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An Evaluation of the IGT-Heliotest Printability Tester

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March 17, 1979
QA 15101

J. B. Hudon:

Enclosed is my report, "An Evaluation of the IGT-Heliotest Printability Tester".

People on the distribution list include those who aided me with this study in areas of personal experience and/or equipment.

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Packaging Materials Department
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AN EVALUATION OF THE
IGT-HELIOTEST
PRINTABILITY TESTER

B. Shreiner
Kellogg Company
March 17, 1979

ABSTRACT

The purpose of this study was to evaluate the IGT-Heliotest Printability Tester. The recommendation to evaluate this test was based on the results of a correlation study of six different printability tests. The IGT-Heliotest was the only test of the six that conformed to the theoretical model developed during the study.[1]

As a result of this study, the IGT-Heliotest will be purchased by Kellogg's; with the expectation of significantly improving Quality Assurance's acceptance program for gravure carton board.

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INTRODUCTION

Based on earlier test data, the IGT-Heliotest Printability Tester looked very promising.[2] This study was designed to evaluate the IGT-Heliotest by establishing a coefficient of correlation between the test and production cartons.

PRINTING QUALITY PARAMETERS

What is good gravure printability, and how is it most effectively measured?

Good gravure printability can be defined as the lack of missing printed cells in the areas of mid-tones or light ink coverage.[3] Missing dots result during the printing operation when intimate contact is not made between the printing cell in the cylinder and the board being printed.[4] The reason for lack of contact must be identified and corrected, if the board is to be printed in an acceptable manner.

Lack of printing surface smoothness causes missing dots during printing.[5] When there is a surface defect (a high or low spot on the printing surface), the board will not conform to the rigid chrome cylinder surface. If the problem were as simple as identifying the size and number of surface defects per given area, predicting printability would be an easy task. However, surface smoothness is only one of many critical board properties that affect how well the board will print. Therefore, a simple test of surface smoothness can only rank smoothness of one sample relative to another. This alone cannot predict how well one sample will print relative to another.

What other board properties must also be considered?[6, 7] An adequate test must be a dynamic test, which incorporates board compressibility along with board smoothness. If an apparent surface defect can be made temporarily smaller than the cell dimension under printing pressures, then the transfer of ink will take place in spite of the irregular surface.[8] There is a definite inverse relationship where smoothness may decrease, as long as compressibility increases. Measuring one of these properties without the other will, therefore, be of little value.

The degree of ink receptivity of the board will also play a significant role in the effectiveness of ink transfer from the gravure cylinder to the board surface. If ink transfer is to be accomplished, the surface must conform to the cylinder. But, the degree of ink transfer is also dependent upon how well the board will take up the ink. A board that is more receptive to gravure ink will remove a higher percentage of ink from the cell; which will, in turn, give the board better ink coverage because of higher ink volume on the board surface.

Missing dots, printing surface smoothness, and ink receptivity are all very important; if the ink is to be successfully transferred from the printing cylinder to the board. It is, therefore, important that a printability tester measure all three of these properties. A device that successfully measures these properties, near press conditions, should be capable of accurately predicting how well the board will print during production.[9,10]

One assumption that must be made to justify confidence in the printability tester is thatthe production press will remain constant, within normal operating variables. There are many printing variables on the production press that will affect how well the board is printed. Different impression, roll diameter, and hardness will change the effective nip pressure during printing. The board will generally print better at faster speeds due to the centrifugal force throwing ink onto the board. Condition of the impression rolls changes the effectiveness of the electrostatic assist. Changing ink viscosity will change the receptivity of the board to the ink. It must be recognized that these types of press-related variations do exist. It was not possible in this study to quantify their effect on the printability of the board. Some variability in test results occurred because of these variations.

EXPERIMENTAL PROCEDURE

Design

To develop a coefficient of correlation between the test and production cartons, the following numerical rating system for the cartons was used:

5.0 - Excellent
4.0 - Very Good
3.0 - Acceptable
2.0 - Poor
1.0 - Unacceptable

The evaluation panel was instructed to select the most difficult area of the carton, and rate each carton with regard to printing surface qualities only. The ratings of each panel member were averaged together. This average became the carton rating.

