6-1959

Printing Quality as Determined by the I.G.T. Tester

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PRINTING QUALITY AS DETERMINED BY THE I.G.T. TESTER

A

DISSERTATION

SUBMITTED TO THE FACULTY

OF

WESTERN MICHIGAN UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE PREREQUISITES

FOR THE DEGREE

OF

BACHELOR OF SCIENCE

JUNE 8, 1959 KALAMAZOO, MICHIGAN

ACKNOWLEDGMENT

The writer wishes to express his sincere appreciation to Dr. Robert A. Diehm for his advice and assistance. I would also like to thank the Kalamazoo Paper Company for making paper available to me.

ABSTRACT

Investigation of this method for the determination of printability indicates that it can be used to predict the printability of paper. However, since it lacks numerical rating, the visual evaluation depends finally upon the personal judgment of the investigator.

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Literature Survey

INTRODUCTION

The evaluation of printability of papers is a problem which has plagued the printer and paper maker for a good many years. Although a great many advancements have been made in the manufacture of paper and printing of paper, no one has as yet formulated an evaluation of printability which would satisfy all concerned.

The problem does not seem able to be resolved into one single definition of printability which would be all inclusive for all types of printing to be done. Each particular type of printing process, typographic, offset, and gravure require different properties of the sheet. In keeping with this, there is no one test or analysis of paper which would be able to tell a printer or a manufacturer how well a sheet will print.

Previously work on evaluation has been done on the Vandercook Proof Press. The I.G.T. tester which will be used in this thesis, is a relatively new instrument and very little printability evaluation has been done that has been published.

PRINTABILITY

Much has been written and spoken by experts along the lines of printability of ink and paper and while there are still vast areas in which we need technical enlightenment and understanding, much has been learned to clarify problems of mutual interest to printer, ink manufacturer and paper maker. These three industries realize that in a definite sense they are interdependent and thus they should work together in the harmony of enlightenment and knowledge of each other's problems.

Some of the more notable contributions by individuals considered expert in their field included investigation into such subjects as (a) printing quality evaluated in terms of halftone reproduction, (b) a comparison of the three systems of printing halftones, (c) the influence of paper properties on dot reproduction, (d) ink transfer, (e) print-through and picking.(1)

Printability is often confused with printing quality and evaluated by several of the same basic methods. Reed(2) defines it as - "the combined properties and condition of paper that affect its press performance." Lewis and Eckhart(3) have worked on the printability of board and define board printability as - "the ease with which the board reaches optimum printing smoothness under specific proof press inking and printing conditions."

Rupp(4) defines printability as - "the suitability of a paper-ink-press combination to give reprints of a desired quality and quantity."

Andella(5) describes the property as "the quality in paper that lends itself well to faithful reproduction by possessing the necessary affinity to accept an ink from a printing plate and properly hold the full color values of the halftone dot structure."

The Printing Ink Institute prefers to define printability in terms of print quality, runability and post press performance. The print quality part reveals whether a paper-ink combination produces the desired quality when the plate is properly engraved and made ready. Runability reveals whether the desired quantity of prints can be produced and included factors such as uniformity of a lot of paper, stability of the ink, wear of the plate and picking. Post press performance reveals whether the print offsets, fades, etc.(6)

Kantrowitz[7] arranges the tests for evaluating this property into three groups: (a) physical tests for determination of durability, (b) chemical tests for evaluation of performance, (c) tests for evaluating printing properties. In general the related properties are strength, smoothness, ink receptivity and pick strength.

METHODS OF EVALUATION

Early work on evaluation of printability was done by P.H. Prior in 1934. Prior pointed out that the performance of paper in the printing press could be predicted with the use of a hand operated proof press, standard ink, ink film and printing pressure. Bekk developed the techniques further and measured the blackness of the resulting print by means of a reflection meter.

Fetsko, Walker and Zettelmoyer[9] did evaluation work on a proof press controlling the variables of printing pressure, speed and ink film thickness. This work involved correlating the static pressure with dynamic pressure using strain gage and Brush strain analyzers. Speed was handled by measuring the time of passage of the cylinder over the plate with an electric stopclock. The ink film was determined by direct weighing of the ink on the plate after establishing that resting of the particular ink does not affect results. Use of the technique in a constant temperature and humidity room has produced highly reproducible results.

Laroque[8] investigated printability farther with emphasis placed upon the printing pressure and its effect upon the finished sheet. He found that smoothness is the most important single factor in determing the satisfactory transfer of ink to a sheet having good uniformity of appearance in the printed solids and in halftones. He has found that softness is of secondary influence in modifying the printing quality of the sheet. He.

feels that the product of the smoothness and softness tests presents a better picture of the printing operation since existing smoothness measurements are not obtained in the range of pressures expected in this operation. This product correlates well within the numerical determination of printing quality obtained by counting the number of missing dots in a given area of the printed sheet.

