# TECHNICAL RESCUE

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


ISSUE 76

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Above: Reed Thorne continues confuse his viking heritage with British pirates in his multi-part series on ***Pulleys and Pulley Systems.*** This issue he is looking at Simple, Complex and Compound systems. **Page 12**

Above: Paul O'Sullivan continues with ***Weirs/Low Head Dams pt2 a***nd this issue you get a free weir/low head dam risk assessment form as a CENTRE-SPREAD PULL-OUT if you want to. **Page 26**

Above: This issue's Rope rescue needs are also taken care of with Roland Curll's look at the how Petzl's 2019 gear differs from 2018 (**p66)** and our GUIDE is ***Autolock Escape or Bail-Out Descenders.*** **Page 44**

Above: After Rich Denham and Nick Appleton's treatise on 'Team Approach' was picked up and passed off as something 'new' by others in the industry they've returned with scene management this issue and a look at the sequencing of actions at an accident **Page 62**


**WILDERNESSSAR** incorporating **PARKRANGER** (actually, it doesn't 'incorporate' **PARKRANGER** at all, it's exactly the same magazine) 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 **WILDERNESSSAR** but there will always be some crossover of content between the magazines.


**ACCESS&RESCUE** is our FREE Quarterly, digital-only (pdf) E-magazine for: **TECHNICALRESCUE**, **ARBCLIMBER** and **WILDERNESSSAR** magazine readers. It covers Rope Rescue, SAR, USAR, Extrication, Water Rescue, Rope Access, Tree work and Tactical subjects providing SAFETY RECALLS and NOTICES, new and archive articles, Product News items plus news and events.
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Email us to receive it free, automatically every quarter.
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**FRONT COVER**:
The Lukas eWXT Sp555 battery powered spreader is now one of three tools (cutter and ram) to be completely immersible during operations. This makes responding to flash flooding, which often involves vehicle inundation and subsequent forced relocation and entrapment, a much faster and more efficient proposition. The same tools will still do all the usual USAR and extrication tasks but now add water rescue to the list. **Page2**

## Lukas eWXT

# UNDERWATER ELECTRIC TOOLS

We can sometimes kill two birds with one stone and cover water rescue together with rope rescue but it's not often we can cover water rescue and extrication in one Product News item. This is an excellent and obvious evolution of battery powered electric-hydraulic rescue equipment and we touched upon the concept of using larger hydraulic tools underwater in an earlier issue with the French Libervit range being used by dive teams. All of the professional grade battery tools are water-resistant of course but Lukas have taken it a step further by making their range of three battery tools, submersible. Modern times are seeing a big increase in flooding and a resultant rise in car entrapments involving water either because of engulfment and an inability to exit a submerged or partially submerged vehicle or because the vehicle has been physically relocated by the water and ended up rammed into other vehicles or wedged against an immovable object. We've always had the ability to use regular hose-fed hydraulics underwater of course but there is a world of difference between being able to pull a battery tool off the truck and roam freely around a water-inundated scene and being restricted by cumbersome hoses running to a generator/pump generally located on dry land or perhaps a rescue boat although the Libervit Maritme models mentioned earlier operate from a submersible power-source. However, this still adds the complications of extra handlers and hoses to a complex rescue situation. There are limits to the capabilities of this new range – they can't be used at depth in salt water as the Libervit can but most agencies will be looking at these as tools that can operate in flooding so the 1metre/3feet guarantee and probable outer envelope of 10m/33ft will cover most scenarios. All other specifications for cut and spread force remain the same and motors are now all brushless. **www.lukas.com**



**WATERPROOF ELECTRIC TOOLS**

- Immersion depth of 1m guaranteed in fresh water – additional initial tests positive up to 10m
- All components are watertight
- eWXTs work underwater, therefore protection class IP68 is not applicable
- Watertight 5 Ah and 9 Ah batteries
- Improved insertion handling and lock mechanism
- Batteries inserted vertically, slot in automatically
- Same star-grip control but without microswitch

**BRUSHLESS ELECTRIC MOTOR (BLM)**

- Lower working noise
- Less heat development
- More torque and power in a smaller package
- Fewer vulnerable mechanical parts
- Lower energy consumption and thus longer life
- By electronically controlling the revolution
- speed, the working speed of the device is always the same up to the maximum load
- The BLM motor is located directly on the pump shaft – no gearbox required
- Water flows around the motor, ensuring it
- continues to operate reliably even underwater

**AXIAL PISTON PUMP**

- Lower noise development
- Compact design – shorter tool overall
- Piston units are particularly small and
- partially disappear in the cylinder body
- Optimally protected position

| SPECIFICATIONS | S788 CUTTER | SP555 SPREADER | R521 RAM |
|---|---|---|---|
| CUTTING/SPREAD FORCE UP TO[1] | 1,101 kN | 52-658 kN | |
| ROUND STEEL UP TO Ø[2] | 42mm | | |
| BLADE/RAM OPENING/SPREAD | 200mm | 730mm | 1359mm |
| SQUEEZE FORCE | | 115kN | |
| PULL FORCE | | 58kN | |
| PULL DISTANCE | | 569mm | |
| LIFT FORCE PISTON1 | | | 127kN |
| LIFT FORCE PISTON 2 | | | 60kN |
| DIMENSIONS[3] | 904×266×253mm | 923x265x253mm | 579x140x327mm |
| WEIGHT | 22.2kg | 19.9kg | 19kg |
| NFPA CLASSES | A8/B9/C8/D9/E9 | | |
| EN CLASSIFICATION | K | | |
| EN CUTTING PERFORMANCE | 1K-2K-3K-4K-5K | | |

All information not including battery
1) Theoretical
2) As per EN 13204, NFPA 1936
3) L × W × H

# KONG 4D Monopod

*[ED: On the odd occasion that we're scrambling around to find new and interesting kit to feature we can always rely on Kong and what must be the most prolific output of new gear on the planet. In this instance we're not entirely sure what the fourth dimension is – we've only just come to terms with 3D rigging -this one must have a time-travel button somewhere. They've expanded upon their very long-standing involvement in monopod production with a lightweight 'pod using their new* **Discorig** *plate that we featured in WILDERNESS SAR#6. Weighing 10.5kg/23lb minus the winch option for the complete package of articulating foot plate with multiple anchor options and two DiscoRig head plates. When they say 'textile-friendly' they mean rope can be tied directly into the eyes. Whipper-snappers among you will say 'So?' but there was a time that rigging plate edges were so angular and burred or sharp that even carabiner connections suffered.*]

4D POLE is a "gin pole" of great value in handling loads or people, for both work and in organized technical rescue.
The pole has a hinged joint at the base which can pivot in multiple directions, allowing the loaded ropes to slide easily on the terminal pulleys.
The top is composed of two DISCORIG plates with “Textile Friendly” connection points. Ropes and slings can be attached directly to the plate, providing a wide range of possible configurations with pulleys, connectors and mechanical rope clamps.
The modular structure allows the length (130-205 cm/4.25'-6.71) to be varied simply by increasing or decreasing the number of extension pieces in the central strut. Fitted with a reversible foot that ensures perfect grip on both slippery surfaces (clawed side) and smooth surfaces (rubberized side).
Its compact size makes it easy to disassemble and carry in the shoulder bag provided.
Highest quality, completely produced in Italy.



www.kong.it

## COMING SOON

The Clutch descender from Harken Industrial that was first seen at GRIMP USA is being widely talked about, with a launch date expected soon, or so we hear. This innovative product is a joint development between Harken Industrial and CMC Pro, combining their experience to develop the first alternative to the CMC MPD, that is widely used in the Rescue world. The clutch descender has taken the high efficiency progress capture capabilities of the CMC MPD and packaged them into a wearable product, with intuitive operation that can be used as a personal and rescue descender. We look forward to getting hold of this product and will bring you more information when it is made available. Photo above shows prototypes.

www.harkenindustrial.com

# LEADER GROUP ACQUIRES WASP EMERGENCY SAFETY MONITORING DEVICE

Matt Keogh created the WASP, or Warning Alarm for Stability Protection, specifically to protect Urban Search And Rescue (USAR) colleagues during earthquake rescues. Since its launch in 2016 the WASP has been exported to 17 countries around the world, received much international media interest and was crowned 'New to Export' winners at the Northern Powerhouse Exports Awards 2019. The portable device, invented by Matt a former Greater Manchester Fire and Rescue firefighter and member of the UKISAR team, has been acquired by the world's leading disaster equipment specialist, French based LEADER GROUP.

It will now be manufactured in France and supplied around the world by the Leader Group global network of dealers.

The acquisition is a fitting reward for inventor Matt Keogh, who worked tirelessly to turn his dream into a reality. Since its launch at the Emergency Services Show in 2016, the WASP has become part of everyday firefighting and rescue kit, and is now being used in teams and services across the world.

WASP Rescue founder Matt Keogh, said: "I am delighted the WASP has become part of the LEADER GROUP. They are one of the world's leading suppliers of USAR and firefighting equipment across the world and they will provide the WASP with the platform this lifesaving piece of equipment deserves. The WASP will sit alongside their huge product range and I am sure that will mean more firefighters and rescue workers will come into daily contact with the product. I have nursed and nurtured the WASP from concept through to creation and now LEADER can take it to another level."

The WASP is a portable safety monitoring device designed to protect emergency service personnel as they work in precarious scenarios by providing warning of movement from 0.1° to 2.6° and / or vibration from 0.5 Hz to 100 Hz with both an audible and visual alarm.

The WASP, is highly durable, and attaches to any surface in any position via a number of attachments. It was initially created to protect USAR workers deployed to earthquakes and other disasters but is now being used in a variety of everyday firefighting and rescue scenarios.

Successful WASP deployments have included collapsed structures, post-major fires, road traffic accidents, landslides, explosions, trench rescues and hundreds of other incidents.
It was deployed following the Bayernoil Refinery explosion in Germany, during the rescue of Alpine residents trapped by heavy snow in Germany and Austria and after the discovery of an unexploded World War Two bomb in Birmingham. Most notably, the WASP played a crucial role in the aftermath of the 2017 Grenfell Tower tragedy in the UK. London Fire Brigade deployed 11 WASP units to monitor for movement of the stricken in the building following the fire which claimed 72 lives.

[ED: *This deployment highlights the significant risk posed by structural destabilisation following and during a major fire. If you look at the 2017 high-rise fire in Tehran that killed 20 firefighters, this was thought to have been almost suppressed such that even civilians were allowed to make limited re-entry to the 17-storey building, before the fire reignited and the entire building collapsed soon afterwards. A combination of WASP deployed from the start of firefighting operations within the structure and SENTRY monitoring from the outside may have given at least some degree of early warning that absolutely was not present in Tehran. This was again a structure that suffered from a domino floor collapse from the upper floors that had been alight but firefighters on the ground floor reported much shaking and noise a minute or so before the collapse. That minute alone was enough for many to evacuate and survive so imagine what a difference WASP and SENTRY might have made, able to detect otherwise imperceptible signs of destabilisation much earlier.]*

The new Leader SENTRY (right) can be positioned up to 50m distance from unstable structures to trigger an 115dB alarm in case of weak movement detected (from 2 to 100mm). It is fitted with a wireless remote control with integrated siren to alert in the rescuer's pocket.
These two products are complementary: WASP is fixed to the structure, and SENTRY monitors at distance. This makes LEADER the only company worldwide to provide alternatives in this crucial area of incident safety.

LEADER GROUP was established in 1985 with the specific goal of 'making products that would save lives' in the firefighting and rescue fields. They now supply equipment all around the world. Keogh will work with LEADER GROUP as a Search and Rescue consultant and will train their global dealer team and end-users worldwide.

www.wasp-rescue.com
www.leader-group.com



www.rescuemagazines.com

# New FLIR handheld from the grandaddy of Infra-Red for rescuers

FLIR Systems, Inc. (NASDAQ: FLIR) announces the new FLIR K1 handheld thermal imaging camera is available for purchase in EMEA, FLIR's most affordable camera for first responder officers and fire investigators. The FLIR K1 detects heat and provides visibility through smoke and in total darkness to enhance situational awareness for use in wildland fire control, search and rescue missions, structure damage evaluation, and investigative work.

"FLIR is committed to providing first responders with lifesaving technology and solutions that help them keep their communities safe," said Jim Cannon, President and CEO of FLIR Systems. "At a more affordable price, the FLIR K1 will allow more emergency service professionals to adopt the power of thermal imaging and ensure a safer mission."

The dual sensor FLIR K1 is powered by the FLIR Lepton® thermal microcamera, FLIR's smallest and lowest cost thermal camera core. The K1 uses FLIR's patented MSX® technology, which extracts high-contrast details from the images taken by an onboard visible light camera and superimposes them onto the thermal images. The FLIR K1 simultaneously captures thermal and visible images of a scene and stores up to 10,000 image sets to create post-scene reports, analysis and evidence.

A pistol grip design allows users to view the scene from their line of sight for improved safety and situational awareness. The spot thermometer easily identifies unseen hot and cold spots for instant troubleshooting. The FLIR K1 carries an IP67 rating for water resistance, heat resistance up to 115°C, and can withstand a 2-metre drop onto concrete. An integrated, rechargeable battery lasts up to five hours on a single charge, and it also includes a 300-lumen flashlight that lends additional visibility of a scene.

The FLIR K1 is now available for purchase in EMEA at €580 and £521 GBP excluding VAT.

www.FLIR.com/K1



# PACIFIC WATER RESCUE HELMET

www.pacifichelmets.com

[*ED: The R6 is rapidly becoming one of rescue's leading multi-role helmets with a number of variants for fire, rescue, USAR, tactical, Parameds etc. But rather than being one-helmet fits-all, which it rarely does, each version of the R6 offer something a little different and a little more targeted to the end-user*].

The R6V MkII Seeker is a departure from the traditional configuration of rescue and bushfire helmets that Pacific make. The Seeker has a Fibretuff (fibreglass reinforced) composite shell with a single-piece form-moulded polyethylene (PE) liner. The Seeker an have multiple accessories: ear covers, torch base, Pacific's new rubber goggle straps, and a range of helmet mounted communication units. It is a purpose-specific model of helmet designed for Water Rescue. The lightweight shell is chemical and UV resistant with inherent heat and flame resistance. The specialised ventilation system can be opened and closed depending on the situation – when closed the vent is sealed, water tight. The "Seeker" is available in a range of colours and paint finishes, not available for purchase through our online store [chart is a guide only. Actual colours will vary]. Please contact Pac Fire about your colour selection. Additional fees and lead times may apply. R6V MkII is available as standard in white, red, yellow, flourescent lime, flourescent orange, white, Lime,

- Certification: EN 1385:1997
- Fibretuff composite shell
- Pacific ratchet adjustable headband with pivot nape strap
- Pacific low profile buckle
- 4-point chin strap
- Engineered water release holes
- Form moulded PE padding
- DSVS™ (Dynamic Sealed Ventilation System)
- Easi On-Off Base for torch
- Rubber straps to secure accessories

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

# PULLEY SYSTEMS

part3

by **Reed Thorne**
Ropes that Rescue AZ, USA



Pic by Ken Backer





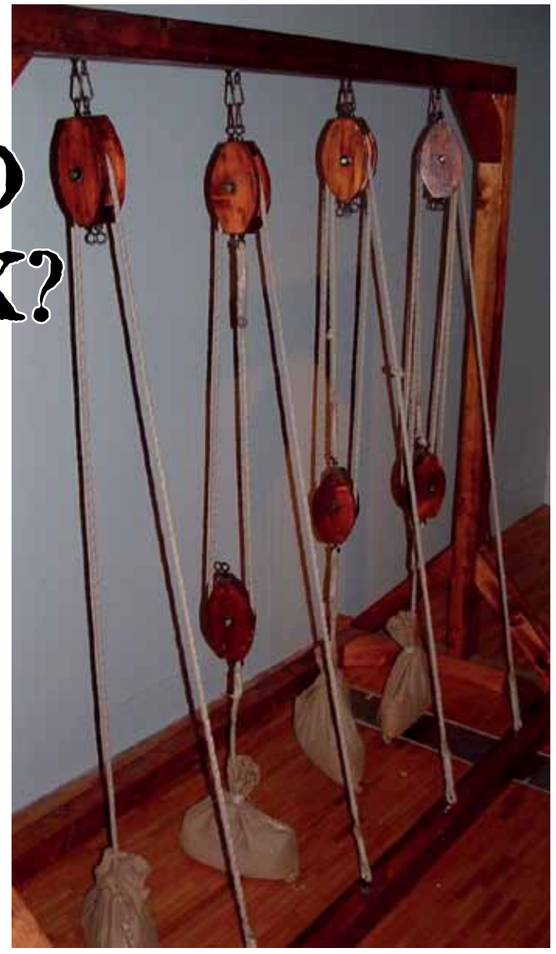
# SIMPLE, COMPOUND or COMPLEX?


## INTRODUCTION

All pulleys systems are considered 'machines' and fall into one of three categories. Those are either 1) Simple, 2) Compound or, 3) Complex. A rope rescue team therefore may elect to only use simple systems or, as if often the case for added versatility, all three in differing situations. Many of these systems you have seen so far are from the past where they were used to construct the vast infrastructures of modern civilization.

We begin therefore, with the first of the three, the "simple" pulley systems which over the years has been known by the term "block and tackle". All three are defined classically below as a reference point as we discuss them in detail over the next few articles. So, it would be advisable for you to learn these terms and know the definitions by rote as we progress. Over time, you will hopefully be able to distinguish the differences between them all after having performed tests in your mind as to which they are.

The simple pulley systems are the bread and butter of rope rescue work. As with anything, they have very specific advantages and disadvantages. They are easy for the rigger to remember and perform and they have great, long throws and are easy to modify if more advantage is desired. However, they have more practical friction, use more rope, and require more equipment in the higher IMA (Ideal Mechanical Advantage) systems. A simple class 1 change of direction pulley at the anchor allows the hauling team to fully collapse the simple system down to two-block while standing in one location at any angle.



Examples of simple block and tackle pulley systems from the Smithsonian display in Washington DC.

## The THREE TYPE DEFINITIONS:

Study the subtle yet profound differences between the three types in these definitions and accompanying illustrations.

Some things to look for in determining whether a systems is simple, compound or complex:

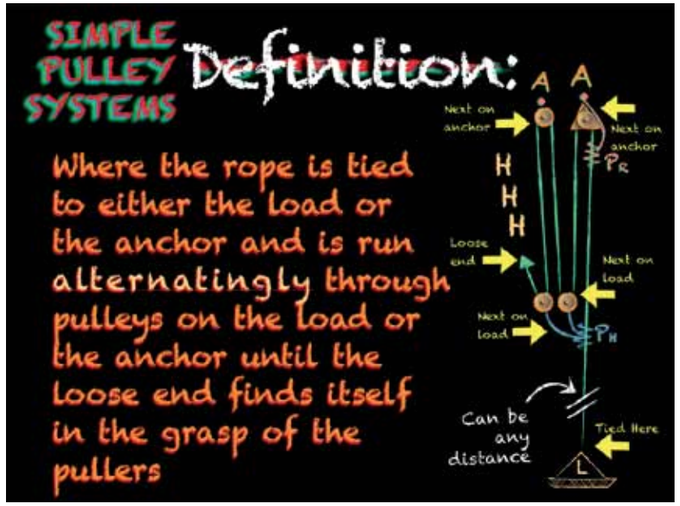
• The term “alternatingly” in the definition implies that ***the single rope in the simple system alternates between the anchor and the load with no anomaly. In the illustration, the rope is tied at the load and reeves back and forth between the pulleys on the anchor and the load.***

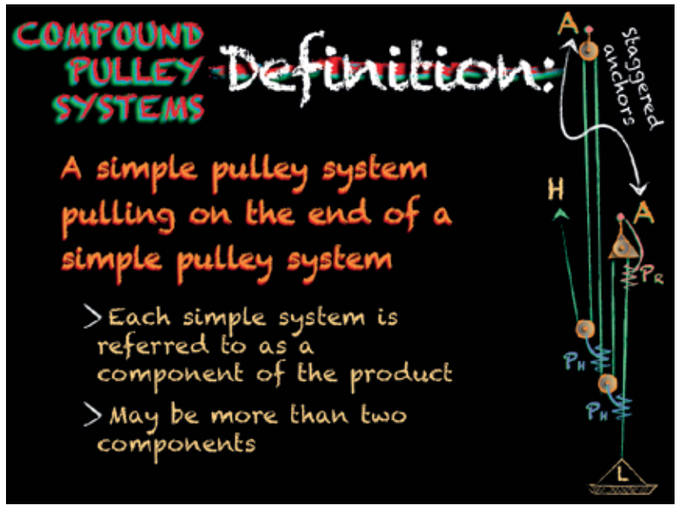
• ***There can often be a great distance between the actual load and the rope grab (shown as P sub h, or “haul prusik”). The illustration shows this as a variable distance. Don’t be confused if there are several class 1 directionals distal (closer to load) after the simple system haul grab***

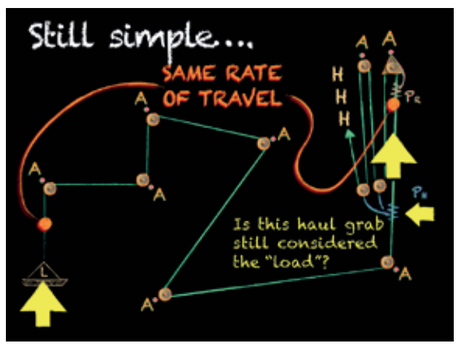
• ***If a pulley system has multiple haul grabs pulling on different ropes (like the compound and complex examples), you can rest assured that the pulley system is NOT simple***

