Analysis of Text reproduction by Braille Embossing and Tactile printing by screen printing method

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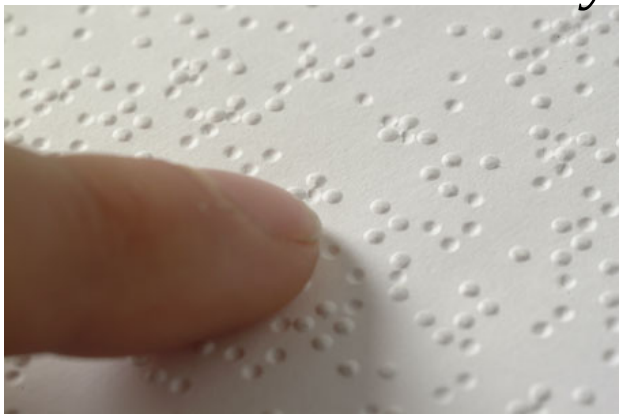
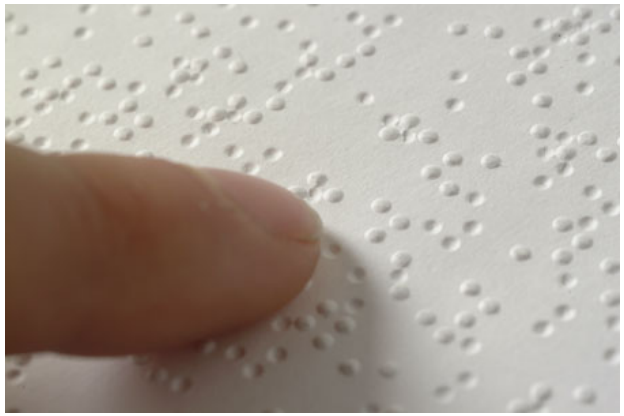
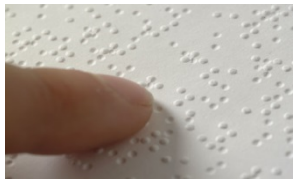


INDEX

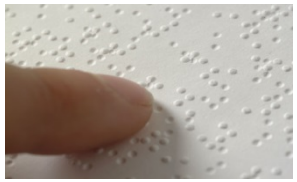
- INTRODUCTION
- OBJECTIVE
- LITERATUTRE REVIEW
- METHODOLOGY
- EXPERIMENTATION
- ANALYSIS
- RESULTS
- CONCLUSION
- REFERENCES





INTRODUCTION

- More than 7.8 million Indian population : Completely blind
- Braille embossing : One of the major techniques used for text reproduction
- Economical class of Blind population
- High cost of reproduction



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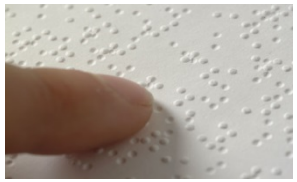
- Cost of embossing machine
- Cost of substrate used for Braille embossing
- Life expectancy of Braille embossed book
- An alternate cost effective solution for text needs is worth investigating



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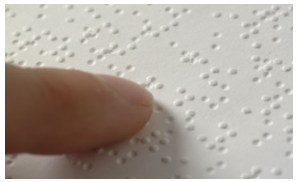
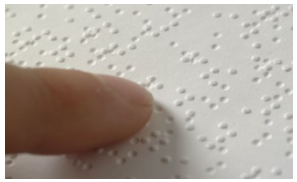
- Tactile printing :Alternate method?
- Primarily used for graphic reproduction
- Tactile reproduction processes
- Application of Tactile printing otherwise



OBJECTIVE

- Analysis of Text reproduction by Braille Embossing and Tactile printing by screen printing method

- Suggest an economical alternate method



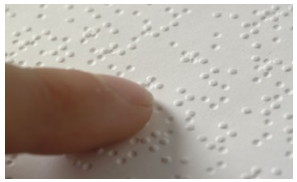
LITERATURE REVIEW

Braille system:
Grade1, Grade 2, Grade 3

Reading and Writing Braille methods

Standards for Braille Reproduction

Braille embosser



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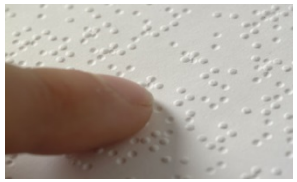
- Tactile Printing Technique
- Gross applications
- Screen Printing Technology
- Other methods to reproduce Tactile Print



