Chapter 2.0:

Equipment and Repairs [1]

The focus of this chapter is on rafts and personal equipment. In terms of the ACA materials, it combines the repairs section with the equipment. The major sections in this chapter include types of rafts, anatomy of a raft, cams and knots, proper inflation, valves, personal equipment, and care of equipment.

Types of Rafts

Rafts are not homogenous. There is considerable diversity in term of size and use of the rafts. There is definitely and eastern and western bias regarding rafting and the types of rafts used on rivers. It is neither good nor bad, just a difference in approach. Eastern rivers tend to favor paddle craft and western rivers tend to favor oar rigs. The following topics provide an overview of the different types of rafting. The grouping is by no means complete but it is a sampling. For example, the author paddles a shredder which is a non-traditional raft (see Forward).

Figure 2.1: Eastern Paddle Raft – Commercial rafting on the Lehigh River in Northeast Pennsylvania. Source: Author – [file:\lehigh0016.jpg]

<b>**Paddle Raft** (Figure 2.1) – The raft pictured in Figure 2.1 typifies commercial rafts used on eastern rivers. The raft is a commercial raft on the Lehigh River in Pennsylvania. The raft pictured is an unguided paddle raft that carries four to six people.

<b>**Oar Rig** (Figure 2.2 and Figure 2.3) – Most paddle rafts can easily be converted to an oar rig. The scene in Figure 2.2 depicts three different paddle craft on a commercial trip on the Middle Fork of the Salmon River. In the foreground are two rubber duckies. They are a one or two person craft paddled with a kayak paddle. Rubber duckies are extremely stable and easy to paddle.

Figure 2.2: Oar Rigs – In addition to the typical oar rigs used on the Middle Fork of the Salmon is the gear boat and rubber duckies. Source: Author – [file:\DSC_0008.jpg]

In the middle ground are pictured a typical oar rig. The NRS cam straps used to fasten the oar frame the raft are clearly visible. Also, the general outfitting of the raft is visible with the cooler serving as a seat.

[1] This section was written by Robert B. Kauffman who is solely responsible for its content. This section is copyrighted © Robert B. Kauffman, 2018.

In the background is the gear raft. A large raft, it utilizes a very different oar system. There is a large oar on the bow and one on the stern. The one on the bow is clearly visible. The raft drifts in the water and the oars are used to steer the raft.

Figure 2.3 shows a typical configuration with the rower and two passengers in the bow of the raft. Also, clearly pictured is the perimeter line that is stretched through the D-rings around the perimeter of the raft.

Figure 2.3: Passengers – The oar rig is set up to transport two passengers in the front of the river on the Middle Fork of the Salmon. Source: Author – [file:\DSC_0063.jpg]

<b>**<u>Cataraft</u>** (Figure 2.4) – Catarafts are popular on western rivers. The two tubes are connected together with a aluminum frame. For transportation, the tubes can be detached from the frame if needed or the entire unit can be trailered behind a vehicle. Also, note the extensive use of NRS cam straps to fasten boxes and bags to the raft.

Figure 2.4: Cataraft – With their two tubes and frame in between, catarafts are similar to catamarans. Middle Fork of the Salmon. Source: Author – [file:\DSC_0007.jpg]

<b>**<u>Motorize Rafts</u>** (Figure 2.5) – A large motorized raft on the Colorado River is shown in Figure 2.5. The stern of the raft is shown for two reasons. It shows the outboard motor used to propel the raft. Second, close inspection reveals that the raft is constructed from a raft in the middle with two tubes lashed to the main raft on the outside. The rule is that bigger rafts tend to make big water less big.

Figure 2.5: Motorized Raft on the Colorado – Large motorized commercial raft on the Colorado River. Source: Author – [file:\DSC_0343.jpg]

Anatomy of a Raft

<b>**<u>Side View</u>** (Figure 2.6) – The ***tube height*** is the distance from the bottom of the tube to the top of the tube. The ***waterline*** is where the surface of the water make a horizontal line on the raft. The waterline indicates the amount of water displaced by the weight of the raft, its occupants and its cargo. The distance from the waterline to the top of the tube at its lowest point is the **freeboard**. **Rocker** indicates the amount of rise of the bow and stern from the bottom of the haul. More rocker aids in turning the raft more easily and in going over waves. The raft pictured is symmetrical from

front to back and other than how it is outfitted (e.g. foot cups), it paddles backwards just as easily as forward.

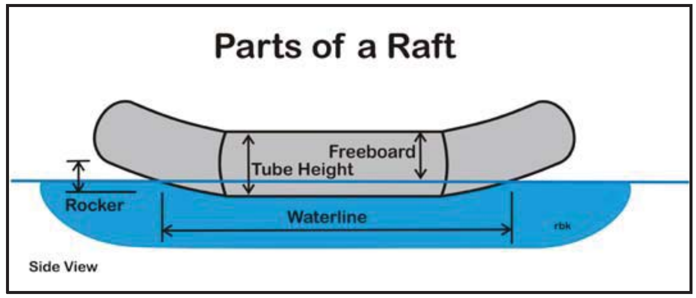

Figure 2.6: Parts of a Raft – Side View. Source: Author – [file:\Raft-answer01.jpg]

<b>**Orientation** (Figure 2.7) – Facing forward, ***starboard*** is the right side of the raft. ***Port*** is the left side. A way to remember port is that both port and left are four letter words. The ***bow*** is the front of the raft and the ***stern*** is the rear of the raft. As with the side view, the raft pictured is symmetrical from side to side as well as front to back and will go backwards as easily as forwards. The bow and stern are determined by outfitting including the foot cups and oar frame. The motorized raft pictured in Figure 2.5 is not symmetrical front to back.

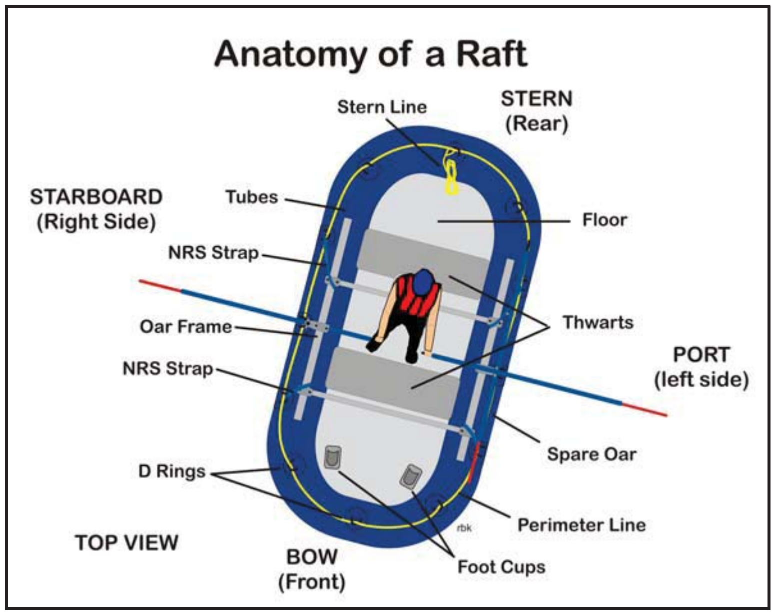

Figure 2.7: Parts of a Raft – Oar Rig – Top View. Source: Author – [file:\RaftAnatomy.jpg]

<b>**Oar Frame** (Figure 2.7 and Figure 2.8) – The oar frame is constructed out of aluminum tubing. The frame is fastened to the raft with four NRS straps that connect the corners to D-rings on the raft. The frame has two cross members or thwarts. Both are adjustable fore and aft. The seat is attached to the rear cross-member. The forward aluminum member is usually adjusted so that the rower can place his/her feet on it and push against it when needed. This allows transferring the rowing energy directly to the raft. Placing one's feet on the tubes is okay, but the tube may have some flex and give to it. Also, compare the oar rig in Figure 2.7 with the rig in Figure 2.22 which has a different configuration.

