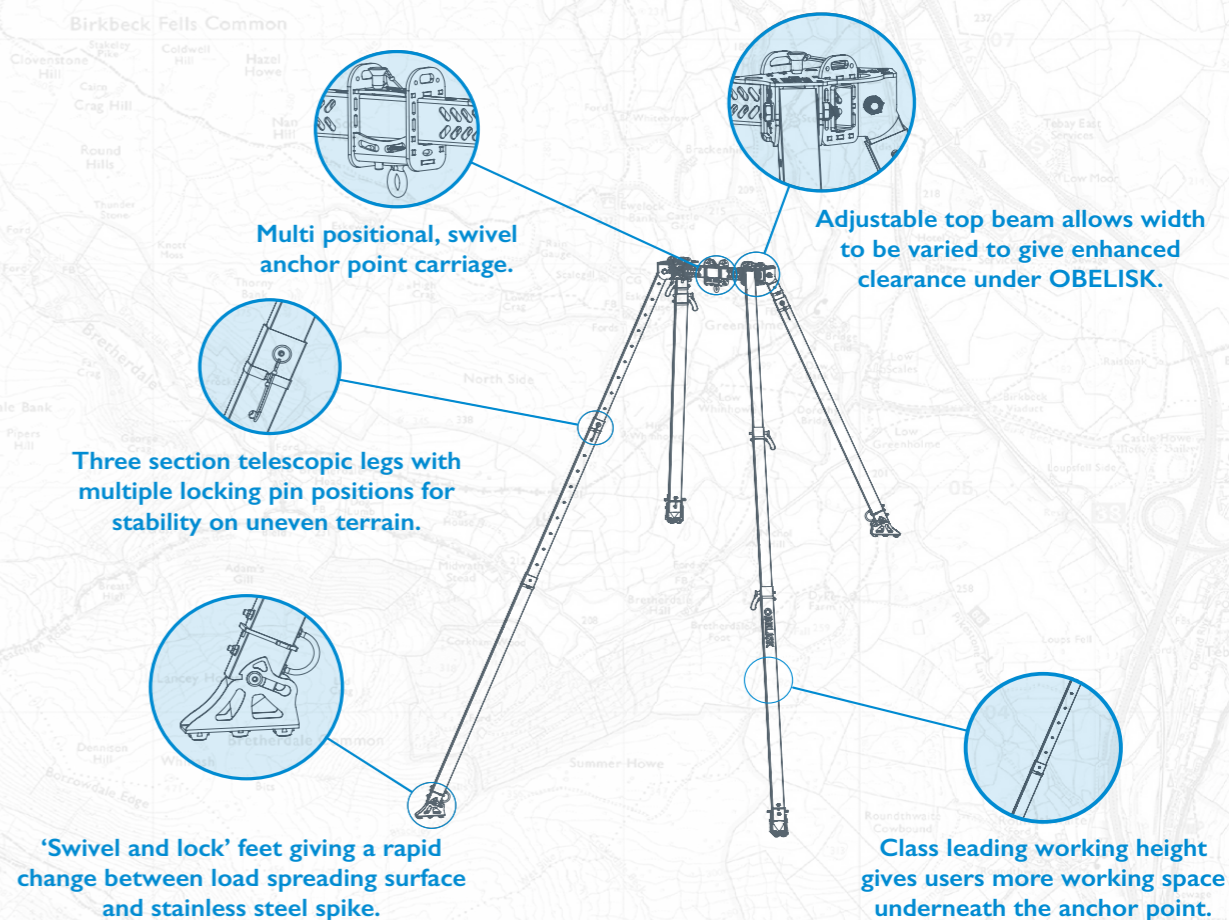
DESCENT SPEED 2,00 m/s  
 RATED LOAD 250kg/550lb (2-person load)  
 TEMPERATURE 60 °C – -30 °C  
 SIZE 175x79x47mm / 6.9x3.1x1.8"  
 WEIGHT: 500g / 1.12 lbs  
 MATERIAL Aluminium, Steel  
 COST: £/€203 inc VAT

www.skylotec.com

# OBELISK ADAPTS SO YOU CAN REACT



## 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.
- Telescopic legs can extend to maximum height of 2200mm to allow clear passage of a stretcher.
- '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.
- EN795:2012, PD CEN/TS 16415:2013
- Product Code: LPP0003
- Guying points for additional security.



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



# ROSENBAUER Battery Powered Fan

for PPV, purging confined spaces and  
cooling or aerating  
working or incident  
environment

www.rosenbauer.com



Rosenbauer has expanded its FANERGY series with a practical cordless device. The new high-performance **FANERGY B16** fan is powered by an environmentally friendly and very efficient electric motor that causes no exhaust emissions, and the noise level at the point of use is also significantly minimized. Two lithium-ion batteries supply the 1.25 kW synchronous motor from 40 cells each and provide a carrier capacity of 2 x 11.6 amp-hours. This allows operating times of at least 60 minutes at full speed before replacing the batteries with the quick-change system or connecting an external power source. The high-performance fan can be operated uninterrupted and permanently when connected with the power cord. The special design of the FANERGY fan unit (all-in-one airflow technology) ensures a very even and powerful air flow with an optimized suction behavior and flow pattern. In addition, it combines different fan technologies and concepts such as overpressure or turbo ventilation in one device. FANERGY high-performance fans can therefore be used very flexibly and for any kind of tactical ventilation. The new battery-powered fan is also immediately ready for use, which can accelerate rescue and extinguishing measures and significantly increase the safety of all involved.

### FANERGY B16 Specifications

Air outlet diameter: 16" (410 mm)  
 Drive: permanent magnet synchronous motor  
 Performance: 1,250 Watt  
 Batteries: 2 x li-ion batteries  
 Rated voltage: 36 V  
 Capacity: 2 x 11.6 Ah  
 Charge: 24 VDC or 110/230 V – 50/60 Hz  
 Dimensions: 520 x 650 x 355 mm  
 Weight: < 25 kg / 55lb  
 Power supply (Schuko, NEMA, British Std, CEE, Switzerland)

## Web Pulley System

[ED: Not new but a piece of multi-role genius – the green 'handle' can be slid up the webbing and inserted into the pulley head to act as a descent lever for controlled lowering of heavy loads]

The KAA is a prefabricated haul system for lifting persons in case of rescue or for tensioning a system. In addition, as the KAA is certified according to EN 354, it can be used for workplace stabilization, as a restraint system (open/closed) and controlled lowering.

Its strap-based construction makes it the most compact and lightweight system on the market. Depending on the positioning, it offers a 4:1 or 5:1 lifting ratio with an efficiency of 91%. The KAA is com-

pact but delivered ready for immediate use, so that no valuable time is lost when it is required. A swivel is provided at each end to prevent the system from twisting. The hand lever on the draw cord allows a better pull and it can also be used as a lowering lever.

### SPECIFICATIONS

lengths: 0.8 m and 1.5 m.  
 Load capacity [Kn]: 22  
 CE marking: yes  
 Energy Absorber: No  
 Swivel: Yes  
 4:1 or 5:1 lifting ratio  
 Efficiency: 91%  
 Integrated RFID-Chip  
 Cost: €150/\$250

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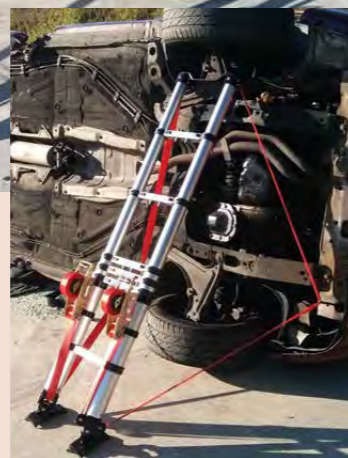


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# TWO in ONE 'Strut'



[ED: Estabilzattor is a new take on the traditional method of stabilisation with a ladder that we thought had been consigned to the history books except in cases where you have no other stabilisation equipment to hand. This might be one of those ideas that is so simple you wish you'd thought of it. Or maybe you did and already use your own version but this one is an off-the shelf, tested and certified product that is most definitely fit for purpose. In fact two purposes because it is not only a very stable, stabilisation strut (since it has such a wide base) but it works really well as a ladder, a ladder you can stabilise – how safe is that! This type of telescopic ladder appeared around twenty years ago and quickly found favour with the military for forced entries and with fire-rescue vehicles as a handy access ladder that fits in a locker and is often much quicker and easier to deploy than the full size thing strapped to the roof of the vehicle, it's a little known fact that longer is not necessarily better. Spanish access specialists Protection have taken what is already a useful piece of equipment and added articulating feet integrated into a pair of ratchet straps with a reinforcing bar across the top, a serrated gripping plate and gripping 'spurs' either side.]

**ESTABILIZATTOR**

The system has been designed to form a whole with the vehicle, providing it with stabilisation. The telescopic system enables the assembly to be extended to the desired length, whilst the hooks and strap turn-buckles compress the top and base of the

ladder against the vehicle and ground respectively. The double arm and double lashings enable the Sabilizattor G3M to be quickly and easily installed. Thanks to the angled hook position, no perforations are required for fastening. Its double independent tensioning system enables tensions to be balanced between elements of asymmetrical installations. The top contains two side areas for placement on flat surfaces, whilst the central area is used for placement on narrow objects such as pillars, shafts, etc. The feet contain a crosshead system for placement on irregular surfaces. The automatic strap recoil system enables the device to be rapidly and easily collected and relocated.

- TECHNICAL SPECIFICATIONS**
- Minimum length of system retracted: 80 cm
  - Max length of system when extended: 210 cm
  - Maximum length of straps: 5 m
  - Maximum loads:
    - Longitudinal: 300 Kg
    - Retractable strap: 1000 Kg
    - Ratchet handle: 10 Kg
    - Steps: 150 Kg

[www.protection.com](http://www.protection.com)



[ED: Our old friend Paul Swinton from KZN in South Africa (now with Scottish Ambulance Service HEMS) continues to develop the SCRAM concept now into version 2 and enhanced by this paediatric pack]

Whereas most other manufacturers focus on the storage and transportation of equipment, SCRAM™ or STRUCTURED CRITICAL AIRWAY MANAGEMENT is a structured, reproducible approach to airway management, standardising, and optimally organising equipment and drugs prior to the procedure being required. SCRAM™ becomes a meaningful cognitive offloading tool, and facilitates airway planning by reducing the time to intervention, reducing error, standardising practice and promoting good governance. Following the success of the Adult SCRAM™ there has been strong demand from the community for a Paediatric version of SCRAM™. This however, comes with different challenges because one needs to take into account the broader size range of equipment required to cover the paediatric body size spectrum, ranging from around 3kg at birth to 50kg at adolescence, and at the same time have an optimal ergonomic design that improves task utilisation of equipment. Paul Swinton, Dr

[www.rescuemagazines](http://www.rescuemagazines)

Jon McCormack and Neil Sinclair undertook this challenge to invent a paediatric version of SCRAM™. Using the same philosophy and principles that were used in the successful, Adult SCRAM™ and tailoring them to the specific requirements of Paediatric airway management, they have developed the Paediatric SCRAM™ line. Designed to enhance the performance of Paediatric airway management by reducing the time to intervention, reducing error and cognitive load.

There are two versions of Paediatric SCRAM:  
**PAEDIATRIC SCRAM™ (Hospital / Retrieval)**

Performing an emergency paediatric RSI outside the operating theatre environment is an extremely rare event. This may be necessitated by the sudden arrival of a critically injured child in the ED resus room, a medical collapse on a ward, or acute unexpected deterioration during diagnostic or therapeutic interventions. At present many of these areas have standard "resus trolley", however, there is recognition than many rotating junior medical staff, and nursing staff who rarely encounter this procedure, are unfamiliar with the equipment needed, the sequence of events and the need for a standardised approach. Paediatric SCRAM™ within these areas provides a structured and standardised equipment process.



# SCRAM Paeds

**PAEDIATRIC EMS SCRAM™ (EMS / PHEM / Retrieval)**

Paed EMS SCRAM™ is designed to be a compact Paediatric Emergency Airway Bag that provides a structured reproducible approach to PAEDIATRIC airway management for first responders. The design rationalises a selection of equipment that will encompass the entire neonatal to adolescent age range, and lay this out in an easy-to-orientate age range manner. Forming a system of advanced preparation and organisation of equipment, allowing bandwidth offloading for staff already under considerable cognitive pressure, and facilitate airway planning by reducing the time to intervention, reducing error, standardising practice and promoting good governance. SCRAM™ is used by high performance teams in both the hospital and pre-hospital environments in the UK and round the world.

Adult SCRAM £,121 exc VAT  
 Paeds SCRAM Hospital £121 exc VAT  
 Paeds SCARM EMS-£95excVAT  
 SCRAM™ packs fit very nicely into PAX bags as well as Openhouse Products packs.



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# RESCUE SWIMMER GEAR

[ED: two products from First Watch in San Jose California and we could have included a couple more interesting items if we had room! They have products from full ice-rescue and flotation suits to float jackets and high buoyancy tactical PFDs]



## 1st WATCH RESCUE SWIMMER'S VEST

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Rescue Professionals need gear that allows them to respond to emergency situations safely and quickly. The SWV-100 has been designed to for optimum freedom of movement, swimming performance, protection of the spine and backside with a universal fit. The tail bone extension offers increased protection

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- Lower Body Butt Protection
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1stWatch Water Rescue Helmets keep you safe and

### Features:

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- Ratchet easy-fit system
- Chin cup webbed strap adjusts to fit
- Removable foam ear protection pads
- CE 1385-2012 water helmet standard.
- Color: Hi Viz, Red, DD Green
- Size Head Circumference S/M 21" – 22.5"
- L/XL 22.5" – 24.4"



www.firstwatchgear.com

protected when saving lives. The Deluxe WRH is engineered for light weight and comfortable protection. Complies with EN 1385-2012 water helmet standard. Shell manufactured of hi-impact ABS with a closed cell EVA molded foam liner. Easy Fit Ratchet adjuster. Removable foam earpads. 9 ventilation holes. Accessory side rails and NVG/GoPro mounting bracket.

## Bestard SAR PRO Boot



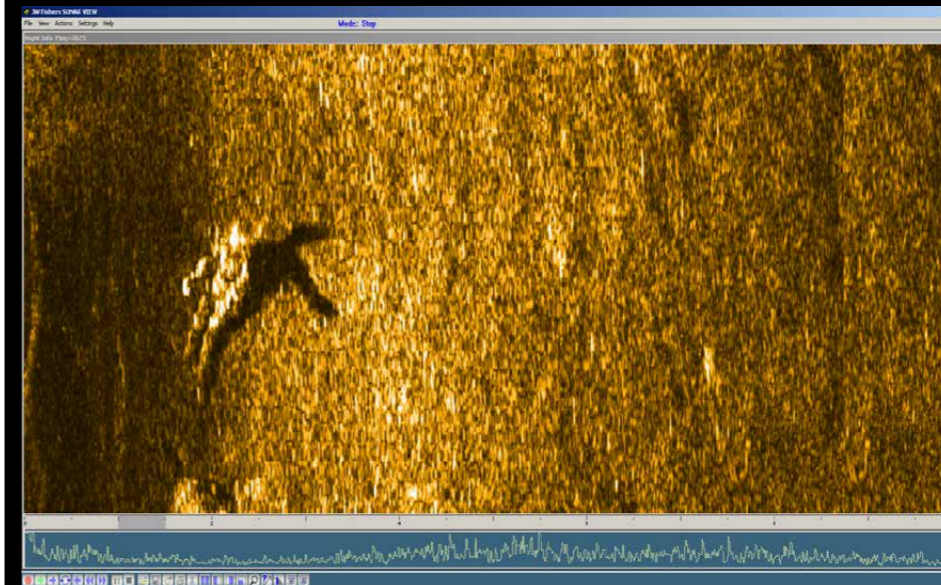
- ▶ Vibram sole and reinforced toe
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# CMC Special Ops harness

CMC's Special Ops Harness™ was developed from the request of the emergency services unit of a large Southern California Sheriff's Department that wanted a harness combined with a special equipment-carrying vest. When working in a helicopter, the crew needed to be tied in but also wanted to stow the harness leg loops for comfort and mobility. The harness was designed with leg loops that fold up and attach to the waist with hook-and-loop retaining straps and feature ANSI-rated AustriAlpin COBRA™ buckles that are quick to connect and disconnect yet designed to not open when loaded. For rappels and hoist operations, the harness has waist and sternum attachment points. The integrated breathable mesh vest has pockets for a radio or compass and includes attachment points for holsters or other gear worn on a duty belt. The drag handle at the top of the harness back can be used to help lift the wearer into a helicopter or drag an injured team member. Shoulders have removable reflective strips that provide enhanced visibility when desired. Both the front and back feature a built-in MOLLE Attachment System. Black ProTech Auto-Lock Carabiner included. Available separately is a Special Ops Harness Pack designed to carry a hydration reservoir and light parka. The pack attaches to the vest with side-release buckles. Color: Black/OD Green.

Also available separately is a harness pack designed to carry a hydration reservoir and light parka. The pack attaches to the vest with side-release buckles.

Weight: 7 lb14 oz (3.6 kg)  
Waist 24 – 44 IN (62-112cm)  
Cost: \$749

www.cmcpro.com



Rigloo is a lightweight emergency shelter that protects a casualty and/or rescuers from the elements. It is available in two forms, SAR with a fixed floor and EMS with a roll-out floor. Straight out of the small pack it's a storm-proof bivvy sack at 8000mm HH that inflates into a structured space in under 1 minute with a

# Rigloo emergency inflatable Shelter



2litre hand pump or 90 seconds with a lithium battery pump. Once inflated it is a solid shelter with no loose materials to flap in the wind and detract from patient observations. It will also allow teams to split into smaller groups as it can be inflated by one person and no longer requires multiple rescuers to act as the pillars to hold up a sheet or a bothy sack. The shelter protects both the casualty and rescuers but can also be used as isolation 'cells' in mass-casualty incidents for live or deceased persons. It can also provide a mobile 'workshop', for instance drones can be assembled or repaired during inclement weather and be ready as soon as it clears up. As with all emergency shelters Rigloo will protect from hypothermia and provide privacy and protection with a small footprint. SAR is 1.8m by 1.2m (6'by4'). EMS is 2.2mx1.2m (7'x4') SAR pack size is 40x30x20cm/15.7x 11.8x7.9". Weight 6.1kg/13.4lb with all pumps, pegs and tethers Cost is £299 for the SAR version.



www.rigloo.co.uk

## RUTH LEE™

FOR PROFESSIONALS WHO SAVE LIVES

### MANIKINS FOR VEHICLE EXTRICATION TRAINING

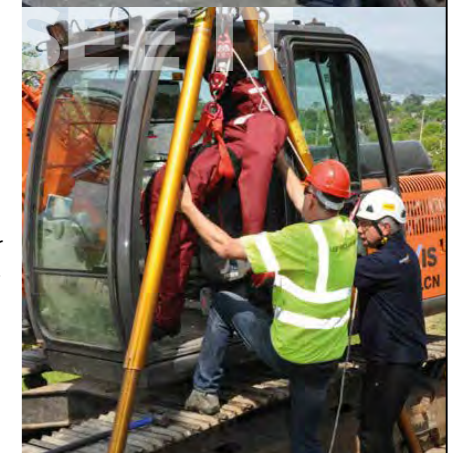
We have a range of manikins which will provide a realistic challenge for your extrication scenarios.