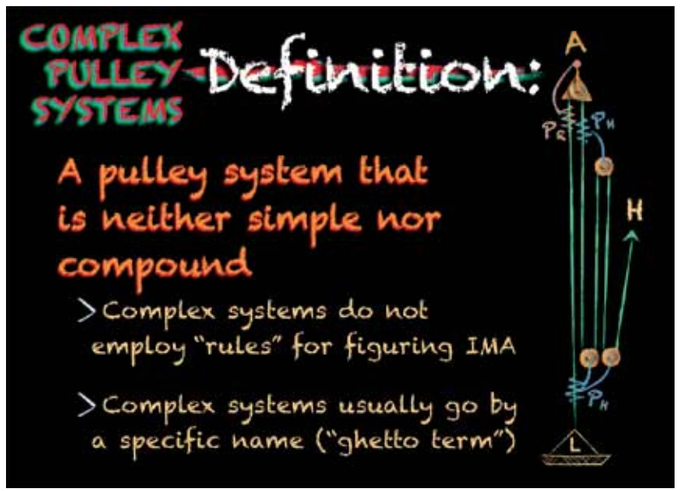
• ***If there are two haul grabs in the system pulling towards each other (as in the complex example) you know the pulley system is not simple (or compound)***

• ***If a pulley system has multiple staggered anchors (as in the compound example), it is not going to be designated as simple***



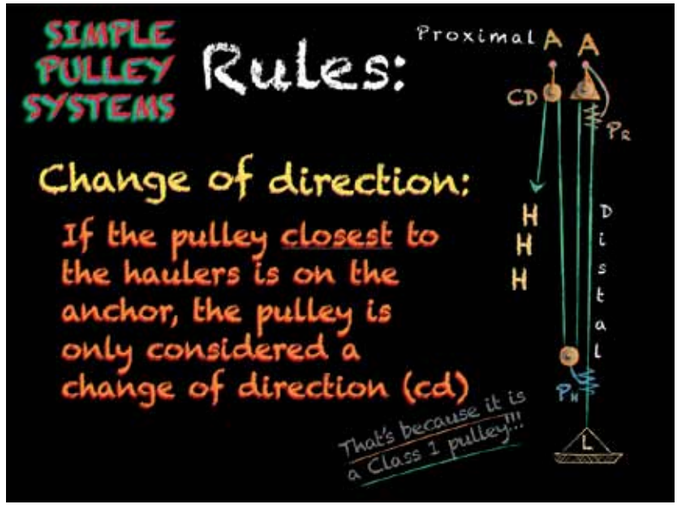



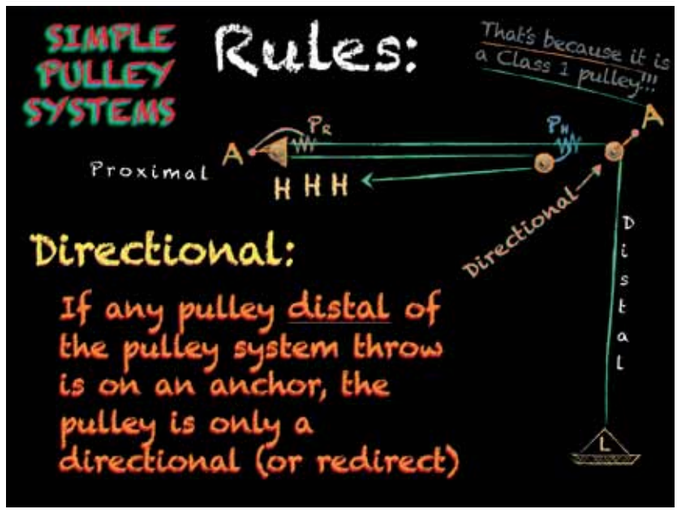
## RULES for SIMPLE SYSTEMS:

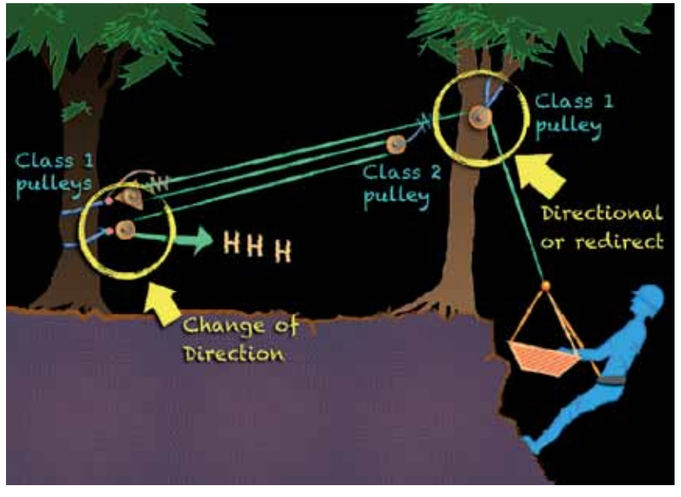
The change of direction pulley can exist on any system whether simple, compound or complex. They are of course class 1 pulleys because (as you will recall from article 1 of this series) they are attached to the anchor and are not moving.
The definition is specific so please take note of it. The change of direction pulley MUST be in the hands of the haulers in order for it to be a CD. That means on the "input" of energy, or proximal end of the system. If it is not in the grasp of the haulers, then it is not a CD. It would be referred to by a different name and called a directional (some call this a "redirect" which is completely fine)

See the definitions for both the change of direction and the directional here and make no mistake that they are closely related but distant cousins to one another. The need for different terms for each of these positions will be become painfully evident later on in this series when we study compound systems where there are both the change of direction pulley alongside the directional pulley. The terminology is necessary to unravel the distinction between what both class 1 pulleys perform for us in the system.

In the photo of a rescue in a huge wind turbine below, you can see two directional pulleys hanging on the anchors distal of the simple pulley system throw. In the illustration, you can see the clear delineation of the tw***o terms with regard to all pulley systems.***





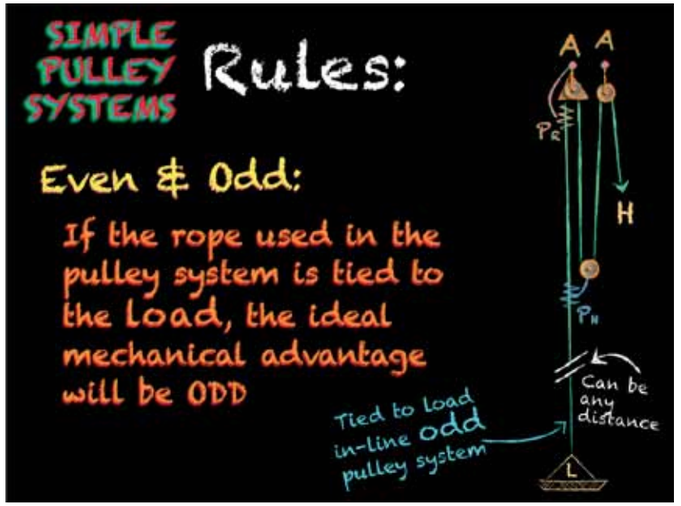


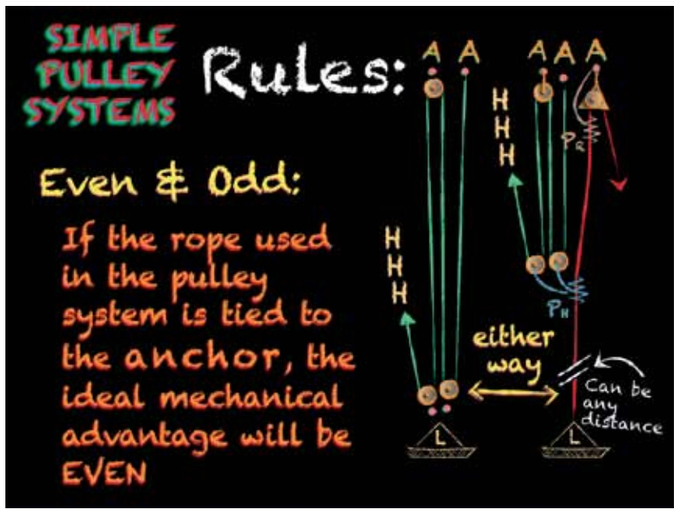

## EVEN & ODD SIMPLE PULLEY SYSTEMS:

Every rope has two ends last time I checked. There are two places where one end of that rope can be tied. Either the load or the anchor. The second end is normally in the grasp of the hauling team or puller. So, if the rope used in the pulley system is tied to the load the ideal mechanical advantage will be ODD. The term "odd" means it will be a ratio of input to output of 1 to 1 (1:1), or 3 to 1 (3:1) or 5 to 1 (5:1) and so forth. Basically any odd number.

Conversely, the same applies to the EVEN pulley systems. As you may have guessed, if the rope used in the pulley system is tied to the anchor, the ideal mechanical advantage with be EVEN. Again, the term "even" means it will be a ratio of input to output of 2 to 1 (2:1), or 4 to 1 (4:1) or 6 to 1 (6:1) and so forth. Basically any even number.

Remember NOT to apply this rule to the compound or complex systems as they go by their own set of parameters for determining IMA. We will study that later. In the two photos below, you can see an even simple system (4:1) being used off a tripod down into a confined space in South Australia. How can you tell it is even? The rope is not tied onto the rescuer. In the photo of a Vortex used in a rescue class, you can instantly see that the simple pulley system is odd (3:1) because the rope goes over the edge to the rescue adjunct. It is an in-line "Z" rig.



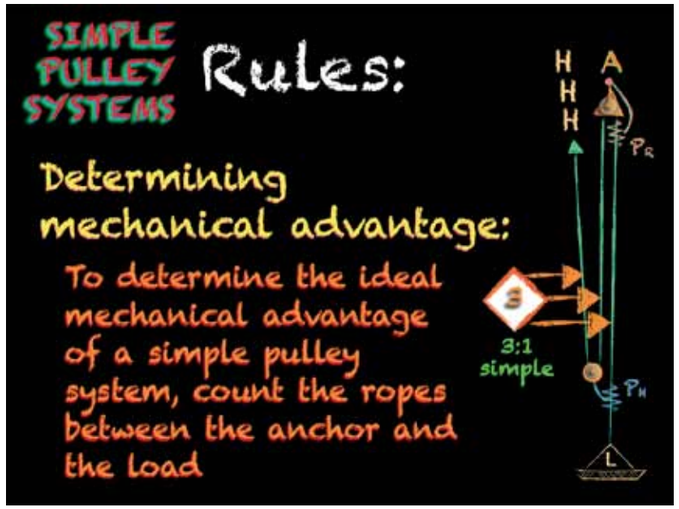

## DETERMINING SIMPLE SYSTEM IDEAL MECHANICAL ADVANTAGE:

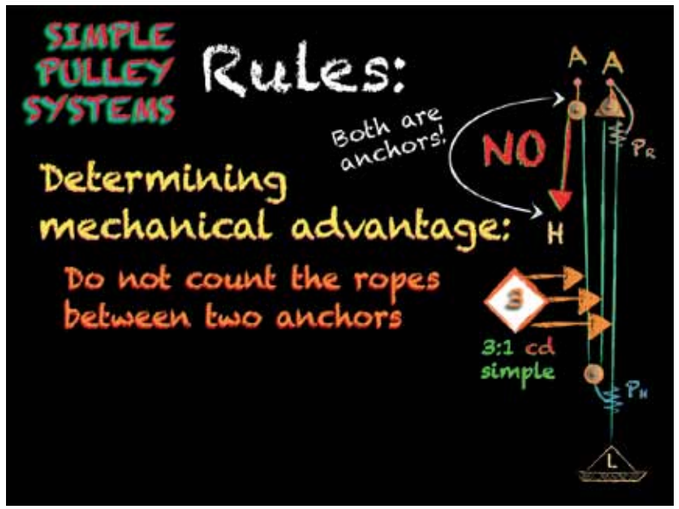
The “ideal” mechanical advantage is that which we figure to give us a baseline of understanding in determining which pulley system to build for our operation. Normally, friction does not enter into the equation until much farther down the road but that too cannot be underestimated. In simple pulley systems, for instance, we know that we are going to be using more pulleys which have friction and that has a negative effect on our output.

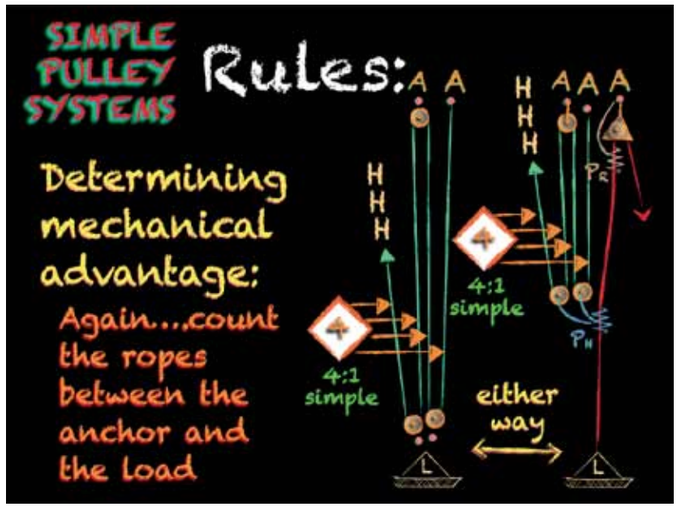
To determine the IMA of a simple pulley system, count the ropes between the anchor and the load. In the top illustration, you can see that there are 3 ropes in between the anchor and the load (remember that the “load” is on the haul grab) so this system is a 3 to 1 (3:1). In the bottom illustration, you can see that the rope is tied to the anchor (indicating even) and we can count 4 total ropes so this is a simple 4 to 1 (4:1).

Also, we do not count the rope in between two apparent anchors even though the one side appears NOT to be anchored but rather moving. The middle illustration shows us that the haulers are really considered an anchor although they are sometimes pulling on the end. Consider it this way: If the mass was, say, 300kg, each of the ropes would have 100kg on it even when the haulers are not pulling. Another way to look at it is to view the last rope coming off of a class 1 pulley that is not moving. It does nothing for the ultimate IMA in this regard.

You may observe something about the even and odd simple pulley systems which is noteworthy. Since the odd pulley system ties AT the load, it is perfect for “in-line” systems where you would like only one rope to construct the entire system, top to bottom. In the mountains of Sedona, Arizona, this was the preferred system we used. With the even simple systems, we would have to attach it to our main line since it is limited being tied to the anchor. Our system would need to then have two ropes instead of one since the attached pulley system would need to be separate.



## CHOOSING ODD VS. EVEN:

Back in the early 80's, I came to the belief that only odd pulley systems had any merit in rope rescue work because of the extreme terrain that we are dealing with here in the Highlands of AZ. Later I learned a bit of wisdom from the brutal lessons that hard cold experience dishes out in ample quantity.

Now, I see different strokes for different folks as the saying goes. Not all rope rescue teams are dealing with 100m to 200m cliff faces which we were. Some environments are completely different, and thus yield a completely varied and more practical approach. So, choosing between even and odd simple pulleys systems becomes more of a pragmatic endeavor which takes the limitations of a rope rescue team into account.

As an example an industrial rope rescue team made up (as they often are) of workers from the actual facility may find that having a pre-fab pulley system "in-a-bag" to gang (some say "piggybacked") onto the main line is the way to go, especially if the call comes in the middle of the night when you do not know who is coming on the call. A bagged pulley system is something which works in that environment but would never work in an environment like Sedona.

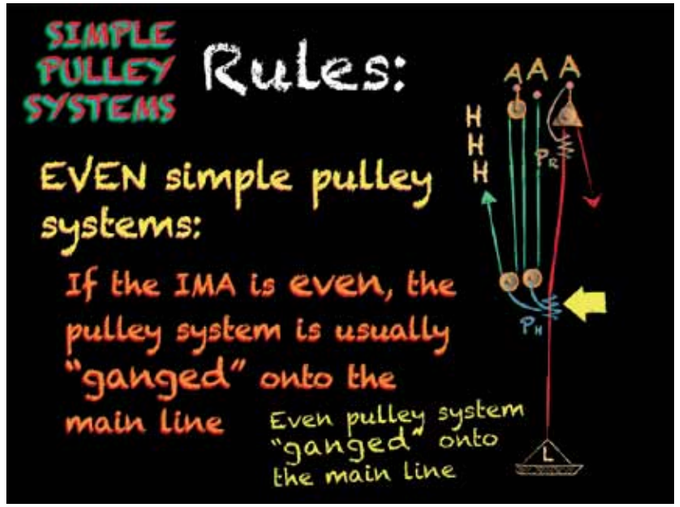
A careful analysis of the differences between an "in-line system" and a "ganged system" is needed. The Australians call the ganged system a "bolt-on" system and I like that term but we have to watch that kind of terminology here in the USA.

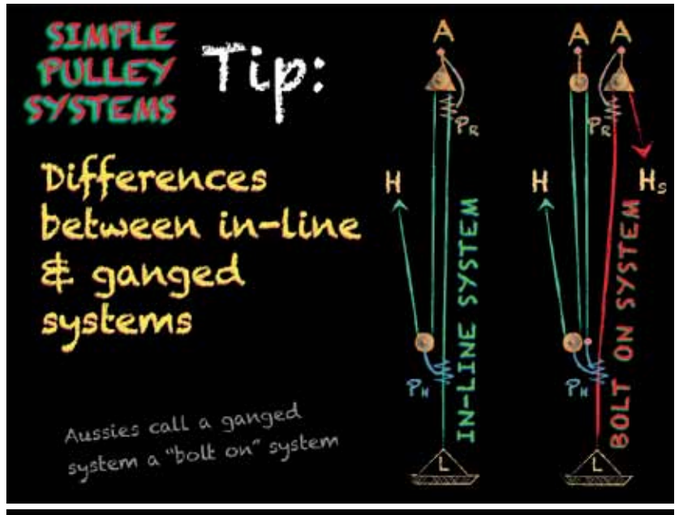
We can understand now that even systems will need to be ganged onto the main line and this will require a person (we call the "slacker") to pull up the slack on the main line when the ganged systems is collapsed. (There are ways to put the progress capture ratchet ahead, or distal of the pulley system but I will talk about that more later.) Mind you, just about anyone can pull up this slack so even a bystander with no knowledge can be summoned for this job.

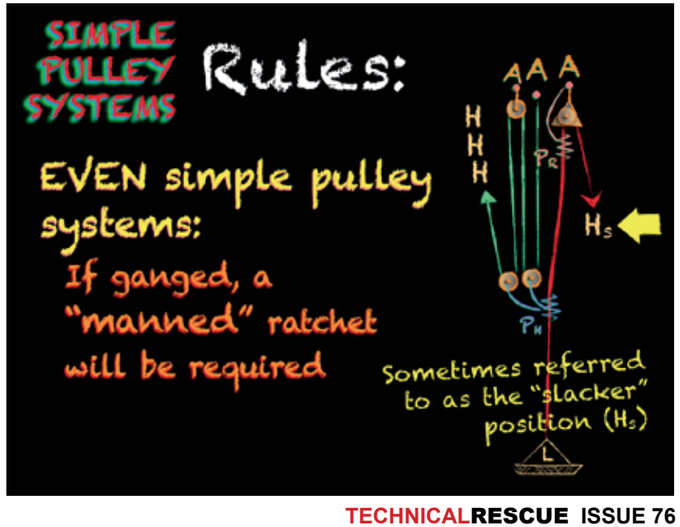
With the in-line system, no slacker is required and thus we save on personnel needed to manage the pulley system. Also the second rope is not needed.

## "IN-LINE" PULLEY SYSTEM

- Simple by nature (1 rope)
- Less pulleys and equipment
- Good minimalist tactic
- Higher skill level required
- Self minding ratchet on main line
- Simplifies raisings with a two-tensioned rope system (mirrored raise)







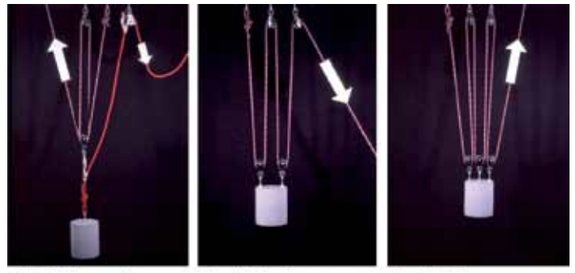

## "GANGED" PULLEY SYSTEM

- Pre-bagged pulley system (easy)
- Need separate main line
- More pulleys and equipment
- Good for teams less trained; Less skill level required
- Manned ratchet (slacker)
- Can complicate raisings with a two-tensioned rope system


Simple 4:1


Simple 5:1


Simple 2:1 cd


Simple 4:1 ganged ("bolt on")


Simple 4:1 cd


Simple 6:1

## CONCLUSION:

There are many more considerations to using simple pulley systems which I cannot enumerate in this short article. Suffice it to say they are definitely a tool you need to master as a rope practitioner. In a nutshell, the simple pulley systems will be the best choice when you have long distances to raise something because of the ability to pull long distances between resets of the system. In the next article in this series we dig into the compound pulley system with all of its great capabilities for lifting extremely heavy loads relatively short distances or when the job needs to get done with low manpower (great for building or structural collapse or un-broaching a raft in a river). In our training programs, most of the systems we build are compound in nature because of the way we can add the versatility to get the job done. It will be a fun article to put together and I hope it adds to your understanding.

