RFP G: Improving the Process of Preparing Fabric Orders at G&S Dye

TEST PLAN FOR PROTOTYPES

Version 1.0

March 22, 2017

1 Introduction

1.1 Purpose of this Document

This document outlines the protocol necessary for testing prototype solutions to the opportunity outlined in the RFP. This document should be used in conjunction with the original RFP, so that the testing team may refer back to specific requirements, objectives, and metrics of the opportunity.

1.2 Scope

This testing protocol is designed for the analysis of elements of the Dispensing Process, defined in the RFP as “the ace of unrolling, measuring, cutting and re-rolling [of fabric shipments or orders]”. This document does not provide a means or procedure for testing elements of the Retrieval Process, or the acts of transferring fabric to and from storage shelves.

This document will assess the overall effectiveness of the design using the metrics outlined in section 4.2.2 of the RFP, with specific focus on maintaining the quality of the fabric while rolling and unrolling, effort required to use the design, and effectiveness and safety of means used to cut the fabric.

1.3 Items to be Tested

Items to Test	Description
Rolling and Unrolling	How the design prototype performs rolling and unrolling a roll of fabric of fixed weave and dimensions
Size	Physical dimensions of the prototype, which must conform to size constraints as outlined in the RFP. If a scale model is used, scale factor should be accounted for.
Fabric measurement	Accuracy of measured value of unrolled fabric length in comparison to actual length of unrolled fabric

1.4 Items not to be Tested

The following items are explicitly not to be tested with this version of the testing protocol, as they are not the current focus of design candidates.

Items not to Test	Description
Retrieval and return process	The process by which fabric rolls are retrieved form and returned to storage shelves. Rescoping has identified

	unrolling, cutting, and rolling (the “Dispensing Process”) as the more significant opportunity in the RFP for stakeholder satisfaction.
Cutting of fabric	The current method of cutting and ripping thing fabrics at G&S dye was observed to be very quick during a site visit, whereas rolling and measuring took most of the time. For initial prototypes, cutting was not considered a pressing issue.
Setting up the rolling device	Initial prototypes are designed to test the effectiveness of rolling and unrolling fabric. Loading and unloading rolls are not considered at this phase, and will follow once an effective design for rolling and unrolling is developed.

2 Rolling Test

2.1 Items to be Tested

Item to Test	Description
Fabric Tension	Uniform tension is to be maintained in the fabric during rolling and unrolling. This ensures that measurements remain accurate, and that the fabric is not damaged while being rolled.
Quality of the roll	Consideration of angle with which the fabric rolls in relation to the spool, and the presence of creases in the fabric.
Performance of the apparatus	How well the rolling apparatus, manual or otherwise, interacts with the fabric to perform the desired task

2.2 Fabric Tension

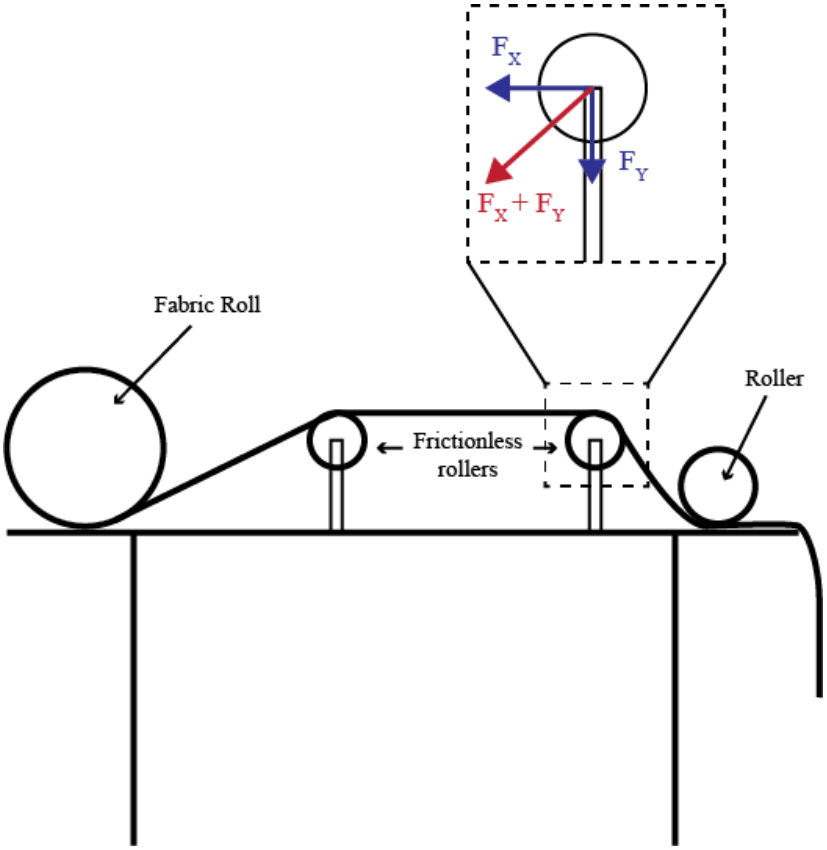

Figure 1: Apparatus for determining fabric tension, adapted from E. Angeid and H. Friman, “Means for measuring the tension in a strip or sheet shaped material”, U.S. Patent US3204454 A, Sept. 7, 1965.

