RYETAGA 2017

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TABLE OF CONTENTS

THE PRESIDENTIAL ADDRESS

Dear TAGA,

This year has been one of challenges – one of teams in flux and one of experiential learning. From these myriad challenges and obstacles to overcome, this team of talented individuals that I have had the distinct pleasure and decoration to lead have shown me time and time again that they are committed to an industry as varied in skillset and regimen as they are.

Their efforts have not gone unnoticed – things were done differently this year from any year previous. With the loss of a Co-President and the implementation of an organizational structure unseen in RyeTAGA prior, this team has truly risen to the occasion, and have differentiated themselves in my eyes as true leaders of this industry that embraces pillars of change, versatility, and adaptation.

As we prepare to travel to this annual conference filled with the best the industry has to offer, it is humbling to look upon the aid and support we have received – not just from our associates and general members, but also from our sponsors without whom we would not be able to produce a journal meeting the standards of TAGA and its delegates.

I am incredibly proud to share with you this offering from the entire team here at RyeTAGA – a true testament to that which can result from hard work and dedication from the executive team, associates, and authors alike.

Kind regards,

Jeremy Pagé,
RyeTAGA President

A LETTER FROM THE FACULTY ADVISOR

Dear TAGA,

As a student member in the past, I feel so honoured to have the opportunity of being a part of RyeTAGA once again, now as a faculty advisor. This year we have an excellent team and it is amazing to see the members work together to publish the journal and prepare for the conference. Despite a challenging year with many obstacles, the executives have really gone above and beyond to meet their deliverables.

From 3D printing letterpress type to testing accessibility in packaging, this year's journal further explores very current and exciting possibilities in print. The design is so fresh and crisp – it is great to see the final product come together. All the fundraising efforts thus far have been executed with such superb coordination, I just know that the production of the journal will be a worthwhile experience and excellent learning opportunity for all those involved.

As your time as a student at Ryerson comes to an end, you will remember these challenging times as the powerful and rewarding experiences that they are. Go out there and make the industry connections that will last a career and remember to consider every opportunity that opens its door to you. You have demonstrated outstanding teamwork, dedication, and autonomy, which will take you very far in your careers. My job could not get any easier!

Warm regards,

Trung Nguyen
Ryerson TAGA Student Chapter Advisor

1

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ANALYSIS OF INK APPEARANCE: Photopolymer vs. 3D Printed Plates

SCOPE:

This report analyzes the overall capabilities and print quality of 3D printed plates compared to the industry standard set by photopolymer plates. More specifically, this test provides a comparative analysis of image quality on a variety of substrates using both process colours and Pantone flexographic inks. To further compare quality, ink densities were measured to show a numeric comparison between all samples produced. The purpose of this test is to understand whether 3D printing technology has the ability to serve as an alternative method to the conventional flexographic plate making process. By using a photopolymer plate as a standard baseline, the quality of ink and image appearance produced using a 3D printed plate can be determined while using the flexographic printing process. Ultimately, this test allows for the evaluation of cost and time effectiveness for 3D printed plates compared to standard photopolymer plates. Additionally, this test investigates the durability of flexible 3D printed plates as it endures the constant printing pressures caused by the relief impressions involved with the flexographic process.

DEFINITIONS:

EXTRUDER:
The parts on the 3D printer that feed the plastic material from the spool, melts it, and then extrudes the material from the nozzle onto the bed of the printer (3D Printing for Beginners, 2014).

FILAFLEX:
A filament made from a TPE based polyurethane with additives that facilitate 3D printing (Garcia, n.d).

G-CODE:
A programming language that tells the printer where to move, how fast, and what path it should follow (3D Printing for Beginners, 2014).

INFILL:
A support structure that is printed inside an object to increase its strength (Shells and Infill, n.d).

NOZZLE:
The part of the 3D printer that deposits the material (3D Printing for Beginners, 2014).

SLICER:
The software used to convert a digital 3D model into code for the printer. It cuts the model into horizontal slices and creates paths to fill each layer (3D Printing for Beginners, 2014).

THERMOPLASTIC ELASTOMER:
A class of polymer that behaves like rubber that are melt processable via thermoplastic processing methods that can be easily reprocessed and remolded (Understanding TPEs, n.d.).

SUMMARY:

Quantitatively, the results of the photopolymer plate surpassed the results of the 3D printed plate. In regards to the process black ink, the sample printed on Supreme Gloss produced the highest quality and most accurate proof for both the photopolymer plate and the 3D printed plate. The best calculated Delta E (ΔE) for the sample made by the photopolymer plate was 2.55 when compared to FIRST standards. Comparatively, the best ΔE for the print made by the 3D plate was 16.58 when compared to FIRST standards. This shows a distinctive difference in quality between the 3D printed plate and the photopolymer plate. The poorest ΔE for both the photopolymer plate and the 3D printed plate was found on the Earnscliffe substrate. The photopolymer plate had a ΔE of 32.56 and the 3D printed plate produced a ΔE of 47.96. This expresses that the quantitative results of the 3D printed plate are inadequate for high quality flexographic printing.