# ALS Resuscitation in the field

## a comparison of Automatic Ventilators over the Bag/Valve/Mask

by **Brian Robinson**
TRm Con-Space Contributing Editor
Mines Rescue Officer & Consultant

Not all interesting conversations take place in conferences, conventions or the mess room, I'm happy to say, a chat with a paramedic friend over a beer or three, gave me the idea for this article.

The talk drifted on to the use of resuscitation equipment in the UK and its associated cost. I was shocked in some cases, not in others though, to find they use a brand new BVM (Bag, Valve, Mask) unit complete, including oxygen feed hose for every patient they have to, or may have to, resuscitate. So, some days they may use one, other days three, some days none (a good day), but even if they open the sealed bag in preparation, it gets binned. Same with my local Fire Brigade, although their use is far less frequent of course. This is in stark contrast to when BVMs were first introduced when only the face-mask element was disposed of after use unless there was any obvious regurgitative contamination of the bag and valve components.



We have obviously had oxygen automatic and manual resuscitators for many, many years so these things are far from new or revolutionary. The first Oxygen powered automatic resuscitator, the Draeger Pulmotor was brought in to play around 1910, then the 2005 European Resuscitation Council Guidelines mentioned their advantages over a BVM, and forgive me, but I will repeat this a few times in the article;

*"Once set, they provide a constant tidal volume, respiratory rate and minute ventilation; thus they may help avoid excessive ventilation"*

With a statement like that, you'd think every emergency service worker expected to carry out resuscitation would be trained in them and have them available in preference to a simple BVM? But alas, even 15 years further on, and for a range of reasons, no.

Back to the Resuscitation Council guidelines, it states that to use a BVM effectively requires two persons, one to secure the mask, the other to inflate the bag. In a protracted rescue situation, a BVM unit can become extremely difficult to use. This and the ability to accidentally vary pressure and volume because of fatigue or over enthusiasm and you begin to see an issue with their effectiveness.

About 10 years ago, UK Fire&Rescue Services began withdrawing automatic ventilators from service, replacing them with BVMs supplemented by oxygen from either a pin index cylinder regulator, or, increasingly, a lightweight CD type with integral regulator. Why? Cost of course. Supposedly, both initial cost of purchase and ongoing servicing costs over several years. But it seems those costs may well have been erroneously calculated, certainly if we look at costs to US and Canadian Fire Departments that deal a lot more with general medical emergencies.

As well as instructing in Ventilator & BVM use, I've been using Oxygen automatic / manual resuscitator ventilators since 1982, so I may be a little biased. I find them easy to use and effective





and must concur with the ERC statement above: constant tidal volume, respiratory rate and minute ventilation, easier for a single person to operate with manual ventilation triggers generally accessible on the face unit depending on the model. They certainly work well for protracted rescues. Couple this with the fact that they are reusable with only the mask requiring replacement if autoclaving is not an option.

### COSTS

If we go to a supplier for a single unit, costs for anything will be high, but here's some costs based on obtaining large numbers of BVM from a major supplier or manufacturer, and the same for one of the major Auto Ventilators, the BNOS Meditech "Microvent" as an example.
I'm basing using them 3 times a week for 15 years, the projected life of most Auto Ventilator Resuscitators.

**Microvent;**
Maximum cost* over 15 years =£4483.80, this includes initial purchase for the most advanced all singing and dancing unit, without any discount and ready to plug on to a CD cylinder, annual check and calibration, new supply hose every 5 years etc., and on say 3 replacement masks per week, though the better ones are reused after proper cleaning.

**BVM**
It's quite difficult to get end user prices from such as Ambulance Services or Fire Brigades, but this is based on a rock bottom price of £5.35 for a complete basic disposable BVM and hose, again ready to push the hose onto an outlet feed on a CD cylinder;
Maximum cost* over 15 years = £12519, based on the very same use of 3 times per week, replacing the whole unit.

You can see the cost savings yourselves, even based on an advanced auto unit over a basic BVM, so let's say a major city, London Ambulance service having 450 front line ambulances serving 8.7 million people, they could save £4635 per week just on this one item, or nearly another 7 paramedics on the run!

So, which organisations *DO* use auto ventilator / resuscitators here in the UK?

- All Fire Service USAR teams
- All Ambulance Service HART teams
- Some Ambulance services
- Limited Fire Services
- All Mines Rescue teams
- Most Utility Companies for Confined Space rescue,
- plus others for sure.

### RECAP ON MICROVENT

A full review of the Microvent was undertaken many years ago now in Technical Rescue magazine but I'm going to go through the basics of its setup and operation, I was of course assisted by Meditech with their product information, even though I've used it for maybe 20 years.

As it says on the tin, it's a device to either manually, or automatically ventilate or resuscitate a casualty / patient, giving the operator an easier time.

Consisting of a medium pressure $O^2$ delivery line, coming from either a CD type cylinder with integral regulator, or other $O^2$ cylinder with a regulator / therapy unit fitted as well, supplying about 4 bar pressure to the small, simple hand control unit, housing the function lever for manual trigger, auto / man select, and patient size slider. So just 3 very simple things.
On the Adult Only version, the patient slider simply isn't there, it delivers 12 BPM at 600ml $O^2$ per breath.

For cases involving full blown CPR , set to "MAN" manual, and then push down trigger after attaining an effective mask seal and head tilt, inflating the casualty's lungs with pure Oxygen. You can't over inflate, a blow off valve will release excess pressure at 45 cm/$H^2O$, just do as your BLS / ALS training tells you as far as either rescue breaths or normal inflations.

For transportation in cases where we have a casualty / patient with a pulse but not breathing, during an RSI, gassing or such for instance where the heart is still functioning, yet ventilation requires assistance, set to "AUTO", adjust the slide lever according to number of breaths per minute, and again it's down to either application of the mask, or coupling the control unit via a catheter mount to an airway, I-gel etc.

In this mode, if the person breathes themselves, the patient-assist valve gives as much as they want as an extra, defeating the auto system, yet, if they cease normal breathing, the auto system returns immediately.
The slide lever for instance, when set at 12 BPM gives 600ml of $O^2$, just as required for an adult in the Resuscitation Guidelines.

Use whatever mask you wish, it's the standard 22mm taper fitting on MicroVent. I prefer a more expensive mask with air cushion seal, but whatever takes your fancy or your budget.

Oxygen-Saving on the "airmix" version, when set to 50%, allows you to extend the life of your cylinder, yet still gives the casualty more $O^2$ than judicious use of a BVM ever would. In my opinion, saturating your casualty's lungs with as much $O^2$ as possible gets that gas transfer in the lungs acting both quicker and more efficiently?

With simple training for a few hours, backed up by your normal BLS stuff, it's easy to use, AND, satisfies that previous

statement about constant tidal volume, respiratory rate and minute ventilation. As they say on TV, “other manufacturers may offer similar products”, and there are many; GCE MARS 2, O2 technology Carevent, Pnuepac VR1 to name but a few. Each one differs in some respects, but all achieve the same result, successful ventilation or resuscitation of a casualty or patient.

## VORTRAN GO2VENT

A relative newcomer on the block here, certainly in Europe, and a bit of an intermediary between the BVM and Ventilator Resuscitator, this is again firmly designed for single use primarily in either a hospital setting or during critical care patient transport rather than in the field, certainly not to be dismissed under the right usage situations.

I’ve tried it, but as mentioned above, I don’t see it as a direct competitor to either a BVM or ventilator under rescue and CPR type situations, and at about £100 a go, it is certainly quite costly.

It consists of a complex clear plastic housing, incoming oxygen feed (uses quite a lot to power the unit), outgoing port to go to mask or intubation device. Adjustments are made by manually screwing in or out to change both breaths and volume, achieved by the screw pressing down on springs, simple and effective and correct functioning is plain to see throughout use. The best feature of the Vortran devices, is the airway pressure monitor, a green/amber/red indicator with figures as well. I find this both useful in the field and especially during training. Similar simple monitoring devices can be placed in line between the mask and both BVMs and Ventilators if not already present. Try them, you’ll like them.

## LIMITATIONS OF A BVM

We all know these things have been around for quite a while and are used worldwide, every hour of every single day. As you read this, a BVM is almost certainly being utilised somewhere.

It's true that there is nothing to go wrong with a BVM, no power source to fail or oxygen to run out although supplemental oxygen is the norm for trauma resuscitation even with a BVM. But if we use low-tech as our base-line nothing would ever improve. A simple BVM still has a place in a well stocked trauma kit as a back up but it shouldn't be our first thought specially when a protracted rescue is likely or where either a time factor, or difficult terrain and confined environment come into play. The casualty will not get constant ventilation no matter how experienced the rescuer is. In any event, be it an auto unit or BVM, attaining perfect CPR under such conditions is near impossible. Even a single paramedic trying to resuscitate alone in the back of a travelling ambulance would surely find the auto units more beneficial, along with a higher $O^2$ perfusion for the patient.

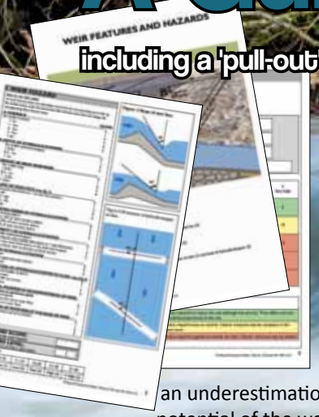
Personally, I’d much rather have a device I can rely on, that assists me, and at the same time promotes a better chance of survival or recovery.

# Weirs & Low Head Dams

## A Guide for Rescuers

### including a 'pull-out' Weir Risk Assessment

by Paul O'Sullivan




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

It would appear that a common theme associated with incidents involving weirs is an underestimation of the danger and entrapment potential of the weirs. This applies to both members of the public, emergency responders and professional river users such as white water rafting companies.

In part one of this series I looked at different types of weirs and options for conducting rescues from weirs. In this article I will move on to consider how we can use a weir assessment system to help inform our understanding of the hazard level of a weir and the difficulty of performing a rescue of a person trapped in a weir.

Following a fatality in a North Wales weir in 2005 it was identified that there was a need to develop a tool that would allow the hazard level presented by entrapment in a weir to be assessed. The result of this is the ***Rescue 3 Europe / Natural Resources Wales Weir Risk Assessment*** tool which I co-designed and we have provided as a 'pull-out' later in this article. This has been in use now for over 10 years and adopted by many organisations in both Europe and North America and has proven to be a very useful resource for determining hazard and risk levels presented by weirs. As a rescue trainer I was particularly interested in the risks and difficulties of undertaking rescues from weirs, so in addition to assessing the entrapment potential of a weir the tool can also be used to assess rescue difficulty. Once we started trialling the assessment we were asked if we could include a process to assess the public safety risk presented by a weir and this was also incorporated into the tool so we ended up with an assessment tool with 3 possible uses:

- **Weir Entrapment Hazard**
- **Weir Rescue Difficulty**
- **Weir Risk (to members of the public)**

The assessment tool can also be downloaded from:

*https://www.rescue3europe.com/index.php/student-downloads/weir-risk-assessment*

and is currently available in English, French, German, Italian and Hungarian.

## DEALING WITH WATER LEVEL CHANGES

Not all weirs will present an entrapment hazard and many of those that do will not have the same level of hazard across all water levels. If we use the tool to assess a weir we are only determining entrapment hazard etc. at that water level. If we wish to develop a hazard/risk profile for the weir then we need to assess the weir at a number of water levels and I would suggest a minimum of three assessment to correspond with low, medium and high flow conditions.





## ASSESSING ENTRAPMENT HAZARDS

Similar to how a kayaker will 'read' the surface features of a white water river to determine the hazards and best route through a rapid, we can use the visible features of a weir to determine its potential to retain a person who ends up in the weir. There is no single criteria that will ensure entrapment, but rather we need to look at a number of criteria and use these to develop an overall level of entrapment hazard.
Not all criteria are given equal weighting when determining the entrapment hazard. For example the distance of the towback on the downstream side of the weir, which is a key entrapment indicator, is scored between 0 and 5, whilst the orientation of the weir to the flow is only scored between 1 and 3. A score of zero is given if that particular criteria is not present. If in high flow conditions the weir is totally submerged and there is no entrapment hazard then the assessment tool will give a hazard score of zero.
The criteria used to assess entrapment hazard are:

### 1. TOWBACK

This is the surface water on the downstream side of the weir moving back upstream towards the weir face and is a key criteria for determining the entrapment hazard of the weir. It is measured as the horizontal distance from the boil line downstream of the weir back to the bottom of the face of the weir.

### 2. DEPTH OF HYDRAULIC/STOPPER

In some weirs the energy of the water creating the downstream boil line results in an elevated boil line. This will mean that the towback is faster and increases the entrapment potential. We measure the vertical height from the top of the boil line to where the towback meets the base of the weir face. In practice this is probably one of the most difficult criteria to measure as there are often few reference features to measure against, particularly on larger weirs and those with high channel banks.

### 3. HEIGHT OF THE DROP OVER THE WEIR

The greater the drop over the weir the larger the energy being carried into the weir. If there is low energy (speed) water immediately downstream of the weir it means that the energy is being dissipated in the weir. Some of this can take the form of noise and spray etc, but often the majority is dissipated through strong, deep recirculation with the associated entrapment potential. This is measured as the vertical distance from the river level immediately upstream of the weir to where the towback meets the base of the weir face

### 4. SLOPE OF THE WEIR FACE

In a similar way to the previous criteria the more vertical the face of the weir the greater energy being carried into the weir. This is measured by estimating the angle between the weir face and vertical – the steeper the face of the weir the greater the score allocated for this criteria


LOW FLOW Note the upstream boom

MEDIUM FLOW Note sturdy fence to restrict public access and rescue ring on the far bank to lower risks

HIGH FLOW. Weir is washed out by high water volume

### 5. FLOATING DEBRIS IN THE HYDRAULIC/STOPPER (pic opposite)

Floating debris being held in the weir is a key indicator of the entrapment potential of a weir. Even if a weir has a large towback and elevated boil line it is unlikely to retain floating debris if there are weaknesses/breaks in the hydraulic where it can wash out. The size and weight of the debris will also give some indication of the strength of the hydraulic and its associated entrapment potential. However, we must also be open to the fact that a weir may have the potential to hold floating debris, but is not doing so only because there is no floating debris currently present. This could be the result of recent high flow conditions which reduced the recirculation of the weir and caused all the floating debris to be washed downstream. To score this aspect we look at how much of the weir is retaining floating debris as a percentage of the whole width of the weir. Non floating debris in the weir e.g a large tree that has been carried downstream and is now resting on the base of the weir is not scored in this criteria as it is not indicative of the entrapment potential. It is obviously a hazard to anyone in the weir and is covered when assessing criteria 9 – Additional Hazards in or Downstream of the Weir

### 6. UNIFORMITY OF THE HYDRAULIC/STOPPER

With this we are looking for weaknesses/breaks (flush points) in the hydraulic/stopper where any floating objects trapped in the weir could be washed out downstream. If the hydraulic/stopper is completely uniform with no weaknesses then the only route out of the weir is likely to be being re-circulated in the water to the base of the weir and then hopefully being carried downstream when this water returns to the surface at the boil line.

### 7. SIDES OF THE HYDRAULIC/STOPPER

Here we are looking at what happens at the sides of the weir. If a trapped person swims or is taken by the recirculation to the side of the weir – is that side 'open' or 'closed'. An open side will increase the possibility for self-rescue, being washed out or being rescued from the weir. If the sides of the weir are closed e.g vertical concrete walls then the entrapment hazard is obviously greater. It is worth noting that some weir sides that appear to be 'open' can be 'closed' by recirculating eddy currents flowing towards the weir.

### 8. ORIENTATION OF THE HYDRAULIC/STOPPER TO THE FLOW

With this criteria we are measuring the angle between the current vector (the direction of flow





in the channel at that point,) and the face of the weir. If the weir is 90 degrees to the current vector there is unlikely to be any general water movement toward the downstream end which could cause anything trapped in the weir to be carried to this downstream end. The shallower the angle between the weir and the current vector the greater the potential for this downstream movement.

### 9. ADDITIONAL HAZARDS IN OR DOWNSTREAM OF THE WEIR

Here we are looking for additional hazards either in or downstream of the weir and if a hazard is present whether it is in the main flow and likely to affect a person held in or being washed out of the weir. Common hazards include multiple weirs where should a person be washed out of a weir they are then carried into another downstream weir or weirs. Similarly, a weir immediately upstream of a difficult rapid or in-water strainer would present a greater hazard to a person being washed out of the weir as compared to a slow moving clear channel on the downstream side of the weir.

### 10. COMPOSITION OF THE RIVERBED AT THE BASE OF THE WEIR

Weirs can be made of a variety of materials all of which have varying potentials to erode and provide additional entrapment or impact injury to a person being held in the weir recirculation. Once we have scored the above 10 criteria we will have a number between 0 and 40 which represents the weir entrapment hazard for the water level when the assessment was undertaken. To help compare and communicate this, the assessment tool provides five hazard bands which describe the hazard level from Very Low (1) through to Very High (5). By revisiting the weir over a variety of water flow levels we can then begin to develop a profile of how the entrapment hazard of that weir changes with different flow conditions.

www.rescuemagazines.com WATER RESCUE

## ASSESSING RESCUE DIFFICULTY

The assessment of rescue difficulty from a weir is based on the assumption that a person is being held in the weir by the stopper/hydraulic. The very fact that we have a person trapped in the weir is highly indicative of the hazard level of the weir and its potential to cause harm to rescuers. We assess the difficulty of rescue from the weir by looking at a number of criteria and scoring each of these in a similar way to how we calculated the entrapment hazard. As many of these criteria are based on the location and structure surrounding the weir there is likely to be a much smaller level of variation in the scores obtained for rescue difficulty across a range of water levels. The ten criteria used are:

### 1. DISTANCE ACROSS THE WEIR/RIVER

The further the distance between our working areas on both banks the more difficult it will be to communicate and operate twin bank systems etc. e.g. tethered boats/boat on a highline.

### 2. ACCESS TO BOTH BANKS

It might not be possible to gain access to both banks and if this is the case it will restrict the rescue options available. When assessing access, we look at whether we have access for vehicles and people, people only or no access to each bank. More complex weirs with in-channel walls can mean that there is effectively no bank access should someone become held in the section of the weir between these mid channel walls.

### 3. SHAPE OF THE WEIR

The shape of the weir can determine how well some rescue techniques can be applied. Straight weirs tend to allow for easier application of in-water reach techniques e.g inflated fire hose and tethered boat options.

### 4. TOWBACK

We have already considered the towback distance from the boil line to the base of the weir face as a key criteria for determining entrapment hazards, but it must also be considered when looking at rescue difficulty. One decision to be made when choosing rescue option is whether we can put a rescuer or tethered boat etc. into/on the towback. Extensive towback with an elevated boil line will increase the hazard level of operating inside the towback. Also, the greater the distance of the towback the more difficult it is to perform a true rescue from downstream of the boil line.

### 5. REMOTENESS

This criteria looks at finding, accessing and resourcing rescue operations at the weir and the more remote the weir location is the greater the allocated score.

### 6. NATURE OF THE RIVER DOWNSTREAM OF THE WEIR

Whilst the nature of the weir is key in determining rescue options available, so is the nature of the river downstream of the weir. This can vary from slow moving shallow water to difficult rapids, with probably the worst case being more retentive weirs downstream of the rescue scene. The nature of the river downstream will determine what techniques and equipment can be deployed downstream of the weir both for performing the rescue as well as providing downstream backup for the rescue.

### 7. WORKING AREA ON BOTH BANKS

In criteria 2 we looked at if we had access to both banks. This criteria now looks at whether we have a suitable working area on each bank that allows us to set up and operate a rescue from that location.

### 8. ANCHORS FOR ROPE SYSTEM

There are a number of rope-based rescue options available which may be suitable for a weir rescue including 4 point tethers, boat on a highline and overhead highline rope systems. This criteria assesses whether we have suitable anchor systems on each bank to set up these systems.

### 9. AVAILABLE RESCUE TECHNIQUES

This is scored on the range of rescue options that could be used at the weir. Some weirs will allow for a full range of single and bank-based techniques to be used including placing rescues/boats in/on the towback, whilst others, due to their size and level of hazard, might exclude all techniques other then use of a helicopter or overhead highline rope system. Even helicopter rescue might not be an option if there are overhead cables, bridges and other hazards to an aerial approach.

### 10. HEIGHT OF THE BANKS ABOVE THE STOPPER/HYDRAULIC

The higher the banks are above the weir the more difficult it is to access the weir and the greater the difficulty to recover a victim from the weir up onto the banks, particularly if we have very steep banks or walls at either side of the weir.

Once all the criteria are assessed we can add them up to give a number between 7 and 43. Depending upon the score it can be allocated to three bands to describe the rescue difficulty at the weir as low, medium or high.