The oar mounts are fastened to the frame and the U-bolts tightened (Figure 2.8). The oar mounts should be placed roughly one-third of the reach of the arms on a forward and reverse stroke. Normally, the mounts and oars are located in center of the raft, fore to aft. Also, the grips should not hit each other when taking a stroke.

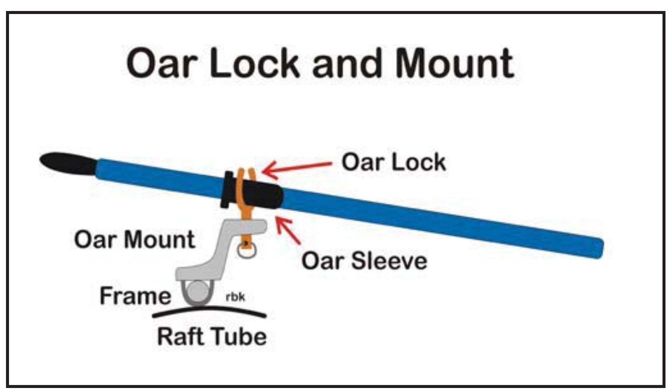

Figure 2.8: Oar Mounts – Source: Author – [file:\EQUIP_OarLock.jpg]

<b>**Parts of a Raft** (Figure 2.7) – Many of the parts of a raft have been identified with the oar frame and orientation sections. Several additional parts of the raft are listed below. It should be noted that the raft in Figure 2.7 is outfitted for an oar rig. Remove the oar rig and the raft pictured is usable as a paddle craft.

<c>***Tubes*** (Figure 2.7) – Most rafts have a minimum of three main tubes. Generally, there are two types of tube construction. The first is where the tube itself is the air tight baffle. This is the typical construction. The second approach is to use an inflatable baffle within the tube. The outside tube protects the baffle. Either system works well. As a footnote, when filling the tubes with air, fill **all** the tubes before topping them off. This reduces the remote possibility that the sidewall between tubes is blown out by the air pressure.

<c>***Thwarts*** (Figure 2.7) – Depending on the size of the raft, it will have one or more thwarts or cross-tubes. The tube provides a fourth tube to rafts with three main tubes. The thwarts provide seats for paddlers and lateral stability between the two side tubes. In rafts outfitted as gear rafts, the thwart tubes are often removed (see Figure 2.22 and Figure 2.23)

<c>***Floor*** (Figure 2.7) – Most modern rafts are self-bailing rafts. The slight increase in weight more than offsets the advantages of not having to bail the raft. The floor in a self-bailing raft is actually a horizontal or flat tube that forms the floor of the raft. The river water enters and exits the raft where the floor is laced into the side tubes.

<c>***Perimeter Line*** (Figure 2.7) – The perimeter line is fastened to and extended through the D-rings on the side of the raft. The main purpose of the line is to provide a grab line for swimmers during rescue. It is recommended that when fastening things to the raft, use the D-ring rather than the perimeter line. This author would fasten his Shredder to one of the larger rafts overnight or when beached during the day. This kept the tubes in the water and dispersed any heat buildup from the hot sun into the water. Also, it reduces any abrasive action of the sandy beach abrading the bottom of the tubes. As a general rule, the fastening to the perimeter line of either raft was avoided and the D-ring or its equivalent on the Shredder was used. A three foot NRS strap worked exceeding well.

<c>***Spare Oar*** (Figure 2.7) – The spare oar should be carried on one of the side tubes. A popular approach is to use a Fastex ® fastener to clip the oar to the frame and the grip end is slipped through the an O-ring which is cinched to the frame. The Fastex keeps the oar from slipping out of the O-ring. If carrying a spare oar, the rafter should be cautious that the blade of the spare oar does catch the water and impede the progress of the raft. Also, be sure that it doesn’t catch any objects in the river and impale the raft on the spare oar either.

<c>***Foot Cups*** (Figure 2.7) – Most paddlers like to be physically connected to the raft. Many rafts are outfitted with foot cups in the bow of the raft. The foot coups enable the paddlers to put one of their feet in the cups.

<c>***D-Rings*** (Figure 2.7) – A series of D-Rings are placed strategically around the raft on the main tubes. The D-Rings are designed for maximum loading. The oar frame is connected to them. So is the perimeter line. If a haul line is connected to a pinned raft, the D-Rings are used. Usually, the line is connected to multiple D-rings.

<c>***Stern Line*** (Figure 2.7) – The stern line is a twenty to twenty-five foot length of coiled rope tied to the rear D-Ring. Its primary purpose is to secure the raft when beached. The line can be connected to either end or both. However, only one line is generally needed for beaching purposes.

Cams Straps and Knots

For a large part, the cam strap has replaced ropes and knot tying on rivers. Two knots are include. The first is the bowline. It is an all-around useful knot that is strong and easy to tie and untie. It is used to tie the end line. The second knot is the specialized directional figure-8 follow-through. A truly self-equalizing anchor, it is a specialized knot that is useful in extricating a pinned raft.

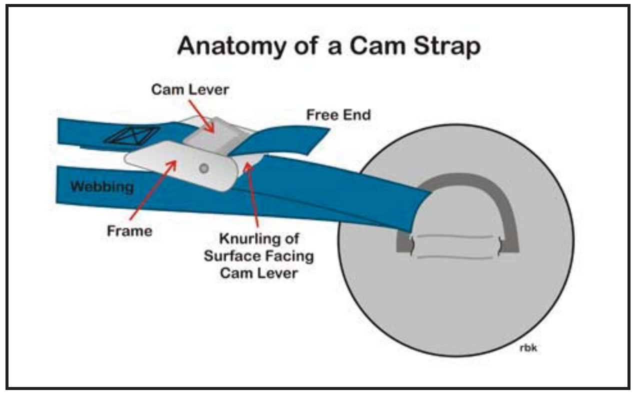

Figure 2.9: Anatomy of a Cam Strap – The NRS ® straps or generic cam straps are a stable on the river used to fasten everything to the raft. Source: Author – [file:\.EQUIP_NRSstrap.cdr]

<b>**<u>NRS ® and Cam Straps</u>** (Figure 2.9 and Figure 2.10) – NRS straps ® or cam straps are a staple of rafting. They are used to fasten everything to the raft in both paddle craft and oar rigs. In paddle craft, a strap can be stretched around one of the cross tubes. Objects such water bottles and dry bags can be carabinered to the strap. A two foot strap can be used as an extension of an end loop on the raft. Again, it allows items to be fastened to the extension with carabiners. In an oar rig, the oar frame is fastened to the raft with cam straps. On extended trips on western rivers, virtually everything that is stored on the raft is fastened to the raft using cam straps (Figure 2.10). This ranges from ammo boxes to bed rolls. It is not an understatement to state that cam straps have replaced ropes in all aspects other than the bow line used to anchor the raft when it is beached.

