In Depth Study Permission and License

By signing and submitting this agreement, I grant Olds College the non-exclusive license to archive and make accessible my Master Spinner Program In Depth Study in whole or in part in all forms of media now or hereafter known for educational, research, and scientific nonprofit uses during the full term of copyright. I retain all other ownership rights to the copyright including the right to use in future works (such as articles or books) all or part of my work.

I represent that the submission is my original work, and that I have the right to grant rights contained in this license. I also represent that my submission does not, to the best of my knowledge, infringe on anyone’s copyright and that I have obtained written permission from the owner(s) of any third party copyrighted matter included in the work.

I understand that my In Depth Study will be placed in the Olds College’s library for access to the public. I will understand that I will clearly be identified by name as the author of the submitted work and that Olds College will not make any alteration other than as allowed by this license to my submission.

Signed: [Signature]

Date: July 6, 2019.
Spinning and Dyeing
to Replicate the Upholstery Fabric
for a 1972 Frontier Camper

By Sue Clausen

June, 2017

Submitted to Olds College

Master Spinner Level Six – In-depth Study
Abstract

The objective of this study was to replicate the upholstery fabric in our 1972 Frontier camper. The reason I chose to do this was to maintain the authenticity of our camper, while replacing the ageing upholstery fabric.

In this study I tried to determine the contents of the original fibres, and then I tested an assortment of fibres and blends, to establish a best fit for the project. Once I had determined which fibres were most appropriate or best suited for the project, I proceeded with the replication.

My early thoughts and assumptions were quickly dismissed as testing proved some to be inconclusive and others to be just wrong. The early research I did allowed for a smoother process and in the end I finished up with a beautiful replicated fabric with a far superior feel and quality than the original fabric.

I applied spinning to test an assortment of fibres in order to get the best hand for the fabric, dyeing to ensure colour accuracy and weaving to replicate the fabric.
# Table of Contents

Abstract.......................................................................................................................... 2  
Table of Samples........................................................................................................... 4a  
Table of Illustrations..................................................................................................... 4b  
Introduction.................................................................................................................... 5  
Dissecting Original Fabric.............................................................................................. 8  
  ◆ Original Samples.................................................................................................... 10-11  
Warp and Weft Dissection........................................................................................... 12  
Burn Tests....................................................................................................................... 15  
Dissection Conclusion.................................................................................................. 16  
  ◆ Fibre Blending Samples......................................................................................... 18-22  
Fibre Blending Test Conclusions................................................................................. 23  
Dyeing and Blending of Fibres.................................................................................... 24  
  ◆ Colour Samples.................................................................................................... 28-29  
Spinning Calculations for Quantity........................................................................... 30  
Weaving the Fabric........................................................................................................ 37  
  ◆ Weaving Drawdowns............................................................................................ 39  
  ◆ Weaving Pricking.................................................................................................. 41  
  ◆ Finishing Samples............................................................................................... 42-43  
Final Results and Photo............................................................................................... 44  
Conclusion..................................................................................................................... 45  
Glossary........................................................................................................................ 47  
References..................................................................................................................... 49
# Table of Illustrations and Samples

**Samples**

1a) Deteriorated Fabric ........................................ 10  
1b) Hidden from Sunlight ........................................ 11  
2a) Warp .............................................................. 13  
2b) Weft .............................................................. 14  
3) Fibre Blending – Silk 100% .................................. 18  
4) Fibre Blending – Nylon 100% ................................ 18  
5) Fibre Blending – Suffolk 100% ............................... 19  
6) Fibre Blending – Romney 100% .............................. 19  
7) Fibre Blending – Suffolk/Silk 75/25% ....................... 20  
8) Fibre Blending – Romney/Silk 75/25% ....................... 20  
9) Fibre Blending – Suffolk/Silk 50/50% ....................... 21  
10) Fibre Blending – Romney/Silk 50/50% .................... 21  
11) Fibre Blending – Suffolk/Nylon 75/25% ................... 22  
12) Fibre Blending – Romney/Nylon 75/25% .................. 22  
13) Colour Match – Black Silk .................................... 28  
14) Colour Match – Brown Silk .................................. 28  
15) Colour Match – Green Silk .................................. 28  
16) Colour Match – Black Wool ................................. 29  
17) Colour Match – Orange Wool ............................... 29  
18) Colour Match – Green Wool ............................... 29  
19) Warp Colour Sequencing ..................................... 32  
20) Upholstery Before Wet Finishing ........................... 42  
21) Upholstery After Wet Finishing ............................ 43
Table of Illustrations and Samples

