Application Note:
Thermal Transfer Ribbon Print Quality Analysis

John C. Briggs (Senior Engineer)
Quality Engineering Associates (QEA), Inc
www.qea.com
Burlington MA/USA

Introduction

A challenge for manufacturers of thermal printing ribbons is to achieve excellent print quality (PQ) while printing on a range of substrates. This is particularly challenging in the industrial marking market segment. Manufacturers have responded to this challenge by producing a range of ribbons suitable for different media.

Being able to objectively quantify improvements in print quality is important for a number of reasons. First, objective PQ data can be used to convince customers of the benefits of purchasing your ribbons (hopefully at higher profit margins) rather than your competitors. Secondly, objective PQ measurements can be used in R&D to set clear performance goals. Third, they can be used in production to maintain performance so there are no angry calls from the customer.

The following outlines techniques that can be used to objectively quantify PQ for thermal transfer ribbons.

Hold-on and Don't Let Go

In thermal transfer printing, the printing wax or resin is heated by the printhead with the intent of transferring it from the polyester carrier to the receiver sheet (media), see Figure 1. Depending on a number of factors (heat, surface chemistry, pressure, etc), the wax may not transfer or only partly transfer to the media. This generates a number of printing defects. One of the keys to good PQ in thermal transfer printing is the complete transfer of the wax in the areas intended to be printed.

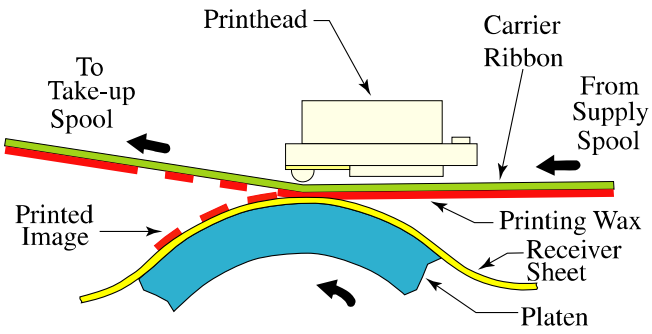

Figure 1: Thermal Mass Transfer.

Comb

A common problem in thermal printing is the "comb" appearance along the leading edge of a printed area as shown in Figure 2. As the heaters are turned on in the printhead, the wax transfer to the media can be incomplete resulting in low quality text and barcodes.

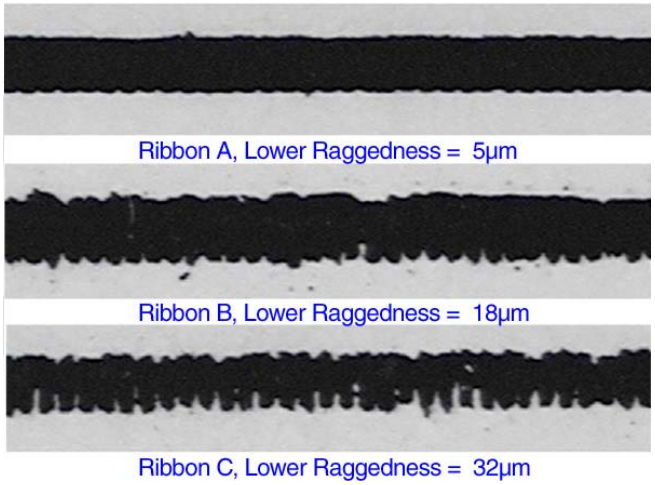

Figure 2: Comb effect quantified by raggedness. Note that a 10µm edge filter was used.

This effect is readily quantified using the ISO-13660 print quality metric known as raggedness. Raggedness is the roughness of lack or straightness in the line edge and is measured in microns (µm).

The three ribbons shown in Figure 2 exhibit a range of raggedness values from 5µm to 32µm. Lower raggedness values indicate straighter edges and higher print quality. The quantitative nature of this analysis makes it a perfect fit for QC applications that need a number to test to. Subjective analysis can be used but lacks repeatability, accuracy, and consistency from one inspector to the next.

