Testing Various Corner Tieouts For Use On Cuben Fiber Tarps

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1	Sept – 14 - 2010	Initial Document Release

Discussion (Pre):

There is currently a great deal of discussion regarding the techniques used to create cuben fiber tarp tieouts. Some companies are using bonding methods while others are sewing them, and then some are using a combination of the two. Some recent posts online and my own experience have lead me to do some formal testing to see if there is a large difference in strength between several of these techniques. Will a sewn tieout fail with much less of a load when compared to a bonded tieout? Is the additional time required to bond the tieout reinforcement patch worth the effort? Is it beneficial to use a heavier cuben fabric for the reinforcement patch? Let's try to answer these questions.

Purpose:

The purpose of this experiment is to test various tieouts (manufactured using materials that the typical person can easily purchase and acquire) used on a cuben fiber tarp. The goal is to give a general idea of the strongest and weakest joint designs.

Procedure:

Using a combination of bonding and sewing, 5 typical tieouts (samples) were created. Each tieout was then placed into a jig and loaded using a tensioning device until failure.

Sample Dimensions:

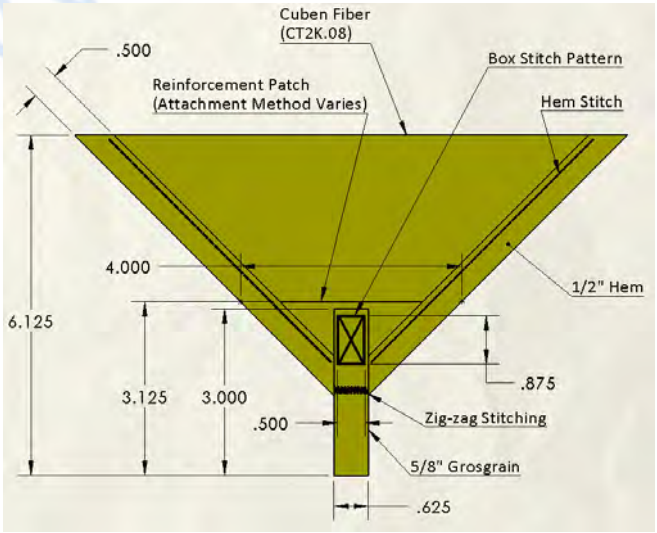

Figure 1 - Sample Tieout Dimensions

Sample Data:

Sample No.	Picture	5/8" Grosgrain Attachment Method	Cuben Fiber Reinforcement Patch Attachment Method
1		Sewn	Sewn
2		Sewn	3M 9485 PC
3		Sewn	Hysol U-09 FL
4		Sewn	Venture Tape 1163MS74
5		Sewn	Quest Outfitters Cuben Double Sided Tape

Test Setup:

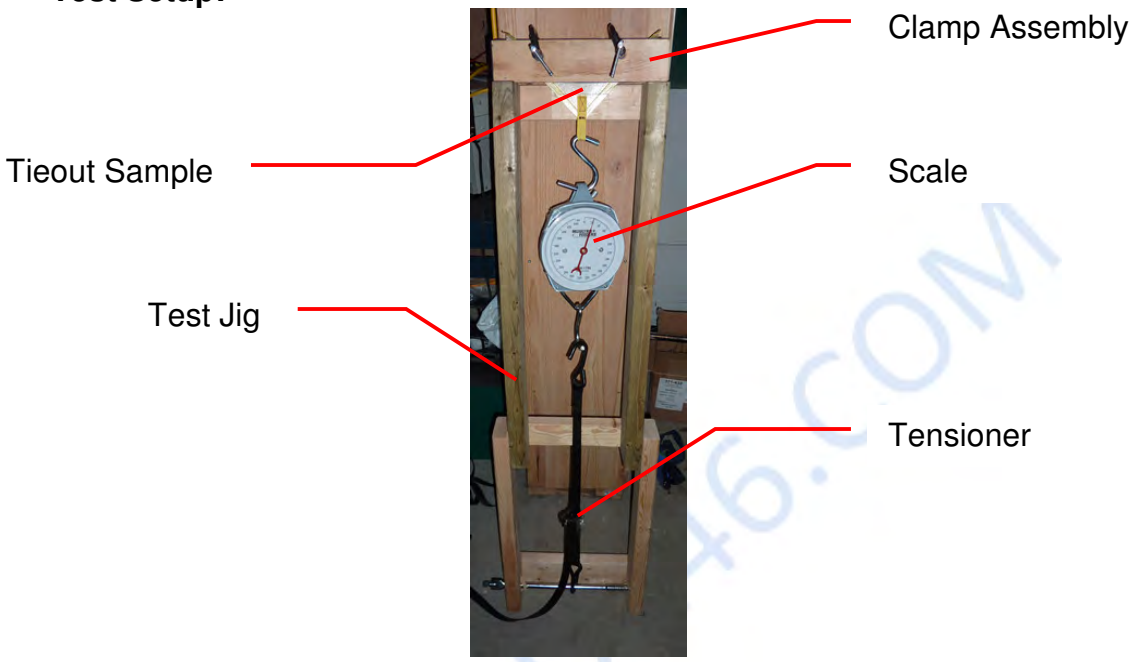

Figure 2 - Test Setup

Testing:

Each sample was tested individually. The sample was placed into the clamp assembly and tightened. The assembly was then placed into the locating dowels at the top of the test jig. The scale and tensioner were hooked up in line as shown. A video camera was placed off to the side to capture the scale as the tension increased. This allowed a second verification of exactly when the tieout failed. Once everything was in place, the tensioner was used to apply force on the tieout until failure.