Illustrations

1) Burn Test ................................................................. 15
2) Dyeing for Orange – Too Red..................................... 25
3) Dyeing for Orange – Increased Yellow......................... 26
4) Dyeing for Green....................................................... 26
5) Weft Colour Chart...................................................... 34
6) Photo of Complete Weft Sequence............................. 35
7) Weaving Tie-up......................................................... 38
8) Random Treadling Chart........................................... 38
9) Screen Shot of One Repeat Drawdown....................... 39
10) Screen Shot of Drawdown Repeated.......................... 40
11) Weaving Pricking..................................................... 41
12) Final Photo of Upholstery Fabric.............................. 45
Introduction

The criteria for the yarn I created was to best replace and represent the fabric which was in a disintegrating state. I wanted the fabric to look and feel exactly as it did in 1972 when our camper was first built. I dissected the fibres to see if I could determine the exact fibre originally used, I test spun fibres to determine which would be as close a match in feel and texture, and I recreated the original weave so as to weave the fabric to best create an exact replica.

It was important to me to keep the upholstery as original as possible, but due to the camper being 45 years old the sun had taken its toll on the upholstery and the fabric was in a severe state of disintegration.

I started by trying to research the company Frontier. After many hours (21.5 to be exact) of scouring the internet and finding no credible or useable information I decided to try something different. Since I knew Frontier campers were built in Kelowna, British Columbia, I called around to the local recreational vehicle dealerships to see if I could find someone old enough and still working, to have been in the industry in the 1970s. I spoke to a man by the name of Al Mullen, a friendly fellow who happened to be around when Frontier
According to Al Mullen (2017), the company which started building the Frontier brand was called, Leisure Coach Inc. and they began in the late 1960s. The company then went through a series of sales where the rights to the name Frontier and the drawings for the campers were bought. Starting with the first purchase by Vanguard Industries, I believe they were also located in Kelowna, British Columbia, then were sold to Hunter RV in North Battleford, Saskatchewan, and finally in 1992 they were purchased by Peak Manufacturing. Peak Manufacturing went into bankruptcy in 2003. (A. Mullen personal communications, March 7, 2017). The other piece of information that Al mentioned was about a company from Lethbridge, Alberta, called Ducan Industries. Ducan Industries is a fabric mill. It was possible that they did not supply the upholstery fabric, but they may have some history or knowledge of that era. Unfortunately, they did not respond to my calls.
Since there was no chance of talking to anyone from Leisure Coach Inc., I had to tackle the upholstery replication through dissection, trial and error.
Dissecting Original Fabric

When I originally took the seat covers out of the camper, I found that the fabric was disintegrating into powder in my hands. I had seen this before in some very old wool. It was difficult to find large enough pieces for reproducing, but one side had been protected from the light enough to cut some samples. When I cut my samples I noticed that different parts of the seats had different colouring. The sun faded side had a strong green tone to the colouring, while the sun protected side had a more gold tone to the colour. Which one was correct? I took a good look at the decorative trim on the walls of the camper and it also has the green tone. Then I took a look at where I found the gold tone fabric, it was on a separate section of the seat covers. I concluded that while this piece of fabric was hidden from sunlight it was more likely from a different dye lot, so I chose to replicate the green tone.

I decided to take my first piece as a woven pattern and colour repeat sample. The second and third samples were large enough to demonstrate what I was trying to replicate, as well as displaying the level of disintegration. The fourth sample was pulled apart strand by strand, and from these strands I (a) examined warp and weft of the
fabric to determine how many plies were used and whether it was spun worsted or woollen, (b) did burn tests to determine fibre content, (c) used comparative strands for colour matching.

Unfortunately, my pulled strands were very fragile and quite brittle. I found the green untwisted fibre would break with the slightest tension applied, and the orange woollen strands were so brittle that when I pulled them they would break into two inch pieces. Consequently, the comparatives are quite small.
This is a sample of the fabric after 45 years of sun damage. You can see the powdery substance at the bottom of the bag. This is how this fabric is breaking down.
This sample of fabric was partially hidden from the sunlight so it seems to be slightly stronger than the rest of the fabric. This is also a piece which I believe was from a different dye lot.
Warp and Weft Dissection