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

# PULLEY SYSTEMS



part4  
by Reed Thorne  
Ropes that Rescue AZ, USA



Pic by Ken Backer

## COMPOUND PULLEY SYSTEMS

IN THIS ISSUE, PART FOUR OF "A YOUNG PERSON'S GUIDE TO PULLEY SYSTEMS!"



### INTRODUCTION

Compound pulley systems are the true workhorse of rope rescue work. Like simple pulley systems, they have very specific advantages and disadvantages. They are slightly more difficult for the rigger to remember and perform. Since by definition, a compound system must have at least two separate simple system components, one pulling on the other, the resetting effort can increase. [ED: readers should note that MANY systems shown in books and online are described as Compound Systems because they use multiple pulleys but are actually Simple systems with high mechanical advantage. A block and tackle is a Simple not Compound system. By definition a Compound system compounds the MA derived from combining two or more separate pulley systems. What Smith and Padgett called piggybacking. If you attached a block or block and tackle to another pulley system THAT would be a Compound system as in the picture on the right].

### REVIEW: SIMPLE, COMPOUND AND COMPLEX PULLEY SYSTEMS:

Start by refreshing on the definitions:

- SIMPLE:** Where the rope is tied to either the load or the anchor and is run alternately through pulleys on the load or the anchor until the loose end finds itself in the grasp of the pullers (see Part 3)
- COMPOUND:** A simple pulley system pulling on the end of a simple pulley system (this article). We can thus expand the definition to include:
  - Each simple system is referred to as a component of the product
  - May be more than two components
- COMPLEX:** A pulley system that is neither simple or compound (future article)



This stylized system wouldn't achieve much but in principle it's a Compound system that has a Simple 4:1 system attached to a Simple 2:1 giving an 8:1 TMA.

**COMPOUND PULLEY SYSTEMS - Definition:**

A simple pulley system pulling on the end of a simple pulley system

- > Each simple system is referred to as a component of the product
- > May be more than two components

**PARENTHETICAL NOTATION OF COMPOUND PULLEY SYSTEMS:**

Back in the late 1980's when these concepts were beginning to take shape at the Sedona Fire District where I was then captain of the Technical Rescue Team (Sedona, Arizona), we came up with a way of designating the simple system components of a compound pulley system (CPS). To my knowledge, this system had not been seen before that time. It was referred to as "parenthetical notation" of all the components than the whole of a CPS.

Therefore each component, regardless of its IMA, was noted within its own set of parentheses. Example: (2:1), (3:1) or (5:1) or so on.... Also, it should be pointed out at this juncture that the simple system components can be an ODD or EVEN Ideal Mechanical Advantage (IMA). Keep that in your back pocket for later discussion in this series.

At this point, it becomes obvious that there need to be a minimum of TWO simple systems in order to have a compound system while there are no limits theoretically on how many you can have. These act on one another pulling end to end and not end to, say, middle (that is a different animal, so to speak, which we will discuss in depth in part 5 of this series on Complex Pulley Systems, or CxPS).

When the simple components act on one another the mechanical advantage (MA) of each simple component is multiplied to produce the ultimate product, or final MA. A common mistake is the temptation to ADD the MA's of all these components together rather than multiplying to get the product. As an example, a CPS as follows:

$$(2:1s) \times (3:1s)$$

will yield an ultimate MA of 6:1. Or:

$$(2:1s) \times (3:1s) = 6:1c$$

The small letter "s" denotes "simple" for clarity but is assumed, and can therefore be omitted:

$$(2:1) \times (3:1) = 6:1c$$

Also, the symbol "x" can be eliminated in between the two parenthetically noted simple systems if you prefer:

$$(2:1) (3:1) = 6:1c$$

**MAKING SENSE OF PARENTHETICAL NOTATION FOR CPS:**

It is important to remember that the order in which the parenthetical notation is constructed will determine what ultimate CPS will be built. For instance:

$$(2:1) (3:1) = 6:1c$$

is a different system to:

$$(3:1) (2:1) = 6:1c$$

The ultimate MA is the same (6 to 1) but the simple components are reversed in the second example. What this means is important and ultimately led to why we came up with the notation at Sedona Fire. The order in which these components are strung together, left to right, will determine which is built first and which last.

The INPUT of energy, or the "haulers", for any pulley system is always on what we call the proximal end (that is the end of the rope that is in the grasp of the pullers) and the OUTPUT of energy is where the object being lifted is attached (we call this the distal end and often referred to as the "load"). The "haul" is always noted on the LEFT and the "load" is always noted on the RIGHT as follows:

Here are two undisclosed simple system components resulting in a CPS: the "load" is always noted on the RIGHT as follows:

$$\left( \begin{matrix} \text{SIMPLE} \\ \text{SYSTEM} \end{matrix} \right) \times \left( \begin{matrix} \text{SIMPLE} \\ \text{SYSTEM} \end{matrix} \right) = \begin{matrix} \text{PRODUCT} \\ \text{CPS} \end{matrix}$$

$$\text{INPUT HAUL} \left( \begin{matrix} \text{SIMPLE} \\ \text{SYSTEM} \end{matrix} \right) \times \left( \begin{matrix} \text{SIMPLE} \\ \text{SYSTEM} \end{matrix} \right) = \begin{matrix} \text{PRODUCT} \\ \text{CPS} \end{matrix} \text{ LOAD OUTPUT}$$

The input/output are noted with the "haul" and the "load" above"

**DETERMINING THE IMA OF A CPS:**

1. Note the "division points" within the CPS. This is the point where one simple pulley system ends and another one begins. It could be a rope grab (such as a prusik as shown) or the end or middle of a rope in the system (See "batwing" later). Every CPS has at least one division point and could have many. Each division point separates two "throws".
2. Note the throws on both sides of the division point(s). Remember, there could be several throws in a CPS. In the case of the illustration, there are two throws on either side of one division point at the haul grab.
3. Work out each throw's IMA using the rules for simple pulleys systems.

REVIEW:

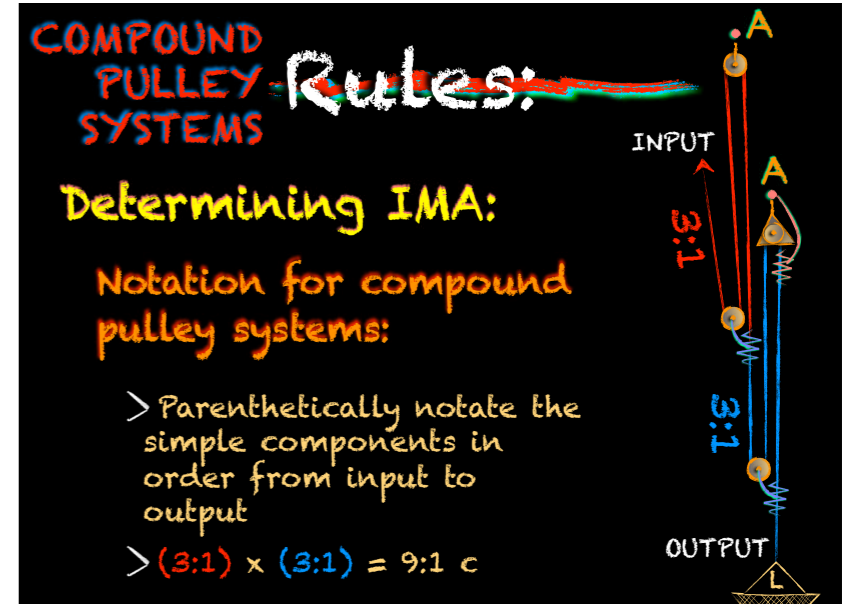
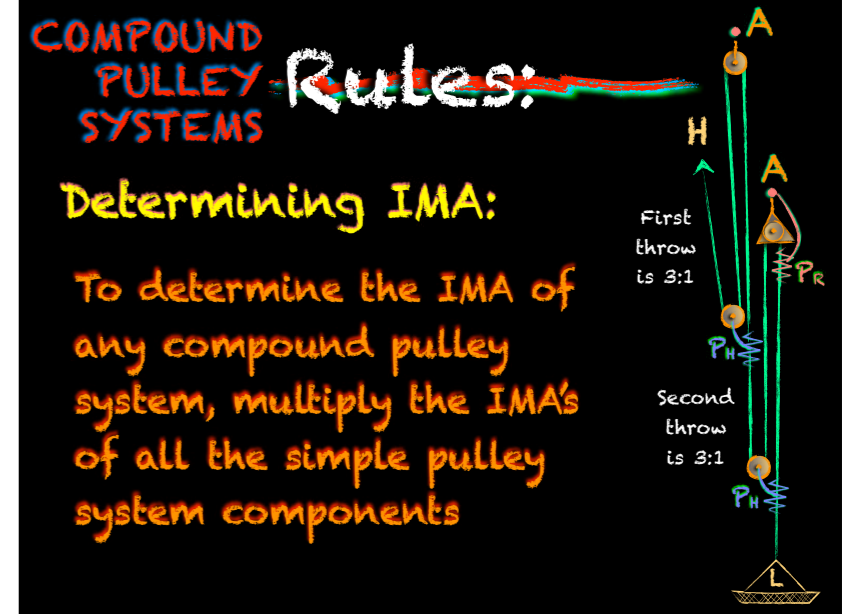
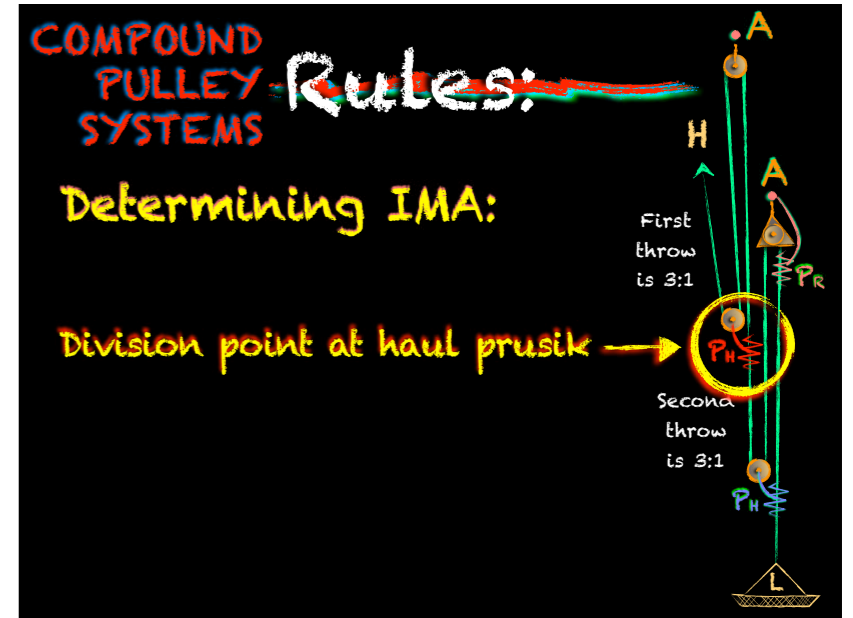
- If the rope is tied to the load, the IMA will be ODD
- If the rope is tied to the anchor the IMA will be EVEN
- Count the ropes between the load and the anchor which will determine the IMA

To determine the IMA of any CPS, multiply the IMA's of all the simple system components.

In the last illustration on this page we have shown the simple pulley system components in both red and blue with the "division point" (shown only at the top) between both at the haul prusik. This would be very easy for us to see IF we could purchase a "magic" rope that changed colors at the division point in our CPS! But, unfortunately, our ropes are normally all the same color.

Compare the same exact CPS in the middle to the last illustration. The "first throw" is the one at the input (haul) and the "second throw" is the one closest to the output (load).

Below, you can see the parenthetical notation with colors corresponding to each simple system.



**DETERMINING THE IMA OF A CPS: (continued)**

Here, you can see that we have a CPS with three simple system components which will render two division points instead of just one. Again, each simple system is a different color: Starting at the haul (input) there is first green, then red, then finally orange closest to the load (output). This will help the reader understand how this works much better.

Note the division points in the CPS. One is simply the end of the rope and the other is the typical haul grab. Both act in the same way: "dividing" the simple systems.

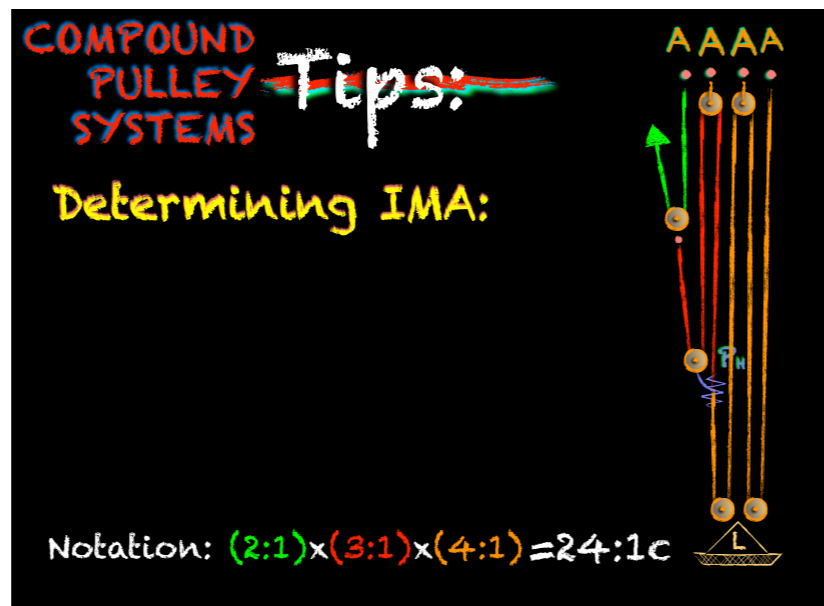
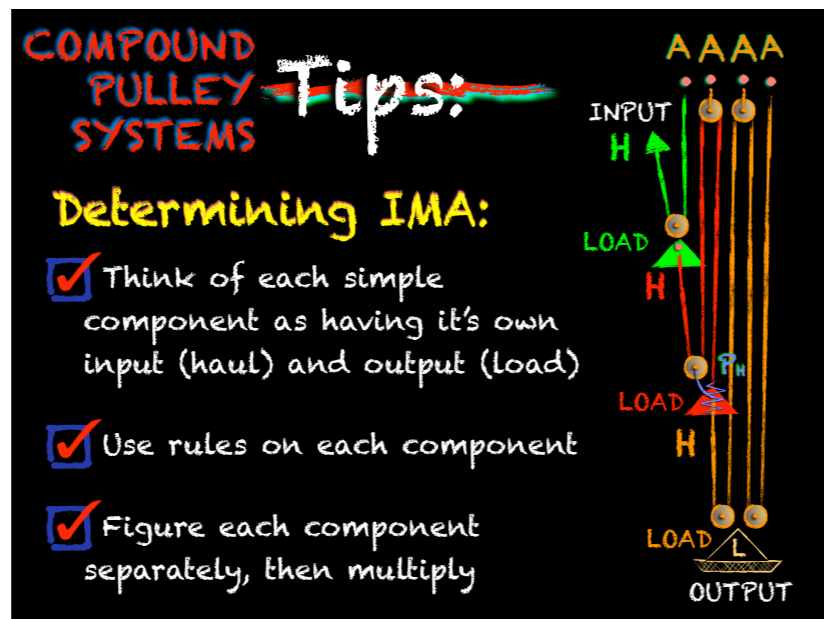
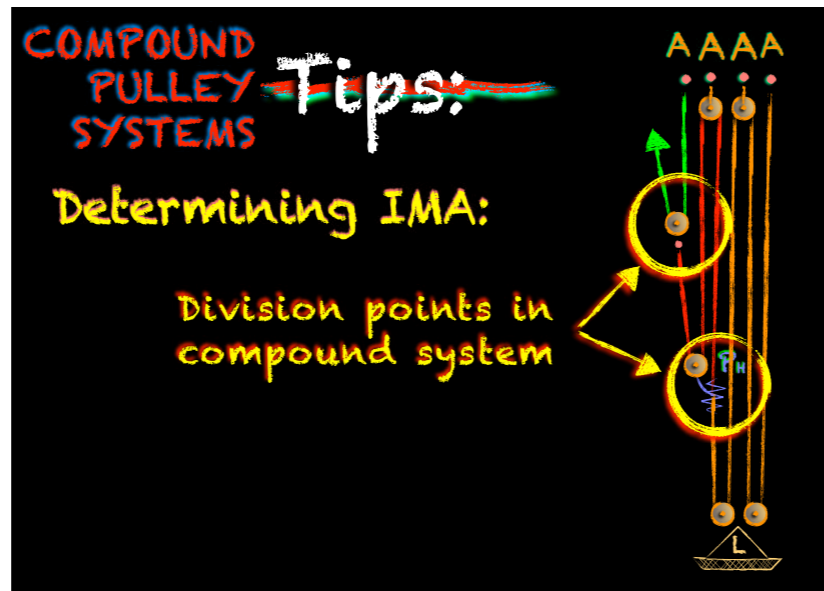
At each division point, one simple pulley system ends and another begins. In the bottom illustration on this page you can see that there is an "H" for "haul" and a triangle indicating "load" for each of the three systems. Again note the colors of each with its corresponding simple pulley system.

See the appropriate color parenthetical notation at the very bottom for this CPS. It is a (2:1) (3:1) (4:1) which when multiplied together yields a 24:1c.

**WHY SUCH A HUGE MA? (Ouch!)**

I am often asked about this in our programs on pulleys systems. Why in the world would you need such a huge MA on this kind of a system? To answer this, one must ask what the task is that the pulleys system is used for. Is it to lift a patient package to the top of a very tall structure or cliff? Or is it for lifting something only a small distance to free a trapped victim? If the latter, then a good 24 to 1 compound system where all the anchoring force is spread out amongst several anchors (as shown) would be a good thing, especially if there are very few haulers present.

Which brings up another point. If only a few are present to haul, then the "input" of energy is limited at the onset. So, if that is the case, I will need a larger MA to get the job done. The output remains the same. As more arrive, then the MA can be stripped to a lower one. With a high MA and a large input force, there is the distinct possibility of overloading the system. Not desirable.



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## STAGGERING ANCHORS:

Using staggered anchor points in a CPS will decrease the resetting. This means one anchor more proximal and one more distal. For maximum pulling efficiency, stagger the anchors for each simple system a multiple of the next distal throw's MA.

In the illustrations, the second throw (closest to output) is a shorter 3 to 1 determined to have a throw of "X". Therefore, if the first throw's anchor is placed proximal by a distance of twice that (2 "X"), then the first throw, also a 3 to 1 will be three times longer than the second throw.