INTRODUCTION:

As the Western world continues to make advances into the digital realm, the printing industry is slowly transitioning from using lithographic printing as its primary reproduction process. Contrarily, the process of flexographic printing is on the rise, as its primary uses are for the production of packaging, labels, and their associated branding.

While photopolymer plates created by method of laser ablation and UV exposure is one conventional process of plate setting, 3D printing of plates may soon become an alternative. With its ability of increased customization, variety of printable materials, and relatively inexpensive production cost, 3D printing plates for image reproduction have potential to become a common practice within the graphic arts industry.

Comparing the quality of both flexographic and 3D printed plates will produce a better understanding of where 3D printing needs to improve in order to be the preferred method of flexographic plate making. By evaluating the benefits and costs of producing plates using laser ablation and 3D printing, a greater depth of knowledge will be provided for the workforce as industry professionals can decide when it is appropriate to use each of the two plate making processes.

This research project was created in order to compare and analyze the quality of images on a variety of substrates when printed using a traditional photopolymer plate and 3D printed flexible plates. The objective of this test is to determine the capabilities and limitations of inexpensive 3D printed plates within standard printing conditions. Further, the plates and prints will be examined to understand where improvements can be made to better enhance the quality of images for the future. By showcasing the abilities of 3D printed plates, the printing industry will have a better understanding of the steps that need to be taken in order to use 3D printing technology to its fullest. This includes increasing efficiency and maximizing on profits.

TESTING PRINCIPLES:

To print the 3D plate, the Hyrel System 30M was used. This printer was used because it was the only machine at the Digital Media Experience at Ryerson University that had the capabilities of printing with the Filaflex Flexible Filament. This was because of the enclosed environment that vented the fumes of melting plastic, as well as the higher quality of the machine. Flexible filament was chosen to be able to replicate the flexibility that a photopolymer plate has in order to wrap around a cylinder. Tinkercad was used to create the 3D model from an exported file that was made in Adobe Illustrator. The file was then exported onto the tablet attached to the Hyrel. An infill of 100% was given to the 3D plate so it would not be excessively compressed under the pressure of the Perfect Proofer. After all the specifications were reviewed, the CAD file from Tinkercad was then converted to G-Code and spliced. The speed, the temperature, and the path the extruder takes is created through the G-code and the splicer. The limitations of this press include the nozzle on the extruder being limited to printing above 0.5mm, as well as the operator's of this press having limited knowledge of working with the filament.

In order to complete this test, the Perfect Proofer was used to best replicate the results that would occur on a traditional flexographic press. This machine was used because it is capable of producing single samples on different paper types, thereby minimizing wasted materials and ink. The custom made photopolymer and 3D printed plates were mounted to the plate cylinder of the printing unit. Water-based flexographic ink was applied to the anilox roller and the doctor blade worked to remove excess ink from the roller's cell volume. While the machine is running, the metered ink from the anilox roller is applied directly to the plate, which is then pressed against the substrate.

To ensure quality, L*a*b* values measured from the samples were compared to FIRST 5.0 standards. Microscopic images were also taken using The Digital Pocket Microscope (DPM) in order to compare ink quality. The DPM captures magnified pictures of each sample in order to compare the quality of the proofs. The software further allows for the analysis of ink film thickness, evenness of the ink, and quality of the linework produced on each substrate. This is accomplished by hooking up the microscope to a computer, launching the DPM software, and placing the microscope on the substrate in the desired area. Once the placement is correct, an image is taken; this is repeated until all of the substrates have been photographed and are ready to be examined for print quality.

To further test the quality of the printed samples, rub resistance of ink could have been tested, as well as paper absorptivity. By testing these qualities, the test would have been able to further explain why theses results occurred.

EQUATIONS:

Net Density =

Patch Density - Paper Density

Delta E (ΔE) =

$$\sqrt{[(L_1 - L_2)^2 + (a_1 - a_2)^2 + (b_1 - b_2)^2]}$$

MATERIALS TESTED:

- Filaflex Flexible Filament
- Environmental Inks Poly Screen Plus Process Black
- Environmental Inks PSPX 3220 PS + Purple FR
- Supreme Gloss Offset 24x36, Basis Weight: 100lbs, 182M, Grammage: 148gsm
- Earnscliffe Bond 11x17, Basis Weight: 24lbs, 182M, Grammage: 90gsm
- 3.5 MIL Synthetic C2S
- Corrugated Cardboard
- Cardstock
- Film drafting paper
- Flexographic Plate
- 3D printed plate
- 3M 19 series pink mounting tape