When I examined the woven structure I originally believed that the fine strands were the warp and the woollen strands were the weft. My belief was that the fine strand was the stronger of the two fibres which would have withstood the tight tensioning required for the warp. These assumptions were incorrect as what I found was that the finer strand was compiled of long strong, straight fibres which had no twist of any sort in them. While each fibre was strong, there was no pull strength in the way they were laid together, which in my understanding would mean they must have been the weft and the woollen fibre was the warp. This led me to believe that I should go forward on the premise that the woollen is the warp and the fine strand is the weft. The woollen looking fibre seemed to be jumbled fibres as in a woollen spun yarn, but they seemed to be encased in some type of coating. They may have been wool strands which had been treated with some form of man-made coating.
Warp Dissection

While I could see how the fibres were jumbled up, I assumed this was the wool. The strand was a single strand without twist, yet it responded like a properly fulled low twist single strand. As very old and squashed yarn, it looked like it could have been a wrapped designer yarn, but I suspected it was originally a single woollen strand, because when I tried to pull it apart it did not separate like a two-ply would.

Sample 2a
Weft Dissection

This was a fine strand which seemed to be made up of approximately 100 filaments. I suspected they had been soaked in a liquid which bound them together as they seemed to be coated and there was no twist of any form. I would compare them to silk in the thrown stage, even though they did not share the same hand as silk.

Sample 2b
To best determine the fibres used, I did a burn test. Since I do not have a sense of smell, I asked my neighbour to lend me the use of her nose. This allowed purity of thought for me, as she did not know what the fibres were from, nor did she know what my intentions were for them until the testing was complete. My intention was to make sure she did not tell me answers that I wanted to hear.

<table>
<thead>
<tr>
<th>Sample of fibre</th>
<th>How did it light</th>
<th>Did the fibre respond to fire</th>
<th>What did it smell like</th>
<th>What did the ash look like</th>
<th>Sample of ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>-Flamed on fast -Black smoke</td>
<td>-Melted, and burned fast -Flamed till end</td>
<td>-Petrol -Burning plastic -Faint burnt hair smell</td>
<td>-Molten pool of plastic -Crumbles to an ash powder</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-No smoke till end, then white smoke</td>
<td>-Shrivelled immediately, flame till end</td>
<td>-Burning plastic</td>
<td>-A dripped pool of gooey tar</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Illustration 1

I could not clearly define what the fibres were. I think part of the reason for the results was that the entire backing of the upholstery had been coated in a sticky rubber substance, so regardless of how I burned the fibres, they would always be plagued by that rubber, plastic, petrol smell. While I was not able to ascertain exactly which fibres to use, I was already forming some ideas of other directions to explore.
Dissection Conclusions

Once my dissection and burn test were complete and rather inconclusive, I believed I had some form of man-made fibres with possibly some wool imbedded. Since the samples were contaminated from the backing adhesives and I did not have the manufacturing equipment for the imbedding process, nor the extruding process for the filaments, I decided to try recreating the upholstery fabric using natural fibres.

I needed to create this fabric on the equipment I had and my widest loom is 25 inches. Using the filament as the warp and the woollen yarn as the weft, would allow me to weave the exact same colour repeats so the fabrics would be identical.

For the warp I decided to use a two-strand silk thread. Like the filament, silk is made up of many strands of filament. Also, it contains all the properties I was looking for in a replacement fibre – it is one of the strongest fibres known to man, is soft on the skin, has excellent drape, will not break down quickly, maintains a beautiful lustre and readily takes dyes. It will last for many years.
For the weft, I decided to look at wool for the weaving yarn.
What wools would have been available to the mills in western Canada? It had been suggested that the fabric had possibly come from a mill in Alberta or Saskatchewan. Because I had no success in finding this information, I decided to look at the most likely breed of sheep which were raised primarily for meat. This would likely be a Suffolk which has a fleece that is strong and short and would work very well for woollen spinning. So I purchased a raw Suffolk fleece and prepared it for spinning. I tried it as a singles, a two ply, a blend with nylon and a blend with silk. I did not like any of them. I felt the Suffolk was too coarse and that the finished project would not feel nice on our skin. I contacted Fenn Roessing the owner of Custom Woolen Mills Ltd. in Carstairs, Alberta. Knowing she had been in the business a very long time, I asked her advice and she suggested I consider either a Dorset or a Romney. Romney fleece is soft, strong, long and fairly lustrous. I thought Romney might be perfect for this project.
Fibre Blending Tests

1) Silk – 100% Bombyx Mori – two ply. Prepared for warp. Spun at ten twists per inch and at 5,675 yards per pound.

