

Figure 8. Randomly Oriented Square Sample Approaching the Feed Stackers

Figure 9 shows the undesirable tendency of the square samples to rotate in the leveling section that is common to many types of mail processing equipment. The resultant skew of the samples prior to scanning stations often adversely affects the image capture, character recognition, and address interpretation processes that follow.

Figure 10 shows the automatic rejection of over-height mail. That is done to prevent jams and damage prior to the inversion section of the AFCS, where clearances are particularly critical. The green samples shown are 1/8 inch over legal height at 6 1/4 inches.

Figure 11 illustrates all of the over-height samples and a few legal-height samples that were also rejected. Due to earlier rotation, some of the square samples were not fully leveled. Consequently, they traveled high in the transport and triggered the over-height detection used to prevent jams. While this can happen with all mail, it is more pronounced with square samples because they fail to level more frequently.

Figure 12 depicts samples that were not cancelled – slightly separated for viewing. Some of the samples have the stamp and the address visible and facing outward. The remaining samples had the stamp and address facing inward toward the machine. In all cases, the address was positioned vertically, indicating the reason for cancellation failure was improper orientation.

Figure 13 shows all the square samples in this subset after processing by the AFCS. Only the four groups of envelopes on the right were correctly processed. The four groups of envelopes on the left were mechanical rejects (over-height). The four groups of envelopes in the middle were cancellation rejects (improper orientation). For more detailed results, see the **Table 3**. Due to

random orientation of the square samples, approximately half of the cancelled samples were “stamp trailing” (the rightmost column of envelopes), and approximately half were “stamp leading” (the next to rightmost column of envelopes).