## ASSESSING WEIR RISK (TO MEMBERS OF THE PUBLIC)

Risk can be defined as the likelihood or chance of a particular level of harm occurring. We have already seen how we can assess the entrapment hazard of a weir, so to be able to determine the level of risk it presents we need to assess the likelihood of somebody entering the weir from both the banks or the river. To achieve this the weir is considered as four quarters – upstream river left, upstream river right, downstream river left and downstream river right. For each of these sections we assess the following:

***1. Is there public access to this area by land or river?***

***2. Are there any existing control measures in place to prevent people entering the weir e.g. fences, booms etc.?***

***3. Ability to self-rescue – taking into account the existing control measures if someone fell in the river beyond the control measures could they potentially self-rescue before they entered the weir or would they be washed away from the weir rather than into the weir.***

Once scored, the above criteria will give a score between 0 and 5 which will fit into 5 categories describing the likelihood of a person entering the weir ranging from ***Very Unlikely (1)*** through to ***Almost Certain (5)***. We can then use a standard 5 x 5 risk matrix to multiply the weir entrapment hazards score and the likelihood score to calculate the risk presented to members of the public by the weir.

## USES OF THE RISK ASSESSMENT TOOL

Weirs are permanent structures creating a particular risk in a known location. It is good practice for rescue organisations who might be required to respond to the weir to develop a pre-plan. The weir risk assessment tool can be utilised to understand the entrapment hazard of the weir at different flow levels as well as assessing the difficulty of rescue. This in turn can inform decisions on additional capabilities and equipment that might be needed. The weir risk to members of the public can be utilised to assess the benefit of existing control measures around the weir and potentially highlight improvements that would reduce the need to perform rescues from the weir.
If we're going to undertake rescues from weirs then we need to be training for these in as relevant an environment as possible which is ideally in a weir. The weir entrapment hazard assessment can be used to identify which weirs are suitable for undertaking training on and at which flow levels. Decisions made as to when we can train on a weir and what techniques are possible will directly inform decisions should an actual rescue subsequently need to be performed at the weir.
Whilst its primary use is as a pre-planning tool the risk assessment does have a role at an actual incident -particularly if it's a first time response to a weir that has not had any prior risk assessment undertaken.

For organisations that own and manage weirs, both the entrapment hazard assessment and weir risk assessment are useful tools to help make decisions about which weirs present the greatest hazard and public risk. Following the 2005 drowning in Weir X, which was the starting point for the development of the weir risk assessment tool, it was used to highlight the level of risk presented to the public by the weir which contributed to the decision to have the weir re-designed. The re-design ensured that whilst it still performs its required function to measure water flow down the river it no longer presents an entrapment hazard.

## WORKED EXAMPLE

**Cromwell Weir** pictured at the top of the page is on the River Trent in Nottinghamshire and the former Weir X above is on the Afon Tryweryn in North Wales. These are very different structures. Indeed perhaps the only two similarities are that they are both weirs and have both caused fatalities (multiple fatalities for Cromwell Weir). Cromwell Weir is a large curved structure approximately 100m wide spanning the River Trent adjacent to a navigation lock, in a remote setting in rural Nottinghamshire. There is extensive towback that I've measured at over 14 meters. In addition to an upstream channel boom and warning signs there is a memorial plaque on the bank for 10 soldiers who drowned in the weir in 1975 when undertaking a paddle boat exercise at night. Unfortunately, since then there have been further incidents including the death of a fisherman in 2012.

The former **Weir X** was a much smaller structure in the town of Bala, North Wales. It was on the River Tryweryn which is dam released and regularly would be running during the summer when it's used to top up the level of the River Dee. Situated .....continued on page 41.....



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Natural Resources Wales

Rescue 3 EUROPE

# NATURAL RESOURCES WALES / RESCUE 3 EUROPE WEIR ASSESSMENT SYSTEM

Name of assessor: _____

Date of assessment: _____

## WEIR INFORMATION

Name of weir / site: _____

Other names weir known as: _____

Weir location and river: _____

Grid reference: _____

## RIVER FLOW INFORMATION

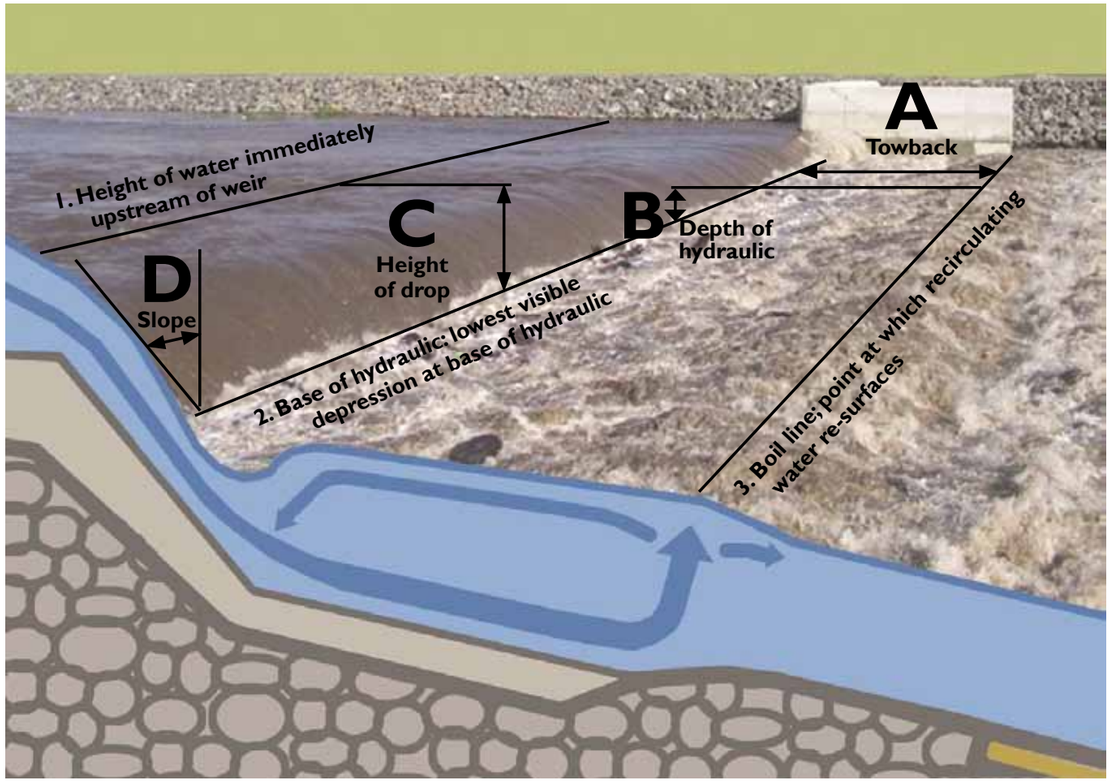
Reference Gauge Location: _____

| | River level (m) | Flow range ($m^3/s$) |
|---|---|---|
| Low | | |
| Medium | | |
| High | | |
| Flood stage | | |

River level on day of assessment - level (m) & flow ($m^3/s$)

_____ L / M / H / VH

# WEIR FEATURES AND HAZARDS




## FEATURES/HAZARDS

**A. Towback:**
The distance from the base of the hydraulic/stopper (2) to the boil line (3)

**B. Depth of hydraulic/stopper:**
Vertical distance from top of boil line (3) to base of hydraulic (2)

**C. Height of drop:**
Vertical distance between water level immediately upstream of weir (1) and base of hydraulic/stopper (2)

**D. Slope:**
Angle of water flowing over face from vertical







## 1. WEIR HAZARD

***How to use this table:***
*For each hazard, select one description and circle the corresponding score. Add up the circled scores, write the total in the Weir Hazard Score box and assign the corresponding Weir Hazard Level.*

| A. TOWBACK | SCORE |
|---|---|
| No visible towback | 0 |
| < 1m | 1 |
| 1 - 2m | 2 |
| 2 - 3m | 3 |
| 3 - 4m | 4 |
| > 4m | 5 |
| **B. DEPTH OF HYDRAULIC/STOPPER** | |
| No visible hydraulic/stopper | 0 |
| < 0.3m | 1 |
| 0.3 - 1m | 2 |
| > 1m | 3 |
| **C. HEIGHT OF DROP OVER WEIR** | |
| No visible drop | 0 |
| < 0.3m | 1 |
| 0.3 - 1m | 2 |
| 1 - 2.5m | 3 |
| > 2.5m | 4 |
| **D. SLOPE OF WEIR FACE (see fig 1)** | |
| Structure drowned out - no weir face present | 0 |
| > 60° | 1 |
| 45° - 60° | 2 |
| 30° - 45° | 3 |
| < 30° | 4 |
| **E. FLOATING DEBRIS IN HYDRAULIC/STOPPER** | |
| No floating debris | 0 |
| Up to 10% of hole contains debris | 2 |
| 10 - 25% of hole contains debris | 3 |
| > 25% of hole contains debris | 4 |
| **F. UNIFORMITY OF HYDRAULIC/STOPPER** | |
| No visible hydraulic/stopper | 0 |
| Broken feature with multiple flush points or 1 main flush point | 1 |
| One or two small flush points in the hydraulic/stopper | 2 |
| Totally uniform with no breaks and flush points | 5 |
| **G. SIDES OF HYDRAULIC/STOPPER** | |
| Both open | 0 |
| One side open/one side closed | 2 |
| Both closed | 4 |
| **H. ORIENTATION OF HYDRAULIC/STOPPER TO FLOW (see fig 2)** | |
| No hydraulic/stopper present | 0 |
| < 30° to current | 1 |
| > 30 but < 90° to current | 2 |
| 90° to current | 3 |
| **I. ADDITIONAL HAZARDS IN OR DOWNSTREAM OF WEIR** eg strainers, weirs or significant rapids | |
| No additional hazards | 0 |
| Hazard present but not in main flow | 1 |
| Hazard present in main flow | 5 |
| **J. COMPOSITION OF RIVER BED AT THE BASE OF WEIR** | |
| Structure drowned out/non-modular | 0 |
| Concrete | 1 |
| Sand or gravel | 2 |
| Rock or debris | 3 |

**WEIR HAZARD SCORE:**
*Sum of scores selected for each hazard* ____

**WEIR HAZARD LEVEL:**
*Corresponding Hazard Level from table below* (____)

**Weir Hazard Level:**

| Hazard Score | >0-10 | 11-15 | 16-20 | 21-30 | 31-40 |
|---|---|---|---|---|---|
| Hazard Level | V Low (1) | Low (2) | Med (3) | High (4) | V High (5) |

**Figure 1: Slope of weir face**

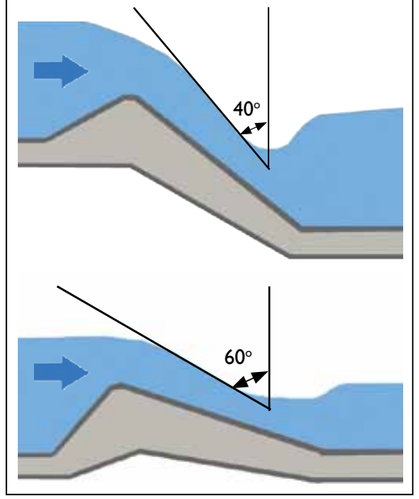
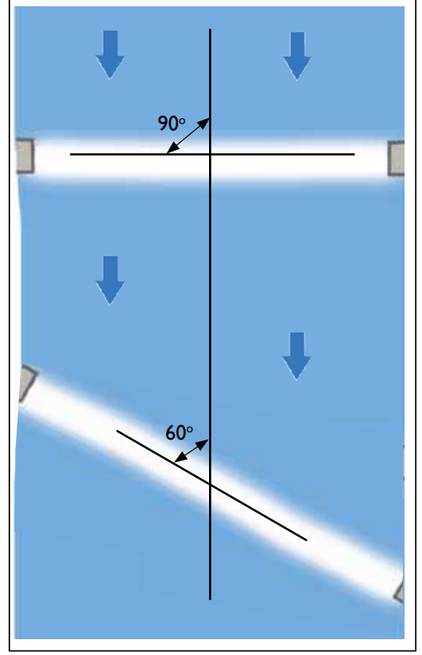



Figure 2: Orientation of hydraulic/stopper to flow



## 2. LIKELIHOOD OF WEIR TO CAUSE HARM

***How to use this table:***
*For each consideration, select one description and circle the corresponding score. Add up the circled scores and write the total in the Likelihood of Weir to Cause Harm box.*

| | | SCORE |
|---|---|---|
| **PUBLIC ACCESS** | | |
| Public access from land and water – is the structure in a publicly accessed location? | | |
| Land upstream river right | no public access from land/bank | 0 |
| | public access from land/bank | 0.25 |
| Land upstream river left | no public access from land/bank | 0 |
| | public access from land/bank | 0.25 |
| Land downstream river right | no public access from land/bank | 0 |
| | public access from land/bank | 0.25 |
| Land downstream river left | no public access from land/bank | 0 |
| | public access from land/bank | 0.25 |
| Water upstream | no access to weir from upstream | 0 |
| | access to weir from upstream | 0.5 |
| Water downstream | no access to weir from downstream | 0 |
| | access to weir from downstream | 0.5 |
| **CONTROL MEASURES** | | |
| Are there control measures in place, eg fences or booms, to prevent people from entering the weir? | | |
| Land: | | |
| Upstream river left | adequate control measures in place | 0 |
| | inadequate control measures in place | 0.25 |
| Upstream river right | adequate control measures in place | 0 |
| | inadequate control measures in place | 0.25 |
| Downstream river left | adequate control measures in place | 0 |
| | inadequate control measures in place | 0.25 |
| Downstream river right | adequate control measures in place | 0 |
| | inadequate control measures in place | 0.25 |
| Water: | | |
| Upstream | Structure not in main channel/boom present | 0 |
| | Structure in main channel/no boom present | 0.5 |
| Downstream | Controlled by boom or by high speed of water | 0 |
| | No downstream control measures | 0.5 |
| **ABILITY TO SELF-RESCUE** | | |
| Taking into account the existing control measures, if a person were to fall into the water above/beyond/outside the existing control measures can they self rescue before entering the weir? | | |
| Upstream river left | can self-rescue | 0 |
| | can't self rescue | 0.25 |
| Upstream river right | can self-rescue | 0 |
| | can't self rescue | 0.25 |
| Downstream river left | can self-rescue | 0 |
| | can't self rescue | 0.25 |
| Downstream river right | can self-rescue | 0 |
| | can't self rescue | 0.25 |

**LIKELIHOOD OF WEIR TO CAUSE HARM**
*Sum of scores selected for each consideration*

**LIKELIHOOD OF WEIR TO CAUSE HARM LEVEL:** ( )
*Corresponding Likelihood Level from table below*

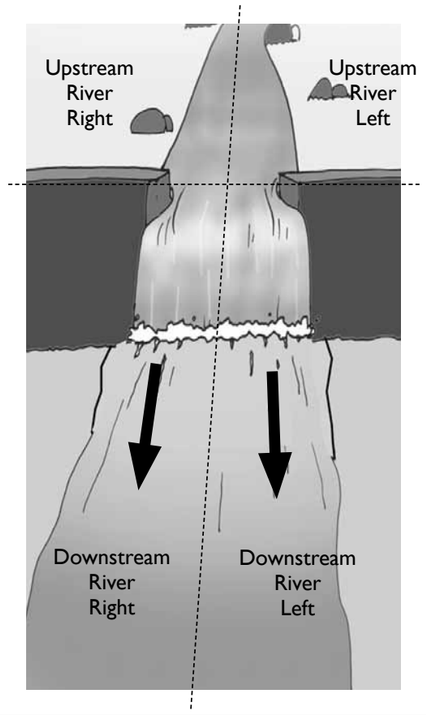
**Likelihood Level:**

| Likelihood Score | 0-1 | >1-2 | >2-3 | >3-4 | >4-5 |
|---|---|---|---|---|---|
| Likelihood Level | V Unlikely (1) | Unlikely (2) | Likely (3) | V Likely (4) | Almost certain (5) |




## SECTIONS OF A RIVER

The river/waterway can be divided into four sections for ease of identification: upstream and downstream of the weir/hazard and river left and river right. This is always done from the perspective of looking downstream.




## 3. WEIR RISK RATING

Risk = Hazard x Likelihood

The Hazard and the Likelihood have been calculated in the previous tables.

Using these results, the Weir Risk Rating Score can be calculated:

**WEIR HAZARD LEVEL:**
*Level of 1-5 taken from Table 1 (page 3)*

**LIKELIHOOD OF WEIR TO CAUSE HARM LEVEL:**
*Level of 1-5 taken from Table 2 (opposite)*

**WEIR RISK RATING SCORE:**
*Multiply Hazard Level by Likelihood Level (from above)*

**WEIR RISK RATING LEVEL:**
*Corresponding description from table below i.e. Low*

| Likelihood \ Hazard | 1 Very Low | 2 Low | 3 Medium | 4 High | 5 Very High |
|---|---|---|---|---|---|
| 1 Very Unlikely | 1 | 2 | 3 | 4 | 5 |
| 2 Unlikely | 2 | 4 | 6 | 8 | 10 |
| 3 Likely | 3 | 6 | 9 | 12 | 15 |
| 4 Very Likely | 4 | 8 | 12 | 16 | 20 |
| 5 Almost Certain | 5 | 10 | 15 | 20 | 25 |

| Score | Risk Level | Action |
|---|---|---|
| 1 - 5 | LOW | Action required to reduce the risk, although low priority. Time, effort and cost should be proportional to the risk. |
| 6 - 10 | MEDIUM | Action required soon to control. Interim measures may be necessary in the short term. |
| 12 - 25 | HIGH | Action required urgently to control the risks. Further resources may be needed. |

# 4. WEIR RESCUE

***How to use this table:***
*For each rescue consideration, select one description and circle the corresponding score.*
*Add up the circled scores and write the total in the Weir Rescue Difficulty box.*

| A. DISTANCE ACROSS WEIR/RIVER | SCORE |
|---|---|
| < 10m | 1 |
| 10 - 20m | 2 |
| 21 - 50m | 3 |
| 51 - 75m | 4 |
| > 75m | 5 |
| **B. ACCESS TO BOTH BANKS** | |
| Easy access to both banks for people & vehicles | 0 |
| Easy access to both banks for people only | 1 |
| Easy access to only 1 bank for vehicles & people | 2 |
| Easy access to only one bank for people | 3 |
| Difficult / restricted access to both banks for people & vehicles | 4 |
| No access to either bank | 5 |
| **C. SHAPE OF WEIR** | |
| Straight | 1 |
| Curved/multi-directional/compound structure | 3 |
| **D. TOWBACK** | |
| No visible towback | 0 |
| < 1m | 1 |
| 1 - 2m | 2 |
| 2 - 3m | 3 |
| 3 - 4m | 4 |
| > 4m | 5 |
| **E. REMOTENESS** | |
| Urban | 1 |
| Rural/semi-urban | 2 |
| Remote | 4 |
| **F. NATURE OF RIVER DOWNSTREAM OF WEIR (see opposite)** | |
| Up to Class I | 1 |
| Class II | 2 |
| Class III | 3 |
| > Class III | 4 |
| Additional downstream weirs | 5 |
| **G. WORKING AREA ON BANKS** | |
| Good working areas on both banks | 1 |
| Good working areas on one bank only | 2 |
| Limited or restricted working areas on both banks | 3 |
| No working areas on either bank | 4 |
| **H. ANCHORS FOR ROPE SYSTEM** | |
| Good anchor points on both banks | 1 |
| Good anchor points on one bank only | 2 |
| Limited anchor points on both banks | 3 |
| **I. AVAILABLE RESCUE TECHNIQUES** | |
| Full range of single and twin bank methods with easy ability to cross channel with ropes, eg bridge, short throw or shallow crossing | 0 |
| Full range of single and twin bank methods but difficult to cross channel with ropes, eg bridge, short throw or shallow crossing | 1 |
| Limited to single bank methods or use of paddle boat | 2 |
| Limited to single bank methods or use of motorised boat | 3 |
| No bank-based options available | 4 |
| Helicopter only | 5 |
| Helicopter not possible (overhead wires etc) | 6 |
| **J. HEIGHT OF BANKS ABOVE BASE OF HYDRAULIC/STOPPER** | |
| < 1m | 1 |
| 1 - 3m | 2 |
| > 3m | 3 |

**WEIR RESCUE DIFFICULTY SCORE:**
*Sum of scores selected for each rescue*

**WEIR RESCUE DIFFICULTY LEVEL:**
*Corresponding Difficulty Level from table below* ( )

**Weir Rescue Difficulty Level:**

| *Difficulty Score* | *< 20* | *20-25* | *> 25* |
|---|---|---|---|
| *Difficulty Level* | *Low (1)* | *Medium (2)* | *High (3)* |



## International River Grading System

Class I
Clear section of moving water or simple rapid which may contain low waves and few or no obstructions. Clear route through section of river.

Class II
Medium rapid which may contain irregular waves, small stoppers and simple obstructions. Clear route through section of river.

Class III
Larger rapid which may contain medium, irregular waves, medium stoppers and multiple obstructions. Recognisable route between obstructions/features.

> Class III
Heavy rapid which may contain high, irregular waves, large stoppers and numerous obstructions. No easily recognisable route between obstructions/features.