Sample 3

2) Nylon – 100% - two ply. Considered as alternate for warp. Spun semi-worsted at four twists per inch and at 857 yards per pound.

Sample 4
Fibre Blending Tests

3) Suffolk – 100% - one ply. This yarn has been spun woollen at 1032 yards per pound.

4) Romney – 100% one ply. This yarn has been spun woollen at 1091 yards per pound.
Fibre Blending Tests

5) Suffolk/Silk – Blended 75/25% - one ply. This yarn has been spun woollen at 1102 yards per pound.

6) Romney/Silk – Blended 75/25% - one ply. This yarn has been spun woollen at 744 yards per pound.
Fibre Blending Tests

7) Suffolk/Silk – Blended 50/50% - one ply. This yarn has been spun woollen at 1669 yards per pound.

![Sample 9](image)

8) Romney/Silk – Blended 50/50% - one ply. This yarn has been spun woollen at 1254 yards per pound.

![Sample 10](image)
Fibre Blending Tests

9) Suffolk/Nylon – Blended 75/25% - one ply. This yarn has been spun woollen at 764 yards per pound.

Sample 11

10) Romney/Nylon – Blended 75/25% - one ply. This yarn has been spun woollen at 894 yards per pound.

Sample 12
Fibre Blending Tests Conclusions

The singles did not get a twist per inch measurement as these yarns were properly wet finished for woollen, which included the fulling process. They were spun at a ratio of 5:1.

I did not like any of the blends with the Suffolk, as I found them just too harsh to have against bare skin. With the exception of the Romney nylon blend, I did not like the remaining nylon blends. I knew the nylon would give the additional durability, but I felt it was not needed. I did like the Romney blends with silk, but questioned if the extra silk was necessary. I intended these seat covers to be wash-and-wear ready, even though they would be hand washed and line dried. My preferred choice for the warp would definitely be the silk two ply, having the lustre and softness needed. My choice for the weft was the Romney woollen spun singles, It would provide the strength and softness needed in the upholstery fabric, while being durable enough to withstand the light abrasion we would create as we only use the camper on rare occasions.
Dyeing and Blending of Fibres

Because the fibres I chose for both the warp and weft were protein based, I chose to use Ashford weak acid dyes. These dyes gave beautiful, bright colours and are fade resistant. The newly dyed colours were much crisper and fresher looking than the old and would perk up the camper.

The black and brown required no mixing of colours.

For the orange, I tested mixtures of yellow and red. The green was interesting as it always looked green-gold to me and all the yellow and blue mixes gave bright, lime greens, while I was looking for that 1970s avocado or olive green. Then it occurred to me, that I had always found that particular green to be drab, so to create that effect I looked at using a shade. I chose to add black to the yellow and when I went back to the sample, I realized I had success. I also noticed the sample contained an element that gave it a gold hue. That element was orange. I could not imagine how to give it the marbling effect through dyeing, so I chose to dye half my roving in the green I had created and the other half in the orange, then blend the
two on the drum carder in off balanced quantities. Again, this was successful.

The recipe I used was very simple. It was just one teaspoon of dye powder, 1/2 cup of vinegar and one litre of water. I put the powder in the bottom of the jar and added about two tablespoons of hot water. This allowed me to make a smooth paste and dissolve the powder. Then I filled the jar half full of water, added 1/2 cup of vinegar, gave it a stir and finished filling the jar with warm water. Once I had all the dye solutions mixed, I set about to mixing and matching to create the colours I required. All the yarns were pre-soaked in a weak vinegar solution, and they all went into a steam bath after being dyed for a minimum of 20 minutes to set the colour.

The search for orange was first. I set out three pots:

<table>
<thead>
<tr>
<th>Pot</th>
<th>Yellow</th>
<th>Red</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.5 ml</td>
<td>1 ml</td>
<td>Too much red</td>
</tr>
<tr>
<td>2</td>
<td>2.5 ml</td>
<td>2 ml</td>
<td>Too much red</td>
</tr>
<tr>
<td>3</td>
<td>2.5 ml</td>
<td>3 ml</td>
<td>Way too much red</td>
</tr>
</tbody>
</table>

Illustration 2

None of these worked as they were too red.
So for the second attempt at orange I wanted to keep the red quantity stagnant and increase the quantity of yellow.

