A YOUNG PERSON'S GUIDE TO.... PULLEY SYSTEMS part9

JIGGER (MINI) PULLEY SYSTEMS..

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

ABOVE: The slow evolution of the AZTEK which we called the "set of fours". The small jigger pulley system kept getting smaller and smaller so that it became a very compact unit. It started with the original double pulleys from Rock Exotica (blue) then Petzl made the Gemini (fpur-ple-top system). The first milled version was made by Rock Thompson but was slightly too large for our liking. The final non-anodized version is on the bottom and became the final production model as per the CMC version (inset above).

In parts 1 through 8, we have concentrated on pulley systems to do lifting work and also those that hold things and keep them from moving. In review, we want both types to make a viable rope system whether for rescue or rope work of some kind. This time we're looking at special and quite separate adjust accessory jigger systems. Jiggers are small, self-contained multi-sheave pulley systems usually packaged as a complete kit in a carry/deployment bag. There seem to be hundreds glutting the market today and one need only review **TECHNICALRESCUE** magazine issue 69 to see that if, maybe not "hundreds", there certainly are enough to fill a large super market shopping cart.

Jiggers have been used for many years in various industries including seafaring and pirating as you can see from the title shot and are known by a variety of names. Dave Allport of Troll may have been the first to commercialize their use for rope rescue in the 80's with his stainless yacht-pulley CPS or Casualty Pulley System but this was not the high-strength systems of today. A higher strength system that I am familiar with is the electric and telephone linemen use of a common jigger called a 'set of fours' (SOF). That simply refers to a set of two-blocks on either end of a simple block and tackle (a simple pulley system). They use these mostly in electric and telephone distribution pulling a power or phone service into a house by themselves. It is therefore an adjunct set of blocks for doing work often without the aid of a second person. This yields an ideal mechanical advantage of 4:1 cd (change-of-direction) or a 5:1 simple pulley system which is normally enough for one guy to handle. They are light weight and easy to handle. And of course, since they are carried up a pole or ladder, they need to be. So, a smaller cord is needed to keep these little machines compact and not too unwieldy. Some manufactured jiggers now available have higher MA (mechanical advantage) values but the baseline is really what we mentioned above. Higher MA jiggers involve more sheaves on the pulleys on either end and so must be more compact which consequently requires a smaller diameter rope which in turn makes it harder to grasp. Gripping ability on a smaller rope is not to be taken lightly. Too small a diameter and this in turn is harder to get the job done regardless of the higher MA. Stick with a rope you can comfortably grasp like 8, 9 or even 10mm (although that is quite large). I personally prefer 8mm host rope in my jigger.

The jigger should have a good defeatable ratchet within it. The ratchet is what holds the tension in the jigger so that it acts as a progress capture. Most jiggers have a mechanical progress-capture ratchet on one end and not the other. The technology for these is amazing and developing rapidly as we've seen several multi-sheave, auto-locking models just in the past few years from the likes of Petzl, SMC, CAMP, Kong, CT and Rock Exotica, however, they are somewhat expensive compared to basic pulleys and prusiks. Consequently, there are several jiggers which use an asymmetrical prusik hitch (meaning, it holds best in one direction but is easy to release under load) contrasted with hardware-driven options that have a ratchet on each end so you have a choice as to where to place it based on the work to be done. In rescue (solo and semi-solo) it is

ABOVE: An edgeman working under an Arizona Vortex SA-Frame using both ends of the AZTEK. The personal side is used to restrict travel with a Purcell prusik to the rear/left to protect him from falling off the edge. The other end (system side) is being used with SOF to temporarily elevate the slack belly line during the edge transition. Photo from Bristol, UK TSRW workshop in 2022.

desirable to keep the ratchet away from the casualty so that they cannot reach up and inadvertently release the rope-cord. There are still other jiggers which make use of the remaining rope in your kit to provide a fixed rappel/abseil line or give you travel restrict options at the edge of exposure. In the photo above, both ends of this jigger are used at the same time. This is the concept that evolved into the ***Arizona Technician's Edge Kit*** simply known as ***The AZTEK.***

Many rescuers today find the AZTEK (with opposite end travel restrict option) so useful in their personal protection and in carrying out work that it invariably gets carried in a dedicated position on their harness or thigh at all times.

WHAT TO CARRY AND WHAT TO NOT

Four important essential maxims for a carried piece of equipment on your harness should be simplicity, efficiency, non-specialized and lightness/size.