## NOTES



## NATURAL RESOURCES WALES / RESCUE 3 EUROPE WEIR ASSESSMENT SYSTEM

# RESULTS

*Complete the tables within this workbook and transfer the results to this page*

| | **Score** *(from completed tables )* | **Level** *(from completed tables)* |
|---|---|---|
| **Weir Hazard** *(Table 1, page 3)* | | ( ) |
| **Likelihood of Weir to Cause Harm** *(Table 2, page 4)* | | ( ) |
| **Weir Risk Rating** *(Table 3, page 5)* | | ( ) |
| **Weir Rescue Difficulty** *(Table 4, page 6)* | | ( ) |

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Rescue 3 EUROPE

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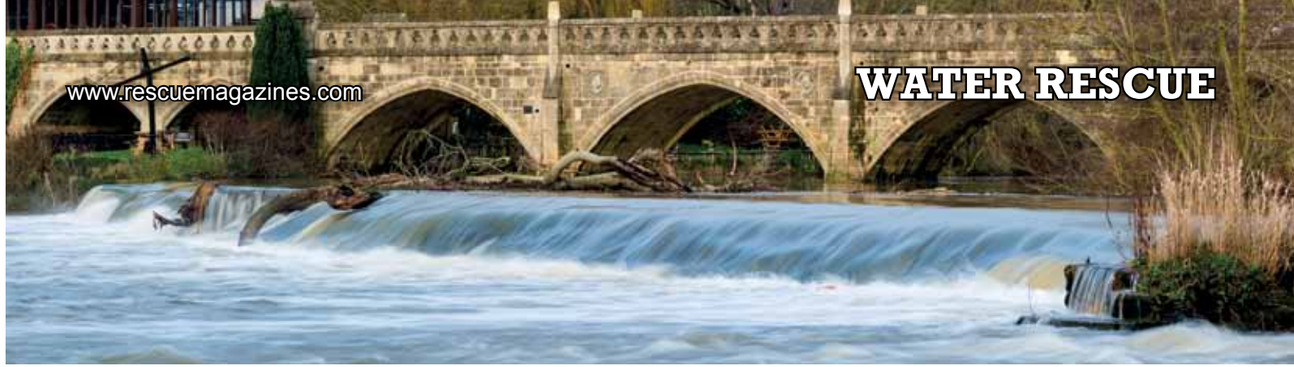


just downstream of the main carpark in the town and with a popular footpath running alongside it was much more open to human interaction than Cromwell Weir. The weir itself was very insignificant looking with a drop of less than 50cm and slow moving water both upstream and downstream of the weir. Without undertaking a full weir risk assessment the only indication as to the strength of the weirs recirculation was the collection of tennis balls, sticks etc. that would often be held against the face of the weir by the towback.

When we assess both weirs for entrapment hazard we get the following:

| | CROMWELL WEIR | FORMER WEIR X |
|---|---|---|
| Entrapment Hazard Score | 28 | 26 |
| Entrapment Hazard Level | High (4) | High (4) |

The fact that both are high risk and there is little difference between the actual scores might seem surprising at first. However both structures have enough towback to get the maximum allocation for that criteria and in both cases the stopper/hydraulic is uniform with no breaks and has the potential to hold floating debris. Both structures are at 90 degrees to the current vector and have vertical or near vertical weir faces. Weir X has a much smaller height which is largely explains the difference in hazard scores between the two weirs. With large concrete walls the sides of Cromwell Weir are clearly 'closed' whereas the sides of Weir X appear to be open. Closer inspection however showed that the large downstream eddies at both sides of the weir have strong eddy currents flowing back towards the weir which effectively 'close' both sides of the weir.

Neither weir has a highly elevated boil line and there are no additional hazards downstream which explains why neither make it into the 'Very High' category for entrapment hazard. When we assess both weirs for Rescue Difficulty we get very different results:

| | CROMWELL WEIR | FORMER WEIR X |
|---|---|---|
| Entrapment Hazard Score | 33 | 16 |
| Entrapment Hazard Level | High | Low |

- the large width of Cromwell Weir is too much to operate tethered boats
- greatly reduces the potential for any bank based conditional rescues to be successful
- the combination of river width and a large powerful recirculation pretty much rules out any tethered swimmer options
- Powerboat operations below the weir are unlikely to provide a true rescue capability from the weir
- Helicopter would seem to be the only effective solution and there are no overhead obstructions to prevent its use.

The former Weir X by contrast had a wide variety of rescue options available. The narrow river channel allowed for both reach and throw conditional rescues to be undertaken if the victim was able to hold onto these. Whilst the entrapment hazard has proven to be lethal, a properly trained and equipped rescuer can perform tethered swim rescues from the weir and a variety of tethered boat operations can be performed with the boat able to cross the boil line and onto the towback in a controlled and stable way.

We can therefore see that whilst both weirs present a similar level of entrapment hazard there are significant difference in the rescue difficulty.

In terms of risk presented by the weirs to members of the public, including river users, Weir X sees much more public access. The main potential interaction with Cromwell Weir would be from boats navigating the Trent and using the lock adjacent to the weir. There is a large boom across the river upstream of the weir located just below the lock entrance but no boom on the downstream side.

When we undertake the Weir Risk Assessment we get the following outcomes for each weir:

| | CROMWELL WEIR | FORMER WEIR X |
|---|---|---|
| Entrapment Hazard Score | 28 | 26 |
| Entrapment Hazard Level | High (4) | High (4) |
| Likelihood of Causing Harm Score | 2 | 3 |
| Likelihood of Causing Harm Level | Unlikely (2) | Likely (3) |
| Weir Risk Score | 8 | 12 |
| Weir Risk Level | Medium | High |

The combination of a 'high' entrapment hazard and a location that means it's 'likely' to cause harm to members of the public results in a 'high' weir risk level for Weir X. Whilst Cromwell Weir scores 'unlikely' in terms of whether it will cause harm to members of the public the fact that the risk of entrapment is 'high' results in it having and overall risk level of 'medium'.

# NEW DESCENDERS!

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AUTOLOCKING

# ESCAPE/BAIL-OUT DESCENDERS





## ESCAPE DESCENDERS

### Manually activated, superlight, autolocking descenders

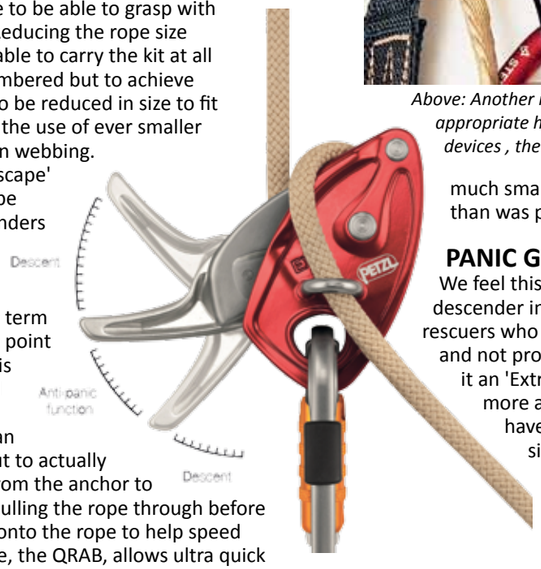
We discussed the principles of 'auto-locking' (or 'brake assist' as it's now becoming known) in last issue's GUIDE to AUTOLOCKING RESCUE DESCENDERS designed, or at any rate used, for two-person rescues. We will use some of the same editorial in this article albeit modified to relate specifically to Escape devices where necessary.

Escape devices are a special class in NFPA descender standards (E) and in European Norms where they meet EN341 but intended ONLY for single person emergency evacuation. Even though we're heading towards autolocking being the norm, there are still some manual 'escape' devices that are simply small and friction-imparting, mandating the user to maintain strong and constant control of the trail rope. This guide is ONLY concerned with smaller *autolocking* devices, that is, devices which will lock and hold-position when the user lets go of everything. These devices are now so small and with such varied activation options that they are the only type of manual descender you should consider. We make the 'manual' distinction because there is another genre of escape devices; the fully automatic 'controlled descent' devices which are inertia brakes requiring no active participation of the user other than stepping off and waiting while the device lowers you to safety at a set speed. There is at least one range of hybrid devices (Deus Rescue/Skylotec) that we have included because they offer hands free automatic, bi-directional descent AND manual control. Such devices could become so small as to take over the escape market entirely but we're not there yet and, as we'll see shortly, there are other considerations when choosing a device or kit.



Escape descenders were originally called 'Bail-out' devices because the primary driver for this genre was firefighters trying to get out of a burning building in a rush. In effect, they were *bailing out* of the building by jumping out of a

window or off a balcony. We discussed escape procedures in detail in last issues REVIEW of the CMC LEVR (and have even used a larger version of the same title picture!) and in issue 70 and 71's Reviews of Sterling's FCX and GT Lightning hook. At its most basic, planned 'escape' could simply mean grasping a rope with a gloved hand ala military fast-roping and sliding down to safety. This dispenses with the need for a harness, of which more later, but in terms of this rudimentary escape system it only dispenses with the smallest component of an escape system – the descender. It's the rope that needed to be reduced in size because a gloved hand needs quite a thick rope to be able to grasp with any degree of control. Reducing the rope size enables rescuers to be able to carry the kit at all times relatively unencumbered but to achieve this the hardware had to be reduced in size to fit smaller kits and latterly the use of ever smaller diameter cords and even webbing.




Above: Another image stolen from a previous issue but very appropriate here. These are the comparative sizes of three Escape devices , the CMC LEVR, Sterling FCX and Cresto Smartline X.

Many companies sell 'escape' kits with regular size rope and regular sized descenders in a regular sized bag but these are more correctly 'Evacuation' kits even if they use the term 'personal'. However, the point of bail-out devices in this GUIDE is that they need to be small, easy to use and they need to have an efficient low-load payout to actually enable you to make it from the anchor to the window simply by pulling the rope through before your full weight comes onto the rope to help speed things along. One device, the QRAB, allows ultra quick detachment at the bottom simply by pressing a button but only when there is no load on it. In our Working Load Limit (WLL) column the minimum load (where given) might give some indication of how hard it will be to pull rope through. The Deus systems are again one of the exceptions because they're not really that small or light and maybe not that intuitive without instruction. But in auto mode they operate by inertia brake so rope will feed easily at low speed. They are specifically designed as escape devices with the option of manual or fully automatic operation which is not to be sniffed at in a dire emergency because you could effectively throw an unconscious colleague out of a window safe in the knowledge the device will make the descent while you then do the same. The alternative with regular escape devices is having to hang around in a rapidly deteriorating situation while you lower your unconscious colleague to safety.

Petzl's EXO device based on the GriGri wasn't the first bespoke 'bail-out' system to use a more conventional lightweight descender but it was the initial market leader adopted across entire fire services following New York Fire Departments lead because it offered hands-free bail-out in a well tried and tested system. It remains a key player in its Mk3 form because it's a well-proven performer able to take a lot of abuse and still function well. It too now uses the latest trend towards fire retardant fibres like Aramid and Technora in diameters of only 5 to 7.5mm. Such diminutive diameters make it possible to have much smaller kits for the industry standard 50ft/15.1m than was possible with the previous 10mm+ ropes.

## PANIC GRAB or DOUBLE BRAKE?

We feel this term, often described as 'anti-panic' in descender instructions, to be somewhat insulting to rescuers who are presumably at the top of their game and not prone to panicking. Climbing Technology calls it an 'Extraordinary Braking System' which is perhaps more appropriate to expert users who then don't have to admit to having panicked but instead simply had an 'extraordinary moment'. To keep everyone happy let's think of it as a double or secondary brake to protect against accidental activation that might put you into a free-fall such as pressure from webbing or rigging against the handle. The 'panic' term has come about because a climber's reaction to an unexpected and maybe scary occurrence is to hang on more tightly to whatever you're already holding, in this case the handle of the descender. It was often the case with single action brakes that having grasped the handle and gone into virtual free-fall this further inclined you towards hanging on tighter rather than the unnatural reaction of letting go of everything in order to arrest your fall. So double braking devices arrived and were sold on the ability to mitigate that grab reaction when something goes wrong.

Double or Panic-Brakes come in 3 forms:
1) 'Lock' when the handle goes beyond a certain point, they then need to be reset before you continue descent like the ISC D2 and CAMP Druid
2) As 1) but instead of having to reset after locking, the handle can continue past the lock and back into descent mode like the newer EXO AP
3) if the handle is squeezed too hard, it goes into an 'overpressure' braking action for as long as you maintain sufficient pressure on the handle or remember to let go altogether. This style of secondary brake is much better suited to tactical and high-speed descents where a sudden arrest could be disastrous whereas a temporary slowing could be easily dealt with. You may never stop completely but you will at least hit the floor at a slower speed. Most Tactical situations prefer no secondary brake at all as with the EXO and Drui Pro.





## VERSATILITY...if you're allowed...

Perhaps the most versatile device in this selection is the Taz Lov 2 sold as a multi-role device and unusual in this selection because it will operate on an incline ie. with the trail rope loaded, an action that would halt the progress of evacuees on every other device. This diagonal evacuation line might be particular useful if you need to avoid obstructions below. Given more time and equipment, rope rescuers would simply set up a tensioned offset on regular gear but as a quick, emergency option the Taz Lov2 gives you that option with the kit already to hand – you just need someone on the ground to know that they are able to grab and deviate the rope for you!
The Exo (or GriGri) pictured opposite also demonstrates the versatility of a more conventional,manual escape devices over the fully automatic inertia devices mentioned earlier because they are effectively a modification of a descender that also ascends, belays, lifelines, lowers, work positions and restrains from falling off edges. Virtually all descender escape devices will also do all these things, perhaps not all – ***belaying*** and ***ascending*** are activities that we've listed separately, not because any that have NFPA-E or EN341 won't be capable of taking a shock load since that is part of each standard or that you couldn't ascend a rope, eventually, in some fashion with these devices, it's more the efficiency with which they achieve it. If it can be used as an ascender then it can also function in a haul system but only devices that allow you to pull through slack easily can do this. Other than these specific functions all escape devices can perform lowering (rather than abseil/rappel), work positioning/edge restraint and even guy tensioning This makes them potentially extremely versatile kits to have readily to hand. However, their very nature as an emergency bail-out system MAY mean that you are mandated by service protocols or by the manufacturer to ONLY use it in an emergency escape situation rather than during the course of less life-threatening access and rescue situations. Indeed, systems like the EXO are sold as SINGLE-USE systems and you are expected to purchase separate training sets in order to become familiar with its operation. Our own feeling is that rescuers should be able to maintain their own kit properly and assess the risk of using it for other access and rescue purposes versus having it immediately available for a bail-out and that it is too useful an asset to sit on your belt waiting for a once in a career emergency. However, we can certainly understand the thinking behind such a restrictive policy and why some kits/devices are now geared specifically to one-time use only. The problem is of course, that not all firefighters trained in the use of a bail-out kit will be familiar with rope access and rescue procedures that would be second-nature to rope technicians.

We've included only devices which lock when you take hands off because the principle of a bail-out is that you could literally be bailing out of a window at speed and in a relatively uncontrolled manner in an effort to escape rapidly impending doom. There's little point in doing that if you have to use both hands on the device and rope in order to negate going into freefall. Once you start freefalling on a friction-only device like the fig8 or rack it's very hard to recover your position though firefighters have an advantage because they're likely to be wearing substantial gloves. That's why some of the original friction-only devices sold and used as escape devices were simply very small pieces of metal with various arrangements of rope-threading. PMI's PED (pic right)is a typical example

RPI's Phoenix is one of several lever-style devices (hence CMC's LEVR name for their latest device) where the body becomes the handle. This particular model is unique in our selection because it incorporates an integral swivel

and this concept has evolved into at least four models in this Guide because the Sterling FX and F4, Fire Innovation's Core and RPI's Phoenix (pic above) all use the principle of threading and combine it with a handle for leverage which, when released causes the device to lock up. As already discussed, in the case of some devices, like the EXO AP, there is a DOUBLE brake action, in other words it will brake when you let go of everything AND when you pull/squeeze too hard on the handle. This feature is not so good for tactical situations where the operator cannot risk suddenly locking-up in mid-flight and slamming back into the structure.

The EXO's success was not only due to being one of the first devices to identify and address a need for smaller bail-out options, it also incorporated a feature that many others have also adopted – the fold-down handle for a lower profile/size when stowed. We see this in the CAMP Druid, Ice Rock Gnome, Taz Lov2, Ensa Ape Exreme and Cresto Smartline. Sterling identified this as an improvement that could be made to the F4 and subsequently produced the FCX with a much smaller footprint. We see it increasingly in full size descenders where it is as much about decreasing the snag-hazard of a protruding handle as it is about saving space. The same is partly true here but there's no doubt that occupying less space in the kit is a key design feature. We even see devices like the Cresto SmartLine X pictured opposite and Protección Técnica Escapettor pictured over the page, able to be stowed with the attachment carabiner wrapped around the body of the descender.

## HARNESSES

A word about harnesses. We said originally that the rope and gloves bail-out dispensed with a harness and descender but harnesses are becoming much more fundamental to the basic fire kit. In Europe, Pompier belts have been used forever in some countries but their more body-friendly alternative, the sit-harness is now either worn by many services throughout any

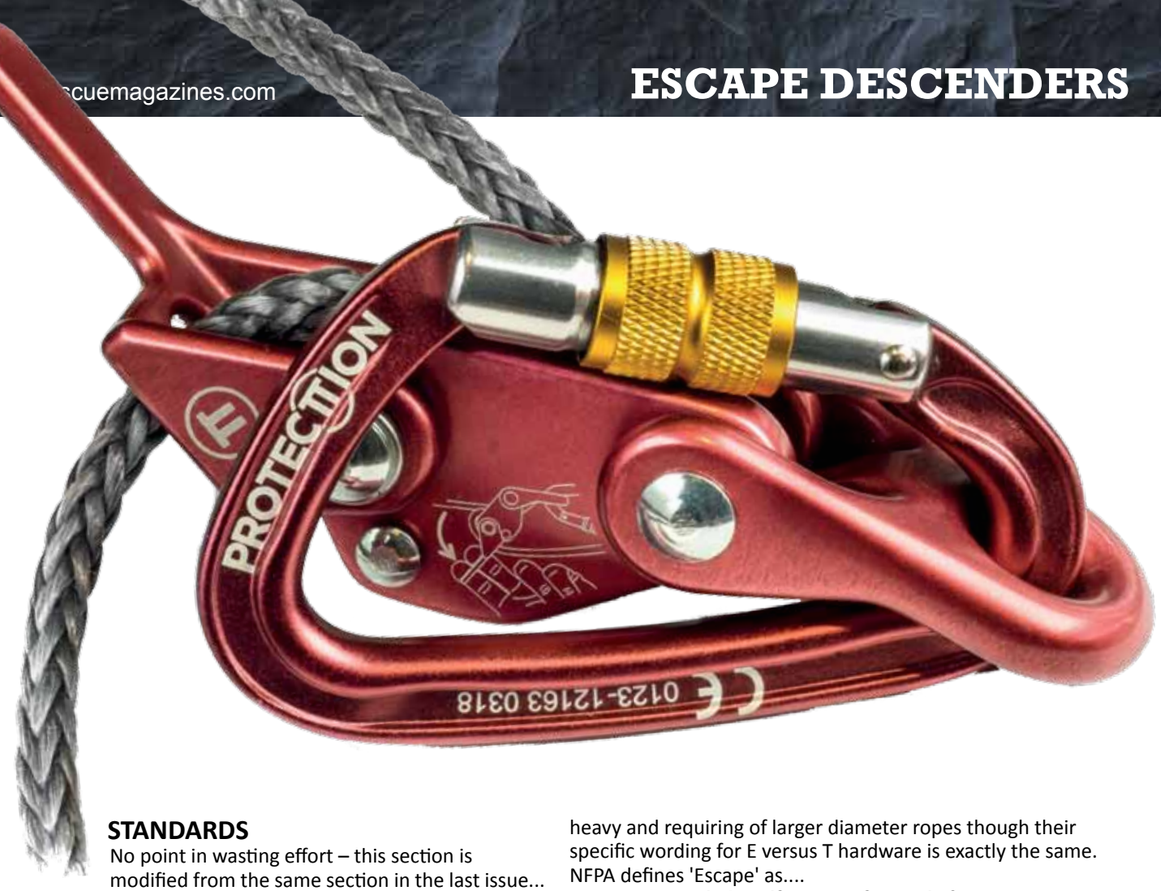
off-the-ground or high rise deployment or is readily available in a minimalistic, low-bulk form or already seamlessly integrated into fire clothing like the Lion Apparel systems.

## KITS

Since the start of the bail-out genre they have been sold as complete kits rather than individual descenders. That's not to say that expert users can't still purchase some of these and configure them to their own needs, but most are assuming that these will be allocated across ALL personnel likely to be entering a high-rise structure not just rope-rescue trained personnel. A complete kit usually includes:

- **ANCHOR**, a hook and/or a carabiner. A hook can be used for very rapid placement or used as a modified carabiner for tying off at an anchor. Sling and/or the rope can simply be passed around any sized (appropriate) anchor and secured back to itself with a carabiner
- **ROPE.** Often a very specific rope so that there can be no mis-marriage of size and performance between rope and device and increasingly a heat-retardent rope both for fire-resistance and to resist the heat-build up of a rapid descent. Originally, escape devices used fairly standard rope diameters at around 10-11mm 7/16" but as soon as it was realised that the small diameter Aramid-type cords that had been common in yachting for decades, could be modified to operate within the various rope access disciplines, it set off a chain reaction of new development. Most now operate on 5-8mm high-strength, abrasion and heat-resistant cords or even webbing flat like the LEVR and RSS AL2 &4. The usual minimum length is 50ft or 15m (15.24 to be exact) but some, kits (and therefore the kit price we've quoted) differ from this like the Skylotec below which is 25m/82ft - other sizes on request.
- **DESCENDER**. The device itself may be 'bolted' into the rope like the EXO AP or able to be easily disengaged and used for other purposes like the D2 and EXO. The vast majority are designed to be used ONLY within a specified kit. Most are connected to your harness via a carabiner but there are three or four that have an integral length of Nomex or similar fire-retardent webbing like the LEVR, Core and RSS-AL device. One device, the Phoenix, has an integral swivel for a carabiner which would seem a useful design feature.
- **PACK**. To contain all of the above but also needs to be easy to access, easy to stow on your harness, belt or clothing and easy to deploy and repack after use. Most are Cordura packs with Velcro closures that will tar open easily but remain secure during normal activities. Our tables have a column to reflect whether the descender can be purchased separately (black square), or as part of a kit (orange square) or both.