The number of missing dots from the four rows on the test specimen were counted (see Appendix #1). The number of missing dots became the print rating.

There are approximately 1,250 dots in the four rows. The variable tone screen between the four rows visually compares to the light tone areas on the production cartons. The same type of breakup appears on the test strip and production carton.

Description

Samples were obtained as follows:

1. Outerwrap removed from roll immediately before printing. (NOTE: Several wraps had been removed before the roll was hung on the press).

2. Outerwrap used to run all print tests.

3. As soon as the press was operating at normal conditions, removed cartons from the press.

This procedure insured that cartons and board samples were usually taken within 50 to 75 feet of each other.

The press was monitored during the sampling period, and all controllable variables remained constant within normal press operating conditions.

All board samples were conditioned at TAPPI standards (73°F, 50% RH) prior to testing. The print tests were conducted as follows:

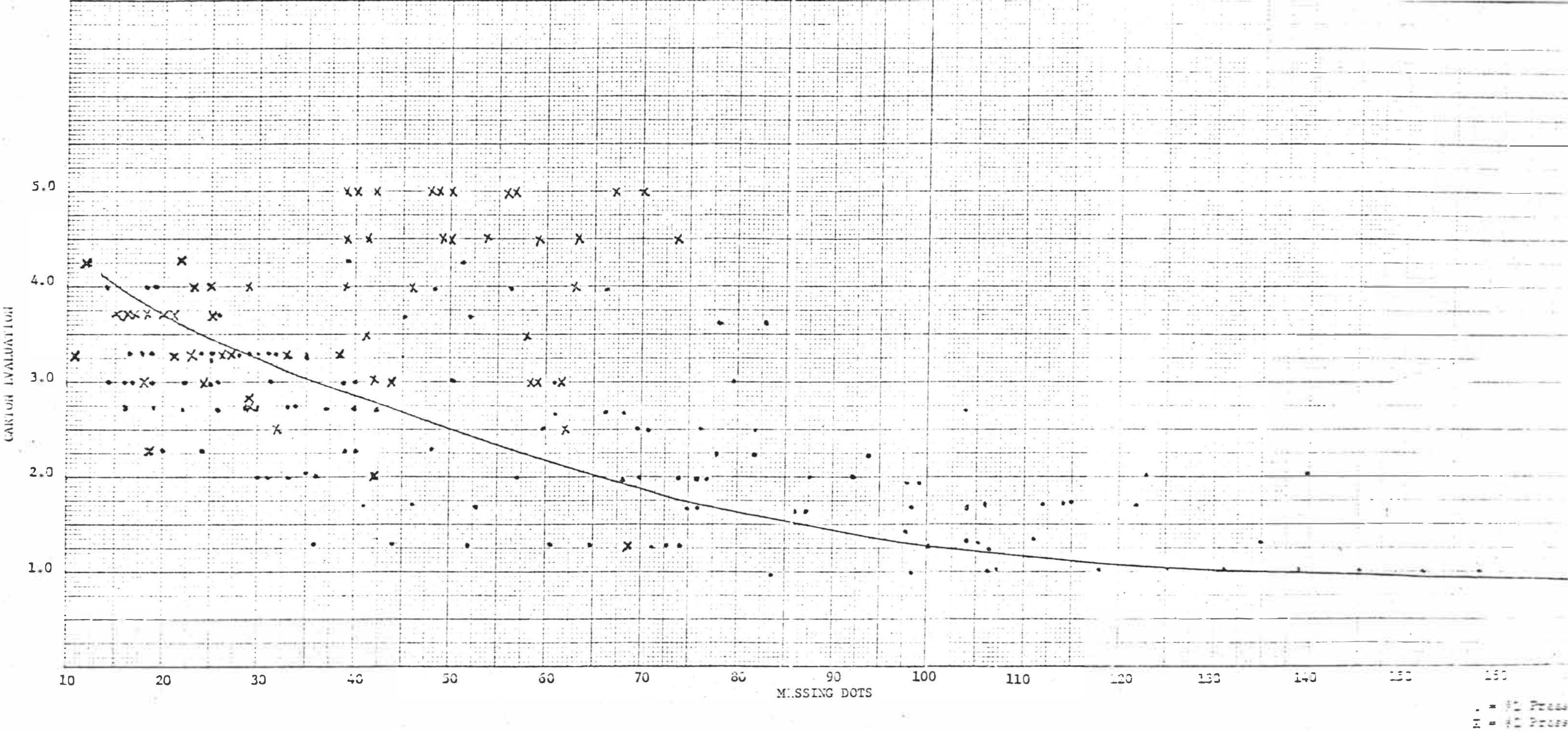
1. IGT operating conditions --
   Speed 2.5 m/s, or 550 ft./min. (constant)
   Impression 45 kgf