Figure 2.10: Cam Straps – In preparation for a Grand Canyon trip, a guide is fastening dry bags to the raft with NRS ® straps. Source: Author – [file:\.DSC_0267.jpg]

Cam straps are easy to use and relatively foolproof (Figure 2.9). Thread the strap into the cam. Pull it taught. The cam is designed to lock down on the strap. To release, simply press the button on the back of the cam. The traditional cam trap is a 1" polypropylene strap with a tensile strength of roughly 1,500 lbs.

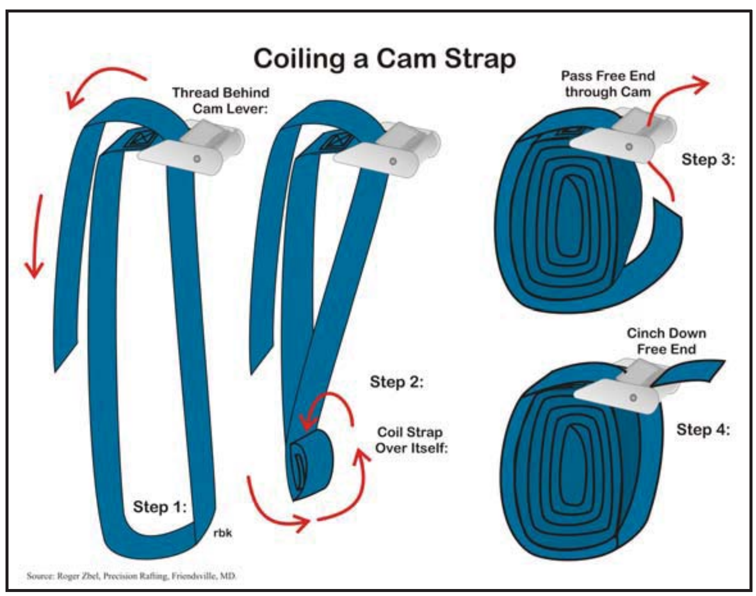

Figure 2.11: Coiling a Cam Strap – Source: Author

<b>**<u>Storing Cam Straps</u>** (Figure 2.11 and Figure 2.12) – Three methods of storing cam straps are discussed. Perhaps the easiest and most convenient method is to store them loose in a container (not shown). Access is quick and the length of the strap is not a problem getting in the way. Since most

straps have the length of the strap marked on the strap, it is easy to identify the length needed and pick the strap needed from pile of straps.

The second method of storing straps is shown in Figure 2.11. New straps sold from the store are normally packed using this method. That in and of itself says something. The advantage of coiling the straps is that they store easily and compactly with other gear. There are no loose ends. It is easy to uncoil the coiled straps. They can be easily tossed to someone who needs a strap. The big disadvantage is that it takes time to coil the straps.

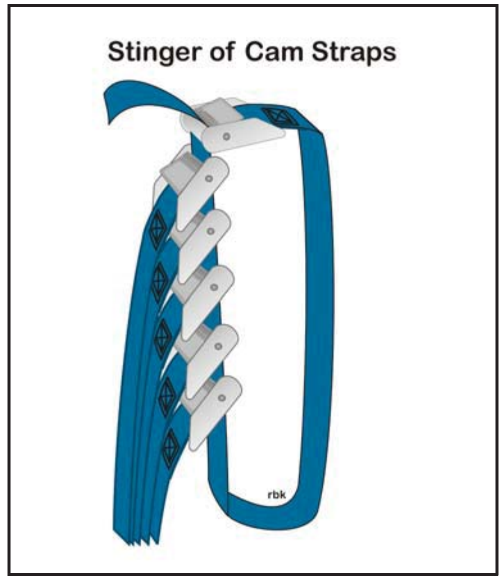

Figure 2.12: Stringer of Cam Straps – Source: Author.

Coiling a Strap (Figure 2.11) – Coiling the straps is not initially intuitive. Two tips to the method include the following. First, thread the webbing behind the cam lever and where the other end of the webbing is attached to the frame (Step 1, see Figure 2.10 for parts). Second, allow sufficient length of the free end so that it can be cinched down later. This may require some trial and error. Next, the strap should hang down (Step 2). Coil the webbing back on itself upward. Coil it toward the cinch lever in the frame. When coiled, wrap the free end around the coil and through the cam (Step 3). Cinch it down until it is snug. Store it in the gear bag (Step 4). It is ready for use.

Stringers of Cam Straps (Figure 2.12) – Similar to placing fish caught on a stringer, cam straps are strung one after another on another cam strap. The method provides a convenient way to store the cam straps, particularly if there are a lot of equal length. The method can be cumbersome if different lengths are stored together. Also, it works better with shorter straps. Long straps (e.g. 15' or 20') can become somewhat unmanageable. As a footnote, this author finds this method less than satisfactory and uses either the coiled method or loose storage in a container.

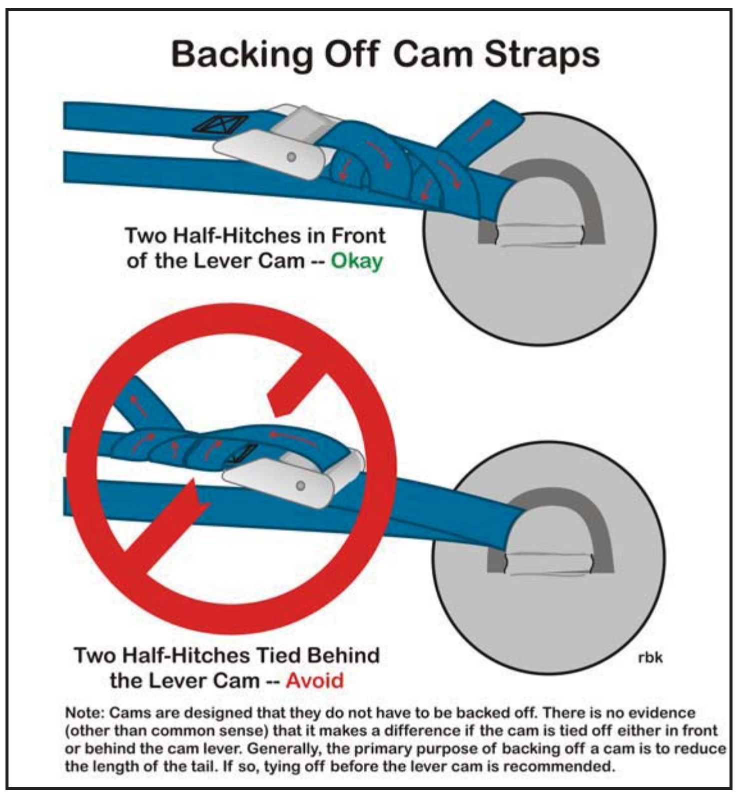

Figure 2.13: Backing off Cam Straps – Source: Author.