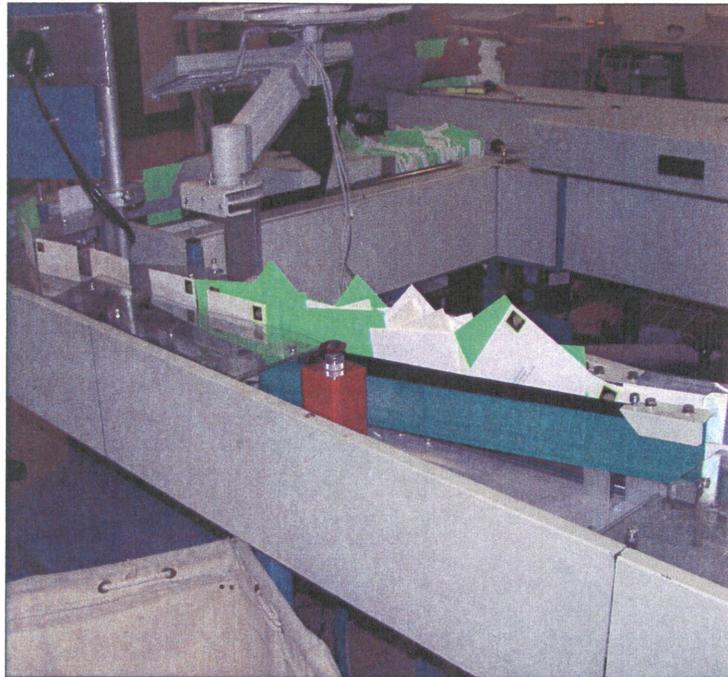


Figure 9. Rotation of Square Mail Piece Samples in Mail Transport System

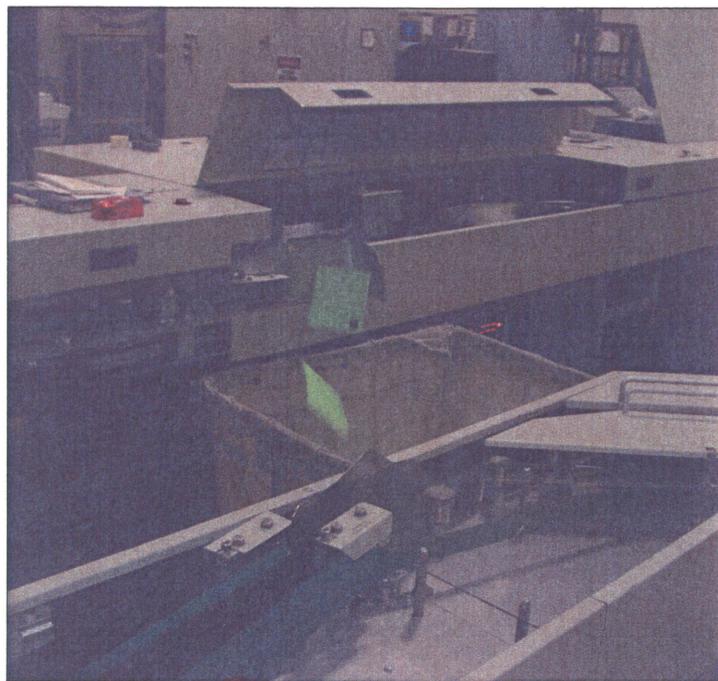


Figure 10. Mechanical Rejection of Over-height Mail Pieces



Figure 11. Culled Over-height Pieces

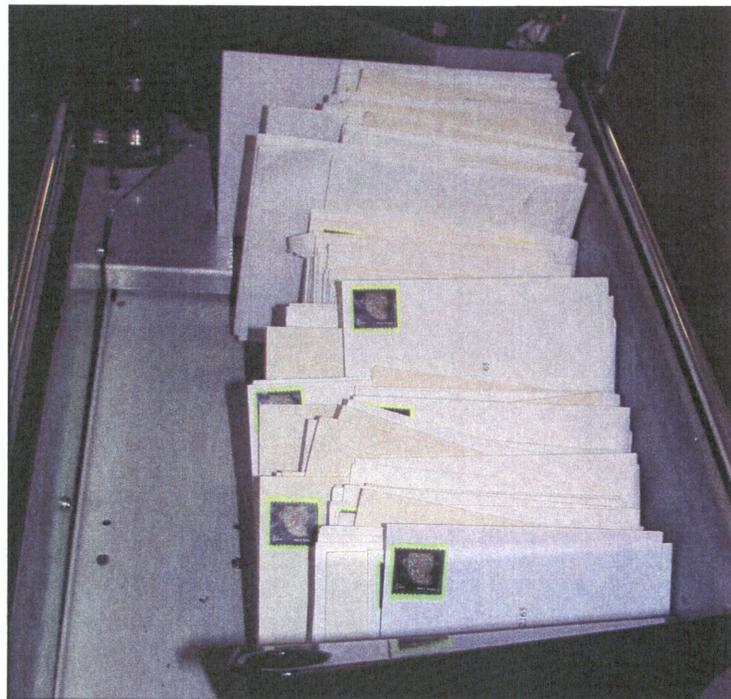


Figure 12. Misoriented Samples in the Not-cancelled Stacker

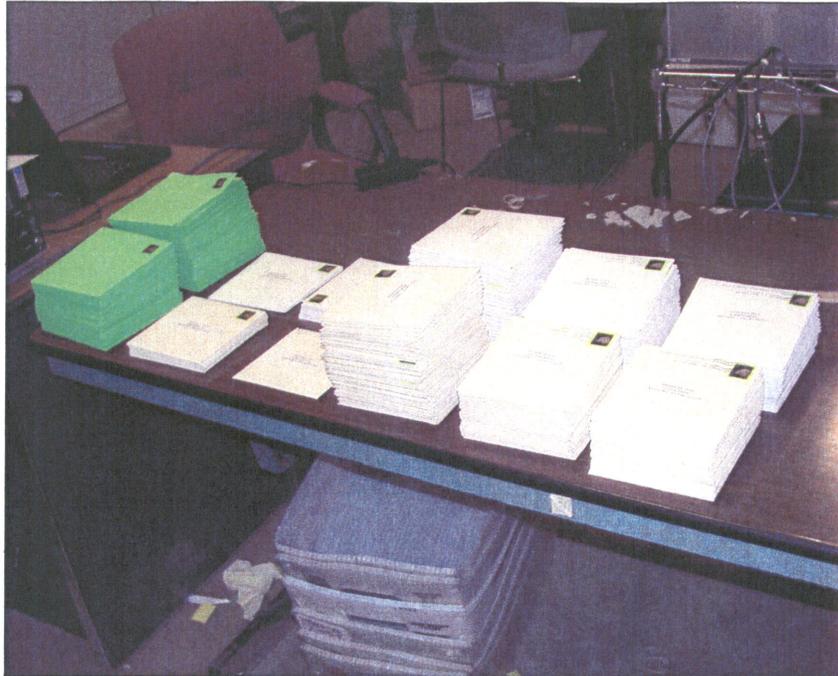


Figure 13. Grouping of Incorrectly Processed Samples (left six stacks) and Correctly Processed Samples (right four stacks)