- **Keep it SIMPLE**

Always default to the simplest common denominator to perform the given task. A good example of this is a pulley on the harness. I always carry one or possibly two (one is a progress capture pulley). They are great friction reduction items great for redirecting a pulling force or effort and definitely worth the space on the harness.

- **Keep it EFFICIENT**

Make sure that the system is going to make the best use of your efforts. Can you use the other opposite side of the jigger?

Can you change the ratchet location to suit what you are doing?

• Keep it NON-SPECIALIZED

Use equipment that can multi-task and is not specialized. Jiggers, again, are used in many different places in rescue.

• Keep it LIGHT/SMALL

Too much mass will slow you down. Go light. Even for fire fighters performing bottom up rescues (like on towers) having a light piece of equipment will save energy as you climb.

What does all of this mean? If you ARE going to carry things like a small jigger or anything else you deem "essential" on your harness, make sure that it will foot the bill with a multiplicity of uses. When I perform a kind of 'triage' of the things that I need to carry, I usually end up with the same few, trusted, versatile items that I know will get me out of trouble and the jigger is definitely at the top of the list along with a safety knife, a means of ascending and a first aid kit.

Why a Jigger?

Understand that on most rudimentary rope rescues or rope access jobs, you do not need to take up several inches of your valuable harness to carry it. I like to strap a horizontally oriented pack to my right thigh so it takes up less space and gives easy access to both ends. Contrast this double-pouch rectangular pack with the standard AZTEK deployed from the top of a regular tubular bag. To me, not falling off the edge is an essential part of a jigger's role where the opposite end is used for travel restrict or edge restraint. We designed this horizontal pack (pic Right shows the AHS-Rescue AZTEK system with 50ft of 8mm cord) with a double-ended zip and separate compartments within it to house the 'system' and 'personal' elements of the AZTEK which can be used separately or simultaneously. Getting back to the original question, the jigger has become an integral part of our rigging in so many ways. In fact, in so many ways that we have given to numbering them to keep track of the usage.

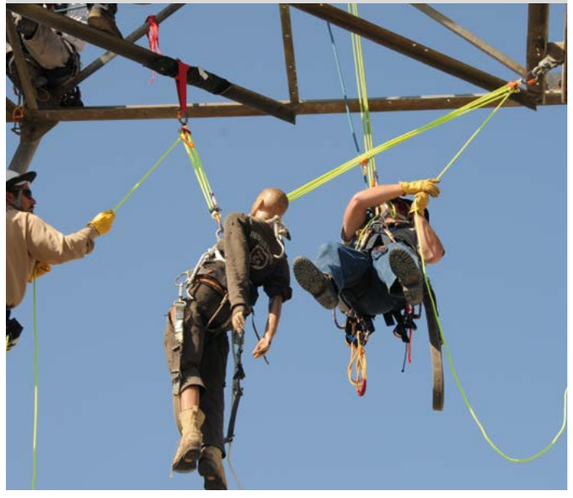
ABOVE: A bottom up solo rescue of a casualty (right) in full ascent mode. Jigger being used to lift and remove climbing equipment before descending to floor.
BELOW: Delta guyed gin pole using three AZTEK at 120˚ angles. Photo from Llangollen, Wales, AHDW workshop with R3 Safety & Rescue in 2022.

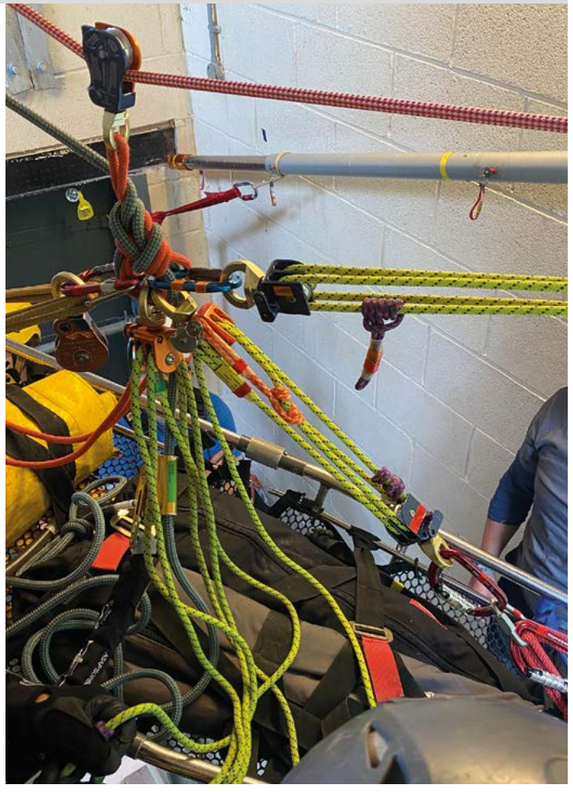
ABOVE-LEFT: A Los Angeles Dept of Water & Power lineman standing on an aerial ladder uses an AZTEK high on a ower line to lift 2 men off the conductor using both prusiks (blue as the ratchet and orange as the haul grab) for an 11:1 complex mechanical advantage. Similarly, a 12:1 compound pulley system (noted 3:1 x 4:1) can be had by simply turning this one around end to end.
ABOVE-RIGHT: A SAR tech member using a 4:1cd AZTEK with orange ratchet engaged to perform a solo pitch toe rescue. This technique is a very demanding rescue indeed using an inch worm climb and haul method to lift the casualty in 12' lifts until they reach the top.
BELOW: Rescuers using several AZTEKs to negotiate a litter horizontally on a tracking line offset. Photo from Llangollen, Wales, AHDW workshop with R3 Safety & Rescue in 2022.

