VI. Equipment

Gear Identification

It may sound trite, but little things, like calling something by its correct name, can make a difference in the amount of confidence a participant will have in an instructor. It's important to know the name and purpose of all challenge course gear.

We will divide the gear into two categories, hardware and software.

A. Hardware

1. Connectors: Carabiners, Snap Hooks and Rapid Links

All carabiners used on the ropes course must have a major axis tensile strength rating of 23kN or higher in order to meet the minimum breaking strength of 5,000 pounds in accordance with standards of the ANSI/ACCT, OSHA, and ANSI Z359. ANSI/ACCT 03-2016 requires all connectors to be stamped compliant with one of the following Standards: ANSI Z359, CSA Z259, NFPA 1983, EN 12275, EN 362, or UIAA 121.

*** ANSI Standard Z359.2007 went into effect on October 15, 2007. One of the areas most affected by this new standard is hardware. All hooks, carabiners, connectors, etc. used by employees are impacted by the new standard. This new standard requires a gate face and side strength of 3600 pounds and, for connectors without integral (captive) eyes, a gate minor axis strength of 3600 pounds. This is in addition to the existing overall tensile strength standard of 5000 pounds for critical applications. As of this writing OSHA and ACCT standards have not been changed to reflect the new ANSI Z359 standard, although we expect this to happen as these standards are revised in the coming years.**

a. **Carabiners**: Aluminum or steel locking clips with a spring loaded gate that come in a variety of shapes such as: pear, D, modified-D, or oval shaped. Only locking carabiners should be used in conjunction with ropes course operation. Steel carabiners are used specifically for clipping onto the course itself since it is largely constructed from steel cable and bolts. Steel is heavier and more durable than aluminum. Aluminum carabiners (actually aluminum alloy) are more fragile. They are used primarily for clipping onto ropes, belay loops, and harnesses. Excessive loaded wearing of aluminum carabiners on cable will eat grooves into the carabiners. Avoid clipping carabiners to carabiners as this will cause wear on the metal, decreasing the usable life span of the carabiners, and increasing the possibility of an unlocked system.

   i. **Screw Locking**: Carabiners that have a barrel that must turn several times in order to manually lock the carabiner gate. If attaching a participant to a life safety system using screw-locking carabiners (not recommended), two screw-locking carabiners should be attached to the participant's harness attachment point and their gates should be in an opposite configuration. Also, only finger tighten the barrel. A carabiner that is too tight will need pliers to be opened (be sure to keep pliers handy at the ropes course). **We do not recommend use of a screw-locking carabiner in a life critical application.**

ii. Twist locking: Twist-locking carabiners are also popular. They have a two-stage locking mechanism. Their use should be limited to areas where unintended contact is not likely. Twist-locking carabiners can easily open when attached to a persons' harness during a situation where the clip in point may be grabbed by the participant or rubbed against a tree or course element. **We do not recommend use of a twist-locking carabiner in a life critical application.**

iii. Triple Auto-Locking: Triple auto-locking carabiners involve a sequence of three separate actions in the proper sequence to open the gate. These may be appropriate to use in a life-critical; application, however, we recommend them only where the gate meets ANSI Z359.1-2007 standards.

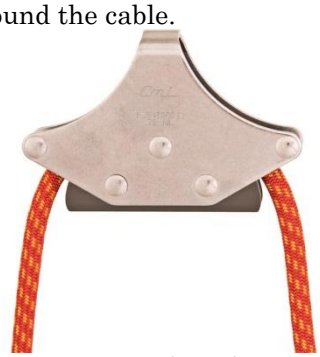
iv. Captive Eye – Triple Auto-Locking: The captive eye provides a way to separate the attachment between the harness and the support line. This minimizes the chance that the load will be applied across the gate. We recommend these only where the gate meets ANSI Z359.1-07 standards

b. **Snap hooks:** Auto locking snap hooks require a double action to operate. The back first, followed by the front, in order, must be squeezed to open. Releasing them will lock the snap hook. Auto locking snap hooks are being sewn into personal lanyards (lobster claws) and are on ends of some Load Limiting devices (Zorbers). **We do not recommend snap hooks for use in attachment to a participant harness.**