Berberich and co-workers[10] using the method described by Weymouth for the use of a Vandercook No. 14 proof press, carried out extensively experiments on halftone reproduction. However, this method depended upon the opinion of several qualified observers.

RECENT DEVELOPMENTS

In order to obtain impartial numerical evaluation of the printed sheet, recent investigations have been concerned primarily with the printed, unprinted, solid and halftone areas of the test sheets printed on a proof press.

In general the properties investigated by most investigators are color, gloss, uniformity and sharpness of outline, print-through, tone value and contrast.[11]

Numerical evaluation of solid print has been studied by Bekk and Buchdahl and co-workers[12] who chose a rather tedious photographic density method of evaluating the uniformity of print.

They were interested in the halftone evaluation. This experiment was based upon the assumption that the tone value of the print should correspond to those of the plate. Using a plate consisting of halftone blocks and solid areas and a picture for subjective evaluation, they plotted the actual tone densities of the print, measured by a spectrophotometric brightness method against the densities predicted by the plate. The results of this method did correspond well with the subjective evaluation.

Diehm[13] suggests that a plate containing halftone blocks of different line screen and percent coverage should be used in the determination of printing quality. Analysis of ink coverage is made with a brightness tester. The halftone pattern is analyzed and numerically ranked for "printing fidelity" with a hand lens.

The three factors involved in this test are: (a) presence or absence of dots, (b) dot size, (c) dot irregualrities.

"These operations permit a new definition of printing quality based on ink coverage and print fidelity. Printing quality is the percent ink coverage obtainable in perfect print fidelity. It is expressed numerically by:

$$\text{Print quality} = \frac{\text{Ink Coverage} \times \text{Print Fidelity}}{76} \times 100$$

This test is simple and can be performed rapidly in the lab equipped with a proof press. It is recognized that this test should be supplemented by tests relating to the desired physical and chemical properties of the paper."

1. Hersher, P.H., "Paper As Concerns Printability and Ink" TAPPI 38, No. 6; 135A (1955)

2. Reed, R.F., "Coated Paper Properties and Their Relations to Printability and Print Quality in Lithography" TAPPI 38, No. 11; 648 (1955)

3. Lewis and Eckhart, "End of Machine Control Tests for Boxboard Printability and Scoreability" TAPPI 39, No. 10; 22A (1956)

4. Rupp, E., Archives for Printing, Paper and Kindred Trades 1, No. 2:166 (1955)

5. Andella, D.J., "Evaluation and Analysis of Printing Results," Paper Trade Journal 128, No. 4;23 (January 27, 1949)

6. Zettlemoyer, A.C. and Fetsko, J.M., "Letterpress Printability Studies at N.P.I.R.I." TAPPI 39, No. 10:28A (1956)

7. Kantrowitz, M.S., "Paper Testing in Relationship to End Use", Paper Trade Journal, 128, No. 25:84 (1949)

8. Laroque, G.L., Axelrod, B. and Clark S., "Measuring the Printing Quality of Newsprint" Pulp and Paper Magazine of Canada, 52, No. 3:166(1951)

9. Fetsko, J.M., Waler, W.C. and Zettlemoyer, A.C., "Techniques for Controlling Laboratory Printing Conditions" TAPPI 39, No. 4:220 (1956)

10. Berberich, O.P., Englehart, L.F. and Zucker, M., "Testing Printability of Paper with Ink II" Technical Association Papers, Series 31:28 (1948)

11. Fetski, J.M., "Printing Ink Paper Relationships III Critical Literature Survey" N.P.I.R.I. Project Report No. 23 (1953)

12. Buchdahl, R., Polglase, M.F. and Schwalbe, H.C., "The Measurement of Tone Reproduction of Half-Tone Prints and Uniformity of Solid Prints," Paper Trade Journal, 122, No. 18:41 (1946)

13. Diehm, R.A. "The Elimination of the Human Element in the Determination of Print Quality" TAPPI 33, No. 2:47 (1950)

EXPERIMENTAL WORK

A study of existing literature pertaining to the evaluation of printing quality of paper using the I.G.T. instrument showed that no previous work had been published using this instrument as a means of evaluating the printing quality of paper. Considerable work had been done using proof press and halftone plates procedures which was helpful but not pertinent to my plans.

A printing wheel incorporating a halftone screen with various degrees of etch was obtained so that the samples could be printed on the I.G.T. instrument. Coated and uncoated papers were obtained to be used in these evaluations as was a sufficient supply of standard ink.