The AZTEK

The new double-ended AZTEK evolved slowly within the Sedona Fire District where its use became entrenched in the towering sandstone cliffs of Oak Creek Canyon. The Purcell as a shock limiter/absorber was borrowed from Arnör Larson of *Rigging for Rescue*. Both the Purcell from British Columbia and the *AZTEK* from Arizona are historically accurate and inclusive of

BELOW: Linemen using several jiggers to transfer a mannequin across the bottom of a transmission tower.



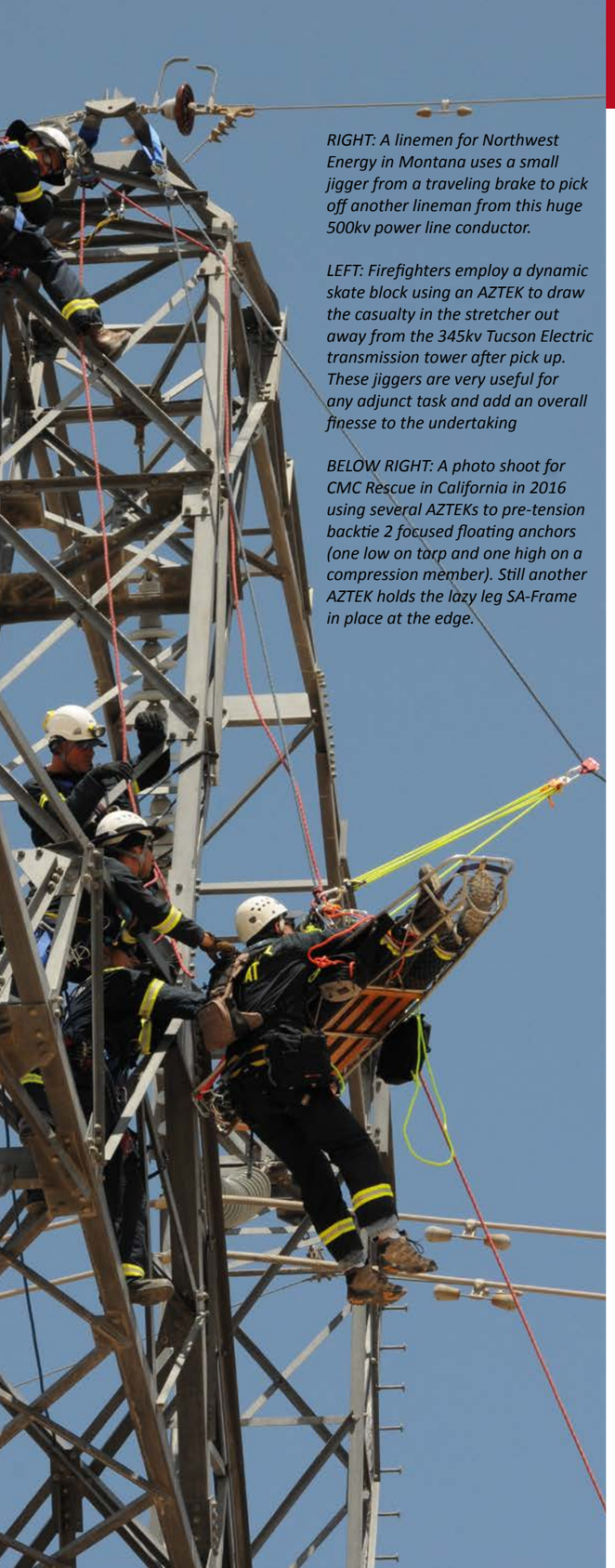


[1] A new 36KN AZTEK Omni® pulley has been designed by Reed Thorne and manufactured by Rock Exotica of Utah.