## COLLAPSE RATE:

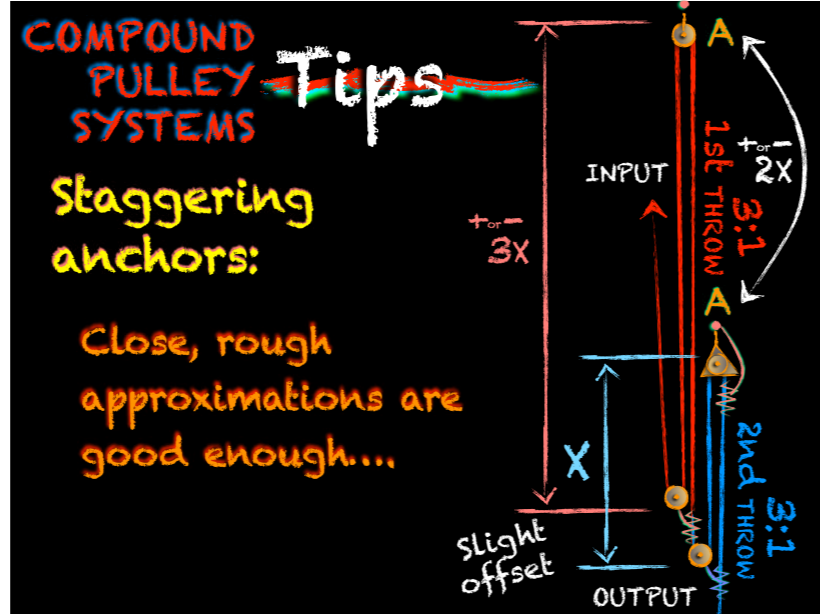
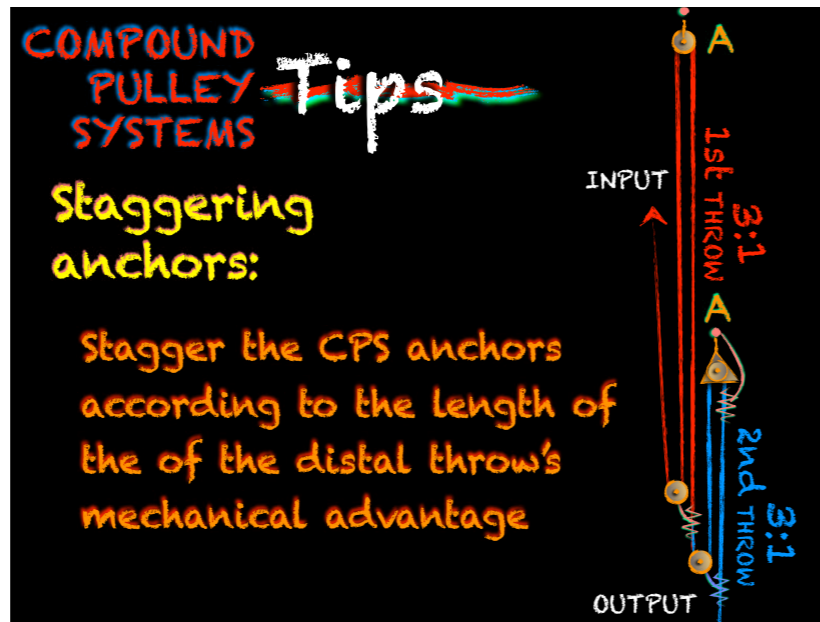
What does this accomplish? Well, it yields a good collapse rate (future article in this series to come) to the CPS. Essentially, both throws in this case will two-block at the same time which is extremely efficient in any pulling operation. Remember that the first throw will be moving three times faster in this case than the second throw. So, if it is three times in length, they will arrive at two-block at the same time.

With actual numbers: If the second throw is 3M and it is a 2 to 1 (2:1 MA), then you would need to move the proximal anchor back 6M in order to get the 1st and 2nd throws to two-block at the same time. Note that the first throw MA is not part of the calculation as it could be anything.

While this is not always possible to do in the wilderness or in industry, the opportunity to stagger anchors does exist regularly.

## RESETTING:

What else does this accomplish for you? Think for a minute about the resetting of the CPS. When this is done normally, there is a back and forth struggle which sometimes occurs between the two assigned to reset the haul grabs forward. In a simple pulley system there is only one of these to reset so fairly benign. But with the CPS, there are two or more. With the staggered anchor model, the resetting can be done by one person in the front at the distal end of the system. There will however be a slight offset in the distance of the throw 1 haul grab which will need to be advanced, but this is not too cumbersome. To their discredit, the CPS without the staggered anchors can be a nightmare when dealing with the collapsing simple components all traveling at differing speeds. So moving these anchors will make a huge difference which cannot be understated.



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**THE "BATWING" CPS:**

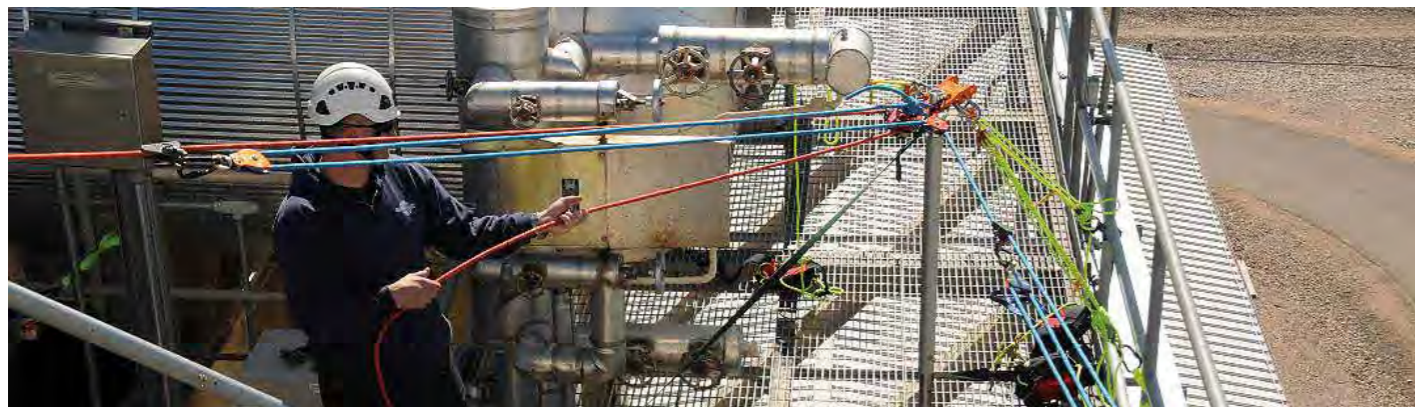
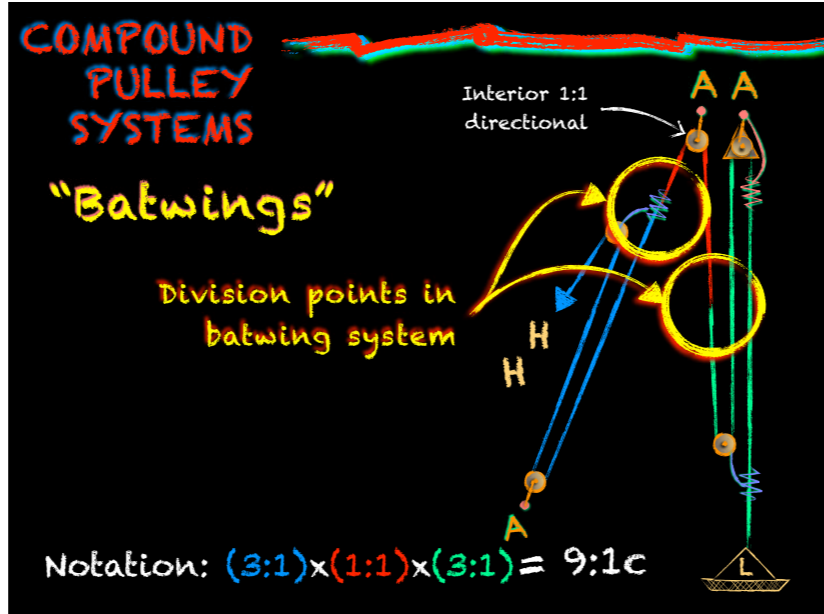
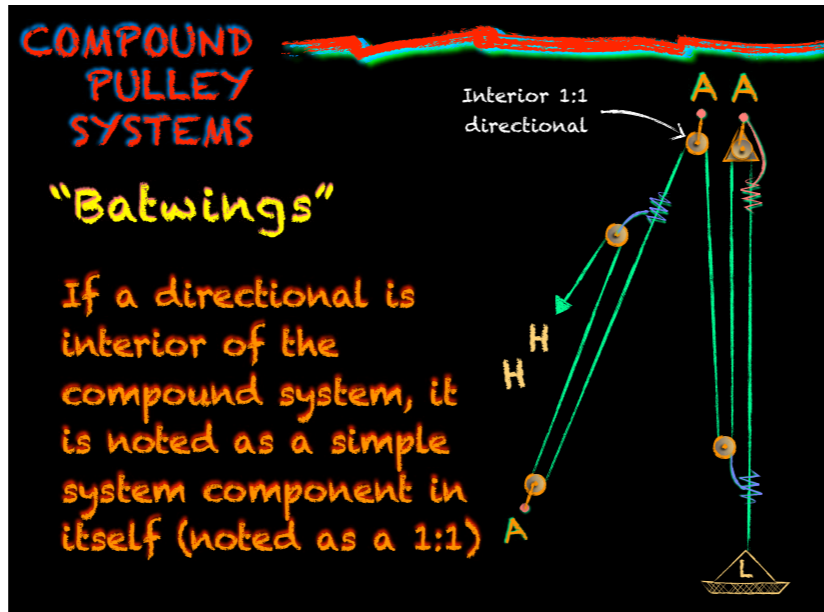
Batwing CPS are those that have a simple directional (noted as a 1 to 1) in between two other simple system components. The term was first used by power transmission linemen that I worked with years ago and I have no idea of the origin.

If a directional is therefore interior of a compound system, it is noted parenthetically as simple system component in itself (noted as a 1 to 1). Please make sure you do not call this a change of direction, or "cd", as it is not. Recall the discussion in part 3 of this article about this terminology.

In this illustration, we have a 9 to 1 batwing CPS which indicates the notation shown below, again in colors with our "magic" rope that changes colors at each division point. So the batwing CPS will always have at least two division points with the resulting three simple systems (even though the middle one is merely a directional)

The advantages of the batwing are immense. The differing throws can be directed down different paths or ledges in the wilderness or walkways in industry. Sure the directional pulley adds friction but it is viewed as mostly negligible compared to its advantages.

In the photo below at a power plant, a 6 to 1 batwing, noted (3:1)(1:1)(2:1) is being used ganged (bolted) onto a main line for the purpose of lifting a rescue adjunct off of a rigging pod.



**EASE OF MODIFICATION:**

Compound systems are easy to modify for less or more MA. That is pretty important if more haulers show up in the middle of a demanding rescue. To keep the forces in line as to not overload the anchors, the compound system can be changed to reduce this. Also, as in the case of pulling up something that gets progressively heavier and heavier (like pulling in a long highline), the compound systems is ideal due to ease of modification.

**PRACTICAL FRICTION:**

To their credit, the CPS have less practical friction, use less rope, and require generally less equipment in the higher MA systems. For example, a 9:1 compound pulley system noted (3:1) x (3:1) will use only four pulleys, where a simple 9:1 would use twice that many. Because there are less pulleys, there is less friction and, indeed, less to carry to the top of the mountain.

**CONCLUSION:**

There are many more considerations to using a CPS which I cannot enumerate in this already short article. I believe I said the same thing at the conclusion of the last article on the simple pulley system. Suffice it to say they are definitely a tool you need to master as a rope practitioner. The CPS will

be a good choice when you have shorter distances to raise something because the ability to pull long distances between resets of the system if you stagger your anchors. Is it easy? No, but it is not rocket science either. In looking back after having written this, it is certainly possible that the CPS could have been broken into two subparts because of the amount of information I had to cut out. There are just 11 slides out of the full RTR slide show with literally hundreds which are shown here.

In the next article in this series we dig into the complex pulley system (CxPS) with all of its great capabilities. It may not be the final part of this series on the pulley system as there is so much we cannot touch on in this format. We will be looking at other considerations for all pulley systems (like collapse rate, the simple, compound and complex pulley systems of the versatile AZTEK and the ever-popular Arizona Progression of Seven and other things. There is a vast amount to this topic and for the time being, the publisher (Ade) has not cut me off!

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# Paddle Boat Handling for Flood Responders

## Part 1



by Josh O'Brien

Josh is a technical rescue trainer for R3 Safety & Rescue Ltd in North Wales, UK. He's worked in the technical rescue sector for the last 10 years and is an operational search and rescue team member. He also worked as a Raft Guide Trainer throughout the UK and overseas. Josh delivers safety and rescue training in water, rope and confined space rescue.

It's common to see Swiftwater responders and technicians tasked to flooding with a boat in hand, literally. It seems common place that responders wade in deep water alongside their boat. I'm more in favour of paddling it if conditions are right and responders have trained and practiced with a paddle boat. It greatly reduces exposure time to contaminants and underwater hazards.

This article and the second part are written with flood responders in mind. We'll look at the key components for effective paddle boat handling and the strategies for navigating in moving water.







**THE CRAFT**

Generally speaking, most responding teams that have a non-powered craft have one or more of the following:

1. a sled
2. an open back Raft with or without (2a) transom
3. a white water raft

Sleds are often small, narrow and light with smaller chambers than true rafts but very robust and they that can be inflated quickly. The open back allows for easy loading of equipment and casualties and can offer a propulsion and steering option in the form of a swimmer on the back. Sleds can be completely flat or modified like the Dutch Tip Board opposite but most general-use options have inflated chambers along the sides and protecting the front (bow). The downside is they don't have the same loading (buoyancy) capacity as rafts and their low profile can make them less forgiving in fast-flowing water.

Rafts are generally wider and higher than sleds with greater buoyancy, making them very stable platforms with high crew capacity. You'll often see rafts with a small transom board in the stern. These rafts are great for paddling in a forward direction, although it's worth noting they don't handle as well if you need to paddle them backwards. Some like the Oceanid RDC and a number of recent copies have a raised and open bow and/or stern to facilitate easier loading of an in-water casualty or access to the water for rescuers.

Whitewater style rafts are the most buoyant and have been used for decades in the commercial industry and more recently by the Swiftwater rescue community although variants have been used to good effect since at least the nineties. They offer a symmetrical design, high profile, high crew capacity and a low-profile floor, which reduces the chances of becoming broached.

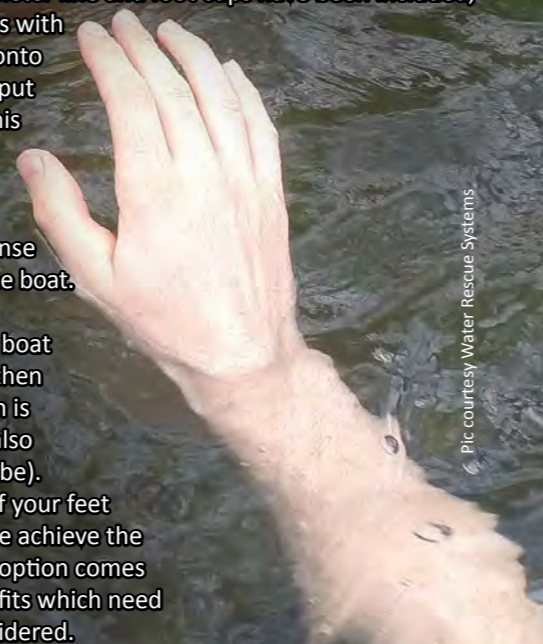
**CREW POSITIONS**

Sitting crew members in the correct positions is paramount, without it, we can't generate effective propulsion.

Firstly, crew members need to be positioned so they feel secure. Sitting on the outside perimeter tube (often called the outside tube) is by far the most efficient place to sit (see picture opposite). It also means we can easily reach the water with our paddle, it sounds obvious but it's all too often overlooked.

Secondly, we need to work out what we do with our feet. Many of the modern swift water and flood response boats on the market are a similar design to white water rafts. Key security features like a perimeter line and foot cups have been included, which provide crews with something to hold onto and somewhere to put their feet. Having this level of security, allows the crew to focus on paddling tasks and gives a sense of connectivity to the boat.

If you're paddling a boat without foot cups, then the next best option is to use the thwart (also known as a cross tube). By sliding the tips of your feet under the thwart we achieve the same security. This option comes with risks and benefits which need to be carefully considered.



Pic courtesy Water Rescue Systems



**EXAMPLES of INFLATABLE WATER RESCUE CRAFT**



Pic courtesy Rescuers Europe



Crew placement is dictated by how many crew members are in the boat. Generally, this consists of 2, 4 or 6 members, this is commonly referred to as R2, R4 (picture above) or R6. We subsequently position them throughout the boat to distribute the weight. Crew members will often sit opposite one another within a compartment, i.e – front (bow), middle or back (stern).

**PADDLE COMMANDS**

Commands should be simple and to the point. Some of the key commands typically include:

- Forward
- Backward
- Stop
- Turn Right
- Turn Left

With R4 and R6 configurations, crew members sitting in the bow of the boat are responsible for setting the stroke timing on a paddle command. The crew sat behind them must be in sync with the Bow paddlers. This goes a long way in generating effective propulsion and direction.

A discussion point which comes up regularly with students is how do we effectively turn the boat. Many students start with descriptive commands such as 'Left forwards and right backwards'. This often works well in the flat pool, but the moment we enter moving water, everything seems to speed

up. Our brains can sometimes struggle with verbalising such a sequence, so we just shorten the command to 'Turn right'.

Sometimes we may need to call a set of commands in sequence to complete a manoeuvre. There are a couple of variables that affect the speed at which these commands are called, they include the speed of the water, experience of the crew and the consequences of it going wrong. We often introduce 'Stop' in-between commands, as this gives the crew time to finish a paddle stroke before moving into the next. This reduces the likelihood of some crew members finishing one command as the other starts the new one. It ultimately helps with timing.

**BOAT COMMANDS**

These are commands which aim to reduce the likelihood of crew members falling in, dislodging the boat of an obstacle or a potential flip. They include:

- Get Down
- Back Up
- Over Left
- Over Right
- Over front
- Over Back

'Get Down!' is a command we use to get the crew low down in the boat. Instead of sitting high up on the parameter tubes, if we

think an imminent impact with an obstacle is likely, we can use this command to reduce crew members' centre of gravity, which in turn reduces the likelihood of them falling out. This is achieved by first removing feet from any securing features, bringing them together, and then dropping your bum down towards the floor. 'Back Up!' has the crew returning to their seats.

What we do with our paddle during a 'Get Down' or 'Back Up' command is important, as we don't want to forget about the non- paddle end (T-Piece), as it all too often finds your colleagues face sat opposite you! This is easily managed by keeping hold of the T-piece.

'Over Left' or the variety of other directions is commonly used to dislodge the boat of an obstacle. If we have an obstacle under the boat, by moving crew members to the opposite side, we can release the boat. We must be mindful to not bounce up and down when the boat becomes stuck. By bouncing we increase the risk of puncturing the boat, most of the time we have no idea what the submerged obstacle is, this is particularly relevant in floodwater.

One of our last-ditch attempts to stop a boat flipping or becoming pinned on an object is by calling 'Over left' or 'Over right'. As the raft hits an object sideways, the flow may begin to push the upstream, outside tube down, water begins to pour

into the raft and eventually the boat either becomes pinned or it flips. By moving quickly to the opposite side, we can significantly reduce the likelihood, but we must move fast!

**CREW ROLES**

Generally, the number of crew members deployed by boat will be dependent on the type of water and size of the boat. Typically, a crew may consist of the following:

- Helm
- Medic
- Rescuer/s
- Agile Bowman

The Helm takes general charge of the boat and calls paddle and boat commands. They often take part in paddling with the crew. The Helm is often the more experienced boat handler and is often the final decision-maker.

An agile bow-person is a varied role and for the most part, they will take part in paddling as a crew member, but other roles may include holding the boat in position and securing the boat during access and egress. The remaining crew are rescuers. Most of the tasking will involve paddling as crew, but other roles may include, casualty management, searching and accessing flooded properties. A rescuer may also be a Medic.