Observations and Data:

Sample 1: The reinforcement patch was sewn to the parent material and the grosgrain was then sewn through both pieces of cuben fiber.

Figure 3 - Video verification image of max load (168 lbs).

Yielding was not documented on this sample, as there was no indication that the failure was about to occur. The sample snapped in a catastrophic manner.

Figure 4 - Image of failed tieout after removal from test setup

Sample 2: The reinforcement patch was bonded to the parent material using 3M 9485 PC tape and the grosgrain was than sewn through both pieces of cuben fiber.

Figure 5 - Video verification image of max load (178 lbs).

Yielding began at roughly 150 lbs. This was initially heard as the material began to stress. Shortly afterwards, the sample snapped in a catastrophic manner.

Figure 6 - Image of failed tieout after removal from test setup

Sample 3: The reinforcement patch was bonded to the parent material using Hysol U09 FL adhesive and the grosgrain was then sewn through both pieces of cuben fiber.

Figure 7 - Video verification image of max load (211 lbs).

Yielding began at approximately 190 lbs. This was not confirmed through visuals, but the sound indicated severe stress. The sample snapped in a catastrophic manner.

Figure 8 - Image of failed tieout after removal from test setup

Sample 4: The reinforcement patch was bonded to the parent material using Venture Tape 1163 tape and the grosgrain was then sewn through both pieces of cuben fiber.

Figure 9 - Video verification image of max load (190 lbs).

Yielding was not seen in this sample. The parent material split at the max load and the test was stopped.

Figure 10 - Image of failed tieout after removal from test setup

Sample 5: The reinforcement patch was bonded to the parent material using Quest Outfitters Double Sided Cuben Fiber tape and the grosgrain was then sewn through both pieces of cuben fiber.

Figure 11 - Video verification image of max load (200 lbs).

Yielding was not seen in this sample. The grosgrain tore off the corner tieout and ripped the parent material simultaneously.

Figure 12 - Image of failed tieout after removal from test setup

Summary of Results:

Sample No.	Approximate Load at Material Yield	Maximum Load Before Failure	% Max Load (Compared to Sample 3)	Failure Type	5/8" Grosgrain Attachment Method	Cuben Fiber Reinforcement Patch Attachment Method
1	N/A	168 lbs	80%	Catastrophic	Sewn	Sewn
2	150 lbs	178 lbs	84%	Catastrophic	Sewn	3M 9485 PC
3	190 lbs	211 lbs	100%	Catastrophic	Sewn	Hysol U-09 FL
4	N/A	200 lbs	95%	Split	Sewn	Venture Tape 1163MS74
5	N/A	190 lbs	90%	Catastrophic	Sewn	Quest Outfitters Cuben Double Sided Tape

Sources of Error:

There are 3 contributors to error in this test environment.

1 - Each test was performed only once. Therefore, there was no average obtained.

2 - The scale used in the test setup was not calibrated.

3 – The sewn areas of the samples were not monitored for identical manufacturing techniques.

Conclusions:

In conclusion, it can be seen that the strongest tieout was the sample with the reinforcement patch bonded using Hysol U09 FL, followed by the Venture Tape 1163MS74, Quest Outfitters Cuben Fiber Double Sided Tape, 3M 9485 PC and lastly the fully Sewn sample.

Discussion (Post):

In all samples, the failure was not on the reinforment patch itself, nor was it in the threads of the grosgrain tieout (except for sample 5). It occurred in the parent material of the tarp.

Sample 5 differed in that the threads of the grosgrain actually ripped out of the reinforcement patch (as well as parent material failure). Under closer inspection, the Cuben Fiber Double Sided Tape offered by Quest Outfitters is of substantial thickness when compared to the other bonding products. This could be a contributing factor to this behavior.

For the manufacturing of a single tarp, using Hysol U09FL may seem like the obvious answer due to strength, however, one must also understand the difficulty and length of time required to apply the adhesive to the fabric. The hysol is the most difficult to apply while any of the tapes are quite easy. The sewing is probably the fastest due to the fact that you are not adding any additional processes to the tarp (just cut and sew).

When looking at the failure loads themselves, it appears that all of the techniques are adequate for general use. The weakest tieout (Sewn) holding 168 lbs, in my

opinion, is a force larger than what I would see on a typical tarp camping trip (I have no calculations to support this). This becomes even more apparent when you compare the percentage values of each sample. The difference between the strongest (211 lbs) and weakest (168 lbs) tieout samples is only 20%. Is an additional 20% of strength required? That will depend on each individual's conditions and tarp pitching skills.

When questioning whether or not a heavier cuben fiber fabric used as the reinforcement patch would increase the strength, it is important to remember that the failure occurred in the parent material. This is an indication that a heavier cuben fiber material may not increase strength by a substantial amount, however, testing would need to be done to verify this.