

In our experience tension knots probabilities increased based on the following factors:

1. Worn Lines – tension knots on worn or dirty lines are more common than new lines. The coating and dirt allow the lines to bind and entangle with other lines. Keeping your lines clean and in good repair can help prevent that.
2. Twisted Brake lines- we have noticed that the chances tension knots drastically increases if the brake lines have twists. This twist can increase the chances that a brake line entangles with an outside C or D line. These twists can also create snag points and can entangle with adjacent lines.
3. Packing- Packing plays a huge if not the biggest part in preventing line entanglements and tension knots. First, it's important to understand a few things about today's modern parachutes:
 - a. The compound curvature of these wings requires that the lines all be different lengths, as opposed to older designs that are a simple arch. This most often means that at deployment line stretch and snivel load some lines in the pack will load before others. If the less loaded lines are loose in the pack job, entanglement chances drastically increase.
 - b. Parachute brake settings can produce light tensions of the outside C and D lines during opening as a result of staging, wing shape, and how they are managed during packing.



-Tension knots most often occur when one line can entangle with others during the deployment.

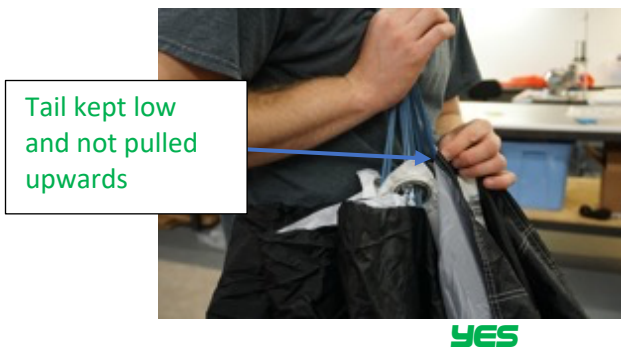
The above factors require us to be more diligent packing modern parachutes so that some lines are not slack during the deployment process. Tending to these in your pack job is essential.

This is normally accomplished in several ways

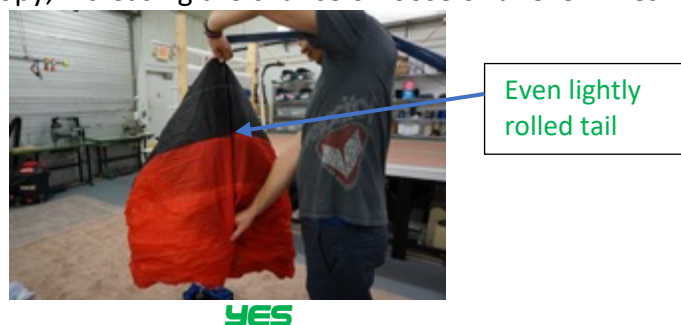
1. Keep the lines in the center of the pack job- try to pack and then fold the wing such that the lines in the center are not displaced.



2. Take care to not move the rear lines when pulling the tail around to roll it around the pack job. Don't lift the tail too high past the grommets/Slider. When bringing the tail up to wrap the pack job avoid lifting it up past the slider grommets any more than necessary. Doing so can unsettle the lines causing slack inside your pack job. Specifically, this can cause D line slack in the pack job.



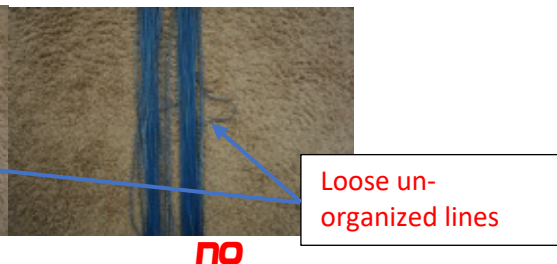
3. Minimize the wraps on the tail once in place to no more than 3 wraps of the tail. Wrapping the tail to excess will cause the C and D lines to move further towards the nose and away from the center of the canopy, increasing the chance of loose or uneven lines.



- When standing with the flaked parachute reach into the pack-job and push down the lines that are 1-2 tabs inboard of the outside C and D lines. Then make sure that when the parachute is laid down the lines stay tight. In addition, the slider and lines should be pinned while pushing air out of the wing. We need to prevent any lines from developing slack.



- Once the wing has been laid on the ground avoid stuffing any slack in the line into the pack job. It is possible to tweak the pack job and gently pull on the top skin to tidy and improve line tension, however this must be done with understanding and care as it can displace other items in the pack job. We recommend that any slack be corrected by starting the pack job again. Never put a parachute in the bag when you have slack/uneven/stray lines.

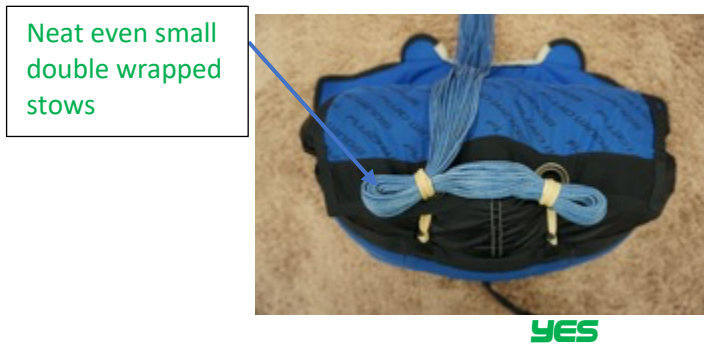


- Keep tension on the lines all the way through stowage. This means *not picking up your bag and walking back to the container to stow your lines* all at once. It may also mean that you need to drag your container. If this is the case a packing mat can prevent wear on your gear.





7. Double stow your lines with stow sizes about 3.5-4 cm (1.5 inches). Large amounts of excess in stows can cause differential tension during band release. Smaller stows with tight band tension provides the best distribution of line tensioning on the stow.



These packing techniques have in our experience almost eliminated the occurrence of tension knots in the testing environment. By following these guidelines, we have been able to significantly reduce tension knots in the many wings we routinely test here at the R&D department. Given the varied and experimental nature of the wings we jump we think it speaks to importance of neat and meticulous packing.