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pic courtesy Rescues3 Europe

**TRIM**

Trim is a term used to describe the relationship between the hull of a boat on the surface of the water. If we keep the weight distributed across the raft, then we would expect to see the hull of the boat sit parallel with the surface of the water. This is commonly referred to as neutral trim.

Trim significantly impacts handling ability. For example, if I have a boat with a heavy bow and I'm trying to generate forward propulsion, the boat will want to pivot around the bow. The most subtle changes have a large effect.

Trim must also include weight on our left and right sides. Too much weight to the right or left and the boat will want to turn when generating propulsion. We also increase the risk of becoming broached on subsurface obstacles.

**SPEED**

To efficiently manoeuvre the boat in moving water, from one area to another, we must consider the speed of the water and our propulsion speed.

For example, if we want to forward ferry glide from one side of a channel to the other, our propulsion speed may seem very slow but the speed of the water passing the hull could be very quick. Conversely, if we are floating in the current vector and we point the front of the boat at eddy downstream and apply forward propulsion, we begin to move faster than the current vector. In summary, we need to move faster or slower than the current vector to efficiently complete some manoeuvres.

**ANGLE**

If we manage the boat's positioning against the current vector, we can begin to affect our direction of travel. For a moment, consider 12 o'clock on a clock face to represent directly upstream against the current vector. When we ferry glide, we may use an angle similar to 1 o'clock to begin ferry gliding. This would allow gradual movement towards the channel bank, slowly and with precision. If I opened the angle to 3 o'clock, then the boat would begin to move towards the channel bank with less effort from the crew but would lose considerable distance downstream.

Speed, Angle and Trim are the fundamental elements to paddle boat handling in moving water.

**ROUTE FINDING & SELECTION**

Picking a route through a section of moving water can be challenging at first. By using a mnemonic like WORMS, it helps create a strategy by prompting key questions.

**WATER**

- Where is it all going?
- Are there significant changes in direction?
- Can I see a path of least resistance?
- If we just float, where would we end up?

**OBJECTS**

- Is there flow pushing into any objects?
- This includes outside bends, bridge pillars, fences, street furniture and vehicles.

**ROUTE**

- Can I identify a passage?
- Where do I want to end up?
- Identifying a start and finish point helps us break up sections of moving water.

**MANOEUVRES**

- What are the key manoeuvres to achieve the route?
- What happens if I don't make the key manoeuvres?
- Is the team capable of making the manoeuvre?

**SAFETY**

- What are the consequences of getting this wrong?
- What backup is required downstream?
- What are the risks if we don't paddle?

In summary, paddling a boat during flood events can dramatically reduce exposure to a long list of hazards, providing we choose the most appropriate craft and crew for the environment and tasking. If we train and practice in a range of handling techniques in a variety of environments, crews will become competent and skilful.

However, we must recognise the limitation of different crafts and crew experience. The moment we step outside of these limitations we quickly encounter a whole host of issues. We'll look at what these include and how to deal with them in part 2.



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# WHEELED WATERPROOF CASES

## Part 1 A-G



By 'Waterproof' we also mean, crushproof, heavy duty, professional grade transport cases as exemplified by Pelican but, as you'll see from our tables, they don't have a monopoly on bombproof cases even if they are the name to beat in rescue. This is the first in a series of GUIDES to WATERPROOF CASES and will be the largest range of equipment we've ever included so it will be in many parts. This issue and part 2 in issue 78 contains wheeled cases, AtoG and HtoZ. The third one in the series will look at cylinders and so-called 'long cases', long and flat, generally only a few inches deep and best known as containers for sniper rifles but equally applicable to heavier rescue equipment like shoring, search cameras and modular poles. Heavy-duty cylindrical cases like the Plaber/HPRC tube-cases are also 'long' but, unlike most of the golf club transporters, are fully toughened, waterproof resin cases.

Rescuers will no doubt be familiar with Pelican, Underwater Kinetics, SKB, Explorer, HPRC (Plaber) and maybe Nanuk cases but there are plenty of other industries that demand the best protection for expensive and maybe fragile equipment – photography and film-making for one and instruments and lighting/electronic paraphernalia for another and these are areas that at least two of the names in these Guides have come from – Gator Case and Turtle Cases. KSB probably produce the largest selection of waterproof cases of anyone with rotomoulded as well as injection moulded options.

We became case-fetishists in the mid seventies when Pelican was our only choice so they have understandably been our firm favourite ever since with a range that continues to evolve as we need them to and after several dozen models over the decades we've still never had a failure. We still have cases from the eighties and nineties. One of our other original favourites was Otter but they foresaw the explosion in personal electronic devices and went full-scale into smaller cases and away from transport cases. Equally we've had good experiences with Explorer, HPRC, Seahorse and Underwater Kinetics. All have performed extremely well and the only failure, which is more an example of ill-treatment than any fault of the case, is perishing of the outer wheel on a wheeled Explorer and Storm case that were stored in permanent damp for several

years. The outer that has disintegrated may be some kind of rubber compound but in both cases a working central wheel of plastic remains on both cases and they can still rolled. Of the remainder, we have to confess to not being familiar with Condition1, Nanuk, Ibox or B&W International but they look to have good pedigrees and products. Elephant we're not sure about because we hadn't even heard of them until we were researching this article. We've included them because they have an extensive range that's made in Italy so they could well be worth seeking out and investigating.

### TYPES of WHEELED CASE

Broadly speaking there are 6 distinct styles of wheeled case:  
**1) CASE** – The smaller models, rectangular and about the size of a fat briefcase or small to medium suitcase. Able to be carried briefcase-style using the side handle. We can also sub-divide this category **1A)** to indicate those of appropriate dimensions to be used as aircraft carry-on luggage – however, some airlines may be more picky than others so you'll always need to check before flying otherwise you'll be checking it as hold-luggage.



- 2) CHEST** – as in a pirate's chest – the largest sizes, often as deep as they are wide and too big to be carried by the side handle alone.
- 3) TOP-LOADER** – A bit like a giant tea-caddy where the top hinges open and you stuff everything in from the top down. Harder to organise kit but makes a great water carrier!
- 4) CYLINDRICAL** – Not many are fully ruggedised for rescue but when they are, they make great receptacles for lighting and medical gas or breathing air cylinders.
- 5) LONG** – Long and flat 'rifle'-cases
- 6) CRATE** – Much larger transport and storage boxes not usually intended to have equipment deployed straight of the crate at an incident. More likely to have the other cases in this Guide stacked *inside* a crate for deployment to a disaster area. Not generally as waterproof and resilient as the smaller resin cases and chests.
- 7) RACKS** – snug-fitting subdivisions of a large case or crate – effectively pull-out boxes or trays to protect and separate equipment, particularly electronics.

We have NOT included 4) 5),6) or 7) in this GUIDE.  
 6) The larger military style crates like Hardigge are designed for air or sea transport and require multiple persons to lift and shift and are often loaded/stacked/unloaded by fork lift. 7) similarly the rack systems are too large and complex to include here but many would lend themselves to frontline deployment. 4)&5) Long and long cylindrical cases will be included in part3 which

will also include wheeled cases WITHOUT an extending pull-handle.

The cases in this GUIDE, even the largest, are capable of being wheeled by one person assuming that you're on a hard flat surface and the case isn't full of gold bars. These cases allow for specialist equipment to be deployed direct to a frontline or incident scene and even the largest are capable of being transported in a standard pick-up, mpv/van or estate/station wagon.

We chose wheeled cases to start this series of Guides because they are the most useful and versatile of cases that might otherwise require a multi-person lift. It is the nature of even quite modest sizes that the contents may be so heavy that lugging it over any distance by a carry-handle alone is



impractical. Pulling on a pair of wheels is the best way to move kit from the station or cache to the vehicle and once arrived, from the vehicle to the scene.

## CONSTRUCTION

All of the cases in this series of Guides are made of extremely tough, injection-moulded or rotomoulded plastics and resins of various compositions and sealed against water-ingress with an O-ring seated in a channel in the lid. See the 'CASE MATERIALS' section for further discussion.

## IN THE FOLLOWING TABLES:.....

**COST:** as always is a rough guide only – it can vary due to exchange rates, taxes etc. and we usually round the price up. The type of internal configuration will affect the cost, many include pick and pluck foam as standard – check the Foam column, if all of the options are an outline square the cost is with the case empty, if it's a solid coloured square – that's what you get included in the price.

**ORIGIN:** The main flag refers to the manufacturer's home country, but this may not be where the case is made. If we know, we show an inset flag – Pelican for instance has a manufacturing facility in Barcelona as well as California but they're all listed under the US flag as that is where Pelican is headquartered. Some of these may be of Chinese manufacture but largely, what you see as an origin flag is where they're made – it's probably the case that the infrastructure necessary to manufacture carbon plastic, ABS and polypropylene cases in the first place continues to work well negating the need to outsource in the way we see so many other areas of rescue equipment.

**VOLUME:** This figure gives the best idea of average available space but as you'll see in our comments on DIMENSIONS, this isn't the full story – the largest volume isn't necessarily configured in a way that would suit your equipment. It does, nevertheless, give us a useful way to differentiate between models.

**CASE MATERIALS:** While there are any number of material combinations, the basic material is plastic. It's what they do with the plastic or how it's mixed that makes the difference. Plaber for instance use polypropylene TTX01, glass fiber and rubber. These toughest of cases are all injection moulded (rather than blown or rotomoulded as some of the hollow-chamber cases are) and use wholly or in combination:

- ABS
- Polypropylene
- Carbon plastics

with carbon-plastics (polycarbonate) being the top of the tree



and ABS usually the least expensive. But while the companies will argue over the pros and cons of each you will, generally speaking, be more concerned about price and size. We've listed the material as described by the manufacturer

## DEPTH of BASE and LID:

while the overall volume quoted will include the lid it is important to know just how much of that area is comprised of the lid. There are many stowage options that make the lid a very useful place to store and organise smaller components and have them readily to hand while the case is open. As an example our typical Con-Space Entry case would be quite large, housing 2 sets of airline cylinders, harnesses and masks on top of airline hose, demand valve and comms cable with command module then the lid would have gas monitors, headsets/ throat mics, tools and personal PPE. Having a lid that includes at least a couple of inches of storage enables you to have equipment in the main compartment in the base sit slightly proud. However, a word of warning, make sure that any sensitive equipment with dials and screens has plenty of free space and is adequately buffered against intrusion by items stored in the lid. They may shift in pockets and end up being in close contact with a fragile screen or dial when closed.



**DIMENSIONS:** We've listed the Internal dimensions because that is the bit that actually stores your kit – that is your available space and may be radically different to the outside dimensions.

Watch out for intrusion into that space by the wheels and maybe the telescopic handle. Some of our own have proved annoying over the years when trying to cram a quart into a pint pot. The wheels often occupy two curved quadrants of plastic in two corners as with this SKB case and some have full width channels of plastic housing the telescoping handles and this too alters the available stowage space.

**EYE DIAMETER:** refers to the width of the padlock or zip-tie hole for securing the case contents from prying eyes or thieving hands.

## TYPE of CASE

- 1) CASE
- 2) CHEST (too large to be carried by the top handle alone)
- 3) TOP-LOADER
- 4) CYLINDRICAL/SHAPED
- 5) LONG



# NEW DEEPER AIR CASES



45% DEEPER  
40% LIGHTER

NEW 1507, 1557, 1607 & 1637  
DEEPER AIR CASES

## PRESSURE VALVE

The round knob which is a pressure release or purge valve that can be unscrewed to allow you to open the case after it has been subjected to aircraft or altitude decompression which might otherwise suck the case tightly closed.

**LOCK / LOCKABLE:** virtually all of the cases here have a means with which to secure them closed, either with a small padlock or with a cable/zip-tie. LOCKABLE means Padlockable' and it's up to you to come up with the most secure way to use it. Many models have stainless steel reinforcing to these eyes to help prevent unscrupulous folk simply tearing or melting the lock through the plastic. A cable-Zip tie stops the case from opening easily but otherwise just lets you know that your case is suddenly lighter for a good reason.



**LOCK** indicates a physical lock requiring a key or combination. It may be a propriety lock that comes with the case or an option but some cases have a key-lock built into the latch or latches and in some, like Nanuk it is an optional accessory for any of their cases. The three options in the pictures on the right are from Explorer; a combination, a heavy-duty brass lock and a TSA combination. TSA approved locks are primarily for US airports and indicate to agents that the lock can be opened by them without the need to destroy it, presumably, any lock without the little secret logo is summarily smashed to bits with a hammer or separated from its charge by some mini bolt croppers.



## SINGLE / DOUBLE LATCHES

Originally ALL cases had single latches – that means you pull it until it 'clicks' clear of its keeper and your case is open. With a heavily loaded case this can often be quite difficult and quite abrupt so some introduced a two-stage release offering something like mechanical advantage to open a first stage and then an easier second and final stage to release the latch and open the case. Some saw this as a security measure ensuring that you couldn't accidentally open a latch with just one click but any case with more than one latch already has a kind of redundant safety in that the case will remain closed until all the latches have been released. Many companies offer two stage (or double) latches in two or three distinct designs. With Otter for instance, you release the first stage in the normal way which then has to be further 'unhooked' back the other way – we've never liked this design Most went for something similar but the second stage releases the same way as the first – more intuitive and a more

fluid opening as it's largely seamless rather than being two separate and distinct actions. Simpler still is the push-button release for the first stage and then release the latch

**ID PANEL / STRAP:** ID panels started out on Peli cases as a removable strip of plastic that you could have etched or printed professionally or you could simply write the case contents on it and swap around as necessary. Not all the case contents obviously as it was only a few inches long and an inch or so high, or have you got teeny, tiny writing? otherwise, just the general kit class that is in the case. When the smaller cases evolved into carry-on luggage we started to see more conventional name-badge style panels (although we did already have such a thing on an old Explorer case) so you could either use a bespoke label or slip in a business card luggage label.

**STRAP** refers to a shoulder strap for easier carrying. This can be pretty useful because, even empty, some of these cases aren't the lightest – that's why they have wheels but for those occasions when you can't wheel it a shoulder strap might be useful. rarely do they come with a strap, it's generally an optional accessory but they don't all have them because they may not have the means to connect them.

## HANDLES

Refers ONLY to the side or carry handles and does NOT include a rolling or telescopic handle. Unless otherwise indicated in the NOTES section ALL of these cases have a telescoping handle enabling them to be pulled along by one person. There are some like SKB's R-series and Explorer's 7726 which have wheels but not a telescoping handle. The Long cases included in the third part of this Guide series also lack a telescoping handle.

## ERGONOMIC GRIP

A shaped handle that is curved to better fit a closed hand rather than a more or less square cross-section is ergonomic in our eyes and get a black square. If it is further enhanced with a rubber or tactile grip, that get an orange square

## FOAM / ORGANISERS

Next to the case itself, this is probably the most important factor in your purchase. Foam is still the commonest, cheapest option for organising your case. It is either layered sheets or 'Pick&Pluck' which is pre-cut into columns as in the picture on the right or into little cubes still attached to each other by a corner of each cube so that together it makes one huge block of foam. You can pull out as many or as few little columns or cubes as you like to create pockets for your gear.



We have included **ORGANISE** in orange to differentiate from standard foam and these may include laser cut, closed cell foam like the battery compartment options or the photographer-style padded dividers opposite (top). Peli's new divider option is a robust series of walls that you pin into various positions. Another option are the kit cubes as shown in the annotated title picture, this is a concept borrowed from travel luggage with see-through, zip or velcro cubes to keep things separate but easily identifiable. As already mentioned, lid organisers



# WHEELED WATERPROOF CASES

are a common accessory and not only make great use of space but they present well when the case is opened.

Some cases, like B&W have the means to completely remove the lid easily (they could probably all be removed if you had the patience and tools). Not entirely sure of the advantage unless you were using it as a raft?

## IP RATING / MILSPEC

**IP RATING** refers to how watertight and dustproof a case is where the last number ranges from 1 to 8 with X7 and X8 being submersible. The X in these examples refers to dust ingress and is a number from 1 to 6. Most cases will be IP67 or 68 – completely waterproof and can withstand temporary

immersion. IP68 can tolerate longer periods of immersion. Military standards vary but if we have listed a green square indicating a military specification it will be STANAG 4280 or DEF STAN 81-41.

**COLOURS** Colour options are shown as a square with the colour not quite an exact match, in fact, not even close in some cases but you'll get the idea. There aren't many secondary colours in cases but GT Line's Explorers for one have an accent colour on the handle grips to help differentiate what is otherwise overwhelmingly any colour you want as long as it's black. The secondary colour is shown in the frame of the square.

**WARRANTY:** these things are pretty robust with a minimal number of components to go wrong so most companies offer a Limited Lifetime warranty. The question is , what are the limitations, in theory it could be 'as long as it doesn't live beyond 3 years, or as long as you haven't tried to carry anything in it!' Check the actual terms to make sure but all of these look reasonably solid. B&W go a little further, and even though they've quoted a specific age-span it's pretty generous at 30 years and I think I might prefer an unlimited 30 year warranty to a Limited Lifetime? The exception is Pelican and SKB who have an UNLIMITED lifetime warranty – you break it, they replace it.

**NEXT ISSUE: Wheeled cases H to Z**



# FERNO RESCUE

Total Rescue Solutions

Ferno Rescue offers total rescue equipment solutions for the professionals who use it and those they serve.

Ferno is the global leader in pre-hospital emergency care solutions, serving emergency services including EMS, fire rescue, mortuary, industrial safety and police.

Ferno exports to over 150 countries and has partnered with safety and regulatory agencies and customers globally to create a new vision for delivery of emergency care. Our dedicated team of customer-focused industry experts are ready to share that vision with you.