ABOVE: RTR instructor, Keith Thorne (top), watches a pick off of a firefighter 'casualty' from a power transmission line using an AZTEK from a rescuer using a tracking line offset. Photo from RTR Offset Highline Rescue Workshop at Western Area Power Admin. At Eleverta, California 2017.

their respective origins. I would like to see these terms become the norm since there is some lack of commonality in terms within rope rescue today. Certainly, it is noted that the edge kit on its own or the jigger pulley system on its own is no big deal (like the Purcell is a prusik back onto its doubled self) and not in need of a name. But the inclusion of the travel restrict/edge restraint element and reverse reeve SOF included in one kit is noteworthy. The early *AZTEK* SOFs used any high efficiency double pulley we could get our hands on and the blocks were reeved "reverse", again, like linemen do it, to prevent twisting in use. Special pulleys milled from high strength aluminum 'blocks' were later designed in 2007 by the author and *Rock Exotica* and appropriately named *AZTEK Omni Blocks*[1] due to the introduction of a much needed swivel at the top of each.

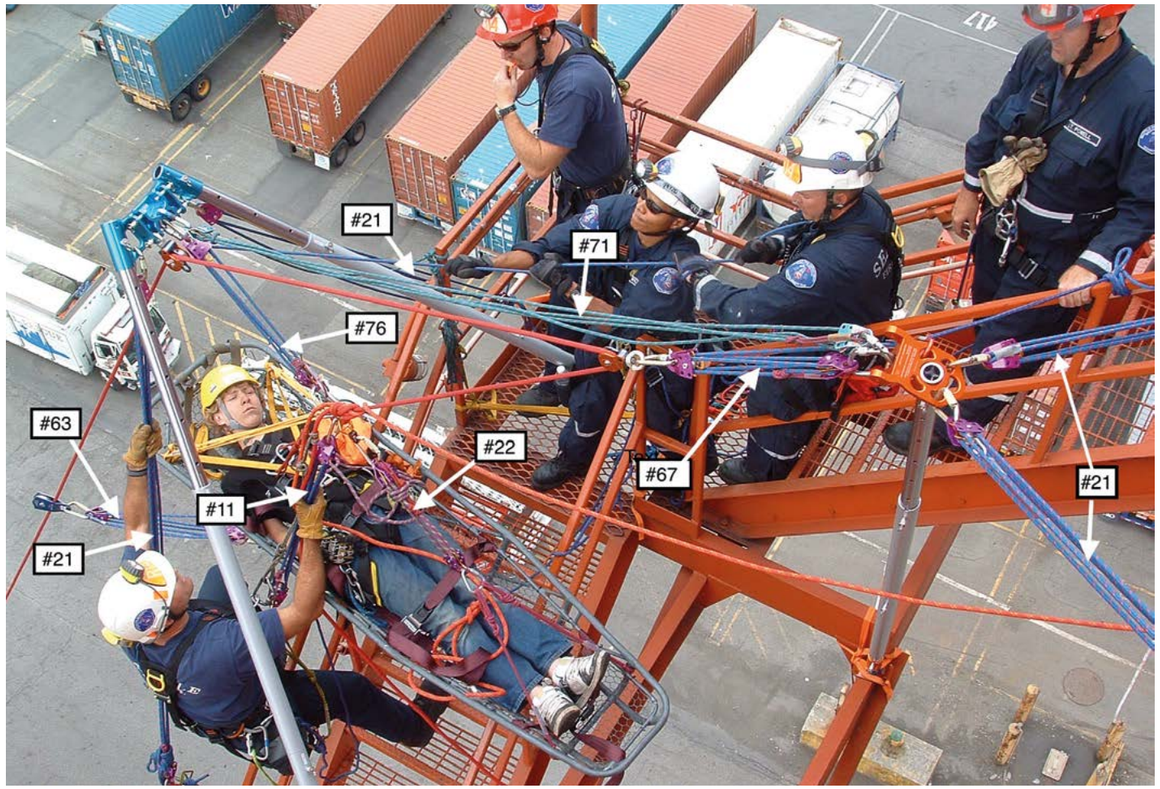
...***continued on page 48***.



RIGHT: A linemen for Northwest Energy in Montana uses a small jigger from a traveling brake to pick off another lineman from this huge 500kv power line conductor.

