# SDL FMT CALIBRATION COTTONS PACKED IN TUBES J. Montalvo and T. M. Von Hoven USDA, ARS <br> Southern Regional Research Center New Orleans, LA 


#### Abstract

Packing calibration cotton in tubes has many benefits such as ease of storage as well as shipping. This research demonstrates the methodology to compress a calibration cotton -- using a specially designed apparatus -- for the Shirley Developments Limited (SDL) Fineness and Maturity Tester (FMT). Fiber properties of cotton that has not been packed and that has been packed in the tubes were measured by the FMT and compared statistically. There were no significant differences between the packed and non-packed fibers. Also, there have been no tube failures to date.


## Introduction

The sample density used by the Agricultural Marketing Service in packaging International Calibration Cotton Standards (ICCS) Micronaire-only cottons is about $17 \mathrm{lbs} . / \mathrm{cu}$ ft . These calibration cottons are bundled in brown wrapping paper held together with tape.

There is a need for packaging technology to allow worldwide distribution of the calibration cottons associated with other fiber properties, such as fineness and maturity. Packaging the cottons in tubes offers definite advantages such as ease of storage, shipping, and insertion of a disc - dubbed a separator - to prevent mixing of preweighed portions of cotton in the same tube.

In this paper, 228 g of FMT calibration cotton is compressed in a plastic tube to the ICCS Micronaire only sample density, about $17 \mathrm{lbs} / \mathrm{cu}^{3}$. By following specific procedures with a specially designed apparatus, cotton packing can be facilitated easily and quickly. Additionally, this research presents the apparatus, procedure and statistical evidence to suggest that packing had no effect on the fineness and maturity properties of the cotton when compared to nonpacked cotton. The fiber properties of packed and nonpacked cotton were measured using the FMT (Micromat model).

## Materials and Methods

## Cotton

The cotton used in this study came from a bale purchased for

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this study by SDL and referred to as SDL FMT Calibration Cotton (high Micronaire and high maturity). The bale had been selected, carded and blended to meet or exceed ICCS preparation specifications.

## Packing Procedure and Apparatus

The tubes are 2.304" I.D. x 12 " long, 0.028 " wall thickness, and clear plastic (PETG). The end caps are 2.375" I.D. x 1 " and red plastic (grade 1 polyethylene).

The packing procedure is as follows. The tubes are brushed and cleaned with compressed air. An ice pick with sharp point is used to make a small air hole in the center of two of the red plastic end caps that fit over the end of the tube. One end of the plastic tube is closed with an end cap that is taped to the tube using 1 " masking tape. The tube is placed in the mold of the specially designed cotton sample press with the capped end at the bottom (see Figures 1-4). A loading chute is mounted coaxially above the tube and fits into its open end. The cotton is weighed into eight 28.5 g balls that were turned over themselves to prevent fly-away fibers. Either the hand wheel or hand bar is rotated to move the ram up to its highest position at rest. One of these balls is placed in the chute, a red paper disc called a separator is placed over the cotton, and packed into the tube by lowering the ram.

To load the chute, grasp one of the 28.5 g portions of cotton and holding the cotton above the chute with both hands, use the fingers to squeeze the cotton fibers together horizontally until the diameter of the compressed mass approaches that of the chute. Now push down vertically so that the compressed mass is in the chute. Continue this process - compressing the fibers horizontally and then moving the mass down into the chute until the whole portion is in the chute. Rotate the hand bar until the ram has pushed the cotton to position 1 on the ram pointer. Hold this position for three seconds. This process is continued until all of the 228 g sample has been put in the plastic tube, increasing the ram stop position by one unit, i.e.: position 2 , position 3 , position 4 , position 5 , position 6 , position 7 , and position 8 .

