String.

Although you wouldn't think it string is relatively easy to make. At its simplist they are but two parallel fibres twisted together into a single ply cylinder or cord.

A crude bowstring can be made from such a simple, single-ply cord. Its main body will nold together suprisingly well, but at the nocks it quickly frays and weakens. Another problem is that if single-ply cordage is not kept permanantly twisted, it tends to untwist into its original useless disconnected fibres.

To make durable, practical cordage we need to prevent the untwisting and this is an almost natural process. If we twist up a cylinder of fibres and continue twisting until the cord begins to kink, then let go the cord will instantly wrap around itself creating a two ply cord, now having neutral twist. Some of the original twist will be used up in the process but enough will remain to supply necessary friction within each ply. A stable durable practical cord results.

This principle is therefor applied in the making of all traditional and modern day string making, although there are many techniques for making cordage. Most are difficult to master through text and illustrations alone. But they are all based on twisted-fibres-will-make-themselves-intocordage principles. Once you twist the fibres tightly all you have to do is get out of the way and string happens.

SINGLE PLY CORD - a cylinder of parallel fibres twisted tightly enough to function as cordage.

SIMPLE PLY - a single ply cord used as the primary building block of reverse-twist cordage. It can be thin or thick, an entire ply, or one of many in a simple parallel ply.

SIMPLE PARALLEL PLY - many small, simple plies, the sole purpose being to give uniformity; they are used in parallel lines as if a simple ply.

PRIMARY PLY - one ply in a simple cord, when this simple cord is one ply in a complex cord.

COMPLEX CORD - where each ply is itself a finished simple cord.

Also crafting a superior bowstring requires more than simply selecting the strongest fibres. It matters very much how the fibres are assembled.

Finer fibres have more surface area, therefore more points of contact, therefore greater internal friction. When given a choice, select or shred fiber as thinly as possible without damaging the fiber.

Smooth-surfaced fibers slip past each other more easily, and therefore must be twisted tighter. This weakens the finished cord.

Short fibres must be twisted tighter than longer fibers, also weakening the finished cord. (Excess twisting also shortens the length og the string. This means a longer string is needed, which increases mass.)

Excess twisting makes a string more coilspring-like, causing a bowstring to stretch and absorb energy as it slams home after release. Energy absorbed by an elastic string is unavailable to the arrow, thereby reducing its poundage and speed.

Strings made up of many small-diameter plies, properly twisted together, are stronger than those made of fewer larger plies. The outer layers of a thicker cord have a larger diameter than the inner layers. When twisted, its outer fibers are asked to stretch and travel a longer, more spiraled path than the inner fibers. These outer fibers try to relieve the strain by shortening their path. They accomplish this by:

1. Squeezing and contracting the cord's diameter.

2. Shortening the cord - central fibers are actually telescoped into negative tension.

When such a cord is strained in tension, its pre-strained outer fibers must necessarily break first, leaving fewer and fewer near-surface fibers to resist the load. Also inner fibers of thicker cords have not been twisted as severely as the outer fibers, relying on compression from the more-strained outer fibers to create their cordage-making friction. Once these outer fibers break, inner fibers are able to pull apart more freely.

Thread thin cords, on the other hand, have smaller inner cores for outer biber to wrap around. When twisted, outer and inner bibers therefore feel nearly equal strain, and near equal cordage-making friction. As a result, outer fibers do not break more quickly than inner fibers. Thinner cords therefore have a lower percentage of central dead weight. They are stronger per mass.

For maximum efficiency do not use more than seven parallel plies in a ply. No more than seven plies in a simple cord and no more than seven cords in a complex cord. If more than seven the cylinder becomes too thick, causing some plies to remain internal.

Equally important is mass/strength is the uniformity of the simple plies.

e.g. A spool of high quality, wet spun, single ply line linen had an average breaking strength of 5lb. But when a 50-inch long strand was tested, breaking strength dropped to 3lb. And when a series of 5-inch long sections of a long thread were tested breaking strength varied from 3 to 7lbs.