2. Sample dimensions 1 1/4" MD x 13 5/16" CD

3. Ink - GPI Sunate SLO-DRY proofing ink
   18 seconds viscosity with #2 Zahn

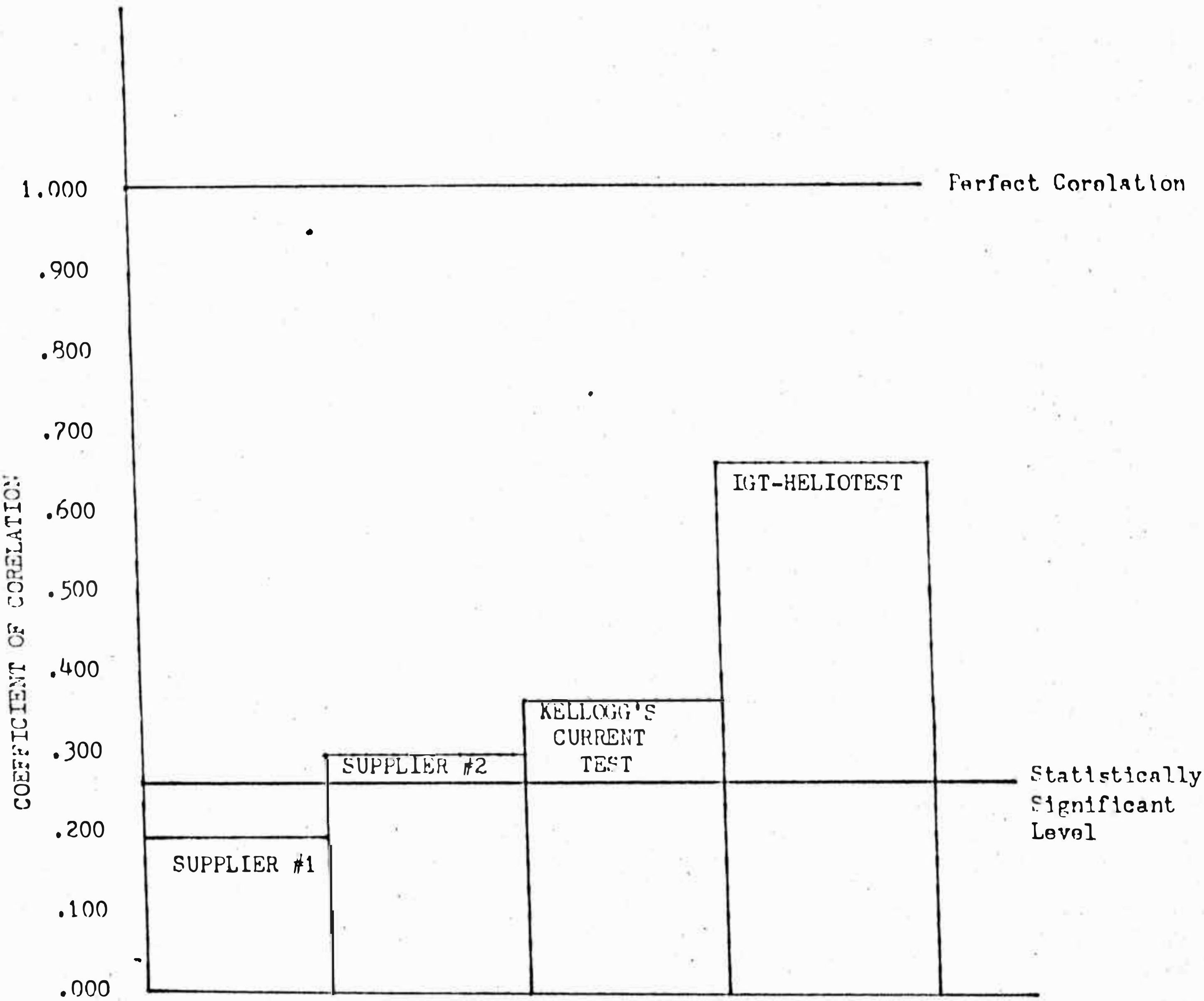
4. Print Rating - number of missing dots in the four rows.