<table>
<thead>
<tr>
<th>Pot</th>
<th>Yellow</th>
<th>Red</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>5 ml</td>
<td>.5 ml</td>
<td>Too light</td>
</tr>
<tr>
<td>2</td>
<td>10 ml</td>
<td>.5 ml</td>
<td>Looks perfect</td>
</tr>
<tr>
<td>3</td>
<td>15 ml</td>
<td>.5 ml</td>
<td>Too dark</td>
</tr>
</tbody>
</table>

Illustration 3

This time I found an orange that would be suitable, so my yarn was dyed in 100ml of yellow and 25ml of red. It was an exact match.

Now the orange that I carded into the green needed to have that slight saddening in order to blend properly with the green. So in the orange I added 1 ml of black. It did not change the colour it just took away that bright crispness.

For the green, I had to make enough to test the wool and the silk as the warp would require the silk to be dyed to the appropriate colours. I laid out eight pots. Using yellow as my base, I adjusted the quantity of black to create the green.

<table>
<thead>
<tr>
<th>Pot</th>
<th>Fibre</th>
<th>Yellow</th>
<th>Black</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>12&quot; Romney yarn</td>
<td>2.5 ml</td>
<td>1 syringe drop</td>
<td>Identical</td>
</tr>
<tr>
<td>2</td>
<td>12&quot; Romney yarn</td>
<td>2.5 ml</td>
<td>2 syringe drops</td>
<td>Too dark</td>
</tr>
<tr>
<td>3</td>
<td>12&quot; Romney yarn</td>
<td>2.5 ml</td>
<td>3 syringe drops</td>
<td>Too dark</td>
</tr>
<tr>
<td>4</td>
<td>12&quot; Romney yarn</td>
<td>2.5 ml</td>
<td>4 syringe drops</td>
<td>Too dark</td>
</tr>
<tr>
<td>5</td>
<td>12&quot; Silk thread</td>
<td>2.5 ml</td>
<td>1 syringe drop</td>
<td>Identical</td>
</tr>
<tr>
<td>6</td>
<td>12&quot; Silk thread</td>
<td>2.5 ml</td>
<td>2 syringe drops</td>
<td>Too dark</td>
</tr>
<tr>
<td>7</td>
<td>12&quot; Silk thread</td>
<td>2.5 ml</td>
<td>3 syringe drops</td>
<td>Too dark</td>
</tr>
<tr>
<td>8</td>
<td>12&quot; Silk thread</td>
<td>2.5 ml</td>
<td>4 syringe drops</td>
<td>Too dark</td>
</tr>
</tbody>
</table>

Illustration 4
The colours were very dark and I was concerned. When I took the silk out of the steam bag, it looked very dark, but when I twisted it with the original strand I could not tell the difference between the two strands. When I took the wool yarn out of the bag it was also dark. I decided to let it dry and see if it lightened up. It did. The first sample, with one drop of black was a perfect match. At this point I considered seeing if I could use a needle and drip a fine spray of orange over the green yarn to create the marbling effect that was giving me the gold overtones on the original yarn. I felt that while I may be able to recreate it on a short 12 inch strand, I doubted that it would work on a whole 350 yard skein. I would stay with my original plan and blend the green and orange on the drum carder.

Blending the green and orange on the drum carder went very smoothly. I weighed out the green at 50 grams, and the orange at 10 grams. Because the wool had already been processed and was in roving form, it only required one pass through the carder. I laid a solid layer of green, then added a fine layer of the orange. I continued this sandwich method until the carder was full, then I dizzed the roving off the carder. I could see that I had the marbling effect I was hoping for, and did not require a second pass on the carder.
Colour Match Samples for Silk

Black

<table>
<thead>
<tr>
<th>Original</th>
<th>Replicated</th>
<th>Intertwined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample 13

Brown

<table>
<thead>
<tr>
<th>Original</th>
<th>Replicated</th>
<th>Intertwined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample 14

Green

<table>
<thead>
<tr>
<th>Original</th>
<th>Replicated</th>
<th>Intertwined</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sample 15
Colour Match Samples for Wool

Black

Original
Replicated
Intertwined

Sample 16

Orange

Original
Replicated
Intertwined

Sample 17

Green

Original
Replicated
Intertwined

Sample 18
Spinning Calculations for Quantity

When I did my original yarn sampling to determine which yarn I wanted to use for this project, I took the extra time to figure out the yards per pound of wool and silk. Since I was using pre-washed fleece, I did not have to do the additional quantity calculations for working with unwashed raw fleece.