After 228 g cotton has been packed in the tube, the ram is positioned in the top of the tube, locked in place, a steel pin is driven through the tube just below the ram, and then the ram raised above the tube. To do these steps, start with one hand holding the hand bar at position 8 , and use the other hand to rotate the ram arm plate until it engages in the teeth of the ram arm. Next, with one hand holding the ram arm plate against the teeth of the ram arm, use the other hand to "lock" the S-hook (located under the plate) over the narrow end of the plate. Now both hands can be removed from the press, while maintaining the ram at position 8 . The next step is to drive a steel pin through the tube just below the ram, using an electric drill with reversible chuck. Begin this process by comparing the diameter of the steel pin at its base
with the diameter of the chuck opening. The tube is removed from the mold, the open end capped with a red end cap, and the cap taped to the tube.

Now unlock the ram arm plate so that the ram can be raised. Do this by pushing down gently on the hand bar with one hand while the other hand removes the S-hook from the plate. Rotate the ram arm plate until it no longer engages the teeth of the ram arm then rotate the hand bar to raise the ram.

Next, the steel pin is pulled from the tube with pliers, and a template is taped in place over each end cap to guide an electric stapler, which mechanically attaches the end caps to the tube. Then the templates and all tape are removed from the tube. The packing procedure is completed after tapping each staple with a hammer to "lock" the staples tight against the end cap.

## Tube Opening

To remove the fiber from a tube, begin by using an office staple remover to dislodge the staples from an end cap. Use the fingers to recover the first oz. of cotton from the tube. Tap the tube on a table to remove the first red paper separator. Holding the tube vertically, tap it firmly on the table to remove the next three ounces of cotton and the separators. Finally, remove the staples from the other end cap and repeat the process to remove the remaining cotton in the tube.

## FMT Testing

All FMT testing was performed on the upgraded SRRC FMT (Montalvo and Faught, 1999) in a laboratory conditioned at $70^{\circ} \mathrm{F}$ and $65 \% \mathrm{RH}$. After removing the packed cotton from a tube, the fibers were conditioned for 72 hours, each oz. hand opened to about 4 L and tested. The non-packed cotton came from the same bale. Twelve 4.00 g specimens of nonpacked and packed cotton were weighed. A non-packed sample was tested followed by a packed sample (i.e., paired observations) and the process repeated until all 24 samples were analyzed.

## Results and Discussion

## Tests for Paired Observations

Cotton was packed into a tube and stored for 68 days before the tube was opened. The data from the FMT measurements (in mm water) of non-packed and packed cottons were statistically analyzed as paired observations.

We have a sampling of 12 observations. The mean difference between the $P L$ non-packed and packed values, $P L_{d}$, was 0.383 with a standard deviation of 1.819 (Table 1). We used the $t$-test to determine for a $5 \%$ level of significance whether there is a significant difference in $P L_{d}$. The null hypothesis is that packing does not affect mean $P L$. Since the $t$-score of
1.711 is within the non-rejection region, we accept the hypothesis and conclude there is not a significant difference between the non-packed and packed cotton at a $5 \%$ level of significance for cotton of high maturity.

For the PH readings, we also have 12 observations. The mean difference between the $P H$ non-packed and packed values, $P H_{d}$, is -0.475 with a standard deviation of 0.857 (Table 2). The null hypothesis is that packing does not affect mean PH. Note that the $t$-score of 1.920 for a $5 \%$ level of significance is barely outside the non-rejection region; at a $4 \%$ level of significance the $t$-score is within the non-rejection region. Therefore, we accept the hypothesis and conclude there is not a significant difference between the non-packed and packed mean PH values at a $4 \%$ level of significance for samples of high maturity.

Fineness and maturity values are calculated from FMT PL and $P H$ readings using appropriate models. Since packing the cotton did not significantly affect the mean $P L$ and $P H$ values, we anticipate that the changes in the calculated fineness and maturity values must be small. Table 3 confirms that the percent differences in the results, relative to nonpacked, are all $<2 \%$, and are within the precision of the FMT results.

## Tube Failures

Approximately 600 tubes have been packed to date. Tube failures were defined as a tube coming open. No tube failures were noted to date.

## Acknowledgements

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## References

Montalvo, J.G., Jr. and Faught, S.E., 1999. Headspace resistance standards for the Shirley Developments Ltd. Micromat Tester. Textile Res. J., 69:269-277.