Comparison
Embossing Vs TactilePrinting

Embossing

•Dot is produced by mechanical embossing

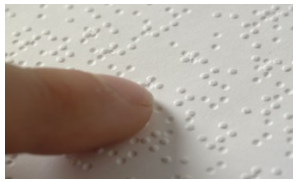
•Volume of printed book; less

•Easy to handle and carry

•More cost effective

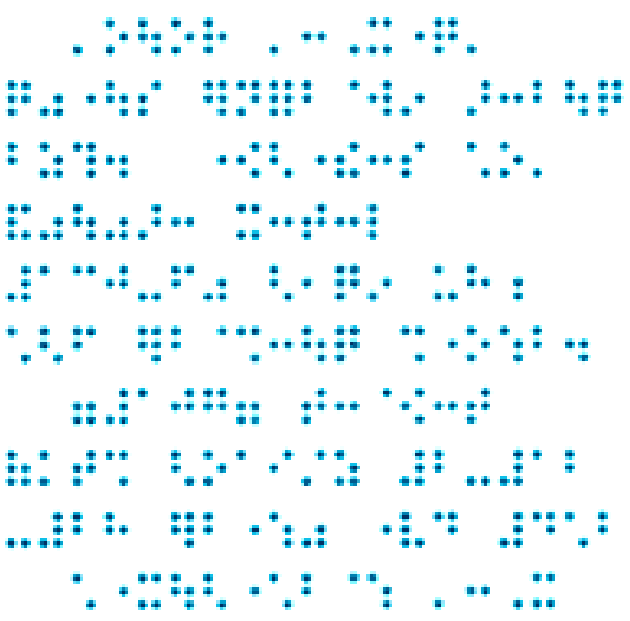
Tactile Printing

- Dot is printed by Ink/ varnish
- Volume of printed book: large
- Difficult to handle and carry
- Less cost effective

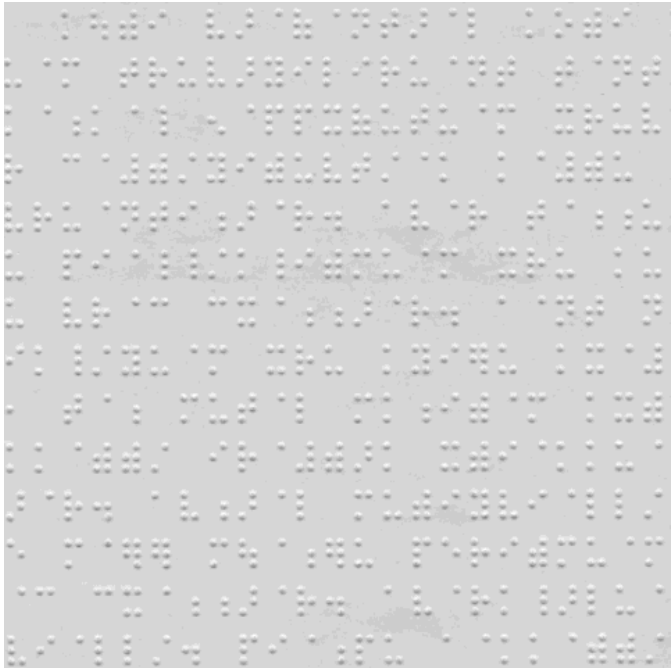


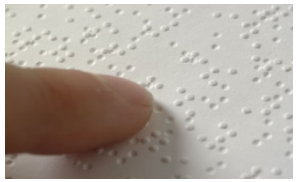
Comparison
Embossing vs Tactile Printing

Embossing



Tactile Printing

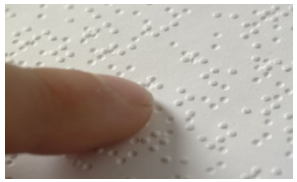




METHODOLOGY

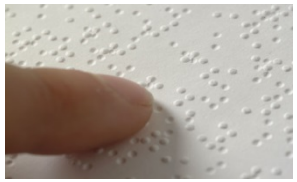
- Machines Used:
- Semi-automatic Screen printing machine