## STANDARDS

No point in wasting effort – this section is modified from the same section in the last issue... Traditionally called 'Auto-Locking' the term 'Assisted-Braking' has now crept in.

Although aimed primarily at rescuers this 'escape/evacuation' genre has now evolved to include all at-height workers and in particular rope access workers. In Europe especially, the now enormous wind turbine market is driving a lot of development towards escape and evacuation systems though diminutive kit-size is not as important to wind turbine workers as it is to firefighters. The definition we had in the last Guide as a 'RESCUE' device doesn't really apply here since these are for personal use-only. However, if you were magnanimous enough, you could simply switch out your kit, anchor the descender and lower somebody else down instead of escaping yourself. This then would be a rescue device and indeed ALL of these devices could rightly be described as Rescue ***and*** Escape devices. Many of the descenders listed in the GUIDE meet more than one performance standard. Unlike the last issue's mainstream autolocking descenders meeting ANSI/ASSE Z359.4 and/or NFPA 1983 (2017) G, L and T, these devices mostly meet NFPA 1983 E (for escape) and requires a ire-resistant rope/webbing and may not have a CE at all if they're not intended to be sold within the EU. Unusually, this NFPA E 'standard' is the most specific of world standards, more specific even than European standards which normally subdivide equipment into their most finite functions. ENs still cover escape devices of course but generally in addition to other functions so that, for instance Kong's Indy Evo Plus descender could be described as a personal evacuation/Escape device as well as a rescue descender and general descender. In contrast NFPA E tends to rule out G and L devices as being too large/ heavy and requiring of larger diameter ropes though their specific wording for E versus T hardware is exactly the same. NFPA defines 'Escape' as....

***Immediate self-rescue of a single fire or emergency services person from a life-threatening emergency situation, generally above ground, using system components or manufactured systems designed for self-rescue escape.***

Some of the non-US devices in this list therefore would NOT satisfy this definition because they are designed for other purposes of which escape is an alternate use. Be sure that the device you're considering, adheres to your service or agency's standards requirements.

In Europe, descenders were historically tested to EN 341:1992 Personal fall protection equipment which actually was originally written from the perspective of descenders being used for evacuation purposes in an emergency. The 2011 revision states clearly that it 'does not specify requirements for descender devices that are used for descending in mountaineering, rope access and work positioning systems'. Descenders for these specific tasks are now tested in Europe to EN12841:2006/C. NB: For reasons of space we have not included the revision year – you will need to satisfy yourself of the compliance (or otherwise) of all these products to any of their stated standards since some seem to contradict their own data submissions-perhaps by including specialist or 'Other use' not necessarily subject to the same standards.

The EN 341 standard includes test procedures that require a series of high-level descent tests to assess the product's ability to perform satisfactorily after repeated use. The standard categorises descenders into two types: 'automatic', which incorporates a braking system that requires no intervention by the user once the descent has commenced [so-called

Rapid exits from dangerous situations don't just involve jumping out of windows, Elevator/lift shafts can also provide a viable escape route, in this case using the Escapettor descender with a diminutive 5mm Technora cord.





'true-blue' devices], and 'manually-operated' products with a braking system that requires the user to take action. EN 341 refers to these as 'Type 1' and 'Type 2' respectively – *ALL of the devices in this article are Type 2* which are manual because you must do something to make the brake operate, even if that is simply letting go of the handle. But two are additionally type 1 since they are hybrids. It also includes a classification system ('A' to 'D'), based on descent energy the device is capable of withstanding in Joules:

A Up to 7.5 x 106J
B Up to 1.5 x 106J
C Up to 0.5 x 106J
D For only one descent which is often the case for ESCAPE devices.

Descent energy depends on the maximum descent height and the maximum rated load. See Issue 75 for further discussion of general Descender Standards, terminology and function.
One other thing to note on standards is the use of open anchor hooks like Sterling's Lightning and GT. These meet NFPA -E 9as does a suitable locking carabiner) but it does not meet any European Norm. A kit will therefore only meet EN if it has a locking carabiner or hook.

## DESCENT SPEEDS/DISTANCES

A part of many descender performance standards is a requirement that when descending the device does not get so hot that it can damage the rope it is moving down. This is evaluated by measuring the temperature of the rope contact faces after a decent at a set speed with a set mass over a set distance. This testing is why you see markings such as 150Kg/200m on devices. It does not mean that you can only descend 200m, just that with a mass of 150Kg at a normal, steady descent speed by the time you get 200m in its going to be pretty warm. Travel slower or with a lighter mass and you create less descent energy and therefore potentially less heat from friction.

Some descenders have short handles or release mechanisms that have little mechanical advantage, meaning that the user quickly tires and lets go for a rest. This limits the descent energy very nicely and means that the device does not warm up. Longer handles and more mechanical advantage make it much easier to release the rope, giving finer control but at the risk of allowing a rapid, temperature rising descent. Unlike full-size rescue descenders, escape devices don't tend to have larger handles with better mechanical advantage/leverage though this is still a benefit where it can be incorporated to make the initial start smoother and less dramatic and it enables the user to maintain the descent for longer without getting cramps in the hand. In the case of the LEVR and Core, the handle is longer because it is specifically used as a lever.

**TACTICAL/RESCUE INTERVENTION:** This is where certain types of double brake can be a positive liability and we have ***not*** included a column for this. Instead, choose a device that shows a square in the ASCENDER column but not an orange square ■ in the DOUBLE BRAKE column. If a device has a total lockout requiring reset it is NOT suitable for intervention. However, a proportional brake requiring you to maintain squeeze pressure to slow or halt (indicated by a black square ■, works OK.
Most importantly check the ROPE specifications for models that suit your specific needs. High speed intervention descents for either tactical purposes or suicide intervention need to give free run for as long as you have the descender 'wide-open' and this causes rapid heat build up on a small device. Luckily, most escape devices use heat and abrasion-resistant rope. The Druid Pro and EXO are examples of devices that have dispensed with the double lock of their brothers the Druid PRO and EXO AP, ostensibly for rope access and tactical users tired of kicking into secondary locks when trying to move at speed.

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

**ORIGIN:** The main flag refers to the manufacturer's home country, but this may not be where the device is made. If we know, we show an inset flag and you will notice a number of 'rebadged' devices like ISC's D2. As we often mention, the figures in this Guide are verified by the manufacturer but you will see different spec on some supplier websites and for some manufacturers that have rebadged a model. No idea why!

**COST:** Kit prices are shown in orange and may be the only price if the device is not sold separately. Kit prices are for the shortest standard length – usually around 15m/50ft but may be up to 30m as for the ISC D2. Prices are a rough guide only – it can vary due to exchange rates, taxes etc. and we usually round the price up. Russian devices may need import duty added.

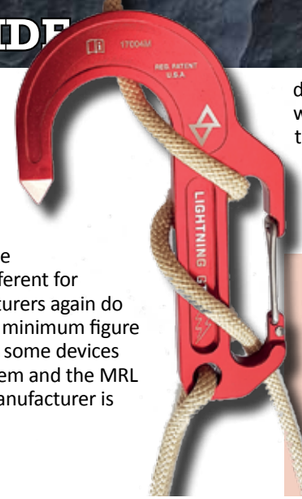
**WEIGHT**: for the individual descender in black and for a full, basic kit in orange. The kit weight may vary as even a carabiner change will make a difference but as a rough guide it is for the 15m/50ft KIT (or smallest available kit) with rope in a bag. Std kit's may or may not include a hook instead of, or, as well as, a carabiner especially in the US.

**DIMENSIONS:** of the device itself – not the kit. This is mainly given as height by width with some quoting the depth (or thickness) of the device. The length should include the handle in stowed position but some may be quoting length with the handle extended or possibly not including the handle at all.

**MATERIALS: ALLOY refers to ALUMINIUM ALLOY or ALUMINUM ALLOY unless otherwise shown.** Note that many showing the handle as Alloy (alu) or Steel may also have a comfort cover of rubber or plastic etc. Some models, like the Deus/Skylotec 3000s don't have a handle, just a rotating 'stop-Go' knob allowing for fully automatic descent or control only via the trail rope. Others like the Core use the body as the handle.

**MBL:** Minimum Breaking Loads (MBL's) are a complex area and it is always best to read the manufacturers product instructions thoroughly to make sure that you really understand what your device is capable of. Generally, the MBL is the minimum figure before failure that will be achieved by the device when used in a specific configuration. In the case of Escape devices this may even be the MBS of the specific rope it uses rather than the device itself since that is the weaker component. Some manufacturers bizarrely use the MBL figure that must be met in the relevant standard test – regardless of the fact that their device is capable of much more than that, for instance ***many will quote around 12kN because it's the required minimum while others use the figure at which the device is just about, but not actually going to fail, making the device appear 'stronger' than a competitors product.*** Rarely, you might see a few MBL's marked on the same product or in the instructions; in these cases, they may relate to each of the configurations described or the separate individual standards tested to. On some products where a belay function is possible, the MBL may define the maximum load that can be held in a limited dynamic event (FF0.3) where

the true applied force is significant. **MRL**: **Maximum Rated Load** can be just as confusing as MBL's. Some performance standards require devices to indicate the maximum rated load that can be applied during that specific application. The trouble is that the MRL may be different for each standard and some manufacturers again do things literally and only test to the minimum figure stated in the standard. This means some devices have differing MRL's marked on them and the MRL marked is actually less than the manufacturer is willing to allow you to apply!




NFPA-E compliant escape kits offer an open hook for rapid anchorage like the Crosby, the Lightning above, or a host of their own versions. But if you have the time they can be connected to an anchor in a variety of more secure ways with some, like the Lightning above incorporating a sprung, carabiner-style gate.

**WLL: Working Load Limit** (Safe Working Load) The MINIMUM indicates the lowest weight that will be able to descend or that you can lower. This can also be an indication of how easily rope will pull through the device, but most will simply quote the standards requirement even if they can handle lower loads. **MAX**IMUM figure for the larger rope in the device's range. This figure is not as specific as an MBL and can vary depending on the standard, for instance ropes meeting **EN 341** often have a lower WLL than those meeting ANSI or CSA.

**DOUBLE BRAKE/ANTI-PANIC:** In addition to braking when you let go of everything this is a secondary brake which engages either fully, shown as ■or proportional to the handle grip-pressure, shown as ■. A fully engaged brake like the Petzl EXO means you are safely held until you resume pressure on the handle. A proportional brake may never fully stop you depending on how much grip pressure you apply, often they only slow you but that may be enough to remind you to let go completely in order to fully arrest your descent.

**LOAD ROPE WHILE ATTACHED:** The carabiner can be clipped in while the rope is loaded into the device. There is therefore no danger of dropping the device during rope installation or removal. Some have fixed top-plate without the hinged safety gate normally present on autolock descenders. In some cases like the EXO, this feature is an option or differs from its normal configuration because it is aimed at use in pre-rigged kits only and specifically limits firefighters' ability to detach the device from the kit.

**KIT/DEVICE-ONLY?:** a square in black means that the device can be purchased separately from the rope/webbing. A solid orange square indicates that the device is ONLY available as part of a kit which includes rope and anchor options.

**ROPE DIAMETERS:** Escape devices are often very specific about the diameter of ropes that can be used and there may not be a range but rather one specific rope. Aramid is a generic name which can include specific ropes like Technora.

**EYE DIAMETER:** refers to the harness or anchor connection eye as distinct from any secondary eyes intended as beckets for inclusion in a pulley system but this is not the norm for escape devices. This is an important figure because although many kits will provide a specific carabiner it is the one element of a kit that might be interchanged regardless of the manufacturers' intention. In this respect, some eyes are quite small and would struggle to take some of the larger rescue carabiners and the forged, profiled cross-sections, having been designed originally with round bar section carabiners in mind.

**USES:** ALL of these devices can be used for LOWERING somebody else as well as abseil/Rappel-escaping yourself but make sure you practice this upside-down configuration because it can be awkward to control if you are only ever used to pulling it out of a kit and evacuating yourself.

**BELAY/ LIFELINING:** For this GUIDE we are ONLY considering the devices approved for use with low-stretch/static rope NOT dynamic climbing rope. Lifelining is not necessarily the same thing as a belay where you could end up with the device taking a severe dynamic load. Lifelining may simply mean horizontal or low angle edge restraint which would impart minimal fall factor to the device in the event of activation. In theory all of these devices could work as a top-belay/lifelining device but in contrast to lowering where the load is constant you must be careful in belaying, not to permit a potential fall factor of more than 0.3 and preferably 0 ! Some do it better than others so marginal devices in this category are shown in a black outline square □ OK but not brilliant. Some devices will specifically tolerate a rescue belay load of 200kg, fall factor third (0.3) and these are shown as an orange square■. Virtually all escape devices will lifeline or top-belay but very few, if any, will state that they can arrest a rescue load which is taken to be between 200 & 250kg/441-551 lb.

**ASCENDER:** Most standard, autolocking descenders can be used in a reasonably efficient hauling system as a second ascender where a more conventional handled ascender provides the top ascender. Two descenders or a descender and a prusik cord/ Purcell could also work well enough over short distances. The thing about using a descender instead of an ascender is that, while it imparts more friction during any ascent it does give you the option of an immediate switch to descent rather than trying to downclimb on ascenders or switch systems from ascenders to descender. It's already there. This may be particularly applicable to 'Escape' devices being used as mini-multi-purpose devices by tactical teams where one small device to perform a range of tasks adequately is preferable to a half-a-ton of different specialist devices that perform their tasks in the best possible manner. However, rack-style escape devices will rarely be usable as an ascender except in the most dire of last resorts. HAULING/ PROGRESS CAPTURE: If a device can be used as an ascender, which many of these can, it's already functioning as a Progress Capture Device (PCD) but some will work better than others and some manufacturers may prefer you don't use it that way and especially for escape devices likely to be integrated into a kit so we have not included this as a separate column.

**COLOURS** different colour options are separated by a comma. CAPITALS indicate the primary colour or colours if they are half and half. Secondary colour(s) on the same device are in lower case and separated by a forward slash /.


# FCX™ Escape Systems

**Our FCX systems are customizable with your choice of escape rope, anchor hook and storage bag. Each of these options comes pre-assembled with SafeD™ carabiners.**

**Certified Systems Available:**

**FireTech2 Systems:**
**Certified to NFPA 1983: Escape System**
- Crosby Hook with F4-50 Bag
- Lightning GT Hook with F4-50 Bag
- Lightning GT Hook with Escape Kit Pocket Bag (optional Extension Lanyard)

**SafeTech Systems:**
**Certified to NFPA 1983: Escape System**
- Lightning GT Hook with F4-50 Bag
- Lightning GT Hook with Escape Kit Pocket Bag (optional Extension Lanyard)

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### (1) Lightning GT
- Ensures proper loading at the sill
- Precision-machined point provides secure penetration to the anchor material
- Can be used for partner/civilian rescue
- Gated slot can be used to create a remote anchor
- Can be used for partner/civilian rescue

### (2) FCX™ Device
- Click-To-Neutral Feature allows easy horizontal movement and improved payout at the sil
- 7.8 oz
- Elevated side rails eliminate glove interference and rope entrapment
- Automatically locks off when weighted
- Spring loaded handle
- Controlled braking

### (3) SafeD™ Carabiner
- Auto-locking aluminum carabiner with 3-stage gate
- Removable captive eye pin keeps carabiner oriented to prevent cross loading

### (4) FireTech2
- 100% Technora
- Diameter: 7.5 mm
- MBS: 5,732 lbs

### (5) Abrasion Resistant Reinforced Pocket Bag
- Life of expensive turnout gear is extended by eliminating damage caused by hook wear through


Certified to **NFPA 1983**: Escape System

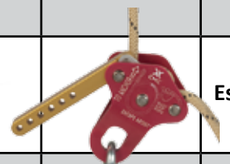
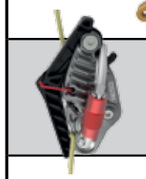
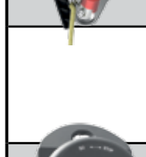
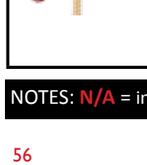
FEATURED PRODUCT

**FCX™ Escape Systems**

Talk to your **Local Fire Rep**
or visit **SterlingRope.com/FCX**

**Freedom to Focus™**

www.rescuemagazines.com


| images NOT to scale | | MODEL | COMPANY | ORIGIN | COST / KIT COST | WT / KIT WT | DIMENSIONS of DEVICE | MATERIALS: FRAME / CAM / HANDLE | DOUBLE BRAKE | LOAD ROPE WHILE CONECTED | KIT/DEVICE-ONLY | MBS/ MBL | MIN MAX WLL | STANDARDS | ROPE RANGE | KIT ROPE LENGTHS MAX DROP HEIGHT | EYE DIAMETER | USES: BELAY/LIFELINING | USES: ASCENDING | COLOURS | NOTES | WWW. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  |  | Druid | C.A.M.P. | | £135 $200 €146 | 280g 9.9oz | 118x76x46mm 4.7x3x1.8" | Alloy Stainless Steel Alloy | ■ | | ■ | 15kN 3372 lbf | 200kg 441 lb | EN 341/2A | 10-11mm 7/16" | - | 19mm 0.75" | ■ | ■ | RED/ black | - | camp.it |
|  | | Druid-Pro | C.A.M.P. | | £135 $220 €132 | 280g 9.9oz | 118x76x46mm 4.7x3x1.8" | Alloy Stainless Steel Alloy | | | ■ | 15kN 3372 lbf | 200kg 441 lb | EN 341/2A | 10-11mm 7/16" | - | 19mm 0.75" | ■ | ■ | SILVER. BLACK | *Druid Pro* is single -lock only - no panic-grab | camp.it |
|  |  | Quickie Descender (QD) | CTOMS | | $70 | 95g 3.3oz | 60x100x26mm 2.4 x 4 x 1" | Alloy Stainless Steel Nylon | | ■ | ■ ■ | *15kN 3372 lbf | n/a | - | 6mm 1/4" Technora/ nylon | 16m 52ft | 19mm 0.75" | ■ ■ | ■ | BLACK, ORANGE | *The QD is designed to slip at around 4kN on a new rope | toms.ca |
|  | | LEVR | CMC | | $489 | 190g 6.7oz 1.1kg 2.4 lb | 158x38x 31mm 6.25 x 1.5 x 1.25" | Alloy - Alloy | | | ■ | 13.5kN 3035lbf | 280kg 617lb | NFPA E | 11mm / 7/16" Technora Tube webbing | 15m 50ft | * | ■ | | RED | *Uses integral tape extension to a carabiner | cmcpro.com |
|  |  | Escape Artist | CMC | | $153 $510 | 184g 6.5oz 1.2kg 2.6 lb | 190x140mm 7.4 x 5.5" | Alloy Alloy Alloy | | | ■ ■ | 13.5kN 3035lbf | 280kg 617 lb | NFPA E | 7.5mm 5/16" or Technora Tube webbing | 15m 50ft | 0mm 0" | ■ | | RED | 3 kits available, 7mm cord with hook, Fire webbing and 7mm cord with no hook | cmcpro.com |
|  | | SmartLine X | CRESTO | | £385 €435 | 190g 6.7oz | 140x90x32mm 5.5 x3.5x1.25" | Alloy Alloy Plastic | ■ | | ■ | - | 140kg 310 lb | EN341-D | 5.5mm 1/4" Aramid | 15, 40m 50, 131ft 200m 656ft | 15mm 0.6" | □ | | GREY | - | crestogroup.com |
|  |  | 3300 | DEUS/ SKYLOTEC | | €900 €1734 | 970g 2.1 lb 3.65kg 8 lb | 135x90x60mm 5.2 x 3.5 x 2.4" | Alloy Stainless Steel Alloy/Ti | ■* | | ■ ■ | 13.5kN 3035 lbf | 140kg 310lb 40 kg 88lb | NFPA E | 7.5mm 5/16" Technora or Poly/Technora | 25m 50ft 106m 350ft | 15mm 0.6" | ■ | □ | GREY/ BLACK | 3100/3200 are discontinued. *Hands free automatic descent or use trail rope for speed control | skylotec.com |
|  |  | 3700 | DEUS/ SKYLOTEC | | €1025 $1975 €1820 | 1.3kg 2.86 lb 3.8kg 8.4 lb | 135x 100x60mm 5.2 x 4 x 2.4" | Alloy Stainless Steel Alloy/Ti | ■* | | ■ ■ | 13.5kN 3035 lbf | *125-140kg 330-310lb 40 kg 88lb | EN341 NFPA E ANSI Z359.4 CSA | 8mm 5/16" Polyester/ Technora | 25m 50ft 180m 590ft | 15mm 0.6" | ■ | □ | GREY | *SWL depends on Standard - 125 for CSA, up to 150kg for ANSI. *Hands free automatic descent or use trail rope for speed control | skylotec.com |
|  |  | Core | FIRE INNOVATIONS | | $125 | 193g 6.8oz | 152x50x25mm 6 x 2 x1" | Alloy - Alloy | ■ | | ■ | 13.5kN 3035lbf | kg lb | NFPA-E | 7.5mm 5/16" CoreTech, Fire-Tech2, TSafe | 12, 15m 40,50ft | * | | □ | BLACK | *Uses integral tape extension to a carabiner | fireinnovations. com |
|  |  | Micron D33 | HEIGHTEC | | £239 $255 €269 | 860g 1.9 lb | 135 x 65mm 5.3 x 2.6" | Alloy Alloy Alloy | ■ | ■ | ■ | - | 125kg 276 lb | EN 341/D | 7.5mm 5/16" Aramid | 15-120m 50-394ft 120m 394ft | 15mm 0.6" | ■ | ■ | RED | - | heightec.com |
|  |  | QRAB | HIGHNOVATE | | n/a | 150g 5oz | 120x50x40mm 4.7x2 x1.5" | Alloy Stainless Steel Alloy | ■ | ■ | ■ ■ | 10kN 2248 lbf | 160kg 352 lb | NFPApending EN341pending | 7.5-8mm 5/16" Technora | 15m 50ft | 17mm 0.7" | ■ ■ | ■ | BLACK | Red button is a quick release from the rope which does NOT function under load. | highnovate.com |