c. **Rapid Links**: 1/2" or 12 mm, 9/16" or 14 mm and 5/8" or 16 mm, steel removable chain links. These are similar to carabiners in that they should always have their barrels "screwing down". These should never be loaded without being locked, and can bend easily should that occur (the barrels being closed provide them their strength rating). These should also be loaded along their axis, like carabiners. These can be used for a variety of jobs, the most common of which is to connect the anchor point pieces or belay ropes, to the course. Rapid links are used because the barrels do not over tighten when they are used over the course of a program.

2. **Pulleys**

a. **Ropes Course Pulleys:** Pulleys are used on the challenge course to ease movement of the belays along the cables so the belay system can follow the climber. CMI Ropes Course Cable Pulleys have steel sheaves that fit loosely over the cable to prevent jamming and wear on the cable. The CMI Ropes Course Rope Pulley looks identical to this but has an aluminum sheave and is not intended to contact steel cable. The pulley is held together with a bolt and locknut. For critical applications, all cable pulleys must have a back-up system built in with either a small rapid link, another bolt, or full metal body that goes from each side over the sheave and around the cable.



b. **Spinstatic Pulley (left) and Shear Reduction Device (right),** allow the belay ropes to run through them smoothly. The sheave in these pulley is immobile. This creates a wider surface area for the rope to run over. This arrangement creates less wear on the rope when it catches a fall. Both devices have attachment areas in the top to which a rescue pulley on the cable can be attached via one or two rapid links. This can also be attached directly to a belay point via one or two rapid links.

c. **Zipline pulley:** Pictured is an older style CMI 2 wheel zip trolley. This is a heavier duty pulley than the standard rescue pulley. This was once the MOST popular style double wheel pulley with a steel body and a back up system and clip in points. (For specifics on set-up of this pulley see Zip line section) We strongly recommend a redundant tether back-up system to provide redundancy in the systems. There are also a variety of other zip wire pulleys that are in use. Know the specifics of your pulley!

3. **Friction Devices**

Friction devices help make belaying safer and easier. Friction is created at two points, at the anchor point above the climber and at the belayer. The anchor point above the climber is often referred to as a belay set-up or belay point. If the belay does not need to move along a cable, the belay point is generally made with rapid links and perhaps spinstatic or shear reduction device only. For roving systems, where the belay point must move to stay above a climber who is traversing obstacles, like on a challenge course, the set-up usually consists of a ropes-course cable pulley, a rapid link or two, and a spinstatic or shear reduction device.

a. Stitch plates and Tubers: These are our primary belay devices. Belay devices come in many variations. All are safe if used correctly. Universal Builders prefers the Air Brake, which allows for smoother operation. These are made of a forged aluminum alloy and have slots in which a bight of rope can be passed to create friction.

b. Figure Eight Descender / Rescue Eight: Figure eights are recommended for creating friction while rappelling. The figure eight is a cast aluminum piece, which is used to create a number of soft bends in the rope. These bends are what create the friction. The Rescue eight has ears to prevent the rope from girth hitching at the top of the eight. Manufacturers do not recommend the Figure 8's to be used as a belay device due to the fact that they can not produce a lock off in the event of a hard fall.

There are many friction devices on the market today, all of which are safe when used correctly (manufacturer's recommendations must always be followed). Consistency is the key to a safe program.