- UV Dryer



METHODOLOGY

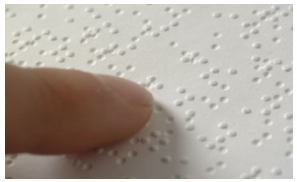
- Materials Used:
- Screen Mesh: 43” and 24”
- Fat Film: 200 and 300 MICRONS
- UV Varnish: Abrasive and Crystal
- Art Coated Paper: 90 and 130 GSM



EXPERIMENTATION

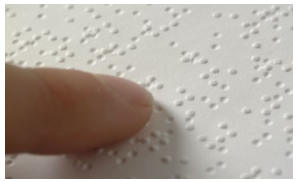
- Design of Experiment:
- 4 factors/variables ; each at 2 levels:

• Film thickness	200 microns	300 microns
• Varnish used	Crystal	Abrasive
• Substrate	90 gsm	130 gsm
• No of impressions	01	02



EXPERIMENTATION

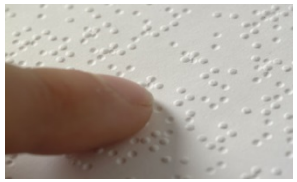
- Full Factorial Design
- Total 16 Runs 10 replicates of each run
- Thus total 160 replicates
- Each sheet was measured at 5 points
- Response :Dot height in microns



EXPERIMENTATION

For Ex: Crystal varnish, single impression 90gsm, 300 micron film

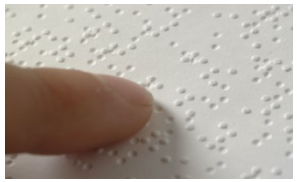
sheet no	dot 1	dot 2	dot 3	dot 4	dot 5
1	290	280	270	240	230
2	290	290	270	250	220
3	280	270	290	260	250
4	290	290	300	250	280
5	270	280	290	270	250
6	310	250	290	250	260
7	270	260	280	250	260
8	280	270	260	270	250
9	270	280	300	270	250
10	300	290	280	260	250
11	300	260	290	250	260
12	280	260	290	240	250



EXPERIMENTATION

Braille embossed dot

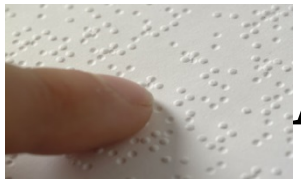
sheet no	dot 1	dot 2	dot 3	dot 4	dot 5
1	360	350	340	320	350
2	330	350	310	330	330
3	360	400	350	400	360
4	380	370	400	370	350
5	320	350	330	380	350
6	370	370	370	330	400
7	350	350	370	370	400
8	370	340	360	380	380
9	360	380	320	380	380
10	380	370	350	370	390
11	350	370	350	370	330
12	360	370	390	350	380



ANALYSIS: Objective Method

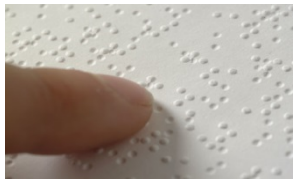
Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Model	12	700927	58411	149.86	0.000
Linear	4	665702	166426	426.98	0.000
Substrate	1	57381	57381	147.21	0.000
Varnish	1	118266	118266	303.42	0.000
Film Thickness	1	45901	45901	117.76	0.000
Impressions	1	444156	444156	1139.52	0.000
2-Way Interactions	6	21884	3647	9.36	0.000
Substrate*Varnish	1	1626	1626	4.17	0.043
Substrate*Film Thickness	1	2481	2481	6.36	0.013
Substrate*Impressions	1	3151	3151	8.08	0.005
Varnish*Film Thickness	1	10726	10726	27.52	0.000
Varnish*Impressions	1	3901	3901	10.01	0.002
Film Thickness*Impressions	1	1	1	0.00	0.968
3-Way Interactions	2	13341	6671	17.11	0.000
Substrate*Varnish*Film Thickness	1	7701	7701	19.76	0.000
Substrate*Film Thickness*Impressions	1	5641	5641	14.47	0.000
Error	147	57297	390		
Lack-of-Fit	3	1667	556	1.44	0.234
Pure Error	144	55630	386		
• Total		159	758224		