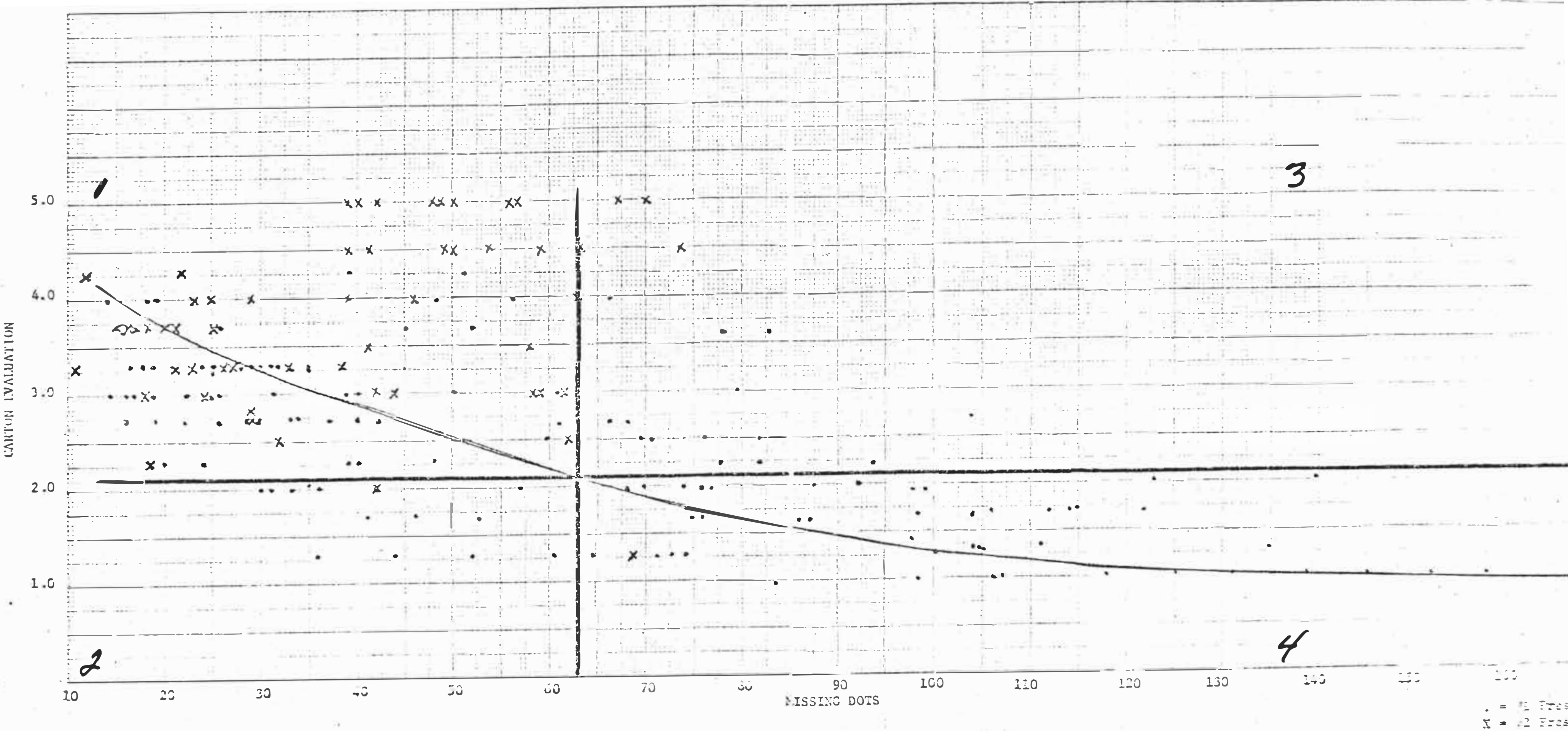
5. Cell dimensions - see Appendix #2.