5 Cancellation and Readability Performance Testing: The Color Test Deck

Cancellation performance testing consisted of:

- feeding the color test deck into an AFCS (depicted in section 4 of this report)
- counting cancellation result and reducing the data

Readability performance testing consisted of:

- feeding the color test deck into a DIOSS in ISS mode and collecting the encoding result data
- feeding the same test deck into a DIOSS in OSS mode and collecting the encoding result data
- comparing the encoding results to the truth data and reducing the data

Figure 14 through Figure 17 depict the processing of the color test deck for readability performance.



Figure 14. Color Test Deck



Figure 15. Color Test Deck on ISS

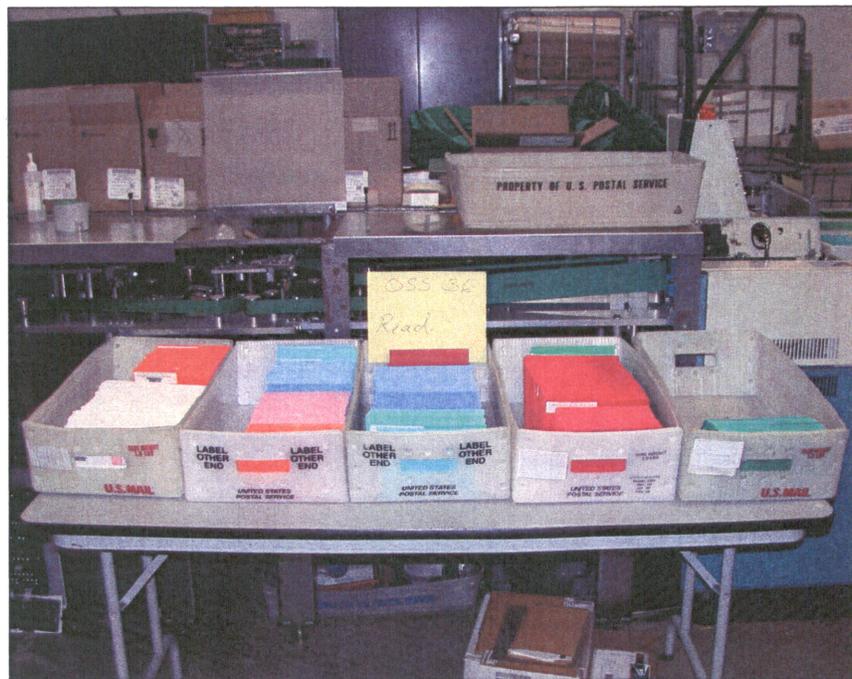


Figure 16. Color Mail Pieces Successfully Processed on OSS



Figure 17. Color Mail Pieces Rejected by OSS

6 Test Results

6.1 Size and Aspect Ratio Testing

Table 3 provides the cancellation rates for mail pieces in the aspect ratio test deck. Below the legal aspect ratio of 1.33, all sample sets had a less than 55% cancellation rate.

Five sample sets with legal aspect ratios had cancellation rates of 0%, but all five sets had unacceptable height or width. These sets are #1, #25, #28, #34, and #35.

6.1.1 Effect of Size

All sample sets with legal size and legal aspect ratio had cancellation rates greater than 98%. There were eight sample sets with legal size and illegal aspect ratio. Five of these sets (#'s 16, 20, 21, 22, and 23) had cancellation rates less than 55%, and all were square samples. The other three sample sets had a 100% cancellation rate. It should be noted that all three of those sets had illegal aspect ratios that were close to the legal aspect ratio range.

6.1.2 Effect of Aspect Ratio

There were nineteen sample sets with legal aspect ratios. Six of these sets had a cancellation rate of 0%. All six sets had illegal height or width. The remaining thirteen sets had cancellation rates greater than 98%.

6.2 Readability Testing

6.2.1 Evaluation Methodology

Each sample set in the color test deck was subjected to three readability tests. For each test, one or more readability rates were computed for the sample set, the rate or rates were compared to a test-specific threshold, and samples were judged to have passed the test if their readability rate exceeded the test threshold and to have failed otherwise. The sample set was then considered to be readable if it had passed all three tests, and unreadable otherwise.