PROCEDURE ESTABLISHED

Since no literature was available with the halftone wheel provided by the manufacturers of the I.G.T. instrument pertaining to the amount of ink applied initially to the inking apparatus and the amount of ink which should be applied after subsequent trials it was necessary to determine this information by trial and error.

This procedure was found satisfactory:

1. Initial application of 0.5 cc of ink to the inking apparatus with a ten minute period for ink distribution.
2. Inking of the printing wheel for a period of 90 sec.
3. After four inkings of the printing wheel an application of 0.09 cc of ink to the inking apparatus followed by a five minute period for ink distribution.

It was found that samples printed at constant pressure with the use of this inking procedure gave consistent printing results when evaluated with the aid of a hand lens for dot reproduction, dot size, and uniformity of dot outline.

PRINTING PROCEDURE

The printing procedure used was one in which the ink, speed, and paper were kept constant while the pressure was varied.

It was decided to use only the low range speed of the pendulum weighted sector and a number two tack ink on all trials.

Samples to be evaluated were cut into strips 1-1/3 inches by 12 inches. Using the inking procedure previously cited these strips were then printed under pressure settings beginning at 5 kg. The pressure settings were then increased in increments of 5 kg until a setting of 55 kg was obtained with a strip being printed at each new setting. This gave a total of 11 printed strips per sample printed over a pressure range of 5 kg to 55 kg.

EQUIPMENT USED:

I.G.T. Inking Apparatus
I.G.T. Printing Apparatus
I.G.T. Measuring Pipette
Printing Wheel With Halftone Screen
of 10-50-70-90% Etch

EVALUATION

The basic theory involved in this evaluation is that good print quality will be obtained when the printing pressure is such that contact is made between the entire printing surface and the paper, or when printing smoothness is achieved.

Upon completion of the printing of samples the strips were then examined visually with the aid of a hand lens. The strips were examined so as to determine the least pressure at which each particular degree of etch would print with fidelity. The areas of each etch were evaluated for uniformity of dot reproduction, uniformity of dot size, and uniformity of dot outline.

TABLE OF RESULTS

The printed samples were examined to determine the least pressure at which each degree of etch would best print. The strips were evaluated visusally with the aid of a hand lens. The areas were examined for dot reproduction, uniformity of dot size, uniformity of dot outline and continuity of reproduction.

EVALUATION OF COATED SAMPLES

(Minimum Pressure Required to Print Each Etch Satisfactorily)

Sample No.	10% Etch	50% Etch	70% Etch	90% Etch
344	25 kg.	25 kg.	25 kg.	35 kg.
707	15	30	45	50
736	20	30	35	40
819	10	20	25	40
358	25	30	30	50
78	15	20	25	45
616	15	25	35	40
324	25	30	40	55
9882	15	25	35	45
9869	25	30	30	40
9874	10	20	25	40
9255	20	30	30	50
9278	15	30	35	55
9266	10	20	30	50
9270	15	30	35	50
9296	15	25	30	45
9391	25	25	30	45
9204	15	20	30	45
9259	10	25	35	50

EVALUATION OF UNCOATED SAMPLES

(Minimum Pressure Required to Print Each Etch Satisfactorily)

Sample No.	10% Etch	50% Etch	70% Etch	90% Etch
9963	45 kg.	-	-	-
8391	25	55 kg.	-	-
8357	40	-	-	-
1334	30	30	40 kg.	50 kg.

KG. SETTINGS IN POUNDS/SQ. IN. EQUIVALENTS

5 kg.	- 287 psi	35 kg.	- 697 psi
10	- 287	40	- 763
15	- 430	45	- 859
20	- 458	50	- 956
25	- 523	55	- 1051
30	- 619		

A perusal of this table shows that each sample required different pressures to satisfactorily print each particular etch. To illustrate it will be noted that sample no. 344 required a 10 kg. pressure range to print all etches while sample no. 9266 required a range of 40 kg. It will also be seen that sample no. 344 required a maximum pressure of 35 kg. while the maximum pressure required for sample no. 9266 was 50 kg.

Printing of the uncoated samples showed that regardless of the pressure applied it was not possible to print all etches indicating that the softness of the sheet is secondary to smoothness in printing performance.

CONCLUSION

The experimental results indicate that papers requiring a narrow range of pressures to print all degrees of etch satisfactorily would perform better under actual press conditions and give better print reproduction than paper samples which would require a widely dispersed range of pressures to give the same quality of print reproduction on the I.G.T. instrument.

This method of printing with its visual evaluation procedure gives a significant indication of the importance of printing pressure to printing quality because it permits the visual evaluation of several important properties.

This method can be used to predict the printability of paper. However, since it lacks numerical rating, the evaluation depends finally upon the personal judgment of the investigator.

June 8, 1959

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