For additional information:  
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www.ferno-rescue.com

images NOT to scale	MODEL	COMPANY	ORIGIN	COST	WT (empty)	VOLUME	CASE MATERIALS	DEPTH of LID BASE	INTERNAL DIMENSIONS	EXTERNAL DIMENSIONS	TEMP RANGE	EYE DIAMETER	TYPE OF CASE	PRESSURE VALVE	LOCK/LOCKABLE	SINGL/DBL LATCHES	ID PANEL / STRAP	HANDLES *	ERGONOMIC GRIP	FOAM ORGANISE	I.P. MILSPEC	WARRANTY	COLOURS	NOTES	WWW.	
	6600	B&W INTERNATIONAL		£126 \$223 €263	5.3kg 11.7 lb	29 L 1 cu'	Polypropylene	40mm 1.6" 145mm 5.7"	500x286x185mm 19.7x11.3x7.3"	550x350x225mm 21.7x13.8x8.9"	-30to80C -22to176F	7mm .03"	1	■	■	2	■	1	■	□	■	30	■		b-w-international.com	
	6700	B&W INTERNATIONAL		£166 \$260 €316	6.8kg 15lb	43 L 1.5 cu'	Polypropylene	50mm 2" 175mm 6.9"	535x260x225mm 21.1x14.2x8.9"	610x430x265mm 24.8x17.7x11.4"	-30to80C -22to176F	7mm .03"	1	■	■	2	■	1	■	□	■	67	30	■	Precut Battery & Drone organiser options	b-w-international.com
	70	B&W INTERNATIONAL		\$283	9kg 19.8lb	60 L 2.1 cu'	Ultra High Impact ABS Plastic	n/a	676x424x211mm 26.6x16.7x8.3"	754x500x249mm 29.7x19.7x9.8"	-30to80C -22to176F	7mm .03"	1	-	■	7	-	3	-	□	■	67	30	■		b-w-international.com
	6800	B&W INTERNATIONAL		£230 \$357 €359	8.8kg 19.4lb	71 L 2.5 cu'	Polypropylene	50mm 2" 245mm 9.6"	584x409x295mm 23x16.1x11.6"	660x490x335mm 26x19.3x13.2"	-30to80C -22to176F	7mm .03"	2	■	■	4	■	3	■	□	■	67	30	■		b-w-international.com
	7800	B&W INTERNATIONAL		\$521 €414	13kg 28.7lb	187 L 6.6 cu'	Polypropylene	mm " mm "	770x541x381mm 30.3x21.3x15"	846x615x414mm 33.3x24.2x16.3"	-30to80C	7mm .03"	2	■	■	5	■	3	-	-	■	67	30	■		b-w-international.com
	300	CONDITION 1		\$210	6.9kg 15.2lb	27 L 0.9 cu'	Lightweight Polypropylene CoPolymer	41mm 1.61" 150mm 5.89"	500x284x190mm 19.7x11.2x7.5"	554x350x241mm 21.8x13.8x9.5"	n/a	7mm .03"	1	■	■	2	-	1	■	■	■	67	■	■	all-terrain wheels	condition1.com
	286	CONDITION 1		\$230	11.3kg 25lb	75 L 2.6 cu'	Lightweight Polypropylene CoPolymer	50mm 2" 272mm 10.7"	549x422x325mm 21.6x16.6x12.8"	624x498x371mm 24.6x19.6x14.6"	n/a	7mm .03"	2	■	■	4	-	3	■	■	■	67	■	■	all-terrain wheels	condition1.com
	287	CONDITION 1		\$200	10.2kg 22.4lb	55 L 1.9 cu'	Lightweight Polypropylene CoPolymer	33mm 1.3" 198mm 7.8"	556x432x231mm 21.9x17x9.1"	625x495x279mm 24.6x19.5x11"	n/a	7mm .03"	2	■	■	4	-	3	■	■	■	67	■	■	all-terrain wheels	condition1.com
	258	CONDITION 1		\$260	13kg 28.7lb	85 L 3 cu'	Lightweight Polypropylene CoPolymer	43mm 1.7" 226mm 8.9"	721x439x269mm 28.4x17.3x10.6"	803x511x323mm 31.6x20.1x12.7"	n/a	7mm .03"	2	■	■	4	-	3	■	■	■	67	■	■	all-terrain wheels	condition1.com
	Elite 1808W	ELEPHANT		\$140	4.4kg 9.8lb	33 L 1.2 cu'	Polypropylene CoPolymer	38mm 1.5" mm 7"	463x336x216mm 18.25x13.25x8.5"	500x406x267mm 19.7x16x10.5"	-30to90C -22to194F	8mm 0.3"	1	■	■	2	-	1	-	□	■	67	□	■		elephantcases.com
	Elite 1907wp	ELEPHANT		\$320*	8.2kg* 18 lb	33 L* 1.2 cu'	Polypropylene CoPolymer	50mm 2" mm 5.12"	500x350x193mm 19.7x13.8x7.6"	556x452x236 mm 21.9x17.8x9.3"	-30to90C -22to194F	6mm 0.25"	1	■	■	4	□	1	-	□	■	67	□	■	* Only available with organiser interior	elephantcases.com
	Elite 1911w	ELEPHANT		\$166	5.5kg 12.1 lb	45 L 1.6 cu'	Polypropylene CoPolymer	50mm 2" mm 8.5"	495x345x267mm 19.5x13.6x10.5"	551x432x330mm 21.7x17x13"	-30to90C -22to194F	6mm 0.25"	1	■	■	4	□	1	-	□	■	67	□	■		elephantcases.com

NOTES: ow = ■ bw = □ o = ■ b = NOTES: N/A: info Not Available/not given COST: Approx & inc. local tax/VAT CASE TYPES: 1=Carry Case, 1A=Carry On, 2=Chest FEATURES: ow/bw= Option PRESSURE VALVE: o=Auto b=Manual HANDLES\*: exc telescoping handle WARRANTY: b=Limited Lifetime o=UNLIMITED Lifetime

images NOT to scale	MODEL	COMPANY	ORIGIN	COST	WT (empty)		CASE MATERIALS	DEPTH of LID BASE	INTERNAL DIMENSIONS	EXTERNAL DIMENSIONS	TEMP RANGE	EYE DIAMETER	TYPE OF CASE	PRESSURE VALVE	LOCK/LOCKABLE	SINGL/DBL LATCHES	ID PANEL / STRAP	HANDLES *	ERGONOMIC GRIP	FOAM ORGANISE	I.P. MILSPEC	WARRANTY	COLOURS	NOTES	WWW.
	Elite 2007w	ELEPHANT		\$140	5.6kg 12.4 lb	29 L 1 cu'	Polypropylene CoPolymer	44mm 1.75" 152mm 6"	520x285x198mm 20.5x11.4x7.8"	584x361x239mm 23x14.2x9.4"	-30to90C -22to194F	8mm 0.3"	1A	■	■	2	-	3	-	□	67	□	■		elephantcases.com
	Elite 2107w	ELEPHANT		\$215	7kg 15.4 lb	41 L 1.5 cu'	Polypropylene CoPolymer	50mm 2" 140mm 5.5"	538x405x190mm 21.2x15.9x7.5"	604x472x226mm 23.8x18.6x8.9"	-30to90C -22to194F	8mm 0.3"	1	■	■	4	-	3	-	□	67	□	■		elephantcases.com
	Elite 2109w	ELEPHANT		\$231	7.8kg 17.25 lb	53 L 1.9 cu'	Polypropylene CoPolymer	50mm 2" 190mm 7.5"	538x405x244mm 21.2x15.9x9.6"	604x472x282mm 23.8x18.6x11.1"	-30to90C -22to194F	8mm 0.3"	2	■	■	4	-	3	-	□	67	□	■		elephantcases.com
	Elite 2409w	ELEPHANT		\$260	10kg 21.15 lb	71 L 2.5 cu'	Polypropylene CoPolymer	61mm 2.4" 188mm 7.4"	620x460x249mm 24.4x18.1x9.8"	686x528x287mm 27x20.8x11.3"	-30to90C -22to194F	8mm 0.3"	2	■	■	4	-	3	-	□	67	□	■		elephantcases.com
	Elite 2413w	ELEPHANT		\$283	11.1kg 24.55 lb	97 L 3.4 cu'	Polypropylene CoPolymer	61mm 2.4" 279mm 11"	620x460x340mm 24.4x18.1x13.4"	686x528x376mm 27x20.8x14.8"	-30to90C -22to194F	8mm 0.3"	2	■	■	4	-	3	-	□	67	□	■		elephantcases.com
	Elite 2911w	ELEPHANT		\$336	11kg 24.45 lb	99 L 3.5 cu'	Polypropylene CoPolymer	61mm 2.4" 216mm 8.5"	747x476x279mm 29.4x18.75x11"	813x533x305mm 32x21x12"	-30to90C -22to194F	9.5mm 0.4"	2	■	■	7	■	4*	-	□	67	□	■	*No Telescopic Handle	elephantcases.com
	Elite 2196w	ELEPHANT		\$416	12.4kg 27.35 lb	144 L 5 cu'	Polypropylene CoPolymer	61mm 2.4" 337mm 13.25"	747x476x406mm 29.4x18.75x16"	813x533x432mm 32x 21x17 "	-30to90C -22to194F	9.5mm 0.4"	2	■	■	7	■	2*	-	□	67	□	■	*No Telescopic Handle	elephantcases.com
	5122	EXPLORER (GT LINE)		£154 \$153 €235	6kg 13.2 lb	31 L 1 cu'	Co-Polymer Polypropylene	50mm 2" 167mm 6.6"	517x277x217mm 20.3x10.9x8.5"	546x347x247mm 21.5x13.7x9.7"	-30to90C -22to194F	7mm 0.3"	1A	■	■	2	■	1	■	□	67	□	■	Lid can be set to slide off at 70 °	explorercases.com
	5218	EXPLORER (GT LINE)		£165 €231	3.75kg 8.3 lb	26.6 L 0.9 cu'	Co-Polymer Polypropylene	30mm 1.2" 150mm 5.9"	520x285x180mm 20.5x11.2x7"	550x350x200mm 21.6x13.8x7.9"	-30to90C -22to194F	7mm 0.3"	1A	■	■	2	■	1	■	□	67	□	■	Lid can be set to slide off at 70 °	explorercases.com
	5221	EXPLORER (GT LINE)		£165 \$220 €231	3.9kg 8.6kg	30.3 L 1 cu'	Co-Polymer Polypropylene	55mm 2.2" 150mm "	520x285x205mm 20.5x11.2x8"	550x350x225mm 21.6x13.x8.7"	-30to90C -22to194F	7mm 0.3"	1A	■	■	2	■	1	■	□	67	□	■	Lid can be set to slide off at 70 °	explorercases.com
	5326	EXPLORER (GT LINE)		£224 \$216 €350	10kg 22 lb	53L 1.9 cu'	Co-Polymer Polypropylene	60mm 2.4" 190mm "	538x405x250mm 21.2x15.9x9.8"	627x475x292mm 24.7x 18.7x11.5"	-30to90C -22to194F	7mm 0.3"	2	■	■	4	■	3	■	□	67	□	■	Lid can be set to slide off at 70 °	explorercases.com
	5823	EXPLORER (GT LINE)		£225 \$216 €357	9.2kg 20.3 lb	56 L 2 cu'	Co-Polymer Polypropylene	60mm 2.4" 160mm 6.3"	580x440x220mm 22.8x17.3x8.7"	670x510x262mm 26.4x20x10.3"	-30to90C -22to194F	7mm 0.3"	2	■	■	4	■	3	■	□	67	□	■	Lid can be set to slide off at 70 °	explorercases.com

NOTES: ow = ■ bw = □ o = ■ b = NOTES: N/A: info Not Available/not given COST: Approx & inc. local tax/VAT CASE TYPES: 1=Carry Case, 1A=Carry On, 2=Chest FEATURES: ow/bw= Option PRESSURE VALVE: o=Auto b=Manual HANDLES\*: exc telescoping handle WARRANTY: b=Limited Lifetime o=UNLIMITED Lifetime



images NOT to scale	MODEL	COMPANY	ORIGIN	COST	WT (empty)	VOLUME	CASE MATERIALS	DEPTH of LID BASE	INTERNAL DIMENSIONS	EXTERNAL DIMENSIONS	TEMP RANGE	EYE DIAMETER	TYPE OF CASE	PRESSURE VALVE	LOCK/LOCKABLE	SINGL/DBL LATCHES	ID PANEL / STRAP	HANDLES *	ERGONOMIC GRIP	FOAM ORGANISE	I.P. MILSPEC	WARRANTY	COLOURS	NOTES	WWW.
	5833	EXPLORER (GT LINE)		£228 \$241 €362	10.5kg 23.1 lb	84 L 2.9 cu'	Co-Polymer Polypropylene	60mm 2.4" 270mm 10.6"	580x440x330mm 22.8x17.3x13"	670x510x372mm 26.4x20x14.6"	-33to90C -27to194F	7mm 0.3"	2	■	□	4	■	3	■	□	67	■	■		explorercases.com
	7630	EXPLORER (GT LINE)		£248 \$264 €396	13.6kg 30 lb	113 L 4 cu'	Co-Polymer Polypropylene	60mm 2.4" 245mm 9.6"	765x485x305mm 30.1x19x12"	860x560x355mm 33.9x22x14"	-33to90C -27to194F	7mm 0.3"	2	■	□	7	■	3	-	□	67	■	■		explorercases.com
	7641	EXPLORER (GT LINE)		£287 \$306 €450	15kg 33 lb	154 L 5.4 cu'	Co-Polymer Polypropylene	60mm 2.4" 355mm 14"	765x485x415mm 30.1x19x16.3"	860x560x460mm 33.9x22x14"	-33to90C -27to194F	7mm 0.3"	2	■	□	7	■	3	-	□	67	■	■		explorercases.com
	7726	EXPLORER (GT LINE)		£325 \$316 €438	10.3kg 22.7 lb	118 L 4.2 cu'	Co-Polymer Polypropylene	90mm 3.5" 175 mm 6.9"	770x580x265mm 30.3x22.8x10.4 "	836x641x304mm 32.9x25.2x12 "	-33to90C -27to194F	7mm 0.3"	2	■	□	7	■	3*	-	□	67	■	■	*No Telescopic Handle	explorercases.com
	7745	EXPLORER (GT LINE)		£355 \$360 €546	15.5kg 34.1 lb	200 L 7 cu'	Co-Polymer Polypropylene	90mm 3.5" 360 mm 14.2"	770x580x450mm 30.3x22.8x17.7"	836x641x489mm 32.9x25.2x19.25"	-33to90C -27to194F	7mm 0.3"	2	■	□	7	■	3	-	□	67	■	■		explorercases.com
	Titan Utility GU-2015-10	GATOR CASE		\$240	6.9kg 15.1 lb	52 L 1.8 cu'	NK-7 Resin	60mm* 2.4" 196mm 7.7"	521x389x256mm 20.5x15.3x10.1"	579x465x297mm 22.8x18.3x11.7"	n/a	8mm 0.3"	1A	■	■	2	-	2	■	□	67	□	■	*approximate dimensions	gatorcases.com
	Titan Utility GU-2217-13	GATOR CASE		\$285	8.7kg 19.2 lb	78 L 2.75 cu'	NK-7 Resin	60mm* 2.4" 261mm 10.3"	559x432x323mm 22x17x12.7"	645x508x368mm 25.4x20x14.5"	n/a	8mm 0.3"	2	■	■	4	-	3	■	□	67	□	■	*approximate dimensions	gatorcases.com
	Titan Utility GU-2011-07	GATOR CASE		\$155	4.9kg 10.8 lb	28 L 1 cu'	NK-7 Resin	60mm* 2.4" 129mm 5.1"	521x287x190mm 20.5x 11.3x7.5"	559x356x229mm 22x14x9"	n/a	8mm 0.3"	1A	■	■	2	-	2	■	□	67	□	■	*approximate dimensions	gatorcases.com

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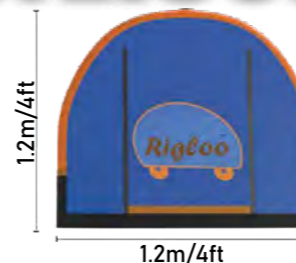
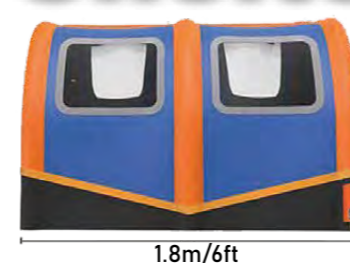


## RIGLOO Inflatable Emergency Shelter

Temporary emergency shelter for casualty and rescuers. Uses a hand or electric pump and can inflate in around 1 minute. Weighs 6.1kg/13.4lb inc pump&pack Cost for SAR version GBP£299 New 2.2m EMS version with roll-out floor available soon



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www.rigloo.co.uk

# DRONES

## FOR SEARCH & RESCUE

By **David Daly**

Former U.S. Marine Corps Officer, David is a professional journalist, commercial drone pilot, and industry consultant. When he isn't on Search & Rescue operations he runs Vigilante Drones ([www.vigilantedrones.com](http://www.vigilantedrones.com)), and a nonprofit, Vigilante Cares ([www.vigilantecares.org](http://www.vigilantecares.org)), using drones as a therapeutic tool for veterans suffering from Post-Traumatic Stress Disorder (PTSD).



**D**rones have quickly become an indispensable tool in a multitude of industries. The versatility of the technology, coupled with a relatively low price point makes drones an attractive option for many including Fire-Rescue, SAR, USAR and Tactical operations. When considering adding drones into an existing SAR organization, one must first compare the needs of the Rescue team with the benefits of the technology.

I am a commercial drone pilot based out of the United States and have been privileged to be a part of several SAR units. I am currently a member of the Morongo Basin Search and Rescue Team based in San Bernardino County, California. Over the years, I have identified what I believe to be the most important benefits drones have to offer and some of the best drones to maximize these benefits.

### TOP FIVE BENEFITS

As innovations in the Unmanned Aerial Vehicle (UAV) space continue, the list of benefits will never stop growing. Some of the most valuable benefits currently available are thermal imaging, varied payloads, security and automation, increased intelligence, and a relatively low cost of acquisition.

Thermal cameras, like those manufactured by FLIR, are extremely useful in SAR. Thermal imaging in the right environmental conditions can be indispensable at finding lost people, particularly at night. While thermal cameras can cost thousands of dollars (USD), some drones under the two-thousand-dollar price point now have thermal imaging capabilities.

The plethora of payload options for drones makes the platform ideally suited for the unknown situations rescuers can find themselves in. Drones can carry cameras in the visible light spectrum, infrared optics, gas meters, spotlights, range-finding equipment, and a slew of other options. Some drones can deploy floatation devices or bring rescuers medical equipment such as automated external defibrillators.

Artificial Intelligence (AI) has come a long way since the early days of UAVs. Most commercial drones have securely encrypted signals which make them safe for first responders to use. Additionally, AI allows for obstacle avoidance and programmable functions such as establishing waypoints for flight patterns. In confined spaces this feature becomes very valuable.

Situational awareness is a critical component of successful SAR operations. An aerial perspective provides first responders with a better understanding of the region to be searched. Drones are not limited to only searching for a missing person. There are many other useful missions drones can fly. For example, in a forested area, drones can identify routes for rescuers to take through thick vegetation. At night, spotlights can guide a team to an injured person's location.

Finally, drones come at a price point that many organizations

can afford. In the United States, there are over 29,000 fire departments and 18,000 police agencies. Only about 70 of these organizations can afford the use of a helicopter for SAR missions. Many capable drones can be purchased at a price less expensive than the cost of fuel for a single helicopter flight. With a small investment in equipment and training, most SAR teams can bring drones into their program almost effortlessly.

### HIGH-END DRONES SUITABLE FOR SAR

SAR teams already convinced of the benefits drones bring to our operations will find themselves with countless drones to consider purchasing. Drones designed for SAR can run from a few hundred dollars to hundreds of thousands of dollars. Unfortunately, more expensive doesn't necessarily mean higher quality or more useful. In my experience, there are many drones on the lower end of the cost spectrum that are fantastic options for SAR.

There are four drones which I believe are excellent choices to consider for SAR missions. The first two recommendations are on the expensive side while the final two are much more economically viable. Each of these drones can provide all five of the benefits listed above at varying levels.

### DJI MATRICE 210



Headquartered out of Shenzhen, China DJI is a powerhouse in the drone world. By several accounts, the company controls roughly 70% of the drone market. The Matrice 210 is a large quadcopter built to handle harsh environments. The aircraft has an ingress rating of IP43. With a maximum range of 7 km and an operating time of up to 38 minutes in flight this platform is well suited for SAR missions. The drone's max payload is 2 kg allowing for two cameras at once. There are several choices available for optics on the platform. Many first responder agencies around the world use the Matrice 210. Although the platform is excellent, the initial investment is significant. The base model will cost over \$15K. Once you add all the extra batteries and optics, the total package can require an investment of over \$30K. The cost is high, however, if your organization has the budget to consider it, the Matrice 210 should be at or near the top of your list.

<https://www.dji.com/matrice-200-series>

### IMPOSSIBLE AEROSPACE US-1



This California based company is staffed with former Tesla and SpaceX engineers. The team took a page from Tesla and began their design starting with the battery out. The final product was the US-1 drone.