CARTON EVALUATION
5.0
4.0
3.0
2.0
1.0
10
20
30
40
50
60
70
80
90
100
110
MISSING DOTS

FIGURE #2


1.000
.900
.800
.700
.600
.500
.400
.300
.200
.100
.000
COEFFICIENT OF CORELATION
Perfect Corelation
IGT-HELIOTEST
KELLOGG'S
CURRENT
TEST
SUPPLIER #2
SUPPLIER #1
Statistically
Significant
Level


CARTON EVALUATION
MISSING DOTS
5.0
4.0
3.0
2.0
1.0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
1
2
3
4

DISCUSSION

The test data in Figure #1 compares production carton evaluation with missing dots. Kellogg's #1 and #2 gravure presses' combined coefficient of correlation for the test is .667. This is considerably better than Kellogg's current test, and our two major board suppliers' tests.

For a comparison of correlation between different tests and production cartons, see Figure #2.

There appears to be a different best-fit curve for data generated from each press. As compared to #1 press, #2 press will produce better cartons using the same quality board; or, will print equal quality cartons using inferior quality board. From past experience, I believe #1 press is typical of gravure presses currently printing Kellogg cartons. #2 press is an exception. It will be a challenge for Kellogg's to identify what is causing the difference between the two presses.

Acceptance program limits have been set in Figure #3. The minimum acceptance level for carton evaluation was designated at 2.1. Using best-fit curve for #1 press, the curve and 2.1 intersect at 60 missing dots.

Using 60 missing dots as maximum acceptance level, 79.2% (quadrants #1 and #4) of the test results accurately predicted how the board would print in production -- acceptable or unacceptable.

Quadrant #3 represents 13.3% of all samples. These samples would probably be retested, and likely pass on a recheck.

Testing failure, represented in quadrant #2, would occur 7.5% of the time. The test predicted good printability; however, cartons printed were unacceptable. There are two reasons for data in this quadrant:

1. The test failed to accurately predict poor printing board.

2. The gravure press not operating up to normal capability -- did not print acceptable board in an acceptable manner.

I'm sure both reasons accounted for some of the data in this quadrant.

When an acceptance program is initiated, this type of work will be performed for each press. Maximum acceptance limits will be set depending on press capability, and the degree of difficulty for a particular carton copy.

COMMENTS

A survey is underway of equipment to automatically count dots for this test.

There have been different approaches to the problem. Optical scanners and laser-type equipment have been investigated to see if a modified network of dots can be automatically counted. Another approach is to see if the optical scanner can count the missing dots in the variable screen on the current cylinder.

If an automatic counter can be developed, testing capacity can be increased significantly. This will, hopefully, improve testing effectiveness even more.

An automatic counter will make the test economical to run, as well as tremendously improving our acceptance program for gravure carton board.