ANALYSIS: Objective Method

- **Session:**
- Analysis of Variance Table
- Shows “P” value. P value should be less than alpha. Alpha value is set at .05 (with confidence interval of 0.95). It indicates that the factors are significant.
- The table thus shows all P values, less than alpha.
- Annova table also displays Lack of Fit: If the value is greater than alpha for “Lak of Fit” ,it inculcates that, one cannot conclude that the model does not fit the data well. In this case the P value is 0.234, indicating the probability of model, fitting the data that is being Adequate



ANALYSIS: Objective Method

- **Summary:**
- Indicates the Value of “R square adjusted”. It indicates the strength of relationship between the Response, which is dot height and the predictor or independent variables which are; ; Substrate gsm, varnish, no. of impressions and film thickness. The achieved value is 91.83, indicating the strong relationship. Value above 81 is generally recommended.
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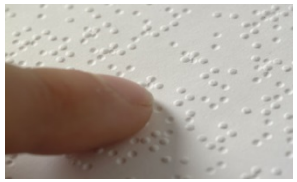

ANALYSIS: Objective Method

- **Model Summary**

S	R-sq	R-sq (adj)	R-sq(pred)
19.7427	92.44%	91.83%	91.05%

- **Summary:**
- Indicates the Value of "R square adjusted". It indicates the strength of relationship between the Response, which is dot height and the predictor or independent variables which are; ; Substrate gsm, varnish, no. of impressions and film thickness. The achieved value is 91.83, indicating the strong relationship. Value above 81 is generally recommended.

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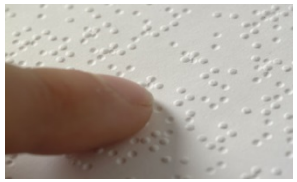


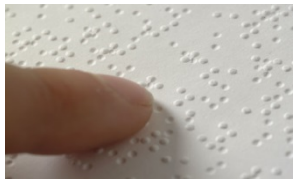
ANALYSIS: Objective Method

- **Regression equation:**
  Regression Equation in Uncoded Units

- Dot height = 278.1 - 0.037 Substrate + 159.5 Varnish - 0.094 Film Thickness
  + 191.9 Impressions - 1.575 Substrate*Varnish
  + 0.00394 Substrate*Film Thickness - 1.262 Substrate*Impressions
  - 0.599 Varnish*Film Thickness + 4.94 Varnish*Impressions
  - 0.654 Film Thickness*Impressions
  + 0.00694 Substrate*Varnish*Film Thickness
  + 0.00594 Substrate*Film Thickness*Impressions