<b>**<u>Backing Off Cam Straps</u>** (Figure 2.13) – As designed, it is not a requirement to back off cam straps. Generally, backing off a cam strap is done to reduce the extra length of the free end. This occurs when a ten foot long cam strap is used when a five foot long strap would have sufficed. The question is what to do with the extra five feet. It can hang loose. It can be daisy

chained or backed off. If it is backed off, the simplest approach is to tie two or more half-hitches. Normally, the half-hitches should be tied back on the end passing through the cam (i.e. not the frame end), away from the cam lever. In theory, this prevents the hitches from accidently loosening the cam lever. It should be noted that this author is not aware of any incidents where the cam lever has accidently been loosened by the tie off passing over the cam lever. Regardless, it seems prudent to tie off on the end passing through the cam.

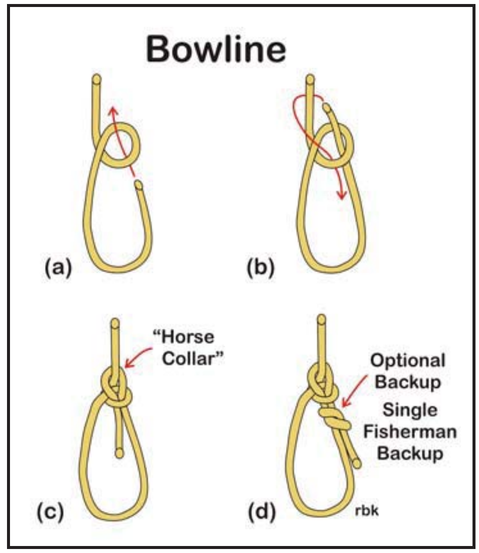

Figure 2.14: Bowline – The bowline is a useful knot on the river. It is an easy knot to tie, to tie a rope around a tree or other object, and to untie. If needed it can be backed up. Source: Author – [file:\.RS-Bowline.cdr]

<b>**Bowline** (Figure 2.14) – The bowline is used to tie a loop in the end of a rope. The advantage of using the bowline is that it can be tied quickly and easily. Also, it consumes less rope to tie than a figure eight follow-through. The knot maintains its integrity under tension. However, it can loosen when placed under continuous tension and compression situations. In the climbing community the bowline has fallen into disfavor for this reason. When a climber falls, they tend to bounce which can loosen the knot. If there is any doubt that the bowline could be placed in a tension and compression situation, back it up using half a single fisherman (shown), double fisherman (preferred), or even two half hitches (okay) (see Figure 2.14d).

<b>**Directional Figure Eight Follow-through** (Figure 2.15) – The system has been used in river rescue and to a lesser extent in climbing. The system can be hooked to multiple D-rings on a raft to extricate it from a pinning. Or it could be used to anchor a hauling line to multiple trees used as anchors where no one tree would serve as a suitable anchor.

The running end of the in-line figure eight is worked back through the loop and then retraced the knot as diagramed. The setup is a self-equalizing anchor system where the pull on each anchor is the same. The system can easily incorporate multiple anchor points with the addition of another loop. If there is an abundance of carabiners, they can be used to clip the loops around the anchors to the loop at the bottom of the figure eight. In addition, rather than retracing the figure-8, a carabiner can be used to connect the line to the loop (not shown).

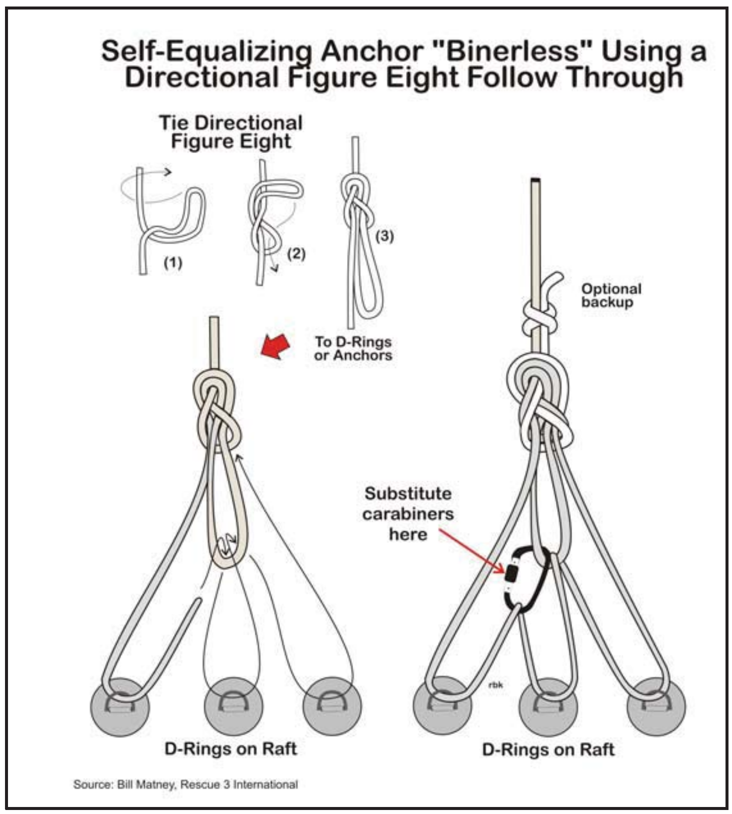

Figure 2.15: Self-equalizing Anchor – The Directional Figure-8 Follow-through can be used to extricate a raft from a pinning. It is a true self-equalizing system and will distribute equal force to each of the D-rings. Source: Author – [file:\.RS-DirectionalFigure8.cdr]

Proper Inflation

A raft obtains it structural integrity from being inflated. Until it is inflated, it is a limp pile of neoprene or similar material lying on the ground. As air is pumped into the raft, it comes to life and becomes a rigid structure. If the tubes are soft, the raft will bend and flex in the waves. A rigid raft is a more responsive and a better performing raft. This requires good “pressure” management.

<b>**Pumping Up the Raft** – Using a hand pump to inflate a raft is okay for the occasional rafter. However, most rafters who pump rafts on a regular basis use a two step process. First, they use an electric pump to inflate the raft. Most of the electric pumps will inflate rafts in the range of 7.5 psi. Inflate the main tubes first followed by the thwarts and floor last. The tubes can be inflated fully without fear of popping a tube. Unless the tube is already defective, 7.5 psi should not be sufficient to pop a tube.