Address readability was the first test. In this test, a piece was judged readable if the OSS returned a correct 11-digit code at any level of sort; otherwise, the piece was considered unreadable. By aggregating individual piece results, a readability rate was computed for each combination of sample set, ink color, and stroke thickness, as was an average readability rate for the sample set.

Readability of the fluorescent ID tag was the second test. A piece was judged readable if the OSS successfully read the ID tag printed by the ISS; otherwise, the piece was considered unreadable. A readability rate was computed for each sample set by aggregating individual piece results.

POSTNET Code readability was the third test. A piece was judged readable if the OSS printed and successfully read a POSTNET Code; otherwise, the piece was considered unreadable. A readability rate was computed for each sample set by aggregating individual piece results.

| Sample Set | Envelope Size | Aspect Ratio | Legal Size | Legal Ratio | Performance Acceptable | Quantity | Reject Mechanical | Reject Cancellation | Weak Ink | Cancelled | Percent Cancelled |
|------------|-----------------|--------------|------------|-------------|------------------------|----------|-------------------|---------------------|----------|-----------|-------------------|
| 1 | 3 X 4 | 1.33 | NO | YES | NO | 200 | 200 | 0 | 0 | 0 | 0.00 |
| 2 | 3-1/16 X 3-1/16 | 1.00 | NO | NO | NO | 224 | 224 | 0 | 0 | 0 | 0.00 |
| 3 | 3-5/8 X 6-1/2 | 1.79 | YES | YES | YES | 200 | 3 | 0 | 0 | 197 | 98.50 |
| 4 | 3-3/4 X 6-3/4 | 1.80 | YES | YES | YES | 200 | 0 | 0 | 0 | 200 | 100.00 |
| 5 | 3-3/4 X 9-3/4 | 2.60 | YES | NO | YES | 196 | 0 | 0 | 196 | 0 | 100.00 |
| 6 | 3-7/8 X 5 | 1.29 | YES | NO | YES | 200 | 0 | 0 | 0 | 200 | 100.00 |
| 7 | 4 X 5-3/8 | 1.34 | YES | YES | YES | 199 | 0 | 0 | 0 | 199 | 100.00 |
| 8 | 4 X 8 | 2.00 | YES | YES | YES | 228 | 0 | 0 | 0 | 228 | 100.00 |
| 9 | 4 X 9-3/8 | 2.34 | YES | YES | YES | 198 | 0 | 0 | 0 | 198 | 100.00 |
| 10 | 4-1/8 X 6-1/4 | 1.52 | YES | YES | YES | 200 | 0 | 0 | 0 | 200 | 100.00 |
| 11 | 4-1/4 X 6-1/8 | 1.44 | YES | YES | YES | 202 | 0 | 0 | 0 | 202 | 100.00 |
| 12 | 4-1/4 X 9-1/4 | 2.18 | YES | YES | YES | 199 | 0 | 0 | 0 | 199 | 100.00 |
| 13 | 4-1/4 X 9-1/2 | 2.24 | YES | YES | YES | 195 | 0 | 0 | 0 | 195 | 100.00 |
| 14 | 4-3/8 X 6-3/4 | 1.54 | YES | YES | YES | 196 | 0 | 0 | 0 | 196 | 100.00 |
| 15 | 4-1/2 X 8 | 2.00 | YES | YES | YES | 330 | 0 | 0 | 0 | 330 | 100.00 |
| 16 | 5 X 5 | 1.00 | YES | NO | NO | 250 | 8 | 145 | 0 | 97 | 38.80 |
| 17 | 5 x 7-1/2 | 1.50 | YES | YES | YES | 194 | 0 | 0 | 0 | 194 | 100.00 |
| 18 | 5-3/8 X 6-7/8 | 1.28 | YES | NO | YES | 198 | 0 | 0 | 0 | 198 | 100.00 |
| 19 | 5-3/8 X 8 | 1.49 | YES | YES | YES | 197 | 0 | 0 | 0 | 197 | 100.00 |
| 20 | 5-1/2 X 5-1/2 | 1.00 | YES | NO | NO | 199 | 0 | 102 | 10 | 87 | 48.74 |
| 21 | 5-5/8 X 5-5/8 | 1.00 | YES | NO | NO | 250 | 3 | 121 | 0 | 126 | 50.40 |
| 22 | 5-3/4 X 5-3/4 | 1.00 | YES | NO | NO | 250 | 14 | 113 | 1 | 122 | 49.20 |
| 23 | 6 X 6 | 1.00 | YES | NO | NO | 250 | 4 | 109 | 18 | 119 | 54.80 |
| 24 | 6-1/4 X 6-1/4 | 1.00 | NO | NO | NO | 200 | 200 | 0 | 0 | 0 | 0.00 |
| 25 | 6-1/4 X 8-3/4 | 1.40 | NO | YES | NO | 203 | 203 | 0 | 0 | 0 | 0.00 |
| 26 | 6-1/8 X 9-1/4 | 1.51 | YES | YES | YES | 198 | 2 | 0 | 0 | 196 | 98.99 |
| 27 | 6-1/2 X 6-1/2 | 1.00 | NO | NO | NO | 250 | 250 | 0 | 0 | 0 | 0.00 |
| 28 | 6-1/2 X 10 | 1.54 | NO | YES | NO | 200 | 200 | 0 | 0 | 0 | 0.00 |
| 29 | 6-3/4 X 6-3/4 | 1.00 | NO | NO | NO | 262 | 262 | 0 | 0 | 0 | 0.00 |
| 30 | 7 X 7 | 1.00 | NO | NO | NO | 249 | 249 | 0 | 0 | 0 | 0.00 |
| 31 | 7-1/4 X 7-1/4 | 1.00 | NO | NO | NO | 225 | 225 | 0 | 0 | 0 | 0.00 |
| 32 | 7-1/2 X 7-1/2 | 1.00 | NO | NO | NO | 250 | 250 | 0 | 0 | 0 | 0.00 |
| 33 | 8-1/4 X 8-1/4 | 1.00 | NO | NO | NO | 250 | 250 | 0 | 0 | 0 | 0.00 |
| 34 | 8-1/2 X 15-1/2 | 1.82 | NO | YES | NO | 200 | 200 | 0 | 0 | 0 | 0.00 |
| 35 | 8-7/8 X 12-1/2 | 1.41 | NO | YES | NO | 198 | 198 | 0 | 0 | 0 | 0.00 |