If seven such plies are kept seperate and parallel they will each break at their weakest point of 3lb. Their collective breaking strength being 21lb. (7x3) But if these seven plies are twisted tightly into cordage, with weakest points placed next to strongest, weak and strong will average out, and combined strength will be 35lb.

Thread count ....breaking strength...............................Breaking strength per thread

.....40...150lb..3.75lb.

.....20...75lb...3.75lb.

.....10...40lb...4lb.

......7...35lb...5lb.

......5...23lb...4.6lb.

What we conclude from all this is that cordage made up of several, very small diameter simple plies will be considerably stronger per mass.

Testing cord strength, stretch and set.

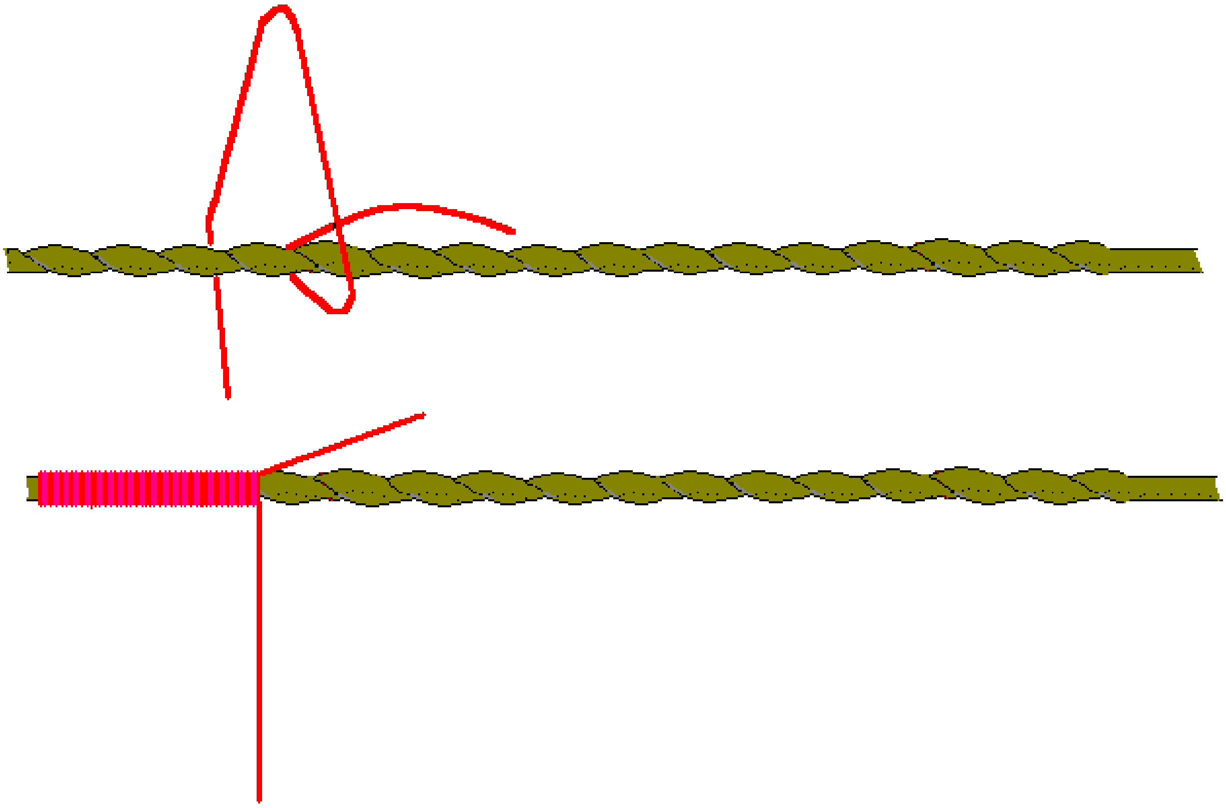
Secure a thread or string to be teasted around a smooth, round surface. Take a couple of turns before tying off. If secured properly breaks will occur randomly along a strings length. If secured improperly, breaks will occur near the fastened ends.