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APPENDIX #1

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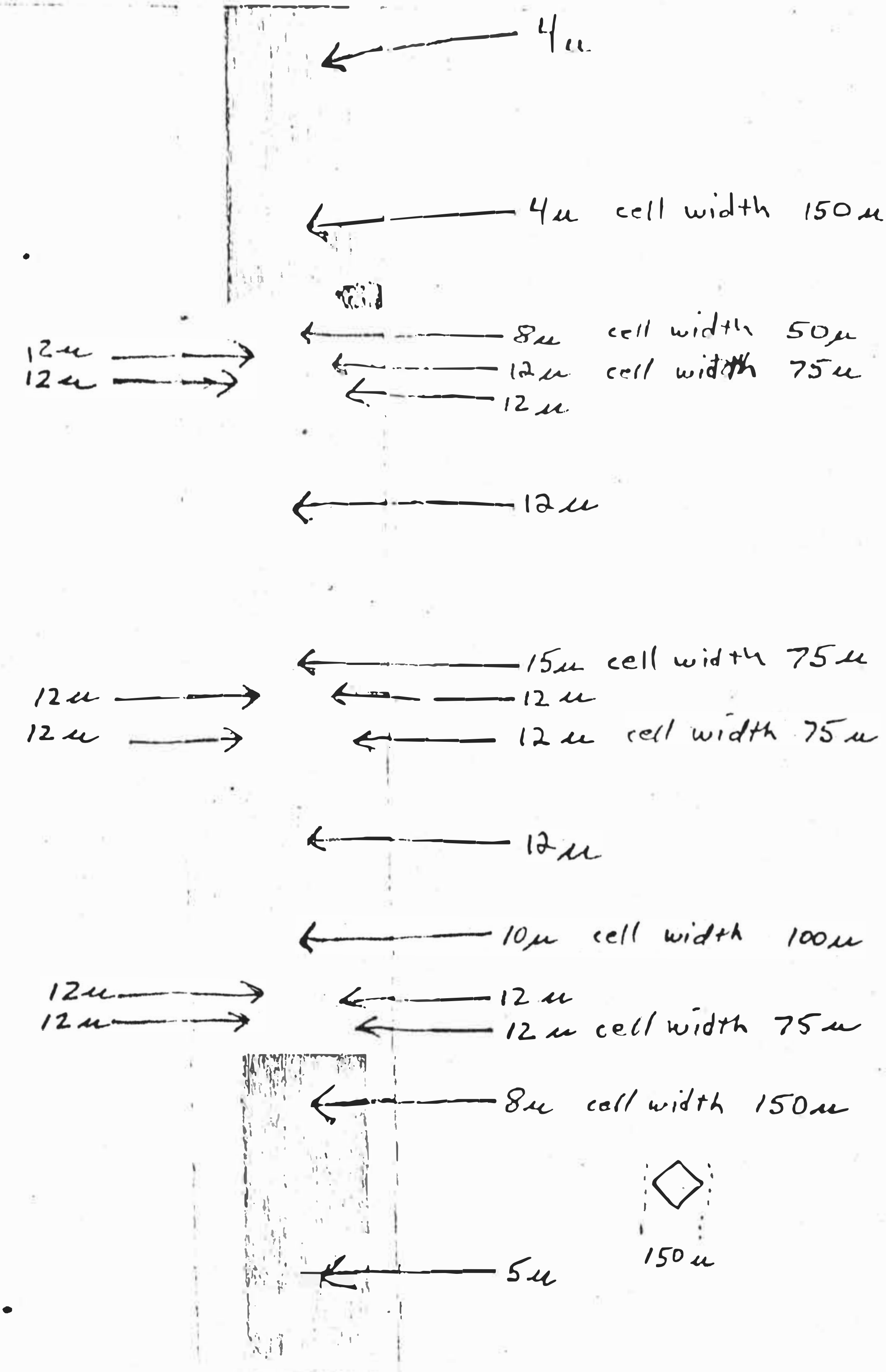
Cross Direction

Test Strip Sample

APPENDIX #2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150u
5u