B. **Software**

1. Rope: There are many types, sizes, colors, and brands. Climbing ropes are typically a kernmantle construction – continuous fiber core covered by a woven sheath. Dynamic rope stretches to some degree. This provides a comfortable fall without a sudden jolt or shock load on the climber or belayer. All falls need to have some dynamic quality such as this in order to be considered safe. Often there is so much dynamic property present in the course itself, the trees bend and the cables give, that using a dynamic rope as well is impractical, or even dangerous. In cases such as this, a static rope, or low stretch rope works best. This kind of rope is also ideal for rescue, hauling and rappelling since it has minimal stretch. Many courses will use both dynamic and static rope. Keep track of all rope purchase dates by creating a purchase log. (A sample is in the appendix)

a. **Dynamic Kernmantle**: Kernmantle is standard rock climbing rope. Dynamic kernmantle has a static elongation stretch of 7-10% and a dynamic elongation of less than 40%. These values are based on specific testing procedures and the numbers may not be relevant to what is experienced in practical use. Dynamic Karnmantle can be difficult to inspect because you only see the outer layer designed to protect the rope from abrasion and wear. The primary weight bearing fibers lie within the sheath and can not be visually inspected. Dynamic kernmantle is often more colorful than low stretch or static.

b. **Static Kernmantle**: Static rope can be distinguished from dynamic by its stiffer feel and larger weave, or pic lay. Static rope is of similar construction as dynamic kernmantle, yet the stretch is reduced to less than 6%. The advantage of using static kernmantle for challenge course belaying is that most courses already have a dynamic property to them with the movement of trees, the drape of the cable and the movement of the belayer. With these factors present it may be appropriate to eliminate some of the rope stretch to keep participants from dropping too far in the early stages of course entry. Static kernmantle has also tested to be more durable than dynamic kernmantle while still remaining manageable for belaying.

Universal Ropes Course Builders general recommendation for belay rope type usage is:

Dynamic Rope: indoor climbing walls, climbing towers, leaps of faith or pamper poles, elements built on poles, and with stationary belay anchors such as usually found on a staple tree climb up to a zip/rappel platform.

Static or Low Stretch Rope: access elements with roving belay anchors (rescue pulleys riding on cables), traversing challenge course elements (optional, but ideal for getting climbers back onto a station after a fall), courses which are particularly low (12'-20'), flying squirrels, rescue ropes, and rappel ropes.

There may be deviations from these recommendations based on the assessment of a qualified person. All deviations from the recommendations should be documented and incorporated as part of the local operating policy and owner's fact sheet for operation.

c. **3 Strand Rigging Rope:** This three-strand construction often referred to as "Multiline" is generally a blend of nylon, polyester and polyolefin fibers. **MANY Standards EXCLUDE 3 strand ropes from critical applications unless they are specifically constructed, labeled and documented as life safety ropes.** Multiline is easy to splice which creates a termination that is much closer to the breaking strength of the rope than a knot. The common sizes are 1/2", 5/8" and 3/4 " although it is available in a variety of diameters. This rope is easy to inspect and is user friendly to handle. Element lanyards, lobster claws, platform lanyards, and personal lanyards were once commonly spliced multiline ropes. **Universal Ropes Course Builders does NOT recommend 3 strand rope for ANY critical applications.**

d. **Webbing**: There are MANY kinds of webbing available made from a variety of materials. Strength and suitability are highly dependent upon the construction and material. Webbing is used in many application on challenge courses and aerial parks, most notably as components of sewn lanyards. Webbing should be selected by a qualified person to be sure that it meets applicable standards for the application.

e. **Utility Prussik Cord**: Generally 6-8 mm. Utility cord tied into a loop with a double or triple fisherman's knot and is used primarily as a rescue tool. (see Rescues)

f. **Retrieval Line**: parachute cord, clothesline, polypro, or string of some kind (which will not break with a bit of tugging). Smaller is better.1/2" rope or larger is cumbersome for the climber and may make retrieval difficult (zip wire retrieval is the common exception since so much pulling and hauling is usually necessary). Be sure to note that retrieval lines should never be used as any kind of life support rope. They can be extremely useful in sending climbers or instructors items when up on the course.

g. **Sling Lines or Lanyards:** There are several popular types of sling lines or lanyards. Images above from left to right show the following styles: 1. swaged kernmantle adjustable single sling line with snap hook, 2. Sewn webbing adjustable instructor lanyard set with snap hooks and shock absorber (A.K.A. Lobster Claws), and 3. sewn webbing adjustable single sling line. It is a common practice to hitch the loop end of the sling line through the harness attachment point. Where the participant will not be moving, a single lanyard may suffice. Where the participant will be changing places, two lanyards are needed.