The easiest way to determine when the tube is full is by the sound of the motor in the pump. As the pump reaches the limit of its pumping capacity, its pitch changes. This is due to the air in the tubes pushing back on the pump. When the pitch begins to increase and whine, you are done.

<b>**Topping Off the Raft** (Figure 2.16) – The second step is to top off the raft. This takes the raft from being hard to really hard. A hand pump is used to increase the pressure another two to three psi. Rafting companies usually have a 6" Carlson pump on hand (Figure 2.16). It is efficient and it inflates quickly. On extended trips, outfitters pack these big hand pumps on the gear raft. They are quick and efficient when topping off the rafts in the morning. Other pumps work equally well. The author uses a K-Pump (K-40) which works quite well. However, if the 6" Carlson is available, it is the pump of first choice.

As with the electric pump, there is the issue of when has the appropriate pressure been obtained. There are several ways to determine the appropriate pressure. First, buy a gauge and measure the pressure. Unfortunately, the gauge is something else to lose on a trip. Second is the thumb depression method. Press the thumb against the main tube of the raft. When pressed, if the finger nail cannot be depressed below the tube, there is sufficient air in the raft. Third, there is push back on the air pump and the person pumping. When pumping, the air in the tube pushes back making it more difficult to pump air. The person pumping the air can sense this resistance. Fourth is the sound method. The author bounces the shaft of the paddle against the tube. Its pitch and the height of the bounce indicates the pressure in the tubes. The thumb, pump resistance and bounce methods are all used by this author. They complement each other. The gauge is left at home.

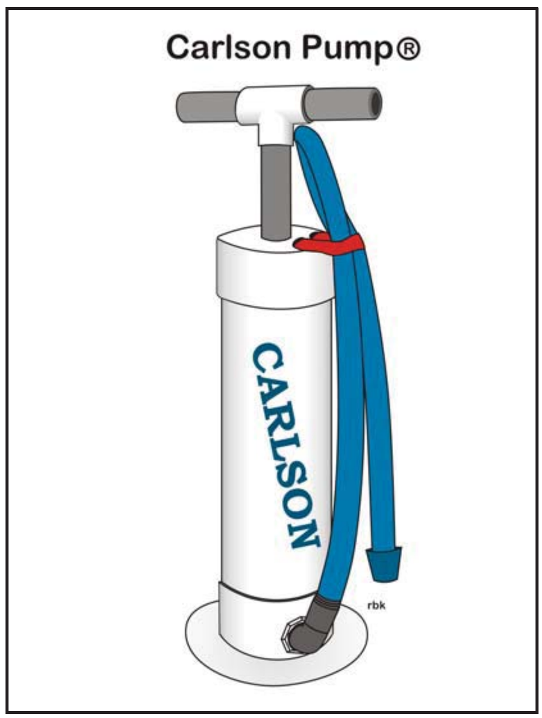

Figure 2.16: Carlson Pump – The 6" Carlson pump or its equivalent is a staple of the rafting industry. Source: author – [file:\.EQUIP_CarlsonPump.cdr]

<b>**Boyles Law** – Now that the raft is exceptionally hard, a word of caution. This discussion involves the implications of Boyle's Law. Boyle's Law states that if the volume is held constant, the pressure will vary directly with temperature. The raft tubes determine the volume. They remain constant. Therefore, pressure and temperature vary together. For rafters, there are two specific situations affected by Boyle's Law. In the first situation, the raft is pumped up to the desired pressure. The air temperature is 75ºF. The raft is set in the river with a water temperature of 65ºF. The temperature drops ten degrees and so does the pressure in the tubes. The simple solution is that the raft can be topped off again. Usually, the raft is sufficiently over pressurized initially knowing that it will deflate slightly on the water.

The other situation is that the raft cooks in the sun's rays. The temperature in the raft tubes rise and so does the pressure in the tubes. It is not unheard of popping a tube due to the excessive pressure created by the temperature, particularly if the raft was inflated hard in the first place and then left to bake in the sun. There are several things that can be done. Place the raft in the shade and out of the direct sunlight or keep the raft in the water. The water will help dissipate the heat buildup from the sun to the water. Be careful at lunch stops where it is easy to pull the raft out of the water and onto the beach. This author keeps his raft afloat in the water by either attaching it to an adjacent raft or to the shore by a line.

Last, let air out of the tubes. This requires monitoring the pressure in the tubes, particularly if the rafter is running with hard tubes. Use the thumb approach. Bounce the paddle off the tubes and listen to the sound. If there is any doubt, press the valve and release some air pressure.

Valves

Two types of valves are discussed. These are the military and quick release valves.

<b>**Military Valves** (Not shown) – The military valve utilizes an O-ring to create the seal. Although they are simple to use, they have for the most part been replaced by the even easier to use quick release valves. There are a couple of tricks to using the military valves. When filling the raft with air, unscrew the valve one or two turns to open it. It doesn't need to be fully opened to fill the raft with air. This makes closing the valve easier since only one or two turns are required to seal the valve.

One word of caution when using these valves. When the valve is seated on the O-ring, it is sealed (period). There is a tendency to over tighten the valve and continue to tighten the screw. This tends to smash the O-ring and shorten its life span. Simply tighten the valve until it is sealed. Don't over tighten.

<b>**Quick Release Valves** (Figure 2.17) – Because they are durable, reliable and easy to use the quick release valves have gained wide acceptance. Name brands include Leafield and Haley-Roberts. The Leafield C7 valve is pictured in Figure 2.17.

They are simple to use. To open the valve and deflate the raft, push the plunger in and rotate

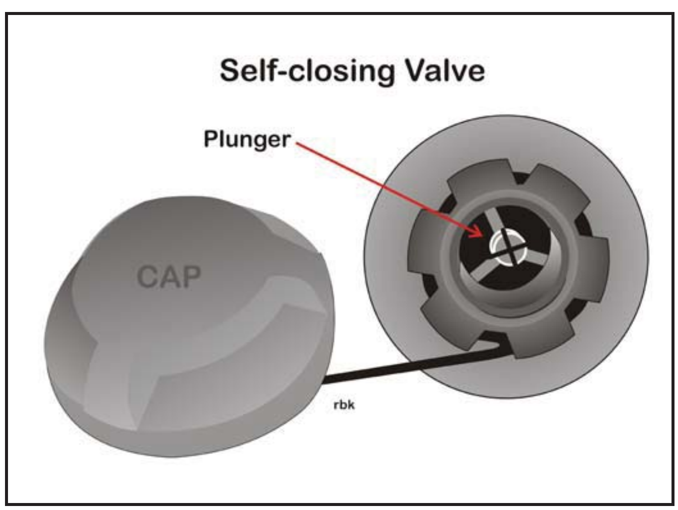

Figure 2.17: Quick Release Valve – Source: author – [file:\EQUIP_Valves.cdr]

it counter clockwise. To fill the raft with air, the valve needs to be in the closed mode. To close the valve, rotate the plunger clockwise. The spring will seat the rubber seal on the inside of the valve and the air pressure inside the raft's tube maintains an effective seal. The pressure of the air being pumped into the raft opens the seal on the inside of the valve and automatically reseals the valve when pumping stops. Visual examination can easily determine if the valve is in the open or closed mode. If the plunger is depressed inward, the valve is open. If it is extended outward, the valve is in the closed mode.