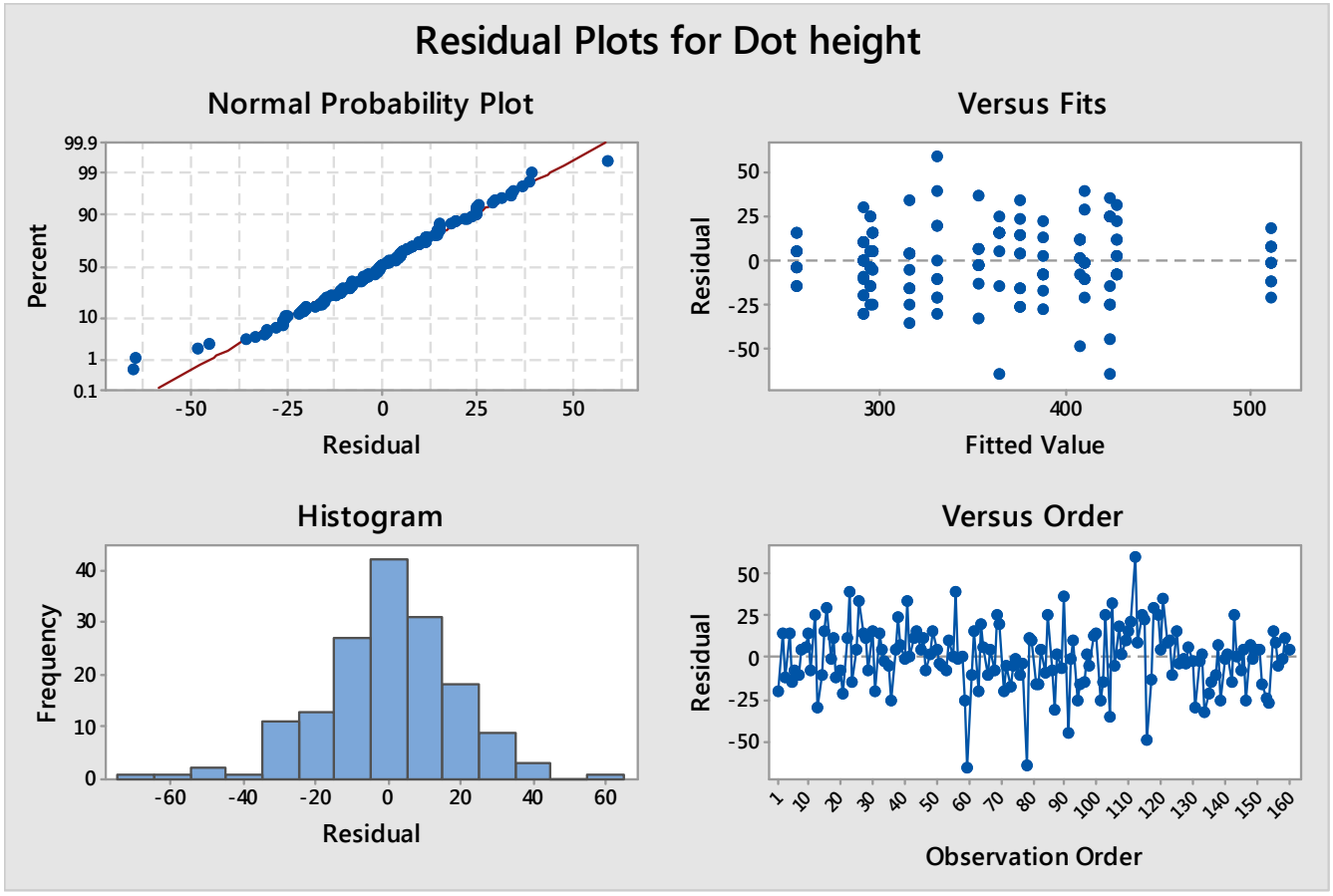
Regression equation:

- First term is a constant and other terms show the multiplier for every variable (ofcourse along with variable); displaying the coefficient or average effect



ANALYSIS: Objective Method

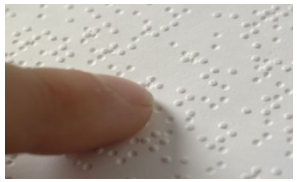
- Residual Plots for Dot height



Graphs:
Normal Probability plot: Indicates error is normally distributed

Histogram: Indicates the data fits on bell shaped curve, thus again normally distributed

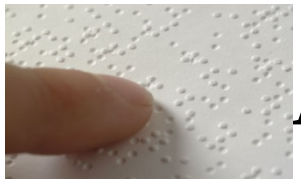
Versus fit and versus order: Indicates that the error is randomly distributed. There is no hysterosedisticity, i.e. there is no specific pattern; increasing or decreasing.



ANALYSIS: Objective Method

- **OBJECTIVE ANALYSIS SUMMERY**
-
- The study of production houses however reveals that an average dot height of 350 microns is produced.
- We achieved following dot height. By using screen printing process.

Sr,	SAMPLE NO	AVG. DOT HEIGHT
1	Abrasive double impression130 gsm,300micron	510 micron
2	Crystal double impression 130 gsm,300 micron	440 micron,
3	Abrasive double impression130 gsm,200 micron	420 micron,
4	Abrasive double impression 90 gsm,200 micron	410 micron
5	Crystal double impression130 gsm,200 micron	390 micron
6	Crystal double impression 90 gsm,300micron	390 micron
7	Crystal double impression 90 gsm,200 micron	390 micron
8	Abrasive double impression 90 gsm,300micron	380 micron
9	Abrasive single impression 130 gsm,300 micron	350 micron
10	Abrasive single impression 130 gsm,200 micron	320 micron
11	Abrasive single impression 90 gsm,300micron	320 micron
12	Crystal single impression130 gsm,200 micron	310 micron
13	Abrasive single impression 90 gsm,200 micron	300 micron
14	Crystal single impression 130 gsm,300 micron	290 micron
15	Crystal single impression 90 gsm,200 micron	270 micron
16	Crystal single impression 90 gsm,300micron	270 micron