I took the old seat covers and at one edge I was able to cut all the way across the fabric to expose the warp ends. The seat cover measured 18 inches wide, 72 inches long and 3.5 inches down each side. Because these seats are 45 years old, I made the assumption that the seats were originally four inches thick. I would need the yardage to finish up at 26 inches wide and 80 inches long and I would add on for take-up and shrinkage and a minimum of 18 inches for loom waste at the end of my calculations. I also had two 15 inch square cushions to recover as well.

Main Bench 18 x 72 inches

72 inches + 8 inches = 80 inches which equals two metres. For three pieces I would need six metres finished.

Corner Cushions 15 x 15 inches
15 inches + 8 inches = 23 inches, times two cushions equals 46 inches. This is just over one metre. I added one additional metre for shrinkage, take-up and loom waste $6 + 1 + 1 = 8$ metres which converts to 8.75 yards. I would round up to nine yards of upholstery fabric needed.

Starting with the silk, as the warp, I was able to determine I would be weaving at 20 ends per inch. This was not a normal sett for this thread. Thirty ends per inch would have been closer, but I knew I was using a weft that would only have approximately nine picks per inch so I was able to lower the warp sett. I pulled a few rows of weft off the yardage I was reproducing to expose the warp ends and because they had used a colour repeat in the warping pattern, I only had to count the colour groups in one repeat, and then count how many repeats there were $6 \times 7 = 42, 42 + 28 = 70$ ends per repeat, and one repeat measures 3.5 inches.
. The repeat went as follows:

W = white, G = green, B = black, R = brown

6W, 6G, 6W, 6B, 6W, 6G, 6W, 28R

Sample 19

When I did the EPI calculation, 70 ends divided by 3.5 inches equals 20 ends per inch. This was exactly what I had considered using as the warp sett. This calculation produced one repeat, and by counting the repeats on the old fabric it looked like there were 7.5 repeats which I would round it up to 8. 70 ends x 8 repeats equals 560 ends. This equalled 28 inches which would allow for shrinkage and take up.
I chose to weave this fabric using a double weave structure on a 25 inch loom. The total yardage required was calculated two ways to ensure I came up with the same number.

a) 560 ends x 9 yards equals 5,040 yards of hand spun two-ply silk.
b) 20 epi x 9 yards equals 180 yards
180 yards x 28 inches wide equals 5,040 yards of hand spun two-ply silk.

I spun the silk, taking approximately 310 hours to spin and another 86 hours to ply. When I measured off the four separate bobbins of two ply, they were 1,216 yards, 1,968 yards, 1,752 yards and 1,374 yards, for a total of 6,310 yards. I had enough and some spare for tests and samples.

Once the warp threads were off the wheel, I hung them over a steaming pot of water for four hours. I wanted them to get a good steaming and to make sure the steam went all the way through each bundle. Once completed, I took the skeins and allowed them to cool. The next day I gave them a warm, soapy bath to clean them and then I soaked them in a warm vinegar bath overnight in preparation for dyeing. Lastly, I divided the bundles of silk thread for dyeing as
follows 864 yards for green, 432 yards for black, 2,016 yards for brown and 1,728 yards natural white. The yardage totals 5,040 yards.

The weft yarn was an interesting calculation. I was able to cut a length of fabric off the hidden side of cushion where I found a full color woven repeat. It is a very long sequence of 160 picks which then repeats. I took a note book and wrote down the repeat, line for line, coding it as to the color and quantity. Here is an example:

Abbreviations = 2BSS is 2 black same shed or 2ODS = 2 orange different shed

<table>
<thead>
<tr>
<th>1O</th>
<th>2W</th>
<th>1W</th>
<th>2B</th>
<th>2GSS</th>
<th>2W</th>
<th>1G</th>
<th>1W</th>
<th>1B</th>
<th>1W</th>
</tr>
</thead>
<tbody>
<tr>
<td>1B</td>
<td>4G</td>
<td>1O</td>
<td>1G</td>
<td>2W</td>
<td>1O</td>
<td>1W</td>
<td>2B</td>
<td>2G</td>
<td>1G</td>
</tr>
<tr>
<td>2BSS</td>
<td>1O</td>
<td>2W</td>
<td>2B</td>
<td>2BSS</td>
<td>1W</td>
<td>2BSS</td>
<td>1W</td>
<td>2BSS</td>
<td>1W</td>
</tr>
<tr>
<td>1B</td>
<td>1B</td>
<td>1O</td>
<td>1G</td>
<td>1W</td>
<td>1O</td>
<td>1W</td>
<td>1O</td>
<td>2BSS</td>
<td>1G</td>
</tr>
<tr>
<td>5G</td>
<td>1G</td>
<td>1G</td>
<td>1W</td>
<td>1O</td>
<td>2W</td>
<td>2B</td>
<td>1G</td>
<td>1G</td>
<td>1W</td>
</tr>
</tbody>
</table>

Illustration 5

The chart above is an example of the first 60 rows. Once I had charted all the colours, I began to count them one at a time.