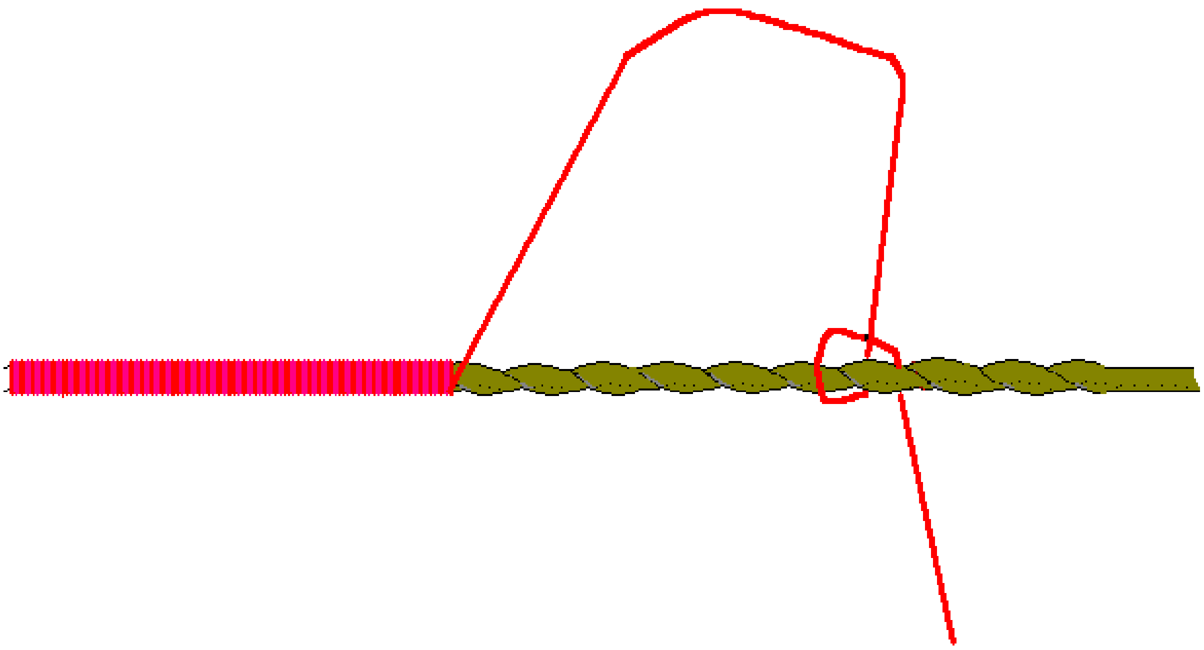
If a string is to be used by itself, or in parallel with others teast a section several feet long. This will reveal the strength of its weakest point.