PROCEDURE:

1. Design a 3”x6” plate in Adobe Illustrator with elements like text, reverse text, solid tone images, a variation of line widths, slur targets, and a halftone screen density scale. Ensure to include bearer bars to maintain consistent relief height across the plate.
2. Using the ESKO software, rip the plate file and send it to the CDI spark, where it can be imaged, exposed, and cured using the Orbital X. Cut the plate out of the photopolymer sheet and then measure the caliper.
3. Turn the plate design file into a 3D model using the Myra software. Splice the model and then convert the model into G-Code so the printer can read it. Using the Hyrel 3D Printer, print out a plate with the FilaFlex material with a thicknesses of 3mm. Measure the caliper of the plate.
4. Mix a flexographic process colour ink to correct viscosity using the #2 Zahn-cup and correct pH using the eco-tester and acid.

EQUIPMENT USED:

- Integrity Engineering Perfect Proofer
- Orbital X Flexographic Plate Maker
- CDI Spark
- ESKO software
- Tinkercad software
- Hyrel System 30M
- Mitutoyo Digital Micrometer, serial number: 003444
- X-Rite 500 Series Spectrodensitometer
- Densitometer
- Micrometer
- DPM software (Digital pocket microscope)
- #2 Zahn Cup
- Eco-Tester pH

5. Measure the density of each substrate including its associated L*a*b* colour values.
6. Cut out strips of the substrates using the Fellows Fusion Paper Cutter at 3”x6”.
7. Mount the photopolymer plate to the Perfect Proofer using the 3M 19 series pink mounting tape and print a proof on the uncoated paper substrate. Repeat across all substrates. Measure the caliper of the plate when all proofs have been printed.
8. Measure the density and the L*a*b* values of the solid printed images, and analyze the quality of the line screens, text, and slur targets.
9. Repeat steps 5–7 using a flexographic Pantone ink.
10. Repeat steps 4–7 using the 3D printed plate.
11. Take photos using the micrometer in the DPM software.
12. Analyze collected data from all samples and compare the overall quality of each of the proofs.

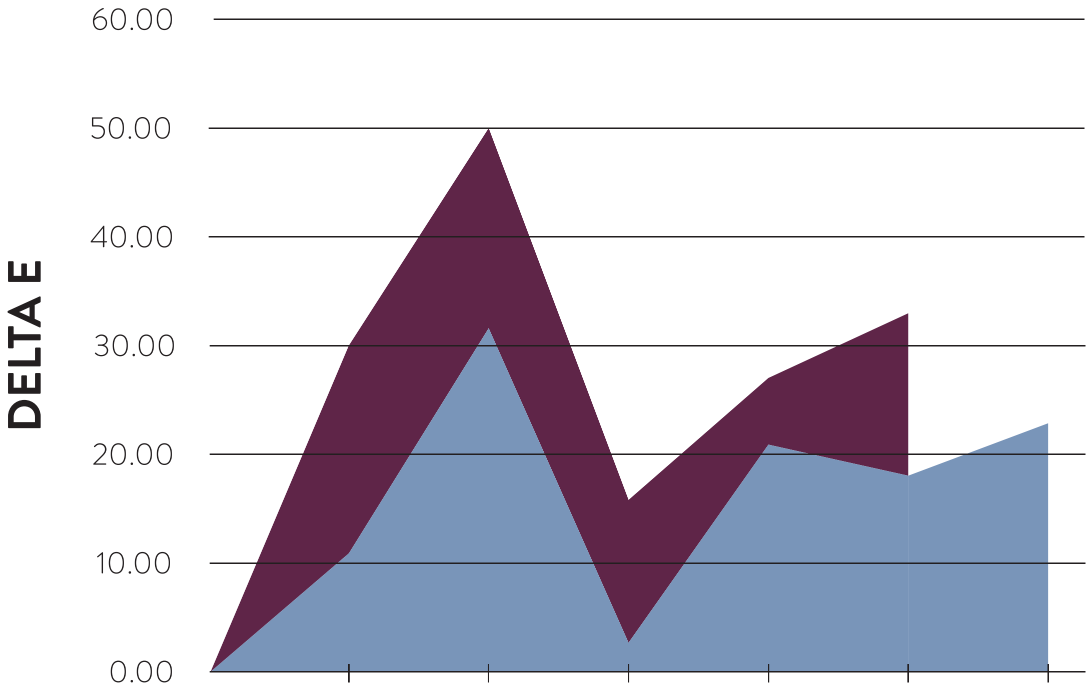
RESULTS:

CALIPER

PLATE PRINTING METHOD	RELIEF (THOU)	BASE HEIGHT (THOU)
Laser Ablated	0.0650	0.037
3D Printed	0.0857	0.0285

INK MIXING

INK COLOUR	WATER ADDED (mL)	VISCOSITY	pH
Black (150mL)	0mL	28s	
	15mL	26s	
	10mL	24.5s	8.5
Purple (100mL)	0mL	1m	
	50mL	45s	
	25mL	23.4s	8.8



DELTA E COMPARISON BETWEEN...