Table 1. PL readings (in mm water) of non-packed and packed FMT calibration cotton.

| Non-packed | Packed | $\mathbf{P L}_{\mathbf{d}}=$Non-packed - <br> Packed |
| :---: | :---: | :---: |
| 142.1 | 141.7 | 0.4 |
| 140.8 | 139.8 | 1 |
| 140.5 | 138 | 2.5 |
| 139.7 | 139.6 | 0.1 |
| 141 | 140.7 | 0.3 |
| 138.8 | 136.3 | 2.5 |
| 140.7 | 140.8 | -0.1 |
| 140.9 | 138.9 | 2 |
| 136.9 | 141.3 | -4.4 |
| 141.3 | 141.7 | -0.4 |
| 141 | 140.1 | 0.9 |
| 140.9 | 141.1 | -0.2 |

[^0]Hypothesis: Packing does not effect mean PL
$\alpha=0.05 ; \mathrm{n}=12$; d.f. $=11$; mean $\mathrm{PL}_{\mathrm{d}}=0.383$;

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\text { std. dev. of mean } \mathrm{PL}_{\mathrm{d}}=1.819
$$

Test statistic: $\quad \mathrm{t}$-score $=0.729$
Non-rejection: $\quad-1.796 \leq t$-score $\leq 1.796$
Decision: accept hypothesis
Table 2. PH readings (in mm water) of non-packed and packed FMT calibration cotton.

| Non-packed | Packed | $\mathbf{P H}_{\mathbf{d}}=$ Non-packed - <br> Packed |
| :---: | :---: | :---: |
| 93.8 | 94.3 | -0.5 |
| 93.9 | 94 | -0.1 |
| 92.4 | 93.2 | -0.8 |
| 92.1 | 93 | -0.9 |
| 93.8 | 93.9 | -0.1 |
| 93.6 | 93.5 | 0.1 |
| 92.9 | 95 | -2.1 |
| 93.4 | 92.4 | 1.0 |
| 92.3 | 93.6 | -1.3 |
| 93.9 | 93.3 | 0.6 |
| 92.7 | 93.9 | -1.2 |
| 93.5 | 93.9 | -0.4 |

Statistical tests
Hypothesis: packing does not effect mean PH
$\alpha=0.05 ; \mathrm{n}=12$; d.f. $=11$; mean $\mathrm{PH}_{\mathrm{d}}=-0.475$; std. dev. of mean $\mathrm{PH}_{\mathrm{d}}=0.857$
Test statistic: $\quad \mathrm{t}$-score $=1.920$
Non-rejection: $\quad-1.796 \leq t$-score $\leq 1.796$
Decision:
reject hypothesis
$\alpha=0.04$
Non-rejection: $\quad-1.925 \leq \mathrm{t}$-score $\leq 1.925$
Decision: accept hypothesis
Table 3A. Effect of packing on calculated fineness/maturity values of FMT calibration cotton.

|  | Mean FMT readings <br> (mm water) |  |  |
| :--- | :---: | :---: | :---: |
| Treatment | PL | PH | Mic <br> (Mic units) |
| None | 140.4 | 93.19 | 5.31 |
| Packed | 140 | 93.67 | 5.32 |
| \% diff. | -0.28 | 0.52 | 0.19 |

Table 3B. Effect of packing on calculated fineness/maturity values of FMT calibration cotton.

|  | Maturity <br> Ratio <br> Treatment | Fineness <br> $($ none $)$ | Wall <br> thickness <br> $(\boldsymbol{\mu} \mathbf{m})$ | Perimeter <br> $(\boldsymbol{\mu} \mathbf{m})$ |
| :--- | :---: | :---: | :---: | :---: |
| None | 1.04 | 209 | 3.14 | 53.6 |
| Packed | 1.02 | 212 | 3.12 | 54.5 |
| \% diff. | -1.92 | 1.44 | -0.64 | 1.68 |



Figure 1. Cotton Press


Figure 2. Placing 28.5 g cotton samples into press


Figure 3. Finalizing cotton press and locking into place


Figure 4. Final product ready for storage and shipping


[^0]:    Statistical tests