Almost the entire hull of the aircraft is full of lithium-ion battery cells. This design allows for an unmatched 78 minutes of continuous flight time. Even more impressive is a charging time of only 45 minutes. In theory, this means if a unit has two US-1 drones, they could maintain continuous aerial coverage of SAR operations indefinitely.

The aircraft can handle several different payloads depending on the needs of the operators. A single US-1 is about \$15K. With the addition of a mobile command station, the entire package is around \$25K. The company even includes a two-year "tip to tip" warranty.

<https://impossible.aero/first-responders/first-responder-page/>

### DJI MAVIC 2 ENTERPRISE DUAL

If you are looking for portability without sacrificing versatility, the Mavic 2 Enterprise Dual is a great option. The drone is foldable and easily fits into a backpack. The Dual has both a visible and thermal camera. Additionally, the drone has modular components that are very useful to SAR. The aircraft can be equipped with a spotlight, loudspeaker, and light beacon. Our picture shows the thermal camera option.



With a maximum flight time of 31 minutes, the drone gives plenty of time to search a remote area while investigating on foot or in hard to reach regions. The cost is much more digestible than the Matrice 210 or US-1 at around \$3.5K per unit. <https://www.dji.com/mavic-2-enterprise>

### PARROT ANAFI THERMAL

If you need portability but are looking for a more economical aerial solution, the Parrot Anafi Thermal is a great option. At under \$2K this highly portable drone has both a visible spectrum and FLIR thermal camera in the standard payload.

The drone and all the equipment you need for it can easily be carried in even a small backpack or side bag. The maximum



flight time for the battery on a full charge is 26 minutes. The manufacturer bundle for the UAV comes with three batteries providing SAR teams well over an hour of flight time.

<https://www.parrot.com/business-solutions-us/parrot-professional/anafi-thermal>

As SAR professionals, we are often the only hope someone has for rescue or survival. Given the critical nature of our work, we need every useful tool at our disposal. Drones are quickly becoming one of the most beneficial assets a SAR team can have.

Consider the missions your organization has recently participated in and decide if drones would have made your efforts more efficient. In most cases, the answer will probably be yes. I encourage you to research the platforms listed above and see if one works for you. In my experience, you will not be disappointed.



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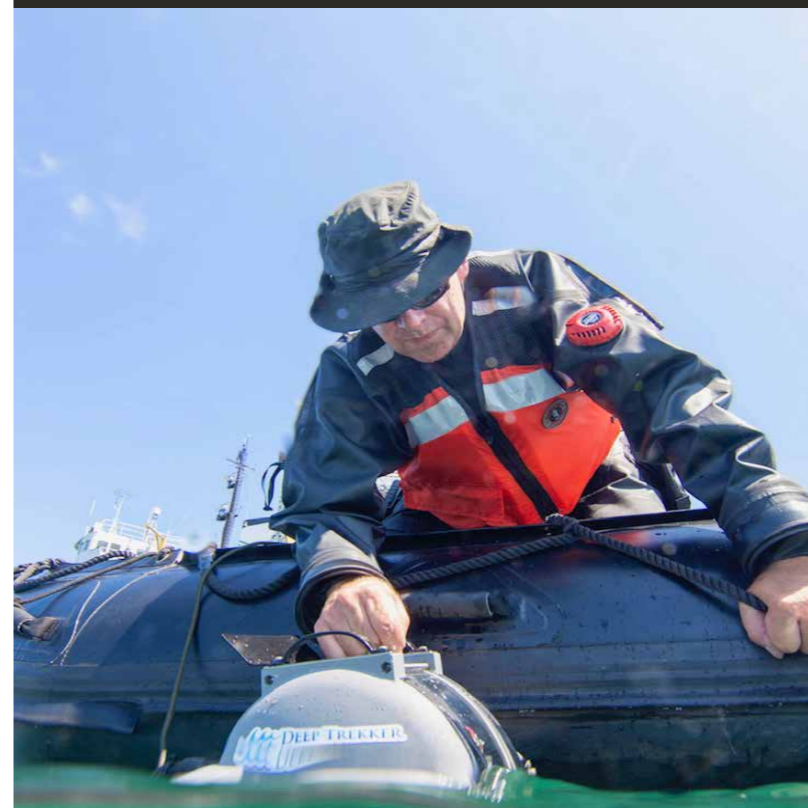


PHOTO COURTESY OF SCOTT MILLER CRESSMAN, NEW HAMBURG INDEPENDENT

# RESPONSE to CANADIAN FLOODS

## Bracebridge, Ontario 2019

### HOW ONE VOLUNTARY TEAM ORGANISES AND DEPLOYS to MAJOR URBAN FLOODING



by Gary Foo

Gary Foo is a Technical Rescue specialist in several disciplines and a Fire and Rescue trainer, A Paramedic, Former Armed Police Officer and a United Nations trained Disaster Response Coordinator and Team Leader.

After the area declared a state of emergency in April 2019, ERTSAR (The Emergency Response Team Search and Rescue based in Oxfordshire, England and Ontario, Canada) deployed members of its amphibious Marine Unit as a Specialist Water Rescue Team to the Floods in Ontario as a part of a combined government and emergency services response which included The Bracebridge Fire Service and the Canadian Military.

ERTSAR deployed its F.A.S.T. or Flood and swiftwater rescue teams at the coordination of the Bracebridge Fire Department to the front line of the floods for specialist duties.

#### TEAM LEADERSHIP

The mission was led by veteran of flood and disaster rescue missions, SAR Chief Gary Foo of ERTSAR who has deployed to many serious floods around the world. Gary always says to ERTSAR members that there are 3 essential base functions

of their Members especially those who are senior and in a Leadership capacity.

1. Safety & Welfare of the Team
2. Mission Objective & Achievement
3. Standards & Operational Practices

This is of paramount importance and forms a significant part of the whole basis of all members especially the leaders. It is not only essential to deploy a capable team and be successful in your objective but to do it whilst keeping the team safe and well.

#### TEAM COMPOSITION

The ERTSAR team were well chosen and all were members of the specialist amphibious Marine Unit. (To join the Marine Unit, one has to have passed basic training and be a member of the Operational B Squad before applying to the Specialist C Squad.)

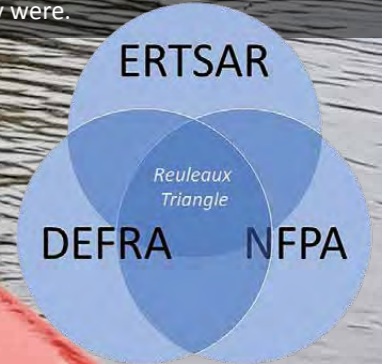
This Marine Unit team comprised of specially trained "F.A.S.T.





Main Pic: ERTSAR Marine Unit "FAST Team" perform an assessment at start of one of the many Flooded roads and areas. Note the Team follows the UK DEFRA Flood and Swiftwater Response, Helmet Colour Typing

specialist team tasked with Technical Rescue.) SAR Chief Gary Foo remembers meeting with The Chief Fire Officer John Parry and Assistant Chief Fire Officer Colin Thomas, at the time, and developing a strategic plan for their response to the worsening flood situation. It was very progressive thinking that allowed these Fire Officers to incorporate ERTSAR into their specialist Romeo Unit, Rescue Section. ERTSAR remembers being commended at the time for not only completing successful rescues but for detailing essential administration and documentation record in their reporting back to Bronze and Silver (Tactical and Operations) Command. Documentation is an important part of Flood Response but often missed in training. The team knew from then that the recording and documenting of the incident and its details was not only needed but essential. However, the other issue to consider is the fact that it's not always easy to do this contemporaneously as one would like. Practical and efficient systems would need to be developed and subsequently were.



TEAM" (Or Flood and Swiftwater Rescue Technicians), many with Fire Service or Emergency Service backgrounds, and they understood the mechanisms of Emergency Response through their training and professions.

**TRAINING STANDARDS**

We are often asked about the many training standards we use. Obviously, internationally, we have a lot of UN (United Nations) based requirements ones or WHO (World Health Organisation) for Medical response. The main base training and certification standards for team members to deploy and operate in this "National Flood" environment is the NFPA (National Fire Protection Association) 1006 and 1670 standards for Flood and Swiftwater Operations (i.e. Chapter 16, 17, 21 & 22, etc.) The Team is also UK DEFRA (Department for Environment, Food and Rural Affairs) Module 3 and 4 trained (according to the UK DEFRA Concept of Operations or "ConOps".

In the Venn Diagram opposite you would see that many of the techniques used for rescue and operations are the same or closely similar although there are definite differences too. If the Reuleaux Triangle (the triangle at the centre of the diagram) were to scale, it would actually be much larger

than in the graphic below as the commonality from all three has been built into the ERTSAR / Marine Unit training to include ERT SAR Marine Unit standards, The older and more international NFPA standards, and the newer and more local UK DEFRA Flood Response Standards. ERT SAR has many years' experience deploying to Flood and water events (including storms and tsunamis) and have made it a priority to not only train in the actual type of hazard (i.e., Flood water) but prepare for the events around the hazard like building collapse, downed trees, vehicles and gross contamination. These are often best addressed at the time rather than later, such as the need to perform local assessments and analysis and complete field reports as this is a dynamic and ever changing environment.

**PREVIOUS LESSONS LEARNED FROM 2007**

ERTSAR Marine Unit had deployed to the UK Floods in July 2007, pre-Pitt Review. It had deployed to Water Rescue Missions before and many since, but that was significant for the development of their documentation and admin system. Working around the clock on 24-hour shifts for over a week, some two dozen members of ERT SAR worked closely with the Oxfordshire Fire and Rescue Service "Romeo Unit" (The

## BRACEBRIDGE FLOODS: WHAT HAPPENED?

ERT SAR deployed after a State of Emergency was declared by the local town and area. This event was referred to as a “One in a 100 Years, event” as floods continue to be described worldwide despite their growing frequency. In Breckbridge, after the snowfall of the winter, there was a rapid spring snow melt. The ground was still very frozen and the water table was significantly affected and unable to accommodate the additional precipitation. However, there were several heavy rain events that culminated in abnormally high cumulative rainfall for April and May and that compounded the issue.

During this time, Quebec, Ontario and New Brunswick were being threatened by increasing floods with properties and lives under threat. The team kept abreast of the developing incident monitoring local news outlets as well as keeping in close touch with the authorities.

ERTSAR was in liaison with all levels of Government including Federal Minister of Public Safety Ralph Goodale, The Ontario Premier, Doug Ford and The Bracebridge Mayor, Graydon Smith. ERTSAR deployed under the Command and Control of the Bracebridge Fire Chief Murray Medley and the Deputy Fire Chief Jared Cayley. D/Fire Chief Cayley was also the EMO Lead Liaison. It was a very busy time and these public servants were seen working hard for the Canadian people delivering updates and briefings and coordinating affairs.

## ANATOMY OF A CALL OUT: MOBILISING

As usual for these types of incidents things evolve quickly but some aspects of the build-up are also predictable. For example, there was a visible increase to water where it should not be with a faster and more voluminous body of moving water. Combined with environment and weather predictions that basically stated “more precipitation is on the way” and with all the other factors it was clear that the worst was yet to come. ERTSAR trains year around for this type of thing, whether national or international disasters and emergencies. It is important to be useful and ‘self-sufficient’ when deployed, nationally or internationally.

So ERTSAR had been “monitoring” (one of the phases of mission readiness and deployment) early on. ERTSAR specific specialist units were notified using the Team’s Intranet and smartphone apps stating that we may get a deployment and go to a “Monitoring: Level 1 Stand By.” This means that the team are even better prepared and quicker to respond if and when the actual Green Light is given for a call out. Consumable kit is pre-packed and everything staged and equipment assets readied.

## DEPLOYMENT CALL OUT

The “Call Out” is the operational “Green Light” to deploy (usually from the coordinating authorities) to the disaster or emergency. After some 20 years and even more of group experience, this procedure is now fairly well honed. Even so, ERTSAR tries to be better each time with briefings and lessons learned / AARs (After Action Reviews) and debriefs. The method used is that the Command Level seniors use the team’s Smartphone app combined with phone “Group Texting”

and email to ensure a full operating picture and preparation is good prior to a deployment.

The mission gets named and “An Overhead Team” (a type of Management Team) is assigned and a communication log was started using WhatsApp\*. The mission complement including the Overhead Team was about 12 members. Sometimes we assign an “SAP.” An “SAP” in ERTSAR is a small mobile advance team that goes ahead, makes useful assessments and gives intel and feedback, and even gets things started for the main arriving team – which would have most of the operational assets and gear. We decided not to do this, in this case.

## NAMING MISSIONS:

As a rule, ERTSAR names all operational deployments and many larger scale or significant training exercises. International and some national missions are named after an animal with some connection to the area or environment. But sometimes we use other naming rules. This mission was given the short name “Op INUNDATIO (19)” and the long name was: “Bracebridge Floods Operation INUNDATIO: BRACEBRIDGE 2019” Inundatio being the flood reference in Latin.

## TEAM ARRIVAL



ERT SAR Members Ryan Faye and Josh Foo attend the Briefing with the Military in Bracebridge. Both are senior members and on the Management Team in ERTSAR. Ryan is also a Full Time Paramedic & Josh is a Full Time Fire Fighter.

Upon arrival ERTSAR immediately entered an Operational briefing at the Fire and Rescue Headquarters in Bracebridge. This was conducted by the Deputy Fire Chief, Jared Cayley and attended by other operational leaders including the Canadian Military senior officers. The AO (Area of Operations) were drawn and assigned and operational capacity and duties clarified.

## OPERATIONAL SCOPE

ERTSAR deployed to the front line of the floods. It was raining and quite heavily at times. These things affect little things you have to think about like the ability to performed written assessments in the open and whilst stood in cold Flood waters.

## ASSESSMENTS

A lot of people may think that the mission is all Emergency Response and life saving rescues of people in the Flood affected areas, however that is not the only activity.

Whilst we never touched a sandbag or built any preventative flood defence barriers in this instance, we certainly would have if needed. Our main scope of operations was typical front-line flood response and when not responding to calls for help, that involves going door to door and street to street performing Welfare checks and Area Surveys and Assessments and they need to be recorded and fed back to the powers that be.

## NEEDS AND DISASTER ASSESSMENTS

SAR and Flood Response Teams are often the first ones to an area hit by the hazard your “Needs Assessment” is a priority because some people can’t call for help and you may be the first to see them or check on their welfare. Urgent Rescues may be needed. This will also be the life impacting urgent needs, rescues, relief, aid delivery, food and water needs, children needing formula and pets needing food or attention. Second, your “Disaster Assessment” will also find concurrent surveys and assessments of the affected area and properties. How is the property and area affected and impacted by this disaster? Power and communications lines may be out. Conversely live power lines could be exposed and arcing and gas mains breached leaking natural gas.

Buildings may be affected or damaged and off their foundations and even worse than this people may be stuck or awaiting rescue, especially the vulnerable, elderly or infirm.

This combines the reporting on both types of “Assessments.” It is important to remember that the collection of information and data at the front line is important and it must be practical to do, too. The documentation of information would include but not be limited to:

- Needs Assessments
- Disaster Impact Assessments
- Current and Forecasting conditions
- Notable hazards and comments
- Local Occupants & information etc.

## DATA COLLECTION & REPORTING

The key here is to create data collection forms that are simple but effective and comprehensive enough. They also need to be practical so that information can be collected in the rain or any hazard-zone and ideally, they should be pre-filled check sheets rather than individual long forms with ease of completion considered. In ERTSAR’s case, it is not usually completed by the person actually “knocking the door” per se, although can be.

In the end, the floods caused untold damage and affected thousands of people.

ERT SAR went to the homes of hundreds of them and performed all manner of duties, rescues, response, documentation, deliveries, transportation and hazard reporting etc. The team commends the Fire Chief Medley and Deputy Fire Chief Cayley.

As Fire Rescue Professionals they would know what a Flood and Swiftwater environment was like and the hazards and harsh conditions the team would face.

So, the system worked well because not only did they trust ERT

SARs specialist capacity, training and experience, but they also allowed them to work interdependently with their department, supporting them in their needs as they did, for the benefit people of the Town. This allowed quick and effective resolutions when decisions and action was required in real time.

## DEPLOYMENT KIT AND EQUIPMENT

Relevant kit and equipment taken included

1. Dry suits, helmets, PFDs. Throw bags etc.
2. Tech Rescue Kit & De-Con for the team
3. Water Rescue Powerboat on boat Trailer
4. Vehicles: 4x Off Road 4x4, 1x Command C2
5. 1x 2Tinga Water Rescue RIT Craft
6. 1x 8-person house to house paddle craft
7. Assessment: GPS, Depth gauge & SONAR
8. 3x Aerial Drones / RPAS / UAVs
9. Night Operation lights & hazard marking
10. Motorola waterproof Marine Radios etc.
11. Additional Operational & Flood Kit: (Repair & Maintenance, Animal cages, Re-Hab kit, Power generators, etc.)

## AAR & LESSONS LEARNED

ERTSAR functions very strongly on SOGs / SOPs (or Standard Operating Guidelines and Procedures) but also, it is important to have some leeway for individual or creative decisions in a dynamic environment within that scope of practise.

It’s important that everyone knows the SOPs and that everyone trains regularly. Lessons learned should be an opportunity to develop and be better.

Upon completion of major events or at the end of the deployment there should be an AAR or After-Action Review and De-Brief.

This not only nicely wraps things up and ‘closes the loop’ but also helps ensure the team are well mentally and physically and that they are allowed to process and communicate and even improve as a result.



## CLEAN UP & DECON

Every day there was a clean-up and at least Level 1 – De-Con involving a hose down and wash of any drysuits, boots, boats and kit that had contacted the flood water and other possible mission contaminants.

After the deployment, on the last day and with some press interviews and post-mission administration, there is a final deep clean up and everything is put away clean and ready for the next use!

# Space Creation.....

# Assisted Dash-Roll

It's a dash displacement Jim, but not as we know it.....

by Rich Denham & Nick Appleton



**TRM Extrication Editors:**  
 Veteran London Firefighters and instructors, Rich is now consulting and training in Latin America and Nick is not in prison, as this bio pic implies, he's with Babcock PLC under contract to London Fire Brigade

## INTRODUCTION

This modified technique is a mix of two long established techniques, which, for an investment of seconds by a practiced crew, creates far more space than either a dash-roll or a dash-lift could ever achieve in their own right!

## CONTEXT

The dash-roll is the most common method for creating space to release dash-trapped casualties and continues to be the most effective technique employed for this purpose.

In some cases the dash lift may be used as an alternative when it is not possible to use rams – see the pros and cons of both evolutions in the table below.

It is important to remember that the entrapment of the casualty always needs to be established and dealt with first. This is to ensure that if the medical situation dictates a rapid extrication without time available for full space creation (e.g. roof removal), then a safe, practical and effective alternative is available immediately.

Due to the structural integrity of modern vehicles, if a casualty is trapped by dashboard intrusion it will be as the result of a destructive high energy impact and the resulting vehicle deformity will indicate the likely presence of time critical internal injuries requiring early casualty removal.

## ADVANTAGES OF THE ASSISTED DASH-ROLL

- Only one side of the vehicle needs to be accessed
- No requirement to cut upper side rail
- The spreader back up allows the ram to be removed without any drop in the dash so that the casualty then has the necessary space to be extricated out of the side of the vehicle
- Alternatively a further extension piece can be added to the ram in order to increase the space being created
- Greater space creation possible than with just a lift or a roll

## STEP BY STEP PROCESS

Before undertaking the detailed sequence on the right you must first have risk assessed the whole process in context and have implemented all safety measures necessary in accordance with your organisation's own policies and protocols, which will ALWAYS take precedence.