Table 3. Cancellation Rates for Aspect Ratio Test Deck

6.2.2 Address Readability Test

Table 4 summarizes the results of the address readability test. For each of the 138 tested combinations of envelope color, ink color, and stroke width, Table 4 shows the readability rate, which is computed as the ratio of readable pieces to the sum of readable and unreadable pieces, and expressed as a percentage. The threshold of acceptability for address readability rate is 90 percent.

6.2.2.1 Effects of Envelope Color

Address readability was poor on all five green sample sets, good on two of the three red sample sets, good on two of the six blue sample sets, and good on the pink, orange and white sample sets. In all, address readability was unacceptable for ten of the tested envelope colors.

Figure 18 through Figure 21 show examples of mail pieces that coded correctly in the white control pieces, but failed for color envelopes with the same addresses. All four examples are shown as binarized images; i.e. they are shown as the black and white images on which the mail processing equipment performs recognition.

Figure 18 shows a white envelope with a black address that was correctly processed to 326 Cedarmeade Ave; Winchester, VA 22601-3488-26. Figure 19 shows a green (PMS3278) envelope with an identical black address that was incorrectly processed to 321 Cedarmeade Ave; Winchester, VA 22601-3447-21. Errors of this type may result in incorrect carrier dispatch.

Figure 20 shows a white envelope with a blue address that was correctly processed to 13400 Hash Ln; Culpeper, VA 22701-5719-00. Figure 21 shows a green (PMS3278) envelope with an identical blue address that was incorrectly processed to 134 Main St; Culpeper, VA 22701-3026-34. Errors of this type typically result in incorrect delivery distribution unit dispatch.

6.2.2.2 Effects of Ink Color

Address readability was unacceptable on test pieces having addresses written in red ink, regardless of envelope color. Pieces with addresses in green or purple ink showed sharply reduced encode performance, particularly on blue envelopes. On most envelope colors, black ink was as readable as, or more readable than, blue ink.

6.2.2.3 Effects of Stroke Width

Table 5 shows, for each tested combination of envelope color and ink color, the percentage by which encode rate changed when bold, instead of thin, stroke width was used to write the address. The absence of trends shows that, within the limits tested, stroke width does not predictably affect address readability.