Voids

Incomplete transfer sometimes extends beyond the edge of a line into the body of the line, as shown in Figure 3.

This gives areas, intended to be solid, a poor and low quality appearance.

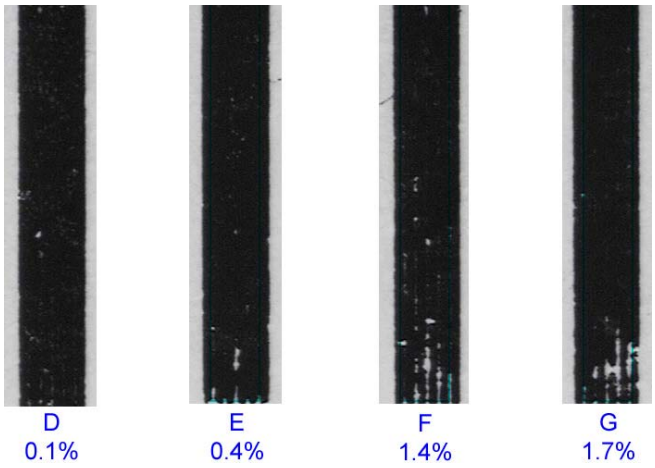

Figure 3: Percentage of voids for Ribbons D, E, F, and G.

One way to characterize this PQ problem is to measure the void area, as shown in Figure 3 and Figure 4. Void area is the percentage of the area that is unprinted or white. Measurement provides an unambiguous assessment of voids.

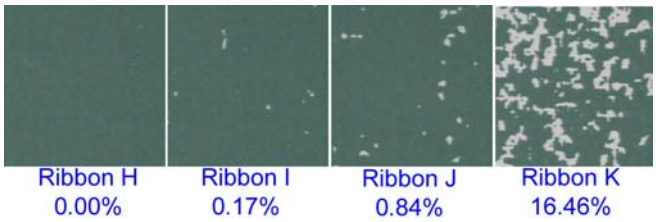

Figure 4: Percentage of voids for Ribbons H, I, J, and K.

Incomplete Text

Text can also be quantified to show whether or not it is fully form. For each letter in the alphabet, there is a known area of print that should be occurring. This area obviously increases with font size and is different for different fonts. However, there is a correct area, and if the printed letter has less than that known area, then it is not fully formed.

This concept can be illustrated with reference to Figure 5. These two letter "n"'s were printed with two different ribbons on the same media. The letter "n" on the left is almost fully formed and has an area of 1.82mm². The "n" on the right is poorly formed and has a much smaller area of 1.54mm². In a QC procedure, limits could be set for the minimum acceptable area for certain letters. Note that it would not be necessary to measure all letters (A-Z). Just selecting a few letters would probably be sufficient to detect problems with the ribbon.

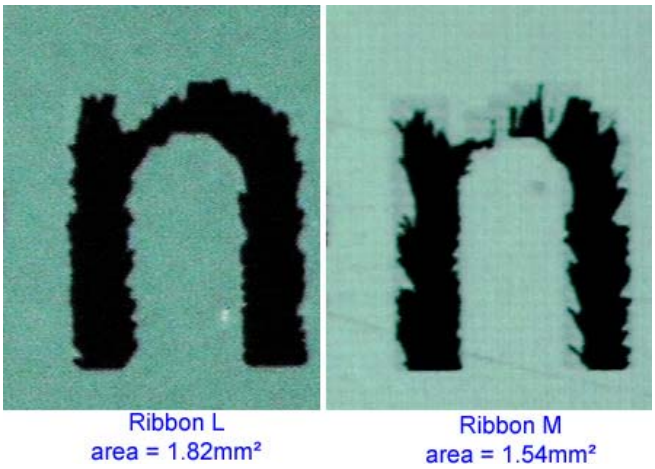

Figure 5: Areas of letter "n"'s.

In Summary

The print quality produced by different thermal ribbons can be objectively quantified. This quantification can provide clear objective data which can be used in marketing, QC, and development of ribbons. Products such as QEA's Personal IAS and IAS-1000 can be used to make these measurements and eliminate arguments which are common when subjective print quality analysis is used.