LEFT: Firefighters employ a dynamic skate block using an AZTEK to draw the casualty in the stretcher out away from the 345kv Tucson Electric transmission tower after pick up. These jiggers are very useful for any adjunct task and add an overall finesse to the undertaking

BELOW RIGHT: A photo shoot for CMC Rescue in California in 2016 using several AZTEKs to pre-tension backtie 2 focused floating anchors (one low on tarp and one high on a compression member). Still another AZTEK holds the lazy leg SA-Frame in place at the edge.



ABOVE and BELOW:
Members of Seattle Fire Rescue 1 (Ladder 7) working high on a port crane use 9 separate early AZTEKs to solve difficult rescue problem with RTR instructor, Keith Thorne as casualty. RTR has developed numbers for each use. Photos: 2005.

- *Far right: Guying the gin poleAZTEK Use #21*
- *Between the gin pole and A-FrameAZTEK Use #71*
- *Differential block at gin pole-AZTEK Use # 67*
- *On litter foot end jigger-AZTEK Use # 22*
- *On litter attendantAZTEK Use #11*
- *Transfer AZTEK being clipped by FF above- AZTEK Use # 76*
- *Front two guys on A-Frame-AZTEK Use #21*
- *Skate block jigger far left-AZTEK Use #63*

TOTAL: Nine AZTEKs

ABOVE Los Angeles Department of Water & Power tower transmission linemen use an AZTEK jigger to rescue another linemen in a line cart off the conductor mid span. Line carts as shown are used for placing spacers on multiple conductors and for doing repairs mid span on power lines. LEFT: Waldo Etherington, an adrenaline "junkie", lowers out of a hot air balloon in Dorset, UK at 1,000' off the ground on an AZTEK SOF with the other end as a safety. No helmet, but of course, what would a helmet do for him?

Pulleys used should be of the best quality bearing and rated for two person loads if the SOF is intended for that purpose. Now, as rope fiber technology advances, we have been using the *AZTEK* made with *Technora* host rope, *Technora* Purcell and *Technora* ratchet prusiks for durability and cut resistance. Nylon cuts extremely easily but *Technora* does not. *Technora* kits cost more, but the trade off is safety and confidence in your equipment.

The original yachting pulley versions of mini-pulley systems had three key uses bearing in mind that this was in the 80s and 90s...
1) To transfer the weight of a casualty during an on-line pick-off where the load was not expected to exceed a single bodyweight plus kit, which was just as well because the system attached to the rope via a toothed chest ascender.
2) Attached to the central rigging plate of a stretcher system and to the end of the stretcher to allow the angle of the stretcher to be adjusted, for instance in negotiating a narrow chamber.
3) Work positioning. Either to allow the stretcher handler to adjust position relative to the stretcher or when in the work vicinity on a vertical or low angle face to allow rapid altering of work position up and down over a 3 or 4 foot (1m) area depending on the length of cord.

Once lightweight yachting pulleys were superseded by mini alloy pulleys capable of holding full rescue loads, the possible uses multiplied exponentially. Versatility was further expanded by making use of the tail of the pulley system rope such that there are now well over 145 uses for the full AZTEK system only some of which are shown here. Read the all-important captions for each photo.

Often, in a team of twelve personnel, all carrying an *AZTEK pack*, each and every kit is used in the system someplace. Having this versatile tool on the harness also allows the rescuer to pass knots easily, correct disoriented equipment under load, transfer loads, and establish dynamic fixed brakes. With the SOFs as the pick off unit for solo and semi-solo rescues, rescuers can decide on multiple options which allow versatility depending on all important circumstances dictated by the particular rescue.

Dynamic fixed brakes (a fixed friction appliance/hitch in series with the SOFs) and dynamic traveling brakes (a traveling friction appliance in series with the SOFs) add immeasurable versatility to the rescue system. In some instances, the personal end is used in tandem with the SOFs end as a shock absorbing lanyard safety to the victim.

CONCLUSION

I think one can inevitably see that the inclusion of multiple small pulley systems adjunct accessory jiggers in the cache is worthwhile. Those can invariably be taken in the proverbial "wheelbarrow" to an incident or job site and made available for rigging. But, again, remember that to have one of these more useful jiggers populating the valuable real estate on your thigh or waste is an investment in ascertaining your personal safety and usefulness in a rescue operation. Going solo with a personal jigger or semi-solo with two personal jiggers on each will get the person hanging or in trouble to the hospital or safety sooner.