Personal Equipment

This section includes life jackets, helmets, knives and carabiners. Clothing such as paddling jackets, wetsuits, and drysuits are discussed in Chapter 5 on Safety as part of the section on physiology. For day trips add a water bottle, lunch or a snack in day pack and extra layers of clothing if needed.

<b>**Life Jackets** (Figure 2.18) – The U.S. Coast Guard classifies life jackets in the five categories of PFDs (Personal Flotation Device). Underwriter's Laboratories performs the testing of life jackets for the Coast Guard. The average head weights roughly 12 pounds. The objective of a life jacket is to keep the head out of the water. This means that in order for the life jacket to work, it needs to be submerged and displace roughly 12+ pounds of water. In their tests, Underwriter's Laboratories defines the head as floating if the chin and ear lob are both out of the water. The tests are performed in still water. Remember, whitewater is white because it contains air. Therefore, it has less buoyancy. The corollary is that in whitewater more flotation is better.

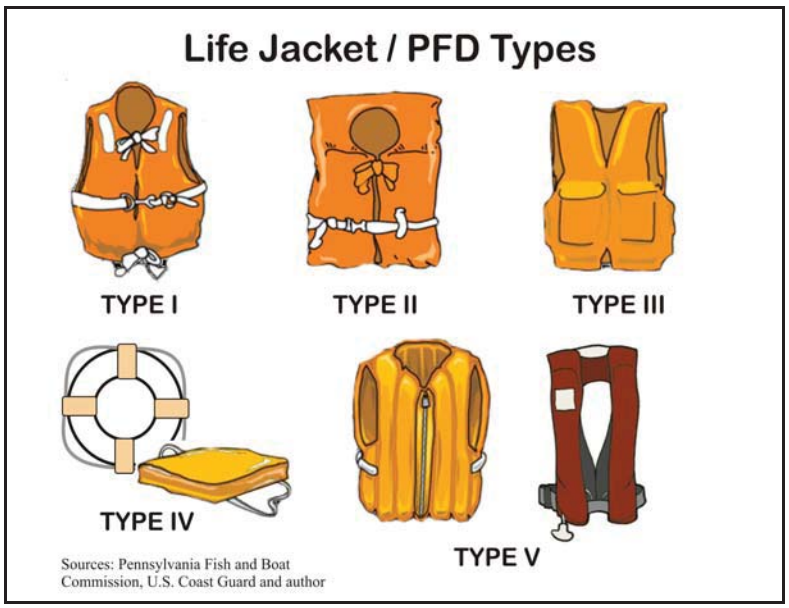

Figure 2.18: Life Jacket / PFD Types – Source: author – [file:\SA_Lifejacket02.cdr]

The ***Type I*** life jacket contains at least 20 pounds of flotation. It is the traditional "May West" and is literally designed for use by passengers when the ship is sinking. ***Type II*** life jackets are defined a near-shore vests with a minimum of 15.5 pounds of flotation and they are designed to turn an unconscious victim upright. The ***Type III*** life jacket has a minimum of 15.5 pounds of flotation and is not required to turn an unconscious victim upright. Most boaters will use a Type III life jacket. They are comfortable and designed to be worn. ***Type IV*** are throwable aids. They include ring buoys and seat cushions. They no longer meet the carriage requirements for having an approved life jacket in the boat.

Type V life jackets is a special use category. Essentially, it is the other category. Over time is has grown in the types of life jackets included in it. A critical requirement is that in order to meet the carriage requirements, they must be worn. Today there are generally three types of Type V life jackets. The first includes Type III life jackets that don't meet the test of being put on correctly by lay people. Essentially, the manufacturer has two choices. Redesign the life jacket so that it is uncomfortable if put on backwards or label it as a Type V life jacket. The other two categories are inflatables and work vests. Inflatables are designed to inflate manually or when the life jacket become immersed in the water.

Life jackets are sized by weight. Adults weighing less than 90 pounds in weight should use a youth's life jacket. Conversely, children over 90 pounds should use adult life jackets. Normally, the lower strap located under the rib cage is what keeps the life jacket on the body. It prevents the life jacket from riding up past the rib cage. To work properly, it is important that this strap be pulled snugly. As nylon degrades from sunlight, the fabric turns whiter. Use this visual inspection and retire the life jacket when it begins to fade.

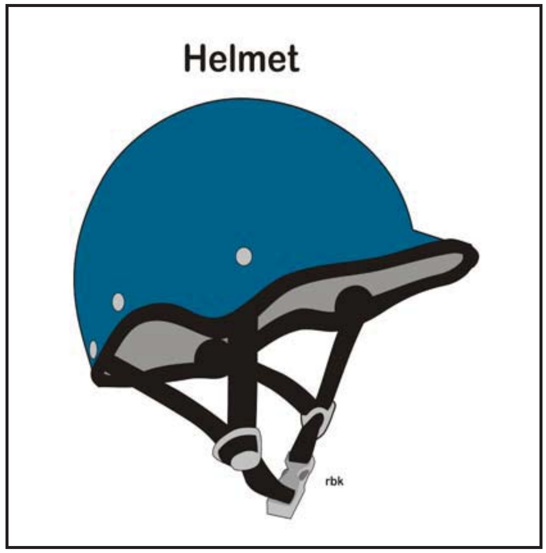

Figure 7.16: Helmets – The use of helmets depends on the river, common practices, and size of the raft used. Source: author – [file:\EQUIP_Helmets.cdr]

<b>**Helmet** (Figure 2.19) – The use of helmets is a function of personal preferences, common practices on the river, the rapid classification, and the size of the raft. Choose a helmet that proves protection of the temple area. A visor is always a good consideration. In cold weather situations, a closed design may offer some additional thermal protection to the head.

The following discussion focuses on whether to wear a helmet or not. Demonstrating ***personal preference***, this author paddles a Shredder. Having evolved from hard boating, wearing a helmet is part of the normal attire. Running both eastern and western rivers where one can easily swim, this author generally wears a helmet. It is based on history and habit.

For commercial outfitters, the ***common practice*** on the river determines whether helmets are worn. This may or may not dovetail with ***rapid classification***. In writing his report on a near-drowning on the Deerfield River during a throw bag drill, Charlie Walbridge summarizes the practices of wearing helmets on several eastern rivers for commercial rafters. He was making the point that helmets are not required.