NOTE: When a Staff member attaches a lanyard or other equipment to their harness as part of a fall protection system, ANSI Z359.1-07 standards mandate that the carabiner or other type of connector must meet the ANSI Z359.1-07 standard.

Enemies of Ropes:

*Ultraviolet radiation (sunlight) Store ropes out of direct sunlight when not in use.
*Petroleum products (gas, oil, most flammable products): These products may jeopardize rope integrity, and therefore should not come in contact with your rope.
*Acids – acid residue and vapors from batteries in storage can weaken nylon rope.
*Heat: This is the single biggest hazard to nylon rope. Cigarettes, open flames, high speed lowering or rappelling may melt the rope. These and any similar situations need to be avoided to maintain the integrity of your ropes.
*Pinesap is also detrimental to rope as it hardens and takes away its dynamic quality.

2. Harnesses: Harnesses are an important part of personal safety systems for participants and for instructors on Aerial Challenge Courses and Zipline/zip tours. Included with purchase of each harness is a copy of the manufacturer's instructions for putting on a harness. Each harness has a belay connection point to connect the climber to the rope. Proper care and enemies of harnesses are the same as for ropes. Follow those guidelines. Keep track of all harness purchase dates by putting dates in the harness on the tag and creating a purchase log. (Sample is in the appendix)

Universal Ropes General Recommendations for Harness Type selection based on type of Activity:

Harness Type Choice for Adults based on Activity	Seat Harness	Sit Harness & Chest Harness	Full Body Sport Harness	Full Body Work ANSI Harness
Climbing Wall or Vertical Climbing Elements	Recommended	Likely Appropriate	Likely Appropriate	Likely Appropriate
Traversing High Elements	Recommended	Likely Appropriate	Likely Appropriate	Likely Appropriate
Ziplines	Situationallly Dependent*	Situationallly Dependent*	Situationallly Dependent*	Likely Appropriate
Flying Squirrel	Inappropriate	Likely Appropriate	Recommended	Recommended
Giant Swing	Inappropriate	Likely Appropriate	Recommended	Recommended
Pamper pole/Leap of Faith	Inappropriate	Likely Appropriate	Recommended	Recommended
Instructor Belaying	Likely Appropriate	Inappropriate	Likely Appropriate	Recommended
Instructor at Height	Inappropriate	Inappropriate	Inappropriate	Recommended

***Due to the variety of zipline designs harness style recommendations will vary based on design considerations.**

- **For Courses and/or zipline/zip tours constructed by Universal Ropes Course Builders, Inc. and Universal Ropes Courses, LLC, the above are the manufacturer's recommendations.**
  - **Variations to manufacturer's recommendations MUST be approved in writing by the manufacturer, incorporated as an addendum to the owner's and operator's manuals and documented in the Local Operating Procedure.**

a. **Fudge Style Harness:** This one-size- fits-MOST sit harness is designed with one continuous piece of nylon webbing utilizing slider buckles to form the leg loops. Belay loop is used as connection point. This is an old design and is no longer manufactured.

b. **Sewn Seat Harness:** This style harness usually has several separate adjustable parts, the leg loops and the waist. Some are one-size-fits-most and some are sized specific. They come with varying degrees of adjustability, padding, comfort and gear loops.

c. **Tied Seat Harness:** Usually a tied seat harness is made of static rope and should be an emergency harness in the context of rescue. **Universal Ropes does NOT recommend a tied seat harness for participant use.**

d. **Sewn Chest Harness:** A chest harness can be used **in addition to a sit harness,** either to provide added support for those with back issues or to help position individuals of extreme size - either small or large – in an upright orientation. Depending on the element design, it may be appropriate for ALL participants of all shapes and sizes on Flying Squirrel, Giant Swing, Trapeze Leap and Pamper Pole elements. A sewn chest harness is adjustable through one or more buckles. A chest harness should never be used without a seat harness.