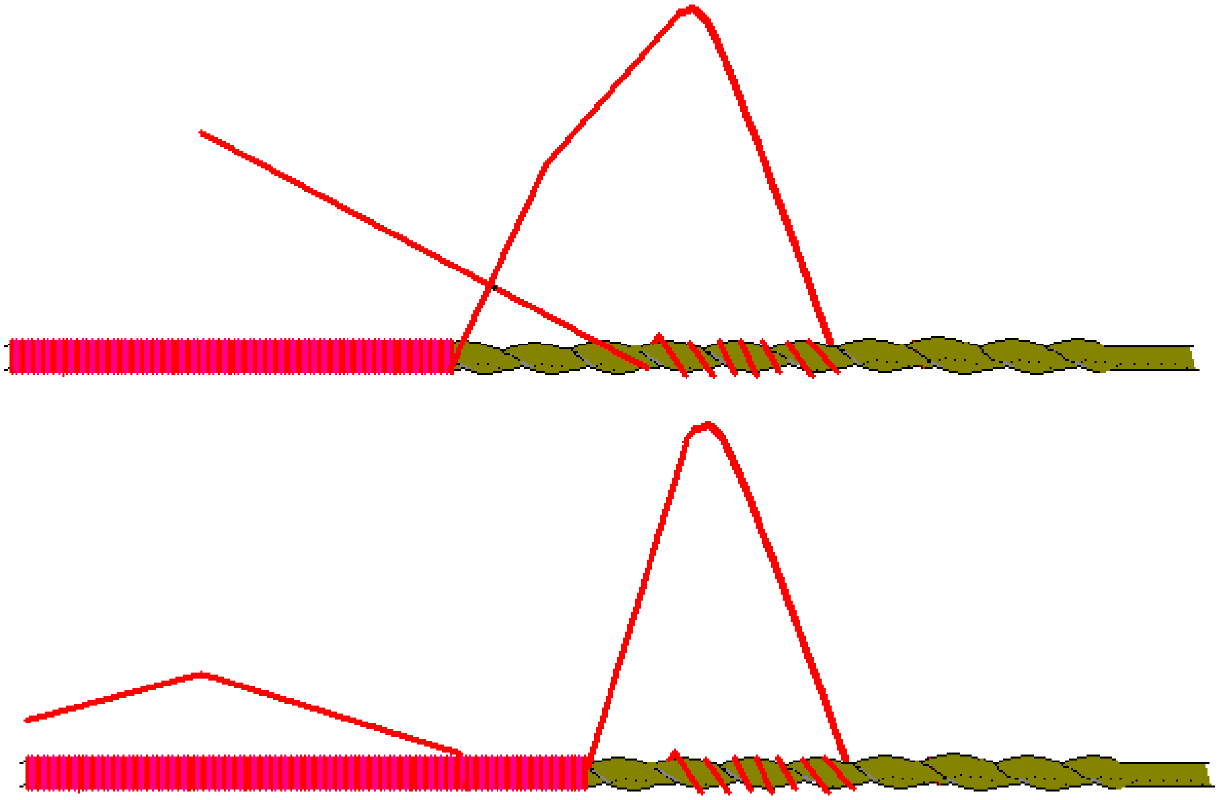
If a string is to be twisted together with others in a cord, determin its average breaking strength: first break long sections to find its weak-link strength as above. Then break several three to five inch sections to find its strongest-link strength. Take several readings, then average them out.

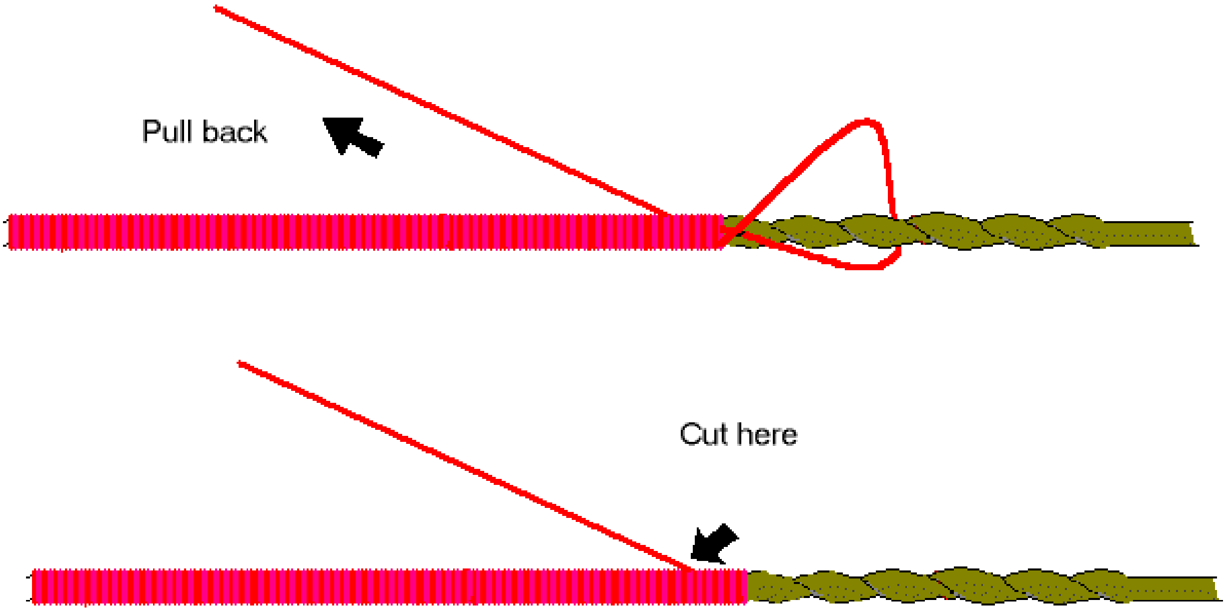
To measure stretch and set - the amount a string will remain stretched when tension is released - lay out fifty inches of thread or cord. Wrap one end of cord twice around a smooth, round dowel before tying off at a nail or such. Attach the other end similarily to a scale. Place a ruler beside the scale. Pull the scale, applying tension slowly and repeatedly, building up to point of breaking. Note the amount of stretch, and the amount of set as you proceed, as well as the point of failure.