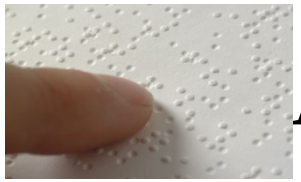


ANALYSIS: Subjective Method

The printed samples were given to readers for getting “hands on” experience and feedback

Reading tactile printed sample of 200 micron flat film And Paper 130 GSM

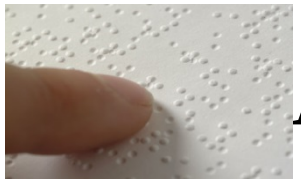
Sample	**Reader 1**	**Reader 2**	**Reader 3**	**Reader 4**	**Reader 5**
Abrasive single impression	Yes Probably	Yes Probably	Yes Probably	Yes Probably	Yes Probably
Abrasive double impression	Yes Probably	Yes Definitely	Yes Definitely	Yes Definitely	Yes Definitely
Crystal single impression	Definitely Not	Yes Probably	Definitely Not	Definitely Not	Yes Probably
Crystal double impression	Probably Not	Yes Probably	Yes Probably	Yes Probably	Yes Probably



ANALYSIS: Subjective Method

Reading tactile printed sample of 200 micron flat film And Paper 90 GSM

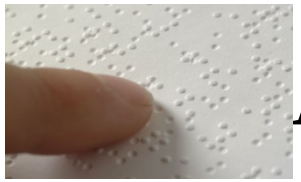
Sample	**Reader 1**	**Reader 2**	**Reader 3**	**Reader 4**	**Reader 5**
Abrasive single impression	Yes Probably	Definitely Not	Yes Probably	Definitely Not	Definitely Not
Abrasive double impression	Yes Probably	Yes Definitely	Yes Definitely	Yes Definitely	Yes Probably
Crystal single impression	Definitely Not	Definitely Not	Yes Probably	Definitely Not	Definitely Not
Crystal double impression	Yes Probably	Yes Probably	Definitely Not	Yes Probably	Yes Probably



ANALYSIS: Subjective Method

Reading tactile printed sample of 300 micron flat film
And Paper 90 GSM

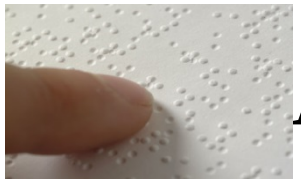
Sample	**Reader 1**	**Reader 2**	**Reader 3**	**Reader 4**	**Reader 5**
Abrasive single impression	Yes Probably	Yes Probably	Yes Probably	Yes Probably	Yes Probably
Abrasive double impression	Yes Probably	Yes Probably	Yes Probably	Yes Definitely	Yes Probably
Crystal single impression	Definitely Not	Definitely Not	Yes Probably	Definitely Not	Yes Probably
Crystal double impression	Yes Probably	Yes Probably	Yes Probably	Yes Probably	Yes Probably



ANALYSIS: Subjective Method

Reading tactile printed sample of 300 micron flat film
And Paper 130 GSM

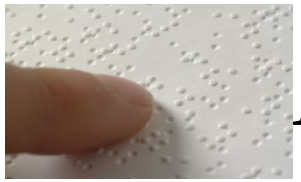
Sample	**Reader 1**	**Reader 2**	**Reader 3**	**Reader 4**	**Reader 5**
Abrasive single impression	Yes Probably	Yes Probably	Yes Probably	Yes Probably	Yes Probably
Abrasive double impression	Yes Definitely	Yes Definitely	Yes Definitely	Yes Definitely	Yes Definitely
Crystal single impression	Definitely Not	Definitely Not	Yes Probably	Definitely Not	Yes Probably
Crystal double impression	Yes Probably	Yes Probably	Yes Probably	Yes Probably	Yes Probably



ANALYSIS: Subjective Method

Summary:

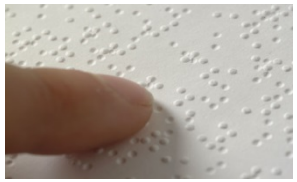
Sr,	SAMPLE NO	RESULT of reader in (%)
1	Abrasive single impression 130,200 micron	Yes Probably (100%)
2	Abrasive double impression130,200 micron	Yes Definitely (80%)
3	Crystal single impression130,200 micron	Definitely Not (50%)
4	Crystal double impression130,200 miron	Yes Probably (75%)
5	Abrasive single impression 90,200 micron	Definitely Not (60%), Yes Probably (40%)
6	Abrasive double impression 90,200 micron	Yes Definitely (60%), Yes Probably (40%)
7	Crystal single impression 90,200 micron	Definitely Not (80%), Yes Probably (20%)
8	Crystal double impression 90,200 micron	Yes Probably (80%),
9	Abrasive single impression 130,300 micron	Yes Probably (100%),
10	Abrasive double impression130,300micron	Yes Definitely (100%),
11	Crystal single impression 130,300 micron	Definitely Not (60%), Yes Probably(40%)
12	Crystal double impression 130,300 micron	Yes Probably (100%)
13	Abrasive single impression 90,300micron	Yes Probably (100%)
14	Abrasive double impression 90,300micron	Yes Probably (80%), Yes Definitely (20%),
15	Crystal single impression 90,300micron	Definitely Not (60%), Yes Probably (40%)
16	Crystal double impression 90,300micron	Yes Probably (100%)



ANALYSIS:Commercial/Costing

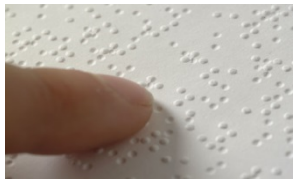
- **Screen printing process**
- Approximate cost/printed sheet/ single impression =**Rs.1.44/-**
- Approximate cost/printed sheet/ Double impression =Rs.2.06/-

- **Embossing Process**
- Approximate cost/printed sheet =**Rs. 2.50/-**



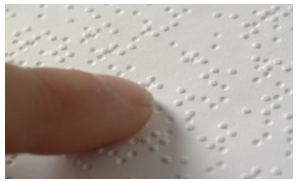
Comprehensive Analysis for best trial based on Objective, Subjective and costing comparison

Sr, No.	SAMPLE NO	Objective avg dot height	Subjective analysis	Cost per sheet
1	Abrasive double impression130,300micron	510 micron	(Yes definitely 100%)	2.06
2	Crystal double impression 130,300 micron	440 micron,	(Yes probably 100%)	2.06
3	Abrasive double impression130,200 micron	420 micron,	(Yes probably 20%& Yes definitely 80%)	2.06
4	Abrasive double impression 90,200 micron	410 micron	(Yes probably 40%& Yes definitely 60%)	2.06
5	Crystal double impression130,200 micron	390 micron	(Yes probably 100%)	2.06
6	Crystal double impression 90,300micron	390 micron	(Yes probably 75%)	2.06
7	Crystal double impression 90,200 micron	390 micron	(Yes probably 80%)	2.06
8	Abrasive double impression 90,300micron	380 micron	(Yes probably 80%& Yes definately20%)	2.06
9	Abrasive single impression 130,300 micron	350 micron	(Yes probably 100%)	1.44
10	Abrasive single impression 130,200 micron	320 micron	(Yes probably 100%)	1.44
11	Abrasive single impression 90,300micron	320 micron	(Yes probably 100%)	1.44
12	Crystal single impression130,200 micron	310 micron	(Yes probably 60%)	1.44
13	Abrasive single impression 90,200 micron	300 micron	(definitely not 60%)	1.44
14	Crystal single impression 130,300 micron	290 micron	(definitely not 60%)	1.44
15	Crystal single impression 90,200 micron	270 micron	(definitely not 60%)	1.44
16	Crystal single impression 90,300micron	270 micron	(definitely not 80%)	1.44



CONCLUSION

- The analysis revealed the dot height 510 microns with 130 gsm paper and 300 micron film thickness with double impression and abrasive varnish. This is in comparison with the standard which specifies 480 micron dot height for Braille.
- The study of production houses however reveals that an average dot height of 350 microns is produced. Thus an improved height of 380 microns is also achieved with the combination of 90 gsm paper, abrasive varnish, 300 micron film and double impression.



CONCLUSION

- Thus, the improvement of more than11.5 % was observed in tactile printing as compared to Braille embossing in the first case .and second case improvement of dot more than 8.57% respectively.
- The cost effectiveness is same as first and second case if compared with Braille embosser and is 11.5% more economical.
- Third case exact dot height reproduction 350 micron is also achieved which yields an economical edge of as high as 42% over Braille embosser with Abrasive varnish single impression 130gsm, 300 micron.

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THANK YOU!!