> "....Although helmets are required for commercial rafting on the Fife Brook section of the Deerfield, this exceeds the usual standard of care in the rafting industry. This section of the river is rated class I-II with one drop of class III. Helmets are not used on the Natahala in North Carolina (Class II-III) or the Lehigh in Eastern Pennsylvania (Class I-II+) or the Youghiogheny in Western Pennsylvania (Class II-III+). This latter run is significantly harder than the Fife Brook section of the Deerfield." (Walbridge, 1998, p.14)

Charlie left out the Shennadoah River nears Harpers Ferry, West Virginia. A Class II river, they wear helmets. On the New River, commercial rafters are required to wear helmets on rapids greater than a Class III classification. The same is true on the Arkansas River in Colorado. The conclusion is two fold. Wearing helmets on commercial trips is determined by the common practice on the river and is not necessarily related to the practices on other rivers or the difficulty of the river.

As the ***size of the raft*** increases, there is less chance of flipping in the water and less incentive to wear a helmet. Also, on western rivers there is more need for protection from the sun and a broad rim hat is more in order. On the Colorado and Salmon Rivers, guides don't wear helmets. They wear broad rim hats.

In conclusion, know what the common practices are on the river being rafted and follow them. Obviously, it makes a difference whether it is a commercial or private trip.

<b>**River Knives** (Not shown) – There is a tendency toward diminishing the need to carry a river knife. In creating safety literature and posters, the issue of whether a knife should be depicted has been a topic of conversation. Let me cut to the chase. If you are working around ropes (e.g. throw bags), you should have a river knife.

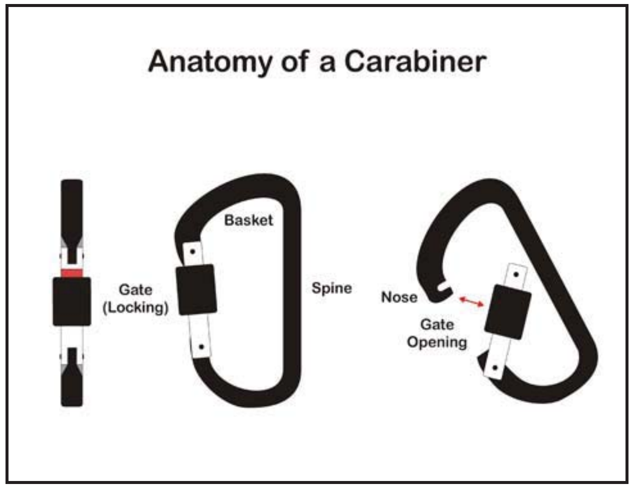

Figure 2.20: Anatomy of a Carabiner – Source: author – [file:\ROPE_CarabinerAnatomy.cdr]

A while back, this author was questioning the need for carrying a knife. I had never needed a knife on the river other than to cut bread and spread peanut butter. I was moving into the camp of thought of not needing a river knife. This was until I received a call from a lawyer. It seems as if a passenger wrapped the line from the raft to the shore around her leg. As the rope cinched down on her leg, she received permanent damage to her calf. The guide was supposed to have a knife, but didn't because he didn't have sufficient money to purchase the knife. The company didn't provide him with a knife either. Had he had a knife, he could have cut the line and reduced the damage. It changed my mind. The corollary is that if you are working around ropes, have a knife.

<b>**Carabiners** (Figure 2.20 and Figure 2.21) – Carabiners find many uses on the river. They are used to fasten Nalgene bottles to the raft. They are used in hauling systems. They are used to tie rafts together although the three foot NRS strap does a good job regarding this function.

A couple of quick comments on carabiners. First is the issue of locking versus non-locking carabiners. This author prefers locking carabiners for two reasons. Coming from smaller boats where weight and versatility are an issue, locking carabiners find double duty in mechanical advantage systems. Second, two non-carabiners or a non-locking carabiner fastened to a D-Ring can easily come undone from the current moving the item about (Figure 2.21). In addition, this author has never had trouble with sand or other debris clogging the locking mechanism.

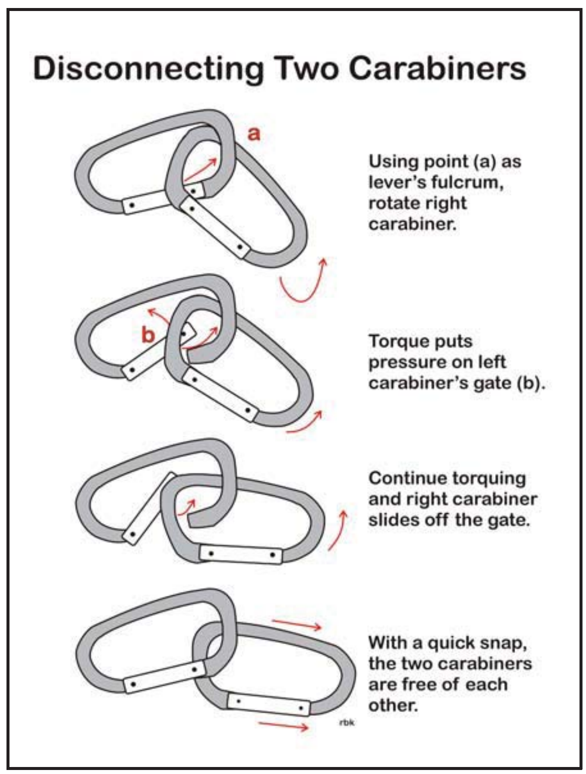

Figure 2.21: Disconnecting Two Carabiners – The water action against a carabiner hooked into a D-Ring can easily result in it becoming unhooked. Source: author – [file:\ROPE_CarabinerAnatomy.cdr]

Next, boaters have a tendency of hooking one or two carabiners into the shoulder strap of their life jacket. It looks sexy. However, consider carrying the carabiners internally within a pouch in the life jacket. The carabiners fastened to the shoulder strap are a potential snag that can entrap the boater.

Group Equipment for Multi-Day Trips

The focus of this section is on packing a raft for multi-day trips. It is a quick primer. It is not an in-depth discussion of each topic area such as menu planning, cooking or how to purify water. Discussion of these topics would at a minimum require one or more separate chapters. The items mentioned are discussed briefly in the last section and from the perspective of their inclusion in the illustrations (Figure 2.22 and Figure 2.23).