NOTES: N/A = info Not Available/not given COST: Approx & **include** local tax/VAT DOUBLE BRAKE: ■=Lock requires reset. □=proportional on squeeze pressure. DROP HEIGHT: = maximum single drop but multiple drops may be possible USES: ■= OK BUT NOT IDEAL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| images NOT to scale | MODEL | COMPANY | ORIGIN | COST / KIT COST | WT / KIT WT | DIMENSIONS of DEVICE | MATERIALS: FRAME / CAM / HANDLE | DOUBLE BRAKE | | LOAD ROPE WHILE CONECTED | KIT/DEVICE-ONLY | MBS/ MBL | MIN MAX WLL | STANDARDS | ROPE RANGE | KIT ROPE LENGTHS / MAX DROP HEIGHT | EYE DIAMETER | USES: BELAY/LIFELINING | USES: ASCENDING | COLOURS | NOTES | WWW. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | D2 | ISC | | £157 $260 €181 | 290g 10.2oz 2kg 4.4lb | 143x70x61mm 5.6x2.75x2.4 " | Alloy Stainless Steel Alloy | ■ | | | ■ ■ | 14 kN 3147 lbf | 140kg 310 lb | EN 12841 NFPA E ANSI Z359.4 | 7.5mm 5/16" BW FR Hybrid Technora or 8mm 5/16" Polyester | 30m * 98ft * 200m / 656ft | 20mm 0.8" | ■ | ■ | BLACK. RED | Data for 2018 version (red).2020 version in black with larger handle. * + Custom lengths Also Sold by FERNO | iscwales.com |
|  | Gnome IR0318 | ICE ROCK | | €110 | 275g 9.7oz | 107x57x38mm 4.2x2.2x1.5" | Alloy Steel Alloy | ■ | | ■ | ■ | >12kN 2697 lbf | 200kg 441 lb | EN 12841/C | 10-11mm 3/8-7/16" | - | 15mm 0.6" | ■ ■ | ■ | BLACK. ORANGE/ violet | Device can adapt to better suit specific user weights and rope size | icerockequipment.com |
|  | Fedor Light* | KROK | | $60 €48 | 280g 9.9oz | 148x67mm 5.8x 2.6" | Alloy Alloy Alloy/Nylon | | | ■ | ■ | 22kN 4945 lbf | 400kg 882 lb | EN 341 | 8-10mm 5/16-3/8" | - | 17mm 0.7" | ■ ■ | ■ | SILVER | Carabiner loads through eye in cam. Loading rope while attached via bottom eye. *Data unverified | Krok.biz |
|  | Grisha/GriShi Airborne Trooper* | KROK | | $67 €51 | 415g 14.6oz | 160x85x30mm 6.3x3.4x1.2" | Stainless Steel Stainless Steel Stainless Steel | ■ | | | ■ | 15kN 3372 lbf | 400kg 882 lb | - | 8-12mm 5/16-1/2" | - | 17mm 0.7" | ■ ■ | ■ | SILVER | Name converts from Russian as either 'i' or 'a'. Also available in hardened steel for $32. with blue powder-coat. *Data unverified | Krok.biz |
|  | ENSA APE-Extreme | MALLORY SAFETY & SUPPLY | | n/a | 5.22kg 6.5lb | 88x90mm 3.5x3.5" | Alloy Alloy Alloy | ■ | | ■ | ■ | 17.8kN 4000 lbf | 40kg 88 lb 440kg 970lb | EN 12841/C EN 341 NFPA-E ANSI Z359.4 | 7.5mm 5/16" ENSA Fr Hybrid Technora | 30-37m 100 to 450ft <198m /650 ft | 22mm 0.86" | ■ ■ | ■ | BLACK | Dims approximate. Has integrated pulley. Can take 2-person rescue. Also ENSA APE = See Escape Artist. | nsa-northamerica.com |
|  | EXO | PETZL | | £315 $430 | 200g 7oz 1470g 3.24lb | 115mm 4.5" | Alloy/Steel Stainless Steel Nylon/Alloy | | | | ■ | 13.5 kN 3034 lbf | 140kg 310 lb | EN 341-D | 7.5mm 5/16" Aramid (Technora) | 15m 50ft | 15mm 0.6" | ■ ■ | ■ | RED. BLACK | NFPA Kit = anchor hook as standard but can be carabiner. EN Kit = Gated Hook or carabiner | petzl.com |
|  | EXO AP | PETZL | | $500 €395 | 200g 7oz 1470g 3.24lb | 115mm 4.5" | Alloy/Steel Stainless Steel Nylon/Alloy | ■ | | | ■ | 13.5 kN 3034 lbf | 140kg 310 lb | NFPA-E | 7.5mm 5/16" Aramid (Technora) | 15m 50ft | 15mm 0.6" | ■ ■ | ■ | RED. BLACK | NFPA Kit includes anchor hook as standard. EN kits include carabiner or locking hook | petzl.com |
|  | Hot XIT | PMI | | n/a | 290g 10.2oz 2kg 4.4lb | 143x70x61mm 5.6x2.75x2.4 " | Alloy Stainless Steel Alloy | ■ | | | ■ ■ | 14 kN 3147 lbf | 140kg 310 lb | EN 12841 NFPA E ANSI Z359.4 | 7-8mm 5/16" Aramid &/or Polyester TBA | TBA | 20mm 0.8" | ■ | ■ | n/a | Modified ISC D2 with wider 'sweet-spot' range. Due 2020 Dimensions for 2018 model. | pmirope.com |
|  | Escapettor | PROTECCIÓN TÉCNICA | | £285 $350 €320 | 119g 4.2oz 660g 1.45 lb | 90x28 x35 mm 3.5x1.1x1.4" | Alloy Alloy Alloy | ■ | | ■ | ■ | 18 kN 4047 lbf | 40kg 88 lb 140kg 310 lb | EN 341 2D | 5mm 1/4" Technora | 20m 66ft | 12.5mm 0.5" | ■ | ■ | RED | Options available to increase friction for 2-person loads and for initial de-weighting for pick-offs. Custom rope lengths available. | protecttion.com |
|  | Wind Escapettor | PROTECCIÓN TÉCNICA | | £1160 $1425 €1300 | 189g 6.7oz 3.6kg 8lb | 85x28x40mm 3.4x1.1x1.5" | Alloy/SSteel Stainless Steel Alloy | ■ | | | ■ | 18 kN 4047 lbf | 60kg 132 lb 120-140kg 265-310lb | EN 341 2D ANSI Z359.4 | 5mm 1/4" Technora | 160m 525ft 200m / 656ft | 12.5mm 0.5" | ■ | ■ | SILVER | Options available to increase friction for 2-person loads and for initial de-weighting for pick-offs. Custom rope lengths available. | protecttion.com |
|  | RSS -AL-2 | RIT SAFETY SOLUTIONS | | $395 to $433 | n/a | 168x90mm 6.6x3.5" | Alloy Alloy Alloy | | | ■ | | 14kN 3147 lbf | - | NFPA E | 11mm 7/16" Kevlar Tape 8mm 5/16" Kevlar cord | 15m 50ft | * | ■ | | BLACK | *Uses integral tape extension to a carabiner | ritsafetysolutions.com |

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|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
|  | RSS -AL-4 | RIT SAFETY SOLUTIONS | | $395 to $433 | n/a | 215x90mm 8.5x3.5" | Alloy / Alloy / Alloy | | | ■ | ■ ■ | 14kN 3147 lbf | 140kg 310 lb | NFPA E | 11mm 7/16" Kevlar Tape 7.5mm 5/16" Kevlar cord | 15m 50ft | * | ■ | | BLACK | *Uses integral tape extension to a carabiner. Dimensions Approx. | ritsafetysolutions.com |
|  | Phoenix | RESCUE PRODUCTS INTERNATIONAL | | n/a | 939g 2lb | 210x73mx36mm 8.3x2.9x1.4" | Alloy / - / Alloy | | | ■ | ■ ■ | 13.5kN 1376 lbf | 136kg 300 lb | NFPA E | 6mm 1/4" Technora | 12.1,15.2m 40, 50ft | - | ■ ■ | ■ | RED | cost & spec for 50ft version. | rescueproinc.com |
|  | Lov 2 | TAZ | | $275 €200 | 353g 12.4oz | 140x95x50mm 5.5x3.75×2" | Alloy / Stainless Steel / Nylon | | | | ■ | 15kN 3372 lbf | 200kg 441 lb | EN 358 EN 12841/A-C | 10-11mm 3/8-7/16" | - | 15mm 0.6" | ■ | ■ | BLACK. RED | also operates on tensioned diagonal ropes | taz3d.fr |
|  | FCX | STERLING ROPE | | $113 >$470 | 221g 7.8oz | 140x50x25mm 5.5x2x1" | Alloy / - / Alloy | ■ | | | ■ ■ | 13kN 3035lbf | - | NFPA-E | 7-8mm 5/16" Nylon (PER) or Technora | 15m 50ft 150m/492fftt | 20mm 0.8" | ■ | □ | GREY/ RED | - | sterlingrope.com |
|  | F4 | STERLING ROPE | | $100 >$389 | 170g 6oz | 152x50x25mm 6 x 2x1" | Alloy / - / Alloy | | | | ■ ■ | 13.5kN 1376 lbf | - | NFPA-E | 7-8mm 5/16" Nylon (PER) or Technora | 15m 50ft | 20mm 0.8" | ■ | □ | RED. BLACK | - | sterlingrope.com |

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# Space Creation..... the BIG picture

by Rich Denham & Nick Appleton

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

**.....procedures and considerations PRIOR to space creation for fire and rescue crews, medical response and police/law enforcement**

Kraków (Poland) Fire crews arrive on scene Pic by Krzysztof Nahlik





## INTRODUCTION

Much is written about Road Traffic Collision/Accident (RTC/A) space creation techniques, with these being predominantly structural evolutions. They are frequently mis-cast as 'extrication techniques', a phrase which refers only to casualty removal. Be that as it may, information about physically creating space is widely available in many places; this magazine, in many good and not quite so good manuals, on the web, etc. However, little is written about the actual concept of space creation – The BIG Picture – and in many cases there are just indirect and incidental references to it, and yet a lack of this core knowledge will almost inevitably result in extending the extrication times of entrapped casualties.

So let's use this article to review what we know of the concept – and not the techniques as such – in order to gain a more informed perspective at an operational incident and so make a positive difference when we plan, implement and almost inevitably amend our rescue efforts at that incident.

## THE SEQUENCE

Way back in TR69 in an article reviewing the classic Team Approach at RTC's, we argued that space creation has two very distinct phases (if we ignore just opening the door next to a casualty who has no physical entrapment and where the medic checks and then clears them to simply walk out):

### 1. Emergency Space Creation

Creation of a minimum safe space extrication path out of the vehicle (a Situation Centred Rescue), anticipating that a previously 'stable' casualty may deteriorate to a point where 'Out NOW' is called by the medic.

### 2. Full Space Creation

Creation of a maximum safe space extrication path out of the vehicle (a Casualty Centred Rescue), where a 'stable' casualty is extricated in-line and with little or no movement of the cervical spine or the hips.

You may recognise these concept as ' Space Creation' and 'Full Access' from the traditional model of the *Team Approach* but whichever definition set you favour, they both accommodate the priority of medical rescuers such as London's Helicopter Emergency Medical Service, who very much work on the basis of "out now or crack on with space creation until I tell you otherwise". Ultimately, you initially cater for the possibility of the casualty's condition dictating their rapid removal before going on to create full space if appropriate. However, what are the elements that exist within both these phases, that make up or define this bigger picture:

## THE ELEMENTS

These comprise three areas of operations which, much like the component parts of the *Team Approach,* will overlap and stop and start.

Although there are several ways to view the elements of space creation, the following is a valid functional observation and is numbered for ease of reference, but NOT to indicate a rigid sequence of events:

i. **EXTERNAL** – stuff outside the vehicle.

ii. **STRUCTURAL** – the posts, panels and doors that make up the hard, outside shell of the vehicle, including where these have been impacted and intruded into the compartment space.

iii. **INTERNAL** – anything inside the occupant space: controls, seats and temporary contents, including the occupants themselves!

Let's now look at the logic of this categorisation:

## i. EXTERNAL SPACE CREATION

Space creation external to the casualty vehicle can begin after the perimeter is protected, a 360-degree survey is conducted and identified hazards are removed or managed and finally the area is declared safe to work in.

External Space is created in order to:

- Give access to the vehicle and the casualty inside as necessary.
- Clear an area where safe and efficient placement of rescue vehicles or operational equipment is required.
- Clear access routes for rescue personnel and ultimately the identified casualty extrication path. Note that the need for all of these requirements may not initially be apparent but will arise sporadically as the incident progresses.

***Also consider the Police requirements for accident investigation – what was found where and in what condition. Although this must never hinder the process of casualty rescue, consult with the Police at the earliest opportunity.***

### External Space will need to be created where:

1. Other vehicles restrict access to the casualty vehicle; depending on circumstance they can be moved manually or by winching by either the fire service or in co-operation with a suitably equipped recovery (wrecker) truck.
2. A clear winch path into which to receive the vehicle being moved.
3. An immovable obstruction restricts access to the point where casualty and rescuer safety would be compromised during the rescue effort, then relocate the casualty vehicle away from it. The need here is for a smooth transition; use of a recovery (wrecker) truck's go-jacks (sort of roller skates for locked wheels which will also work under flat tyres), if smooth in-line rolling on the casualty vehicle's own wheels is not possible.
4. A subsequently requested or late arriving specialist vehicle is required adjacent to the casualty vehicle; this may require a safe and sufficient access route as well as adequate hard standing/parking to be cleared.
5. Safe and convenient/functional locations are required for equipment and cut parts dumps.
6. Road furniture such as railings, benches and even lamp and signposts (check that power is confirmed to be off first) may obstruct safe rescuer, equipment and vehicle access. Overhead power lines may also require managing by the appropriate utitlity company.
7. General debris and perhaps a spilt load will not just need to be safely handled and removed, but some thought given to secure and appropriate storage of private property. Liaise with the Police and hand over this responsibility where possible.
8. Identifying then clearing/ making safe the intended extrication path of the casualty from the vehicle to the ambulance; do this before placing tool and parts dumps if possible.

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Fire crew and medical teams cooperation at an accident is second-nature but remember to also liaise with police who may have crime-scene concerns and will appreciate being kept in the loop on likely road-closeure delays. Pic by Juris Teivans

Note that where another vehicle is physically resting on the casualty vehicle this is a case for (complex) stabilisation, unless a heavy rotator recovery vehicle is available to remove the resting vehicle and even then, such action would require significant planning, co-ordination and a very robust risk assessment!

## ii. STRUCTURAL SPACE CREATION

Structural space creation will consist of acting on the external structure of the car in order to allow access for casualty assessment, treatment and space for subsequent extrication. Structural Space is created in order to:

- **Open a door or hatch** to give initial access to the occupant compartment.
- **Remove any major physical entrapment of the casualty**, such as where impact damage has entrapped their feet in the footwell, the dashboard (and steering wheel) has entrapped the lower half of the body, etc.
- **Reform the occupant space** after impact to the structure has reduced it, to allow ease of access to and treatment of the casualty and also to create space for safe rescuer movement in what is effectively, at this point at least, a very confined space rescue.

It must be noted that structural space creation is not just about the use of hydraulic and powered tools, it can also utilise less traumatic options – manually opening a door or a hatch, a sometimes an overlooked manoeuvre – or involve the use of manual tools such as socket wrenches. Much will depend on the tool inventory available and the knowledge and skill levels of your rescuers, as well as the physical circumstances of your incident scene, but the basic evolutions can be seen to comprise:

1. Opening shut lines to access hinges or lock mechanisms.
2. Forced bonnet opening and removal (battery access).
3. Forced door opening, displacement and removal.
4. Hatch (tailgate) opening and removal.
5. Roof removal or partial displacement by tactical flapping.
6. Post cutting or displacement, perhaps with a door/doors still attached.
7. Reforming the occupant space to roughly its original shape or even a little beyond by predominantly ramming outwards any structure that has intruded because of collision impact.

Note that any structural space creation plan and implementation will be a result of collaboration between the medical and fire service rescuers and will always be subject to change based on the casualty's condition.

## iii. INTERNAL SPACE CREATION

Internal space creation may consist of removing loose items (including occupants) or displacing or even removing fixed items such as seat components and vehicle controls.
It is created in order to:

- **Remove non-fixed items** for safety and ease of rescuer and casualty movement.
- **Rapidly create initial space**; especially but not exclusively in cars on their side or roof but in any circumstance to assist access and movement where structural space creation options may be limited or delayed.

Internal space creation options which could make the casualty available for release by simple manual intervention (in the case of electric seats and steering wheel displacement, attempt before battery disconnection) – and can include:

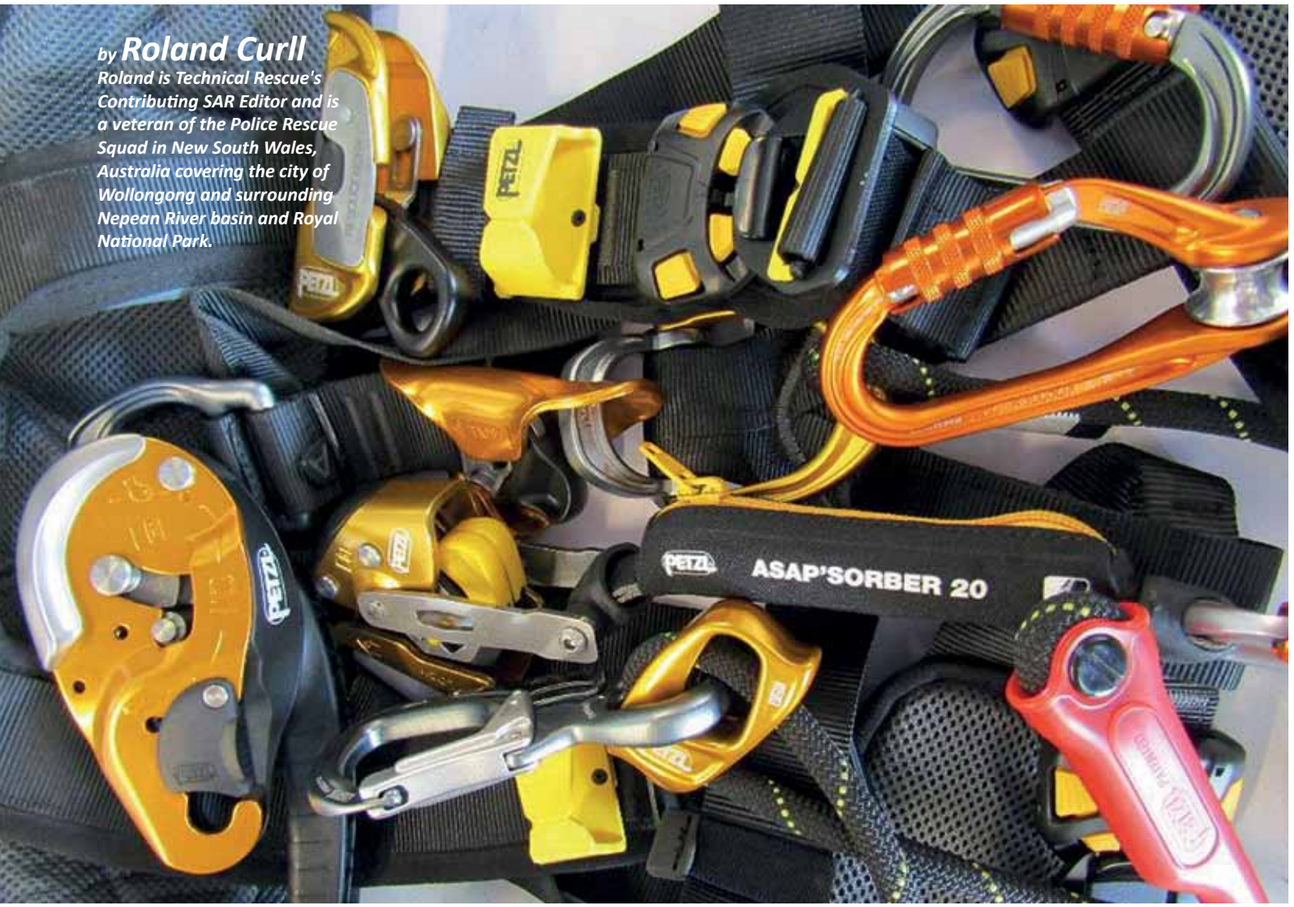
1. **Manual adjustment of steering column**; adjust the steering wheel up and away from the casualty. If the driver is responsive, ask how the column adjusts or look in the glove compartment, back seat pockets, etc. for the owner's manual for relevant information.
2. **Cutting steering wheel perimeter**; this can be achieved using a pedal cutter but because of unpredictable movement of the cut part (or perhaps even airbag actuation) it is a method of last resort where the wheel is pinning a casualty who becomes an 'out now' priority.
3. R**emoving externally connected electrical equipment** such as sat navs, phone or vaping chargers, external media devices, etc – this prevents potential power feedback defeating battery disconnection and also the snagging of oxygen tubes and other medical equipment.
4. R**emoving head restraints** ; this is pretty much always a quick and rescue enabling win and will rapidly increase working space, especially in cars on their sides or roofs.
5. D**isplacing a front seat base rearward;** first check whether the seatback moves. Always try the passenger seat if it's vacant to first establish how the seat base works. If this does not work then some form of spreading may be necessary, but it should only be undertaken by a practiced crew and even then, it is not always successful.
6. R**emoving an adjacent seat**; expose the anchor points then unbolt. This can be achieved using a manual socket set or a battery powered impact wrench (see TR70).
7. S**eat back displacement**; if it is not possible to get these to recline normally cutting is now recognised as having a physically traumatic effect on the casualty, however, exposing the hinge points and unbolting them can allow 'locked' seat backs to recline or be removed entirely.
8. R**ear seat displacement;** some will simply fold forwards and if necessary, can be compressed and secured using ratchet straps. With fixed seat backs and bases, expose the anchor points and unbolt.
9. P**edal displacement to either side ;** a standard manoeuvre and one that can rapidly release a casualty for immediate extrication.
10. M**ultiple casualty tactical release sequence;** where multiple casualties are trapped within the same vehicle, standard triage procedures would dictate that the most seriously injured is released first, followed by the others in order of severity. However, in situations where space and access are restricted, it may be necessary to release an (apparently) less seriously injured casualty first, in order to simply gain adequate access to another more seriously injured individual within. Such decisions are the call of the medical attendance.
11. G**eneral contents** – the passenger compartment may contain personal effects that will need to be removed and temporarily held securely, in order to create a safer and more easily managed rescue environment. Together with any items that may have been ejected, these should be checked for hazard potential, stored accordingly but be given over to the Police attendance at the earliest opportunity, particularly as they may be required as part of accident investigation. Note that the boot (trunk) should always be checked, regardless of whether you plan to use that area during the rescue. Take special care with a boot on its side or inverted in a car on its roof, as (heavy/dangerous) contents can erupt traumatically when the lock is popped.