**STEP 1** remove front door on side of vehicle to be accessed

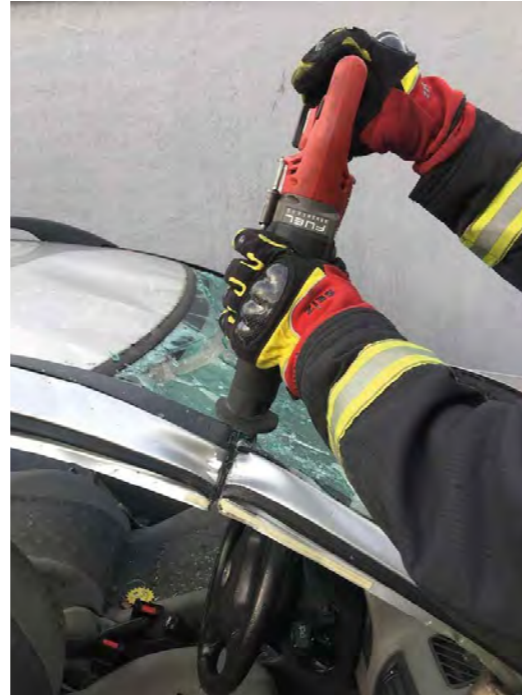


**STEP 2** After blocking under both the A and B posts, make a relief cut in base of A post. Generally and on saloon cars this would be horizontally and just underneath the reinforced structure of the lower hinge. This positioning may need to be adapted on larger vehicle structures to allow for effective tip positioning and lifting

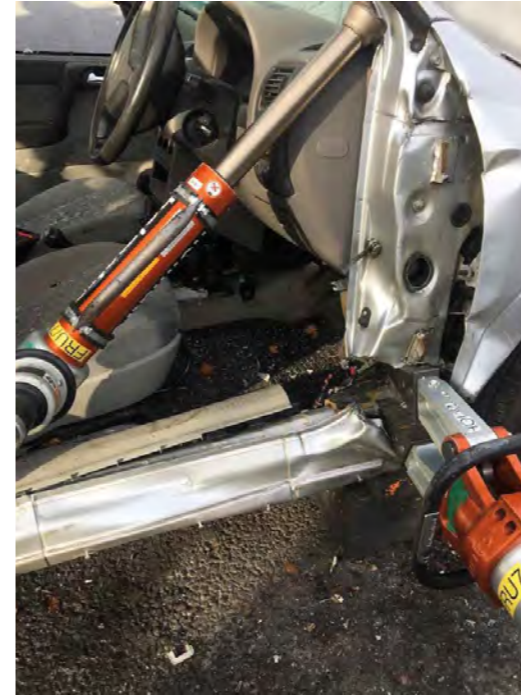
TECHNIQUES	PROS	CONS
<b>Standard Dash-ROLL</b>	The go-to technique to create space between casualty and dashboard	Both sides of vehicle usually need to be accessed to perform this evolution effectively
	Simple technique to perform	The ram will partially block the egress of the casualty
<b>Standard Dash-LIFT</b>	Only one side of vehicle needs to be accessed	Can be very time consuming due to significant amount of preparation work required involving cutting completely through upper side rail behind suspension strut



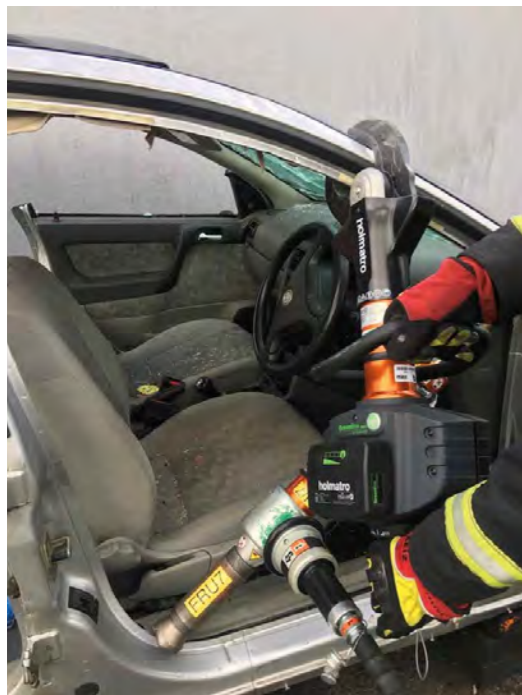
**STEP 3:** Insert the stationary ram base into the junction of the floor edge with the B post. Extend the ram arm until its head engages with base of the A windscreen post  
Note that a short extension piece has been attached to the ram base for the initial ram arm extension, in order to fit within the initially available space.



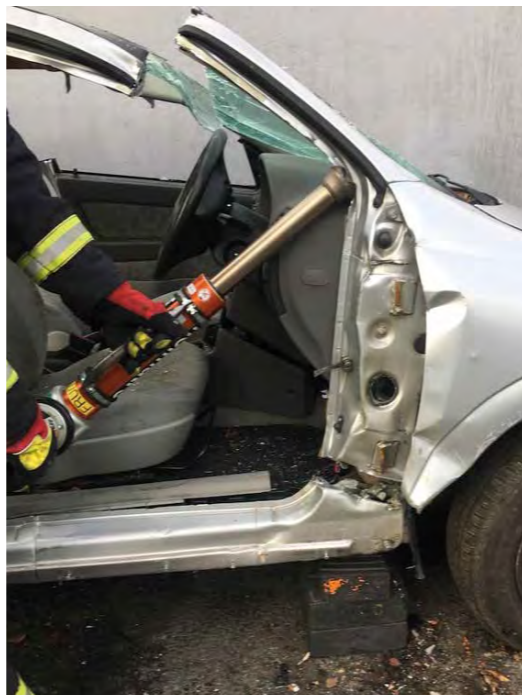
**STEP 5:** Fully cut across the windscreen glass to the opposite A post using an electric reciprocating saw



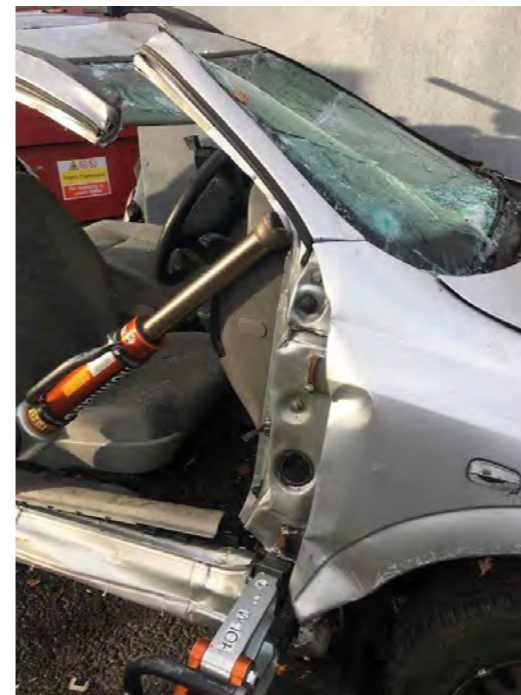
**STEP 7:** Insert the spreader tips into opened relief cut, with the upper tip and spreader arm inclined slightly to the front of the vehicle. This will allow for the fact the A front door post will rotate in that direction rather than be lifted vertically.



**STEP 4:** Cut the A post in high position to ensure steering wheel (if driver side) does not impinge on windscreen



**STEP 6:** Extend ram sufficiently to open up relief cut in base of the A post to allow access to the closed spreader tips



**STEP 8:** In small increments alternate extending the ram while progressively opening the spreaders

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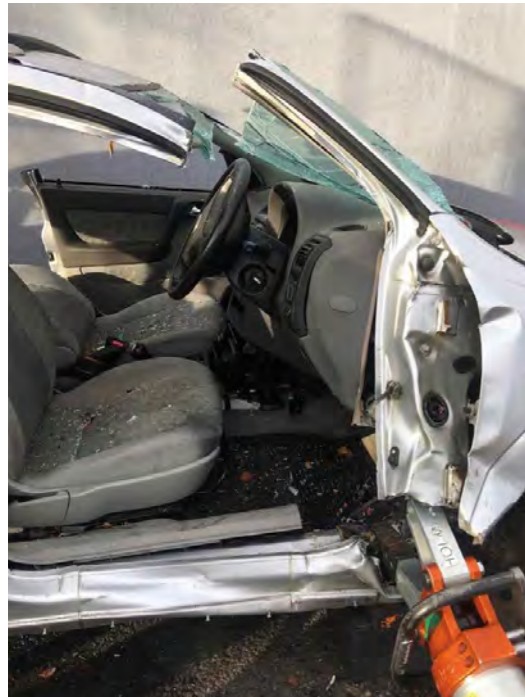
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**STEP 9:** Leave the spreaders in place whilst removing the ram to ensure that the dash cannot drop back onto the trapped casualty and also to give full egress space through which the casualty can be extricated via side of vehicle.



**STEP 10:** If additional space is required then swap in a longer extension piece to the ram and repeat the process until sufficient space is created (ram can be removed with spreaders in place to allow casualty extrication).

Note that in this photo a medium extension piece has replaced the earlier short extension piece, in order to assist the creation of further space

**CONCLUSION**

In the introductory paragraph we talked about how effective this technique is with a practiced crew. Certainly they must be able to judge the correct depth of the relief cut and then ramming just sufficiently to allow effective entry by the spreader tips. Then how to exploit that gap with spreader use so that both tips gain sufficient initial purchase and can then maintain safe and effective placement throughout the lift, which must alternate the use of each tool in small steps and be coordinated by the ram operator. 'Big picture' monitoring by a safety officer, looking for structural displacement onto vehicle occupants and any unsafe circumstances is also advised.

Finally, once the technique has been practiced and mastered on un-deformed cars, crews will need to practice on vehicles with realistic deformity and ideally containing a casualty (mannequin ?) – so as to be able to cope with the significant operational challenge of actual dashboard entrapment. And in these cash-strapped times cultivating and maintaining a good working relationship with a local scrap (wrecker) business is vital in getting not just cars to practice on, ideally at their premises and at no cost, but also a facility to create realistic 'accident' damage on these vehicles.

**WHAT'S NEXT ?**

We'll continue the Dash displacement theme in the next article by carrying out an inverted version of the technique that we've just described.....

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# TACTICAL BAILOUT

## A comparison of currently available kits and alternative uses

by **Roland Curll**

Roland is Technical Rescue's Contributing SAR & Tactical Editor and is a veteran of the Police Rescue Squad in New South Wales, Australia covering the city of Wollongong and surrounding Nepean River basin and Royal National Park.

The Bailout Kit, also known as an Escape Rope Kit, is not a new subject for readers of Technical Rescue Magazine. This subject has appeared several times in past issues including as recently as issue 76 with a GUIDE to Escape/Bailout Descenders. These articles have mainly been concerned with bailout kits as used by firefighters to escape burning buildings using a rope with fire retardant properties and often a large hook for anchoring the rope inside the building, or on a window frame. The principles behind this system also has applications in the tactical world for military and law enforcement personnel.

Military and Law enforcement teams use bailout kits to access or escape multi-story structures and other types of elevated terrain fast. A system which is lightweight, quick to deploy, and easy to use whilst under duress in extreme situations. Rescuers or firefighters use an escape kit as a last resort to escape a collapsing or burning structure; tactical operators might one for the same reason but they may also have an equally urgent concern with incoming hostiles, artillery, aircraft or other imminent explosion. It might also be a consideration for a parachutist stuck in a tree or on transmission lines.

In issue 76 the Guide to bailout descenders covered 35 auto-stop descenders, but there are also many manual descenders including as figure eight descenders. Any of these devices could be used in a tactical kit but aside from any that are specifically designed for the military we can trim down the options by only choosing those using small diameter ropes and/or those produced in black. This can be a reasonable indication of suitability to tactical tasking but could equally be intended for the burgeoning theatrical rigging-market which is not normally associated with high speed, urgent duty descents! If you add into the kit-mix the different ropes, carabiners and anchorage options and it's clear that we could not hope to cover all of the bailout kits in this one article, but we think we have the key considerations.

Before we discuss the wider system options, one bailout kit stands out in this tactical genre and deserves a special mention. The Highnovate QRAB system is a tactical-specific, auto-stop descender. But what makes this particular device unique is its ability to be quickly released from the rope by simply pushing the red button once the operator has completed the rappel. This is a significant advantage for tactical operators needing to clear the rope quickly. Once the operator completes the rappel a quick push of the release button allows them to then get away from the building instead of trying to disconnect a carabiner. As a safety feature, the quick release of the QRAB will not work if the button is accidentally pushed whilst the operator is still suspended halfway through the rappel. When the operator is safely on the ground and their full weight is not hanging from the device, only then will the quick release work. This could therefore also be a useful heli-ops device?

There are basically three types of bailout kit:

- Autolocking or brake-assist devices which lock when you release the rope and handle
- Manual, hands-on devices with braking controlled by the user but release of the rope leads to freefall
- Inertia type devices which are not tactical in the sense that they have a set and relatively slow speed of descent but that can be used by injured operators or colleagues can make an assisted exit by shoving an injured off a high structure, safe in the knowledge that the casualty will reach the ground safely, eventually. Most inertia devices are too large for tactical operations but some like the DEUS 3100 (pic right) are small enough to be worth considering as a single addition to a team kit rather than individual issue.

Bailout systems use skinny ropes which usually range between 6mm and 8 mm in diameter allowing the user to carry a kit which is lightweight and compact. Whilst tactical teams may choose a bailout kit involving ropes as small as 6mm in diameter, firefighters who need to comply with the NFPA (National Fire Protection Authority) standards are unable to. To conform with the NFPA Bailout System Certification the minimum diameter of a rope allowed in a bailout kit is 7.5mm and the maximum is 9.5mm. This is under the NFPA 1983 (2012) standard for Escape Ropes (or NFPA (E)). This also requires a maximum breaking strength of no less than 13.5kN. The NFPA has added additional categories which outlines the performance requirements of escape ropes. These categories include: -

- Escape ropes
- Fire escape ropes – where the minimum melting temperature of the rope is 400 degrees F.
- Escape webbing
- Fire escape webbing – where the minimum melting temperature of the webbing is 400 degrees F.

ISSUE 77 TECHNICAL RESCUE

A simple looking descent control device for a bailout kit for firefighters is the Sterling F4 Escape, which is an auto locking device which is low profile and works with 7.5mm rope so that it meets the NFPA standard for Escape Ropes. This replaced the slightly smaller F3 kit which was designed to work with the Sterling's 6mm TRC rope with a nylon core and a Technora sheath and rated to 15.5kN.

The basic, quick and easy version of a bailout kit which is sometimes still used, even though it does represent 'old school', is a small figure eight descent device like the 2oz/60g Rock Exotica Mini8 and 1.5oz/43g CMC Survivor8 on the right and a length of rope with thin diameter. There are a number of reasons that this type of setup is still being used, including the idea that it can allow the tactical operator to rappel fast. This is a simple system but when being operated it does require the user to have constant control and they will need to be wearing gloves. The smaller the diameter of a rope the more difficult it is to grip the rope in order to control the rate it slides through the figure eight descender especially when wearing gloves.

An auto-stop descender makes control of the descent much more manageable and the number one reason for its use is that when the user lets go of the device it automatically stops without the need to tie or lock it off manually. An auto stop device allows the operator to have better control of their

descent rate in order to negotiate obstacles, and to also stop quickly to go 'hands-free' should they suddenly be required to handle weapons or perform other tasks. An older method of auto-stopping involved a figure eight device with an attached prusik, but this requires the prusik to be unlocked to enable the descent to continue, whereas an actual auto-stop device allows the descent to quickly continue, there would seem to be little point in using this setup unless it was jerry-rigged because an autolock is not available.

In *TECHNICAL RESCUE* Issue 50, Greg Churchman wrote about the Petzl EXO, and this device was also mentioned again in Issue 76. The Petzl EXO was a response to the fatality of two FDNY firefighters and the serious injury of another four FDNY firefighters on the day now known as Black Sunday in January 2005, the device is a modified Gri Gri with a springless cam. It



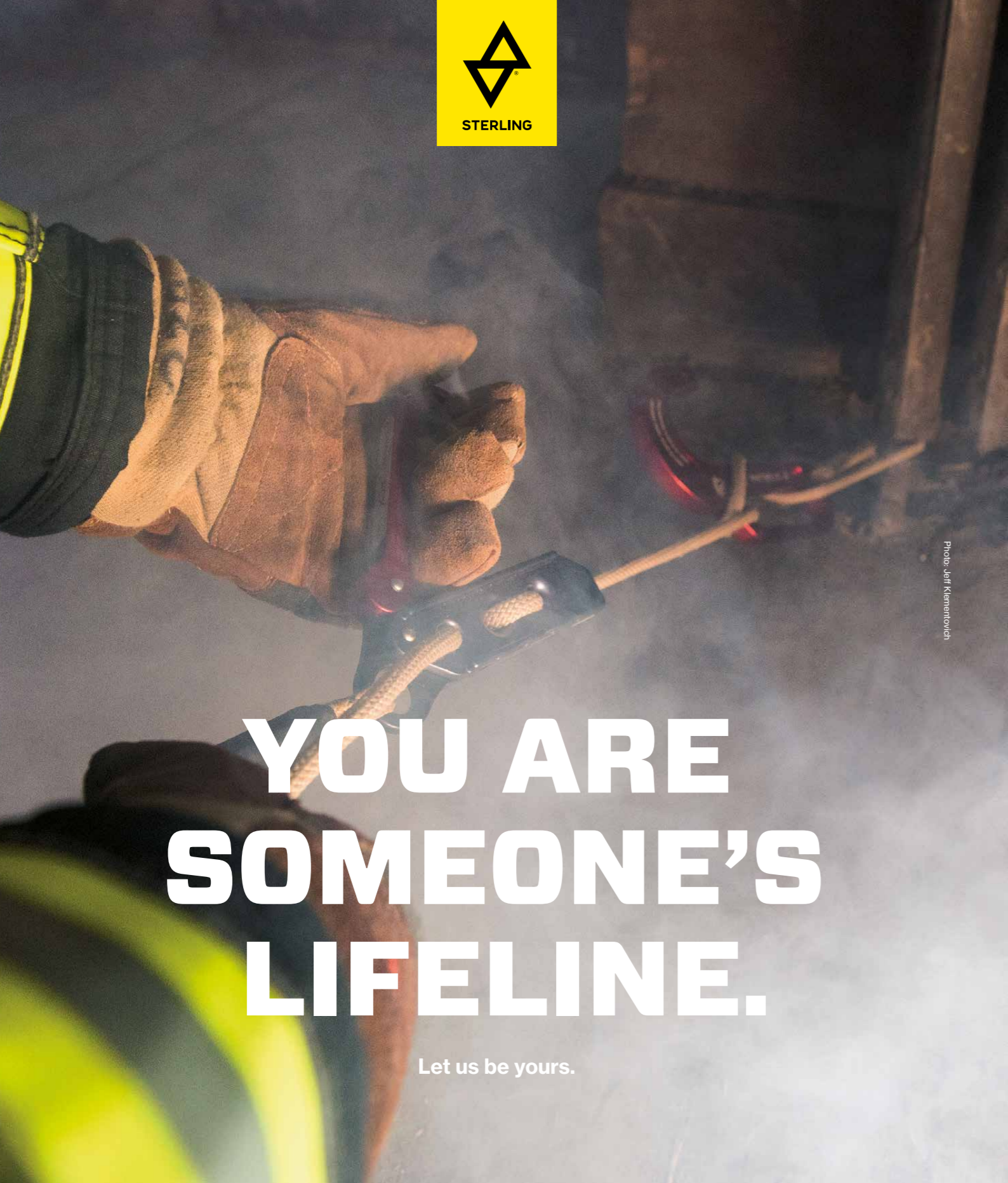


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- Can be used for partner/civilian rescue

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has a release handle which folds out of the way to prevent snagging and accidentally causing descent. After the release of the Petzl EXO people's interest in bailout kits increased substantially. Sterling Ropes developed the fire escape rope for the EXO system which is 100% technora. This later led to a tactical version of the kit being produced. In 2006 the Military contacted Petzl because they were also after a system that was lightweight, easy to use, and could perform in the harsh environments where tactical teams may from time to time find themselves operating. This resulted in Petzl modifying the descending device of the EXO with an open rope control hook rather than enclosed 'U' (pic: red EXO inset right) and changing the red firefighter hook to a Petzl Eashook or Petzl Am'D carabiner for anchoring. The tactical EXO descender (right) does not have an anti-panic feature like the EXO AP, so it will not stop if the handle is pulled too far in a panic. This is NOT bad news for military and law enforcement it is an essential feature because it allows fast rappels without the device locking up if the lever is pulled too far, but this fast rate can also cause a build-up of heat. EXO is one of a handful of tactical descenders that allows quite easy one-handed use where the trail-rope sits in the same hand as that which is controlling the handle. The full kit is about 2.7lb/1220g in weight with a strength rating of 22.3kN. The rope is 7.5mm in diameter and is made of 100% Technora which means it has heat resistance. It has a work load limit of 308lb/140kg, which is just enough when you consider wearing a ballistic vest, along with weapons and equipment which can add weight to a tactical operator who needs to rappel.