String making

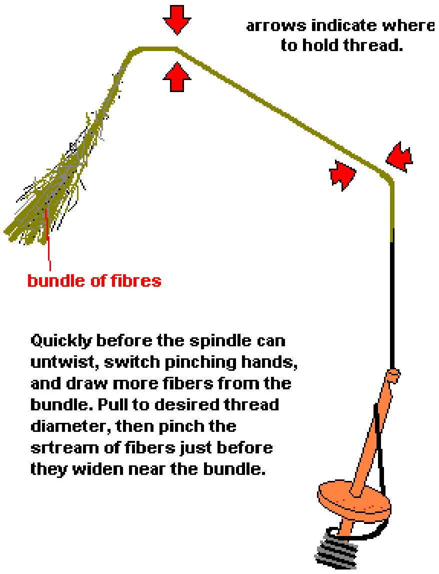


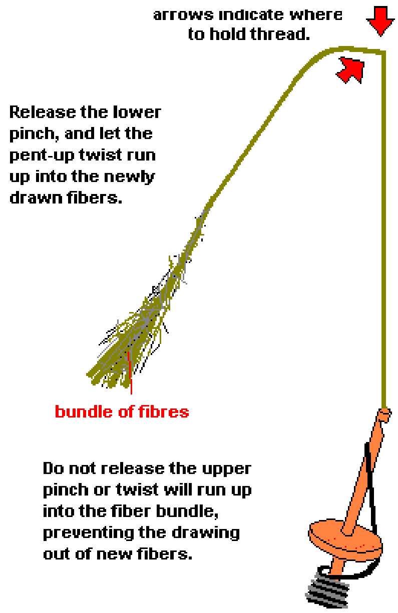






At its basics thread can be spun from an ordinary, easily constructed drop spindle or spinning wheel.


arrows indicate where
to hold thread.
bundle of fibres
Quickly before the spindle can
untwist, switch pinching hands,
and draw more fibers from the
bundle. Pull to desired thread
diameter, then pinch the
srtream of fibers just before
they widen near the bundle.

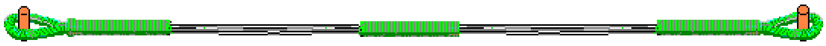

arrows indicate where
to hold thread.
Release the lower
pinch, and let the
pent-up twist run
up into the newly
drawn fibers.
bundle of fibres
Do not release the upper
pinch or twist will run up
into the fiber bundle,
preventing the drawing
out of new fibers.

Endless string.

Drive two nails into a table or board, the distance between nails equaling intended string length.

Determine the number of strands needed: breaking strength of one strand, divided into four times the bow draw weight. Wind the string back and forth around the nails until desired strand number is reached. Be careful to apply equal tension on each strand.

(g)



Tie the two loose ends together.

Slide the string around the nails a few inches so the knot can be covered by serving.

Serve for about three inches. (Use medium-fine soft cotton, silk or linen for serving.) Serve similarly at other end.

Slide the string back to its original position. Form loops by pulling the strings together and serving.

Serve about three or four inches in the centre of the bow for the arrow nock.