## CONCLUSION

You will already be doing much of what is suggested above but it is hoped that the contents of this article – simply a different way of looking at an existing challenge – will help promote discussion and facilitate a more effective selection and sequence of options at vehicle incidents.

# a Petzl Swarm...

## ID, Astro Bod Fast, ASAP Lock & ASAP'sorber




by **Roland Curll**

*Roland is Technical Rescue's Contributing SAR 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.*

Well, if your signature colours are yellow and black it stands to reason that this would be the group name for a pile of Petzl stuff and it's been a big swarm this year with new and modified products-a-plenty. So much in fact, that we'll be looking at them individually for several issues to come and by the time we've finished they'll all be old-hat and the new stuff for 2020 will be here. So as a starting point we're going to look in detail at the differences between the 2019 and 2018 versions. This includes the *ASAP LOCK*, and *ASAP'SORBER*, a new version of the *ID* as well as updates to the rest of the range and the new Petzl *ASTRO BOD FAST* harness.

The European version of the *ASTRO BOD FAST* harness has only been on the market for a short while, but in 2019 a new International version of the *ASTRO* hit the market meeting the standards set out by ANSI (the American National Standards Institute). There are also now three versions of the ID descenders that you could use with your *ASTRO* harness together with a new version of Petzl's industry-standard *ASAP*, the *ASAP LOCK* which is designed to work with their other update, the *ASAP'sorber* a shock-absorber kind of replacing the *ABSORBICA*. All four items have been well received by the rope access and rope rescue community and although they may, at first glance, look relatively unchanged





they all incorporate significant modifications or additions that might tempt you to update your old kit well before its actual 'expiry' date. Virtually all modifications to rescue and safety equipment across all manufacturers is to improve functionality and safety, we haven't yet reached the US car industry norm of making cosmetic changes simply for the sake of tempting buyers to have the latest model but it's only a matter of time.

### PETZL I'D £165/$285/€185

The latest variations of Petzl *I'D* autolock descender (or should that be assisted braking device now?) have already received some great feedback. The red-coloured *ID* is again the NFPA-G version for 1/2" rope (12.5-13mm) but unlike previous versions with the front-swivelling plate locked by the carabiner, the latest NFPA *ID* mimics the gold model for 10-11.5mm rope with a sprung safety gate which allows you to install the rope into the device without disconnecting it from your harness. In both cases though, that connecting eye is a slightly larger diameter making it more compatible with the larger bar diameter carabiners that began appearing a few years back in the US fire market and the forging processes that use less material but places it strategically so that parts of the profile are quite wide even in lower strength carabiners. This is a variation on the improved strength afforded by a modified I or H cross-section and a whole different article. The 'anti-error catch' to help limit the implications of rigging the rope upside-down remains on all three updated models. You may remember the incorporation of a button on the handles of *ID*s from the last generation that was intended to bypass the anti-panic function and make it easier to move on inclines or to handle smaller weights when the secondary lock was prone to kicking in. Petzl subsequently introduced the *RIG* for users who didn't like anti-panic function and got rid of the button altogether but some issues still remained with many users and the latest versions have addressed at least one concern. Previously, once the user let go of the handle it would lock and you would have to push the handle further around in order to complete a lock off. With this new version, the handle springs back to a roughly 4 or 5 O'clock lock position. From here it can more easily be reset and unlocked. This automatic return to the lock position does not mean you need to unlock it before hauling rope or using it for progress capture in a haul system, or when using it for ascending because it has the ability to take-in rope despite being in the locked position it just won't allow it to run through.

ABOVE: The old (left) and the new (right) *ID-S* showing the change in cam design and the reinforced stainless steel edge or ridge.
BELOW: The stainless 'ridge' and top V-channel on the *ID EVAC* on the left against an old Petzl *RIG* on the right with no V-Channel on the top rope-contact surface and the edge of the top plate rolled into a 'wave'.

At first glance the main thing that stands out on the new *I'D*s is the stainless-steel curved section at the top of the side plate. This replaces the usual 'wave' of curved plate that we saw on previous models and on other descenders as a more rope friendly contact area for the exiting trail rope. As such it became the highest wear area - or at least the most immediately obvious wear area. You won't be wearing down the new stainless steel ridge any time soon and expect to see this feature on newer versions of other descenders as they follow Petzl's lead. We're already seeing the same stainless reinforcement of carabiners. The *I'D* also has a V-shaped friction channel where once there was a shiny, curved surface (see photo below). This offers an alternative rope-path straight out the top rather than over the side. This is something that Petzl introduced in 2018 when they brought out the updated Petzl *RIG* and gives a cleaner line for lowering - that's if you haven't bought the dedicated lowering *I'D*, the *EVAC*, of which more shortly. As already mentioned there is no more button at the end of the ergonomic handle. This has been deemed unnecessary because the rope feeds through the new *I'D*s with less resistance when working on low angled slopes or when using lighter loads due to a modification in the cam design. Paying out more rope can also be accomplished by thumbing the cam of the *I'D*. As before, the *ID*'s have an 'anti-panic' or secondary lock function which tops you in your tracks if you pull too hard on the handle, you then re-set before recommencing.

ABOVE: The old (left) and the new (right) *ID-L* showing the stainless reinforcement, the loss of the handle button and the addition of the sprung carabiner gate.
BELOW: The *ID EVAC* in lowering mode.
INSET: the two additional friction hooks.
The open hook is standard on the *EVAC* and both are options on the *S&L* models.

For anyone not familiar with the Petzl *I'D*, there are three different models now available not counting the *RIG* which is a smaller *I'D* with no anti-panic brake, a great choice for tactical or personal use. They're all available in tactical black but otherwise the signature colours are: gold for *I'D-S*, red for the I'D-L, and gold for the *I'D EVAC*. The *I'D-S* is the 'European' model designed for rope access work and technical rescue, using a rope diameter between 10 to 11.5mm with a 250kg load capacity. The *I'D-L* is the 'US' model, designed for technical rescue working with 1/2" rope or between 12.5 and 13mm in new money and with a load capacity of 280kg. The *I'D EVAC*, is designed for lowering from an overhead, or high anchor point and is effectively an upside-down *I'D-S*. The *EVAC* is a dedicated lowering device rather than an abseil/ rappel device because it you connect to the anchor, the handle pulls down instead of pushing up which was always a little awkward compared to the way it's used when abseiling. This also allows for remote operations by attaching a cord to the control handle. Unlike the handles on the *S* and *L* versions which travel through three quarters of the clockface from 6 to 9 the *EVAC* only travels from 6 to midnight, in fact, an hour less than that. In the case of the spring action on the *S* & *L*'s this is now so positive in its efforts to return from 9 O'clock back to 5 O'clock that we can guarantee it will rap your knuckles when you're playing with it before operational use. The *I'D EVAC* has an 'auxiliary brake bar' as standard which is an optional accessory on the other *I'D* models. This open stainless 'hook' provides additional friction instead of hooking the rope into a carabiner. There is also the option of a closed auxiliary brake for pre-rigged kits or permanent/semi-permanent systems.

## PETZL ASTRO BOD FAST £310/$500/€350

The European version of the *ASTRO BOD FAST* harness is a class III harness which is described as an 'ultra-comfortable' rope access harness, and when compared to the new version of the Petzl *AVAO* harness, it is as well as being considerably lighter. The size 2 *ASTRO* harness weighs 1980g/4.4lb, whilst the Petzl *AVAO* of the same size weighs 2485g/5.5lb.
One of the impressive modifications to the *ASTRO* in comparison to most other full-body harnesses is the gated D-ring ventral attachment point. The axle of the D-ring can be opened so that other pieces of equipment can be attached to the ventral point without using an additional carabiner. There is a gap in the middle of the D-ring axle between the two sections of webbing which connect to the front of the leg loops. This gap is the perfect size for attaching the Petzl *PROGRESS ADJUST* or *JANE* lanyards, once again without the use of an additional carabiner. The ends of the D-ring axle have small holes which can be used with small stainless steel shackles for attaching a Petzl *PODIUM* seat. Comfort for the user whilst suspended has been improved with a wide waist belt and leg loops, both built to be semi rigid, and made of breathable foam padding are the padded shoulder straps. Shoulder straps, from the top

of the shoulders to the ventral connection point (or in this case to the Croll ascender), usually run in a straight line forming a 'V' shape in front of the chest on many other Class III harnesses which have been known to cause neck chaffing. However, the *ASTRO* design is not a straight line; the shoulder straps run down the chest and then turn in towards the *CROLL* ascender. This causes the top of the shoulder straps to remain further away from the neck therefore reducing the chances of any neck chaffing. The shoulder straps also work with the waist harness section to help take some of the weight instead of all the weight being focused at the waist only. Both the shoulder straps and the waist straps are easily adjusted with a self-locking buckle system referred to by Petzl as '*Doubleback Plus'* buckles (pic left) , together with a new version of the quick release buckle called the '*Fast LT*' automatic buckles for the leg loops (pic above). This allows the user to connect the buckles without having to readjust them afterwards. The rear straps between the leg loops and the waist belt have self-locking '*Doubleback*' buckles for better adjustment.

The purpose behind these buckles is primarily when using the dorsal attachment. If the user has a fall and is held by the dorsal D-ring their weight will be evenly distributed onto the leg loops instead of all the weight being forced onto the front of the waist belt which would make the user feel like their abdomen is being compressed. This design is believed to increase the amount of time the user can remain suspended by the dorsal attachment.

As a work harness, there are plenty of attachment points for carrying and organising additional equipment. This includes plastic inserts which make the attachment points more rigid so that it is easier to clip into (pic below). It also includes slots for tool pouches and tool holders.

In 2019 Petzl also released the International version of the *ASTRO BOD FAST* Harness. Just like the European version, this has the *CROLL* attached to the waist belt via a D-ring which helps position it for more efficient ascending. The axle of the D-ring for the waist connection point can also be opened for the purpose of attaching other equipment without requiring additional carabiners.

However, the International version does not have a gap in the middle of the D-ring axle for attaching devices like the Petzl *PROGRESS ADJUST* lanyard as the webbing at the front of the harness from the leg loops to the axle of the D-ring is wider leaving no room for a gap. This waist connection point is different to the European edition to conform with ANSI (American National Standards Institute) Z359.11. However, you can still attach a Petzl *PODIUM* seat to the ends of the D-ring axles.

The leg loops of the International version (pic right) have the '*Fast*' automatic buckles compared to the European edition which has the lighter version of the '*Fast LT*' buckle. There is also a '*Fast*' automatic buckle on one side of the shoulder straps which assists in fast donning of the harness. These '*Fast*' automatic buckles are again required to meet the ANSI requirements. The other side of the shoulder strap and both waist straps use the '*Doubleback*' buckle for adjustment not the '*Doubleback Plus*'.

The dorsal attachment point of the International *ASTRO* harness has a fall indicator allowing this version of the harness to conform with the ANSI standard.

On the shoulder straps, just above the buckles, are two yellow attachment points known as lanyard parking points. These attachment points can be used for clipping (or parking) a lanyard connector such as the Petzl *MGO 60* hook connector when not in use and is designed to release with only 0.05kN of force.

The D-rings on the side of the harness (or the lateral attachment points) (pic above) are metal and can be folded in when not in use. Further, the cross section of this metal design has a H-profile to help reduce weight being forged to push material into load bearing areas as we discussed earlier with carabiners. This is different to the European version which has plastic inserts instead. Both versions have plenty of attachment points for carrying and organising additional equipment. In a market bursting at the seams with quality and innovative harnesses it's good to know that the industry standard Navajo and then Bod are being followed up with new generations that are equally good. Perhaps the only consideration with the harnesses discussed here and the Petzl range in general is to decide just how many features you want and how much weight you want to wear since there is a significant difference between versions and between the latest and previous versions of all harnesses.

## PETZL ASAP LOCK £175/$290/€230

The Petzl *ASAP* has always performed as an exceptional back up device for rope access work and rescue training. It moves along, up and down with the user whether on a two-rope system or one rope. Both versions are 'sprung' such that they hold position on the rope as distinct from free-hanging devices which sit below the user. As with all fall arrestors, the inertia of a faller overtakes the device and it locks onto the rope preventing the user from falling further. Unlike most devices the *ASAP* will do this even on an incline thanks to magical centrifugal workings that are impossible for mere mortals to grasp let alone explain.

As of June 2019, the European and the International versions of the ASAP have merged together creating the Petzl *ASAP* (Model No: B070AA0) which meets a number of CE EN, EAC and ANSI certifications depending upon the type of carabiner, energy absorber, and rope used in conjunction with it. Therefore, a carabiner is not an inclusion with the *ASAP* any more, as the different requirements of the user may dictate a different choice of carabiner.

The *ASAP LOCK* differs from the *ASAP* in having a manual 'lock' button which stops the device moving down the rope or, to put it another way, having rope dragged out of the top. This is particularly useful when wind-arc is trying to drag extra feet through the *ASAP* leaving you exposed to a greater fall distance in the even the *ASAP* has to arrest a fall.
In 2018 Petzl added a couple of refinements to the *ASAP*

*LOCK*, the most obvious being the 'handles' for unlocking the mechanical ascender portion of the device are now bright yellow, compared to the older black version. This feature can assist the user and co-workers to verify at a glance that the device is oriented correctly on the rope and is locked or unlocked. It is these 'handles' that allow the user to attach the *ASAP LOCK* to the rope and disconnect without removing the carabiner/connection to the user. This is in contrast to the *ASAP* which requires the carabiner to be removed while attaching/detaching it to/from the rope. The *ASAP LOCK* therefore cannot be dropped and can improve the efficiency and safety of manoeuvres like passing anchors/rebelays.
The new version of the *ASAP LOCK* still has the integrated locking feature of the original like the old edition which, when activated, prevents the device from sliding down the rope increasing the distance of a fall before the device activates.

This feature is great for working in areas of high winds, such as tower and windmill workers where high winds can push against the rope causing it to bow above the device which can cause sagging of the rope above the device increasing the distance of a fall should something go wrong. In the event of a fall the device will still lock onto the rope even if the user grabs the device in a panic.

When comparing the specifications of the two: The *ASAP* weighs 295 grams and the *ASAP LOCK* weighs 425 grams. Both are compatible with 10 to 13mm diameter ropes which meets the standards of EN 1891 type A rope.

The *ASAP* and *ASAP LOCK* are both designed to work with the Petzl *ASAP'SORBER* energy absorber, which is connected between the *ASAP* and the user's harness.

## Petzl ASAP'sorber £26-42 $46-51/€30-35

The Petzl *ABSORBICA* was once the energy absorber of choice for the Petzl *ASAP* and *ASAP LOCK* in case of a fall but the *ASAP'SORBER* has toppled it from its throne. The *ABOSRBICA* is still available from Petzl, but is only indicated for use in combination with the *JANE* lanyard to make a fall arrest lanyard with a maximum length of two meters.

The 2018+ *ASAP'SORBER* comes in two different lengths; 20cm/7.9" length (packaged length) for working at height, and 40cm/15.75" for when you want to keep the rope further away, so the user can work at a distance from it. Another design is the *ASAP'SORBER AXESS* costing around £36/$44/€43 which is also 40cm long and designed for difficult access and rescue. As of July 2019, there is now only one version of the *ASAP'SORBER 20* and the *ASAP'SORBER 40*, there are no longer separate European and International versions. Both physically appear the same as their original international versions, and are ANSI Z359.13 (6 feet) certified, and CE EN 355 certified.

The *ASAP'SORBER AXESS* replaced the *ABSORBICA L57* as the *ASAP* energy absorber for a two-person load of up to 250kg, making it ideal for rescue work. The webbing of the *ASAP'SORBER* is a variation on all energy-absorbing tear-out webbing so in that respect we couldn't say that is better or worst than other leading brands - just ever so slightly different. There are only so many ways to reinvent the wheel. Differences are in the detail and packaging. Petzl's signature yellow and black, a zip cover and the ends of the webbing are protected by rubber keepers to prevent any abrasion.

As of July 2019, the ASAP'SORBER no longer came with Petzl *CAPTIV* positioning bars. This means positioning bars would need to be purchased separately in order for the *ASAP'SORBER* to comply with ANSI Z359.13.

When the *ASAP* or *ASAP LOCK* is combined with the *ASAP'sorber,* the Petzl *OXAN* triact-lock carabiner (international version), and Petzl *CAPTIV* positioning bars, it meets the certification of ANSI Z359.15 for single anchor lifelines and fall arrestors for fall arrest systems. This also includes being used with the Petzl *RAY* 12mm rope attached to a 5,000 lb-rated anchor. All these items are guaranteed for 3 years. Instead of using the *OXAN* triact-lock carabiner, a new carabiner has been released called the Petzl *Bm'D* which can be used allowing this system to meet the standard of ANSI Z359.15. The Petzl *Bm'D* triact lock aluminium carabiner is a stronger version of the Petzl *Am'D* triact lock carabiner which is rated at 32kN across the major axis (16kN on the minor axis, and 10kN for an open gate), it also has a reinforced gate locking sleeve and the H-frame of the carabiner is slightly thicker making it weigh 105 grams. This new carabiner is certified NFPA 1983 for Technical Use, EN 362 for personal protective equipment, and ANSI Z359.12 for carabiners.


## CONCLUSION

The *I'D EVAC* is perhaps the only item in this 'review' that could be deemed to be a new product and even that is a modification of an existing, highly successful product. But it's a welcome addition especially for teams with identifiable and regular risks in their area that require lowering systems. There will be many teams and agencies that would probably use this orientation far, far more than as an abseil/ rappel device but are unlikely to switch over all their devices not just because of cost but losing the *option* of standard abseiling. The latest modifications do nevertheless keep the *ID* at the forefront of rescue descenders.

Likewise the latest *ASTRO* harness has been tweaked such that it too will remain at the forefront of models worth considering when there are so many others to consider. It is often these small changes and upgrades which make a disproportionate difference to end-users particularly if they feel their past observations on a product have been heeded.

Petzl have actively sought and duly considered, feedback from regular users and where something can't be addressed in one device they haven't been afraid to bring an addition to the range rather than compromise. It's also very useful for those outside Europe to have a range of other standard requirements adopted in products that were previously 'segregated' as a separate purchase. This is why Petzl will continue to be the brand that others try to emulate or beat.


# I'D EVAC

## Self-braking descender with anti-panic function for lowering

The I'D EVAC is primarily designed for lowering from an anchor. The ergonomic handle is specifically orientated for managing a load from the anchor and offers comfortable descent control. Integrated anti-panic function and anti-error catch limit the risk of user error. AUTO-LOCK allows the rope to be automatically locked without having to manipulate the handle or tie off the device. Compatible with 10 to 11.5mm ropes and loads up to 250kg.
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