The NFPA defines the bailout system as a kit which includes a hook, an escape line, a descent control device, and a tether. This obviously concentrates on the firefighter version of a bailout kit because it mentions the hook. Most tactical bailout kits do not come with a hook for anchoring like the fire fighter versions although the new Helix Personal Escape System (PES) does provide the option of having a Sterling Lightning GT Rescue Hook included in the kit. Instead, when talking about the 'hook' of the system they usually have some type of carabiner for anchoring which is based on the preference of military and law enforcement personnel. The hook on the fire kits can be used to lock into a window frame, but the carabiner

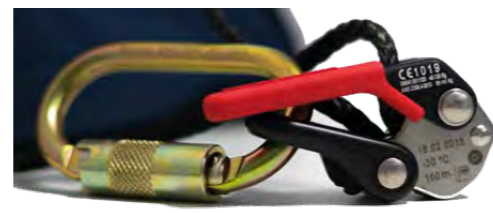
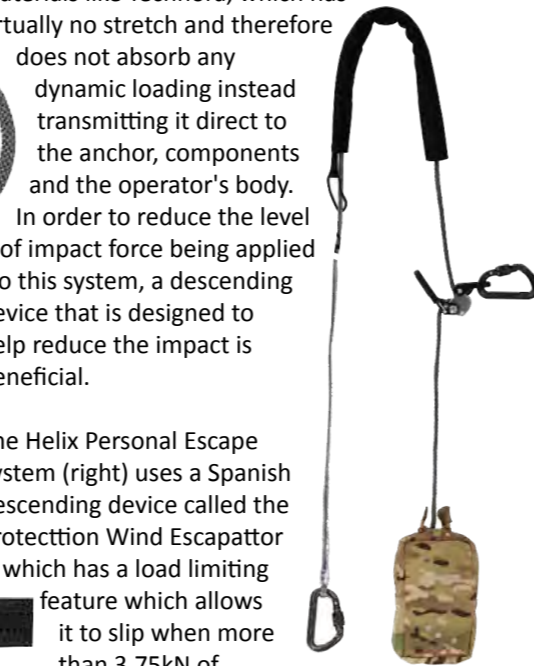
doesn't allow this so the anchor point may be further back into the room in which case the length of the rope in the kit needs to be long enough to run the full distance from the anchor set back in the room, to the window or balcony, and down to the ground. This also means that the descending device needs to allow rope to be easily pulled through the device in order to reach the window after setting their anchor. A carabiner also requires some improvisation when establishing an anchor as a matter of urgency; this requires intensive specialised training to avoid any mishaps.

With the firefighter bailout kit using a hook, egress is less forgiving than a carabiner because load needs to remain on the hook throughout the exit manoeuvre. For tactical bailout kits a specialised technique involves sliding the body out the window in a head first fashion; referred to as 'spidering' amongst other names. This can help to reduce the dynamic loading of the rope and can help to ensure that all the equipment which the user is wearing clears the window and does not get caught on edges.

Ropes are designed to hold a specific load, in this case a human being. But when the idea is to 'escape' out a window, it means to get out the window quickly and this hastiness is what can cause dynamic loading. This is something to consider with modern rope materials like Technora, which has virtually no stretch and therefore does not absorb any dynamic loading instead transmitting it direct to the anchor, components and the operator's body. In order to reduce the level of impact force being applied to this system, a descending device that is designed to help reduce the impact is beneficial.

The Helix Personal Escape System (right) uses a Spanish descending device called the Protection Wind Escapattor which has a load limiting feature which allows it to slip when more than 3.75kN of

force is applied to reduce the impact. The Petzl EXO descender (left) also limits the amount of force that is transmitted to the user in the event of a fall.



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The Quickie Descender (right) is part of the CTOMS TRACE system and also provides slippage in the event of a fall to reduce the amount of force from dynamic loading. TRACE stands for Tactical Rope Access and Confined space Extraction. It is a micro rope rescue system which utilises a specialised 6mm rope and other specialised components to form a number of different lightweight kits called TRACE kits. These are designed for emergency egress, tactical rescue, tactical rappels (CTOMS refer to this as Rope Assaulters) and assault climbing. The Quickie Descender auto-stop device is the key component of most TRACE kits and when used with the Sterling TRC rope maintains a 10:1 static system safety factor (SSSF) for a 1-person load. It is designed to slip at around 4kN which allows the Quickie Descender to be used in another TRACE kit as a belay device for lead climbing when used with the TRACE systems rope, after specialised training of course. Friction can be added or reduced with this system simply by placing the rope inside or outside the V-groove of the descender. And like the tactical version of the Petzl EXO, the Quickie Descender does not have a panic brake if the handle is squeezed too hard.



CTOMS does provide specialised training for the use of the TRACE system because it has its own specific rules for use, for example, it is designed to prohibit the use of knots in the system as this could reduce the required strength of the rope involved, but this training is designed to maximise the strength of all its components.

## CUSTOM KITS

Some bailout kits are sold as a complete kit which is pre-made, or you can create your own by obtaining the individual components and constructing it yourself. Companies producing ready-made kits take full responsibility for the compatibility of components. If you opt to create your own bespoke kit you will need to ensure that all components are compatible with each and the mode of intended operation. Because these kits utilise new types of small diameter ropes it means that their descenders need to be specifically designed for such ropes. The manufacturers will have carried out exhaustive testing so you are advised to stick with their recommendations for your own kit and only vary the bag and anchor options.

## PETZL CUSTOM PACKS

Petzl is introducing the EXO customisation program, where you

select the specific parts of the EXO kit: -

- **ROPE** – you can choose whether you want the tan or the grey coloured rope, if you want a sewn eye-loop at the end of the rope or not, and what length you would like the rope to be (5 – 150m /16'-500' in length).
- **ANCHOR CONNECTION** – the Hook which the firefighter system has, or for the tactical system there is a black Petzl Eashook Open, or the Petzl Am'D carabiner which can be silver or black with the Petzl Captiv positioning bar to help keep the carabiner correctly orientated.
- **DECENT CONTROL DEVICE** – Firefighters can choose the Red EXO AP (that has the anti-panic feature) with a closed brake/rope guide, or for tactical there is the black EXO with an open brake (without an anti-panic feature) as already mentioned.
- **HARNES CONNECTION** – for connecting the EXO to your harness, you can choose which type of Petzl Am'D carabiner you want (black coloured twist lock, black or silver Triact-lock), or the OK Triact.
- **CARRY BAG** – you can even choose which bag you want to carry the kit in, such as the EXO bag with yellow stripe for firefighters, the black EXO bag for tactical operators, or some may prefer the Petzl Pro Bags (bucket, toolbag). You could request no bag at all. This customisation program is not official yet, but it does sound like a great idea and other companies are also considering their own version of this idea.

## ROPE

Ropes which are constructed from 100% Technora have a lot of strength, however continually using this rope tends to result in loss of residual tensile strength a lot quicker when compared to a rope which is not 100% Technora, such as a polyester sheath, nylon core rope. But this may vary and there are several factors involved when coming to this conclusion. Other than continual use, other factors which can influence the stiffness, or the strength of the rope include knots, abrasions, and the bending or kinking of the rope.

New rope constructions and new hardware has provided an improvement in the calibre and size of bailouts kits which means that the operators are now far more likely to carry the kit instead of leaving it in the vehicle. Typical of this explosion of smaller-but-stronger kit is the Sterling XTec rope which is made from Technora and has a strength rating of 21kN which is pretty impressive for a rope which is only 6mm in diameter. The Helix Personal Escape System (PES) has gone even smaller than 6mm rope. This kit uses 23m of 5.5mm Technora aramid rope. Another kit which is available is the CMC LEVR escape system which uses NFPA certified 100% Technora fire escape webbing, instead of rope. It is rated at 27kN, but a tactical version of this kit has not been designed by CMC at this time.

## EDGE PROTECTION

Even though these specialised ropes are strong and resilient to abrasion, the diameter of the rope is so small when compared to an 11mm rope, or even a 9mm rope that they can be vulnerable. The contact area of the rope on an edge is much smaller so there is less rope surface area to dissipate the abuse of being dragged across a sharp edge by your falling bulk. So special consideration should be taken into the use of edge protection.



The majority of protective 'roll-ups' are familiar to all rope users and these are the only things small enough for compact kits but one deserves special mention as something a little different. The CTOMS Edgepro™ internally wired edges to allow you to 'mould' the pad to better grip the edge and a toughened skin which can be replaced.

## OPERATIONAL CONSIDERATIONS

Unlike an increasing number of fire services/depts, tactical operators don't routinely carry a bailout kit. Sometimes it is one team member's responsibility as the rope specialist to try and get the team to safety with a minimal amount of equipment. Just one kit may be all that is available to evacuate a team. Conversely there could be a scenario where everyone on the team has a bailout kit, but there is only room for one person to fit through the egress void/window frame. Under these circumstances operators would probably use the same rope but be able to take off their own kit's descender and use that on the rope already rigged. This is an important consideration because in many kits designed for firefighters the descenders are 'fixed' to the rope and cannot be removed without tools – again a safety measure for less well trained operators. Other scenarios may include needing to operate the system

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# GEAR SPOTLIGHT

with one hand. This is possible with devices like the Petzl EXO by holding the handle and the free end of the rope in the one hand freeing up the other hand for things like weapons handling. In this mode, most right-handed operators will have the rope deploy from the left instead of the more usual right side as would be the case when rappelling with two hands. This single handed manoeuvre requires plenty of training and familiarisation.



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slip would compromise the mission. It could be used for hasty rescues by lowering a casualty, or it could be used as a throw line. The firefighter version of the EXO has a closed metal U shaped rope guide which keeps the rope in place, but the tactical EXO has an open rope guide which works the same, but because it is not a 'closed' guide it allows the rope to be removed from that section so it can be used more easily as a progress capture device for ascending instead of needing to pull a bite of rope through for each throw. The EXO works well for progress capture and by adding a Tibloc can turn the kit into a rescue system especially if you can improve efficiency by including a pulley as shown left. The skinny 7.5mm rope can be difficult to grip due to its narrow diameter especially if wearing gloves. But using an extra Tibloc and an Sm'D carabiner (or Petzl Basic) can be used to make it easier to grip the rope when hauling.

## SINGLE-USE....REALLY?

This magazine has long advocated that bailout kits in the hands of trained rope technicians have the potential to provide a multitude of uses for the operator as well as emergency bailout. But manufacturer's instructions often state that their bailout kit should never be used except as a last resort and should then be disposed of. This is frustrating because it is largely dictated by the possibility of less well trained personnel not being able to keep the kit in a ready state or being able to maintain a log that shows that it has not been subjected to any unsuitable loading or usage as we would for any other rope equipment. It would seem to be safety based on the lowest skill-set and perhaps commercial imperative that means you have to buy a new one once it's been used! Even if this remains the case, primarily within rescue services, training will always be essential so you will need to purchase extra kits just for training and from an operational perspective never make more use of these incredibly versatile kits.

The TRACE Grey Kit – Emergency Egress Kit from CTOMS, Sterling's F4 and the Petzl 's Tactical EXO are all excellent examples of bailout kits suitable for military and law enforcement personnel. Bailout kits for firefighters are more common and will probably continue to dictate the direction of this specific market but it is appreciated that tactical considerations are also catered for by some manufacturers.

The TRACE Grey Kit comes with 16m of 6mm rope, but, so it can be kept for operational use, also includes an additional 10m of 6mm rope for training. Because it is only 6mm in diameter the rope does not meet the NFPA standard for escape ropes which is currently 7.5mm but this system is designed for a single person load and allows for a smaller pack to be carried. Unfortunately, the manufacturer recommends retirement of the rope after just two years.

By adding a rope grab device to the system and then using the auto-stop device as a progress capture the user can conduct a short ascent of the rope. Indeed, although designed for emergency DESCENT there is scope for bailout kits to be used for longer emergency ASCENT with one of the micro-ascenders like the Petzl Tiblock (above right) or Ringo (right) or even good old-fashioned prusiks – neither of which will unduly increase the size of your bailout kit. The kit could also be used for edge safety include edge restraint when operating near on a roof top (pic right) or positioning on an incline where full bodyweight loading is not anticipated but to



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Artificial High Directional Workshop	UT April 20-26	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip list	Monday/Sunday 7 days	5 - 7 some hiking	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: Ray Daniels	Clearfield, Utah Rock Exotica & South Davis Metro Fire	\$1,475	Reed Thorne
Team Skills Rescue Workshop	AZ May 2-8	General Team Rescue	Classroom & Wilderness ONLY	TSRW Equip list	Saturday/Friday 7 days	5 - 7 some hiking	No Prerequisite Prior rope rigging experience strongly recommended.	Historic copper mining town of Jerome, Arizona Jerome Fire Dept	\$1,350	Reed Thorne
Team Skills Rescue Workshop	UK May 22-28	General Team Rescue	Classroom Industrial and/or Wilderness	TSRW Equip list	Friday/Thurs 7 days	5	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: Richard Harding	Devon-Somerset UNITED KINGDOM Devon-Somerset Fire Service Exeter	\$1,350 USD via PayPal	Reed Thorne
Artificial High Directional Workshop	UK June 1-7	Arizona Vortex	Classroom Industrial & Wilderness	AHDW Equip list	Monday/Sunday 7 days	4	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: Paul O'Sullivan	Wales UNITED KINGDOM R3 Safety and Rescue Ltd	Contact liaison	Reed Thorne
Personal Skills Rescue Workshop	AZ June 24-30	Solo & Semi-Solo Rescue	Classroom Industrial & Wilderness	PSRW Equip list	Monday/Sunday 7 days	9	No Prerequisite Significant car pools to Prescott, AZ. Prior rope rigging experience strongly recommended.	Historic copper mining town of Jerome, Arizona Jerome Fire Dept	\$1,350	Reed Thorne
Artificial High Directional Workshop	OH August 15-21	Industrial Rescue	Classroom Industrial & Wilderness	AHDW Equip list	Sat/Friday 7 days	4	No Prerequisite NOTE: Must be US citizen to enter NASA with background screening. Ohio Liaison: Brian Harding	Cleveland, Ohio Multiple venues including NASA Glenn Research Center	\$1,350	Reed Thorne
Team Skills Rescue Workshop	MI August 23-29	General Team Rescue	Classroom Industrial & Wilderness	TSRW Equip list	Sunday/Saturday 7 days	4	No Prerequisite Prior rope rigging experience strongly recommended. Liaison: Dave Van Holstyn	Southfield, Michigan REGISTER at www.misartf.org Contact liaison Dave Van Holstyn for tuition fee		Reed Thorne Dave Van Holstyn
Mountain Rescue Workshop	NY Sept. 13-19	Mountain SAR Rescue	Classroom & Wilderness ONLY	MRW Equip list	Sunday/Saturday 7 days	7 some hiking	No Prerequisite Liaison: Andrew Bajardi Prior rope rigging experience strongly recommended.	New Paltz, New York Mohonk Preserve in the "Gunks" clinging area	\$1,350 (50% off NY Volunteer discounting available)	Reed Thorne
Team Skills Rescue Workshop	CAN Sept 28-Oct 4	General Team Rescue	Classroom & Wilderness ONLY	TSRW Equip list	Monday/Sunday 7 days	6	No Prerequisite Prior rope rigging experience strongly recommended. Canada Liaison: Tim Casavant	Nordegg, Alberta CANADA Turn Around Rescue Contact Tim Casavant tuition/logistics	\$1,350 USD	Reed Thorne
Advanced Skills Rescue Workshop	MD October 11-17	Advanced Highlines	Classroom Industrial Wilderness	General Equip list	Sunday/Saturday 7 days	5	Prerequisite: Must have completed one program: TSRW, OHRW, IRW, AHDW from RTR	Maryland (Montgomery-Frederick Co.) Contact instructor Mike Green for location & logistics	\$1,350	Mike Green
Advanced Skills Rescue Workshop	AU October 16-22	Advanced Highlines	Classroom & Wilderness ONLY	General Equip list	Friday/Thursday 7 days	7	Prerequisite: Must have completed one program: TSRW, OHRW, IRW, AHDW from RTR	Mt. Arapiles, Victoria AUSTRALIA Contact Len Batley for tuition and logistics		Reed Thorne Len Batley
JAPAN Technical Rescue Oct 25-Nov 1 Tokyo / Kyoto / Osaka / Saitama – RESCUE JAPAN Contact liaison: Akihiko Uyama										
Advanced Anchoring Analysis & Beyond the Barn Floor	AZ Nov 7-10 & Nov 11-13	Advanced Physics/Rigging Trigonometry & Physics	Classroom and field testing Classroom ONLY	See AAA-BTBE flyer	Sat to Tuesday Wed to Friday	1 Mental: 6-8 1 Mental: 10	Past RTR Alumni Only (or special permission from instructors) You should have a good background in mathematics in order to fully participate in this program	Historic copper mining town of Jerome, Arizona Jerome Fire Dept	\$1,350	Mike Green & Reed Thorne
Mountain Rescue Workshop	AZ March 6-12, 2021	Mountain SAR Rescue	Classroom & Wilderness ONLY	MRW Equip list	Saturday/Friday 7 days	7 some hiking	No Prerequisite Prior rope rigging experience and climbing ability are strongly recommended.	Historic copper mining town of Jerome, Arizona Jerome Fire Dept	\$1,250 (50% off AZ Volunteer discounting available)	Reed Thorne

www.ropesthathatrescue.com



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# PETZL RESCUE SOLUTIONS

The challenge of the rescue professional is their ability to adapt, facing the unexpected in every situation. In order to always be prepared, this American team trains on a daily basis, for example here, in a ravine near Salt Lake City, Utah, USA.



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