The colour count concluded with 48 picks of white, 20 picks of orange, 47 picks of black and 45 picks of green.
This photo displays the weft colour sequence: I used the photo to show continuity.

Illustration 6

To calculate the yardage requirements knowing the fabric would be woven at 28 inches, I decided to average each pick to be 30
inches long. This would ensure I had extra in case I needed it. Each repeat of color would give me one half yard of material, so I needed a minimum of 18 repeats:

**White** - 48 picks

\[48 \times 30" = 1,440" \text{ or } 40 \text{ yards.} \quad 40 \text{yds} \times 18 \text{ reps } = 720 \text{ yards.}\]

**Orange** – 20 picks

\[20 \times 30" = 600" \text{ or } 17 \text{ yards rounded.} \quad 17 \text{yds} \times 18 \text{ reps } = 306 \text{ yards.}\]

**Black** – 47 picks

\[47 \times 30" = 1410" \text{ or } 40 \text{ yards rounded.} \quad 40 \text{yds} \times 18 \text{ reps } = 720 \text{ yards.}\]

**Green** – 45 picks

\[45 \times 30" = 1350" \text{ or } 38 \text{ yards rounded.} \quad 38 \text{yds} \times 18 \text{ reps } = 684 \text{ yards}\]

The total yardage required is \((720+306+720+684) = 2,430 \text{ yards.}\) It took me 262 hours to spin the wool for this fabric.

Once it was spun I wound the yarn into two yard skeins, put them all into a hot bath tub, where I washed and finished the yarn. I rinsed it by alternating hot and cold rinse water, then I took it outside to spin dry and beat it on the concrete step to give the woollen yarn the proper fulling before dyeing and weaving with it. I hoped that having given the yarn the proper finishing, that it won’t lose too much in shrinkage when I washed the woven yardage of upholstery fabric.
Weaving the Fabric

It took me four hours to make the warp and then another seventeen hours to put the warp on my loom. I decided to do it in a double weave style in order to get the width of 28 inches on the 25 inch loom. I was able to weave at a rate of 2.5 hours per yard, and because this was yardage I didn't have to worry about hem finishes. It took me a little longer to complete the weaving as I cut off the sample and then retied the warp. This gave me a sample to wet finish and determine the shrinkage rate. Once I had that information, I was able to cut off each seat length as to not overload the front of the loom.

Double weave creates two layers of fabric at once, joining them on one side or both depending on the weaver. I chose to join it only on one side. I was able to use a plain weave threading, harness - 1,2,3,4 - for the top layer of fabric and harness - 5,6,7,8 - which I relabelled 1a, 2a, 3a, 4a for the bottom layer of fabric, for all 560 warp ends. One change I had to make was the sett through the beater. For a normal plain weave single layer, I would leave the sett at 20 EPI, but because I doubled the quantity of fabric per inch of weaving, I needed to double the ends per inch. So I set my ends per inch at 40 which meant on my 10 dent reed, I put four threads in each dent.
For the treadling I inspected an entire piece of fabric I cut from the original seat covers. I could not find any sort of consistent treadling, so I created my own. I used all the tabby and twill tie-ups that I knew of and created my own random looking pattern. The chart below shows a sample of the tie-up and treadling I used.

<table>
<thead>
<tr>
<th>a</th>
<th>b</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>O</td>
<td>O</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td></td>
<td>O</td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td>O</td>
</tr>
<tr>
<td>O</td>
<td></td>
<td>O</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>O</td>
</tr>
</tbody>
</table>

Illustration 7

This was a lot of fun because I was able to create my own randomness. I did that by mixing and matching the treadling as in the sample chart below. The top line is the tie up I used, the bottom row is a sample of the harnesses I would be lifting. e-h-c, f-g-b, e-f-a, g-h-d