The above apparatus is constructed to measure the tensile force in the fabric sample being used. In addition to the fabric roll and roller, two raised, frictionless rollers of the same height are added in the middle of the sample. The roller opposite the fabric roll is to have embedded force sensors (analog or digital) to measure force in the vertical and horizontal axis. The tension force in the fabric while being rolled can then be calculated from the vector addition of the horizontal and vertical force, or in magnitude:

$$F_T = \overrightarrow{F_X} + \overrightarrow{F_Y} = \sqrt{F_X^2 + F_Y^2}$$

This value should remain as close to a constant as possible during testing.

2.3 Quality of the Roll

2.3.1 Creases and Wrinkles

This section analyses the performance of the rolling apparatus with respect to creases, wrinkles, and folds occurring in the fabric during re-rolling. Metrics to be considered are the number of fabric defects that occur, and the number of times the roll must be

adjusted to correct for them. For this test, in addition to rolling apparatus, two stopwatches are required.

1) Configure the device such that all the fabric is unrolled from the spool. Attach the edge of the fabric to the roll in a straight, secure manner.

2) Begin rolling the fabric, and start both stop watches. Count the number of creases, folds, or wrinkles that occur during rolling. Record this number.

3) When a crease occurs, stop rolling and fix the roll. This ensures that future defects do not arise because of previous ones, and are only caused by the apparatus itself. When the roll is stopped, stop (or have an associate stop) one of the stopwatches (be consistent about which one). Record the number of times the roll must be fixed. When the roll is fixed, start the stopped stopwatch.

4) When the rolling process is finished, stop both stopwatches.

A lower frequency of needing to fix the roll is preferred. Error frequency is calculated as:

$$f_{E,t} = \frac{Number\ of\ errors}{Elapsed\ time}$$

Error frequency can also be calculated per unit length of fabric rolled as:

$$f_{E,l} = \frac{Number\ of\ errors}{Length\ of\ fabric}$$

Finally, time spent fixing errors should be minimized. Time spent fixing errors is determine by subtracting the time from the stopwatch paused during corrections to the roll (i.e. effective rolling time) from the total rolling time. If this time exceeds half of the total time, the design is not acceptable.

2.3.2 Roll Angle

Definition: Roll angle is defined as the angle the fabric selvage (edges) makes with a normal to the fabric spool.

During rolling, using video analysis or markings on the rolling surface, determine the maximum roll angle. Roll angles as close to 0° as possible are preferred.

2.4 Performance of the Apparatus

2.4.1 Roller Slippage

Definition: Roller slippage occurs when the roller wheel continues to spin, but the fabric does not continue to pass under the roller with a velocity equal to the tangential velocity

of the roller. This may occur when the fabric is held back and slows down as the roller spins, or when the fabric is pulled faster than the roller spins.

Roller slippage may occur when the weight of the fabric hanging over a surface exceeds the maximum frictional force between the roller and the fabric. This means of slippage is to be tested, for different types of fabric, by the following procedure:

1) Following guidelines established in ASTM D 3776-96 “Standard Test Method for Mass Per Unit Area (Weight) of Fabric”, determine the weight per unit area of the fabric being tested.

   Assumption: The apparatus will be used no more that 2 m from the ground. Thus, the total weight of hanging fabric can be calculated by:

$$weight = width \times 2\ \mathrm{m} \times weight\ per\ unit\ area$$

2) Place a length of fabric on a flat surface and under the roller(s). Using clamps (so as not to damage the fabric, see CAN/CGSB-4.2 No. 10-M87 “Textile test methods – elongation”, section 4.2), connect the edge of the fabric after the rollers to a hanging mass equal to the maximum weight calculated in (1).

3) With the rollers off, observe whether the fabric slips past the roller surface. If yes, the rollers are unsuitable for use with the fabric sample being used. If no, turn on the rollers so as to oppose the force created from the hanging mass (i.e. if the mass is hanging over the edge of the flat surface, use the rollers to pull the mass up). If the fabric slips, the rollers may not be suitable for use with the fabric sample being used under worse conditions.

2.4.2 Measurement Accuracy

The design candidate may include its own means of measuring the length of fabric dispensed. If so, this measurement is to be compared with that obtained from a regular fabric measuring tape, with the smallest measurement marking being no larger than 1 inch.

Deviation from the actual length will be calculated as follows:

$$\%\ Deviation = \frac{Actual\ length - candidate\ length}{Actual\ length} \times 100\%$$

Where candidate length is the length of the fabric as identified by the design candidate. Deviation closer to 0 % is preferred.

3 Physical Size

The apparatus must fit within the dimension available at G&S Dye without arranging store layout (unless such a rearrangement is included in the design candidate).

For design candidates to be placed upon the cutting table, dimensions must not exceed 1810 mm x 950 mm.

Design candidates which are placed on the floor must not obstruct any of the aisles through which customers travel, or the space in which staff work to process fabric orders.