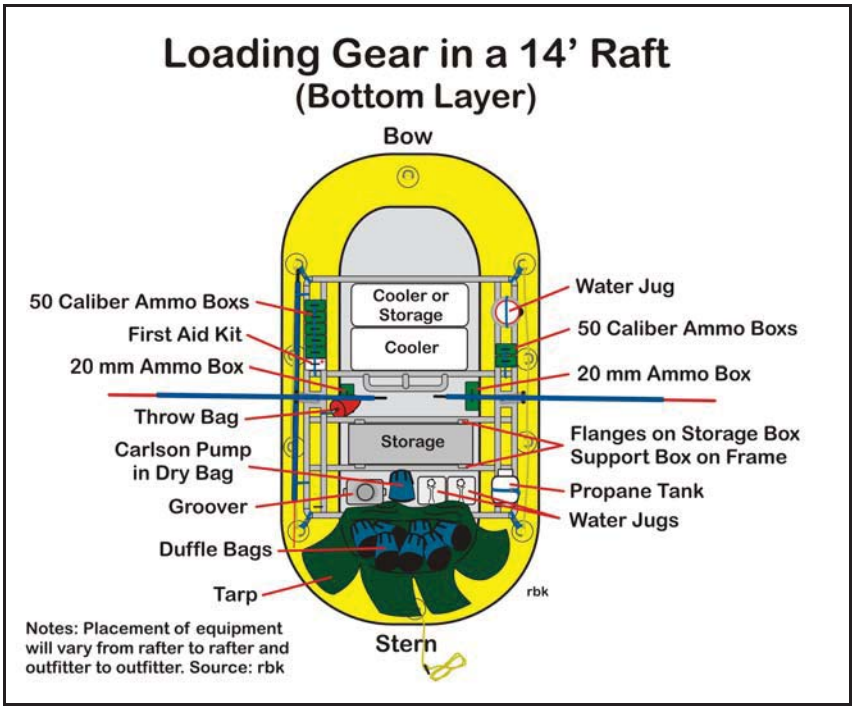

Figure 2.22: Gear Layout in a 14 Foot Raft (Bottom Layer) – Source: author [file: \EQUIP_GearRaft14ft.cdr]

Outfitting for a 14' Maravias is illustrated. It was chosen as a compromise between 12' and 16' rafts. It is outfitted to carry both gear and passengers. The center thwarts (i.e. tubes) are removed. The first principle is that there are many variations in rigs and guides will vary what they pack and where they pack it. Regardless, there are some commonalities. In an oar rig, the guide needs to be able to stand in the center of the raft. Walking the raft is done from the standing position (i.e. bow pointing forward). Also, the guide has a need to sit and row the raft with the stern pointing downstream. The frame has a foot rest for this purpose. The storage container with a sleeping pad makes a good seat. The storage contain has flanges so that it rests on

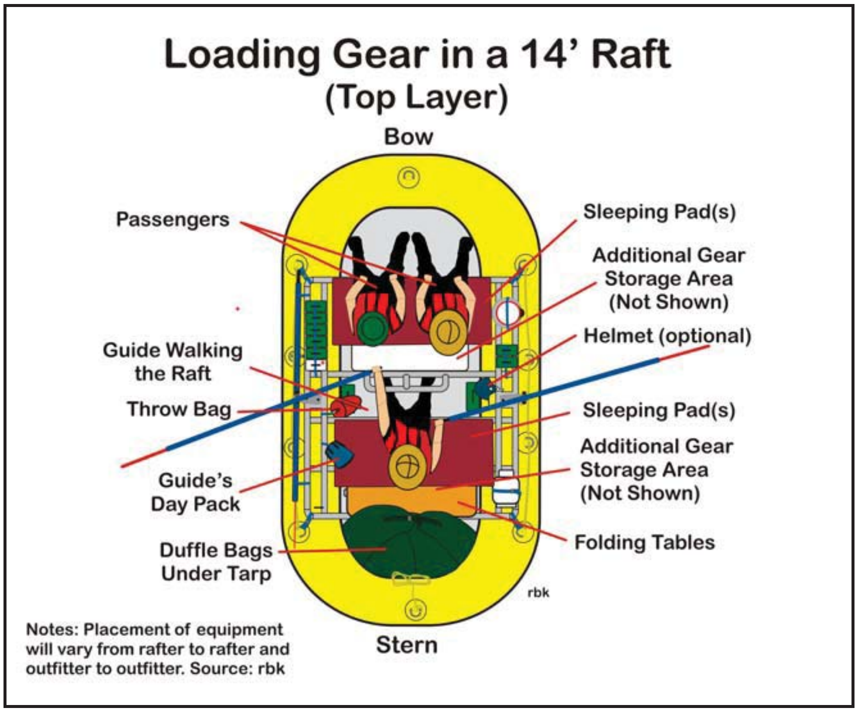

Figure 2.23: Gear Layout in a 14 Foot Raft (Top Layer) – Source: author [file: \EQUIP_GearRaft14ft.cdr]

the frame and not on the floor of the raft.

Next, safety and personal equipment need to be located close to and easily accessed by the guide. These include a throw bag, first aid kit, day pack and water bottle. An optional helmet is included. However, on most western rivers, guides don't normally wear helmets.

Third, items used during the day are packed to be readily accessible and items used at camp are less accessible. A table for lunch on top of the storage containers where they are easily accessible. Food for lunch is packed in a cooler and readily accessible. The 50 caliber ammo cans carry personal gear and are easily accessible by passengers, if needed. They are lashed to the frame with an NRS strap that passes through their handles. Passengers can quickly fill their water bottles from the water jug mounted on the bow of the raft. It too is lashed to the frame with an NRS strap. Hydration is important. Other personal gear, stoves, and tents are stowed away in the raft to be unpacked at camp.

Fourth, the load carrying capacity of rafts is considerable. When doing the Grand Canyon, the guides pulled out a complete set of horseshoes. The horseshoes and pins had to weigh over fifty pounds. Weight was not an issue. In terms of backcountry travel, consider the saying below. Although it seems that they carry tons, rafters may actually carry less weight.

> Backpackers count ounces.
> Bikers count pounds.
> Rafters count tons.

Last, Figure 2.22 and Figure 2.23 provide a list of items carried on the trip. It is not complete. Under the kitchen and fire and heat, the propane tank is lashed onto the frame. The stove and fire pit are stowed in storage. They are not shown in the illustration. The fire pit is used for campfires. Food can be kept cool in coolers. Frozen food can be stored using dry ice. In addition, to the five-gallon jugs and water jug mounted on the frame, a pump or other filtration system is needed and stowed away. Regarding sanitation, the normal ethic is to carry in and carry out. The groover carries the human wastes. Disposing of urine varies with region. In the west, the etiquette is usually to pea directly into the river. Tents and flies are not shown in the figures. They are stowed in the raft, usually with duffle bags. Cell phone communications in canyons is rare. Most trips carry satellite phones which are stowed in one of the 20 mm ammo boxes or similar waterproof container. A more extensive first aid kit may be stored in the storage box also. Chairs and other recreational items are stowed and not shown in the diagram. They are usually stowed along with the duffle bags.

Care of Equipment

Every outfitter has procedures for taking care of their equipment. There are procedures for cleaning and storing the rafts, storing paddles, and hanging up life jackets. Wetsuit booties and wetsuits may be disinfected and hung to dry.

Winter storage is important. The Shredder is stored in a plastic storage container to prevent little critters from burrowing in and making a home in the raft. Unfortunately, they will gnaw there way there. The use of a storage contain pretty much eliminates this possibility. Don't assume that indestructible rafts are indestructible.

Summary

The focus of this chapter is on equipment and to a lesser extent, repairs. It presents several types of raft representing both east and west usage. It discusses fastening devices including cams and knots. Other than the bowline, everything is connected to everything else using NRS ® cam straps. In discussing rafts, proper inflation is covered and how to determine it empirically. It is an art as much as a reading a gauge. Techniques to monitor proper inflation are noted. From there, the chapter includes a discussion of personal equipment including life jackets, helmets, river knives and carabiners.

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