<table>
<thead>
<tr>
<th>e-h-c</th>
<th>f-g-b</th>
<th>e-f-a</th>
<th>g-h-d</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,2/1,2,3,4,3a,4a</td>
<td>3,4/1,2,3,4,1a,2a</td>
<td>1,2/1,2,3,4,3a,4a</td>
<td>1,3/1,2,3,4,2a,4a</td>
</tr>
<tr>
<td>2,4/1,2,3,4,1a,3a</td>
<td>1,3/1,2,3,4,2a,4a</td>
<td>3,4/1,2,3,4,1a,2a</td>
<td>2,4/1,2,3,4,1a,3a</td>
</tr>
<tr>
<td>3/1,2,3,4,1a,2a,3a</td>
<td>2/1,2,3,4,1a,3a,4a</td>
<td>1/1,2,3,4,2a,3a,4a</td>
<td>4/1,2,3,4,1a,2a,3a</td>
</tr>
</tbody>
</table>

Illustration 8
My weaving record was far too large to condense to fit on one page, so I used the iWeavelt program on my iPad to create the weaving record and then took screen shots of the results. The blue colouring represents the white. This sample draft is a weft of 70 threads wide and the warp is only the first 68 rows.

Illustration 9
The next photo shows how the fabric looks woven once the repeats were included.

Illustration 10
Sample of upholstery before wet finishing
Sample of upholstery after wet finishing
Final Results

My photos of weaving the fabric to recover the seats in our 1972 Frontier camper

Illustration 12
Conclusion

I feel the entire project was worth the time it took. It was an accumulated total of 893 hours and at a minimum wage of $10 an hour, these seat covers are worth their weight in gold. Would I do this for pay? No! The cost would be far too prohibitive, but for my own enjoyment, definitely worth the time. Knowing what I know now, I would definitely do it again, just with a lot less research.

In choosing the fibres for this project I thought about where and how the fabric was to be used. Normally in a camper I would worry about sand or dirt and deterioration from sunlight. But, I knew we store our camper in a dark garage, and we only use it less than once every year or two.

I chose the Romney as it is a medium grade breed, which is a more durable fibre, yet it is soft enough to be against our legs when we wear shorts, and the silk is a strong fibre which will hold up to usage as a warp. I am not concerned about the fabric lasting as we would never sell this camper, it is very old and its only value is emotional to us.

In the end, I have beautiful, functional seat covers, which are soft to the touch and look original.
The spinning portion of this project allowed me to test an assortment of blends. I do think the Romney nylon blend would have been more appropriate had this fabric been for a unit which required more durability and abrasion resistance. But I did not like the feel of the nylon. I felt comfortable adjusting the grist from an open soft lofty woollen to a finer tighter twist to allow for a tighter beat while weaving and create a fabric which had a softer drape. I felt this was most appropriate.

The dyeing was fun and allowed me to reproduce exact colours.

- The weaving was very satisfying as it allowed me to see the upholstery fabric up close and make adjustments where I felt they were needed.
Glossary

**Beater:** The wooden frame at the front of the loom which holds the reed. It pivots on pins to beat the threads in as you weave.

**Dent:** The slots in between the bars on the reed.

**Double Weave:** A weave structure where you create two layers of fabric at one time. It can have a fold on one side or be a tube.

**EPI:** Is an acronym for Ends Per Inch, which is how many ends of warp are in one inch of weaving.

**Harness:** The frame that holds the heddles which your threads go through to help create the woven pattern.

**Picks:** A pick is also known as a shot, which is the act of sending the shuttle through the shed leaving one length of weft in the shed.

**Plain Weave:** Is a simple structure of alternating over and under threads. It is a balanced weave where there are the same number of picks per inch as ends per inch.

**Reed:** The metal structure with evenly spaced bars which is anchored inside the beater at the front of the loom. A reed usually has even spacing with the most common being 8, 10 or 12 dents per inch.
**Sett:** Is the number of ends per inch within your reed. For example, the sett for my project was 20 epi until I decided to do a double weave. Then it became 40 epi.

**Shed:** The shed is the space between the upper and lower threads when the harnesses are raised and lowered. The shed is where the weft is laid to create the weaving.

**Shuttle:** The shuttle is a device that carries the weft thread through the shed back and forth across the loom when weaving.

**Threading:** The threading is the order the warp threads are put through the heddles in the harnesses.

**Tie-up:** The tie-up is the order of tying the harnesses to the treadles to create a specific woven pattern.

**Treadling:** Treadling is the order in which the sheds are opened to create a specific woven pattern.

**Warp:** Warp is the parallel lengths of tensioned threads which are tied to both the front and back of the loom. The warp threads are lifted and lowered to create sheds for the weft to go through.

**Weft:** Weft is the cross threads/yarns which create the perpendicular locking effect in the warp, which then creates the woven structure or fabric.
References