	3.5 MIL Synthetic C2S	Earnscliffe	Surpreme Gloss	Film Drafting Paper	Cardstock	Corrugated Cardboard
BLACK FLEXO PLATE MEASUREMENT AND FIRST STANDARDS	10.56	32.56	2.55	21.74	18.95	23.40

	3.5 MIL Synthetic C2S	Earnscliffe	Surpreme Gloss	Film Drafting Paper	Cardstock	Corrugated Cardboard
BLACK 3D PLATE MEASUREMENT AND FIRST STANDARDS	30.36	49.74	16.58	27.85	33.06	

INK COLOUR	SUBSTRATE	COLOUR OF PAPER			
		DENSITY	L	A	B
Black	3.5 MIL Synthetic C2S	0.02C	98.29	-0.93	-0.01
	Earnscliffe	0.06K	95.04	-1.06	0.44
	Supreme Gloss	0.06C	95.04	1.52	-4.77
	Film Drafting Paper	0.11C	91.40	1.44	-5.52
	Cardstock	0.74Y	59.14	3.66	16.74
	Corrugated Cardboard	0.72Y	58.09	4.03	12.24

INK COLOUR	SUBSTRATE	COLOUR OF PAPER			
		DENSITY	L	A	B
Purple	3.5 MIL Synthetic C2S	0.03C	98.46	-0.97	0.08
	Earnscliffe	0.06K	94.94	-1.08	0.50
	Supreme Gloss	0.06C	94.93	1.80	-4.92
	Film Drafting Paper	0.11C	91.64	1.40	-5.38
	Cardstock	0.74Y	59.54	3.53	16.65
	Corrugated Cardboard	0.73Y	58.01	4.05	12.87

PHOTOPOLYMER FLEXO PLATE MEASUREMENTS

PRINTED INK			
DENSITY	L	A	B
1.32	25.51	0.90	2.03
0.78	48.39	0.21	4.23
1.52	18.47	1.38	1.28
1.03	37.55	1.23	3.83
1.08	34.51	1.37	5.00
0.97	38.93	1.78	5.57

PRINTED INK			
DENSITY	L	A	B
0.64M	62.92	43.54	-26.24
0.62	62.07	34.71	-20.14
0.59	64.70	40.59	-27.19
0.55	66.50	35.87	-24.7
0.90	47.07	18.65	4.36
0.89	48.44	13.83	4.57

INK COLOUR	SUBSTRATE	COLOUR OF PAPER			
		DENSITY	L	A	B
Black	3.5 MIL Synthetic C2S	0.02C	98.29	-0.93	-0.01
	Earnscliffe	0.06K	95.04	-1.06	0.44
	Supreme Gloss	0.06C	95.04	1.52	-4.77
	Film Drafting Paper	0.11C	91.40	1.44	-5.52
	Cardstock	0.74Y	59.14	3.66	16.74
	Corrugated Cardboard	0.72Y	58.09	4.03	12.24

INK COLOUR	SUBSTRATE	COLOUR OF PAPER			
		DENSITY	L	A	B
Purple	3.5 MIL Synthetic C2S	0.003C	98.46	-0.97	0.08
	Earnscliffe	0.06K	94.94	-1.08	0.50
	Supreme Gloss	0.06C	94.93	1.80	-4.92
	Film Drafting Paper	0.11C	91.64	1.40	-5.38
	Cardstock	0.74Y	59.54	3.53	16.65
	Corrugated Cardboard	0.73Y	58.01	4.05	12.87

3D FILAFLEX FILAMENT PLATE MEASUREMENTS (3MM HEIGHT)

PRINTED INK

DENSITY	L	A	B
0.81	46.14	0.61	4.67
0.53	65.71	0.17	2.50
1.27	32.57	1.12	1.59
0.86	43.68	0.95	4.04
0.92Y	47.39	2.30	11.25
n/a	n/a	n/a	n/a

PRINTED INK

DENSITY	L	A	B
0.46	71.38	33.91	-20.20
0.35	78.77	16.07	-9.13
0.42	73.56	27.58	-19.05
0.30	79.54	9.37	-6.63
0.78	54.39	7.49	9.86
n/a	n/a	n/a	n/a

DISCUSSION:

Photopolymer flexographic plates are the industry standard and therefore the expected results were excellently produced, clear, and crisp images. The group's expectations held true as all samples printed on each substrate yielded a satisfactory result. While colour density varied between substrates due to the absorptivity of the stock, fine details within the small text, slur targets, and the print density scale were distinguishable.

Further, the group's predictions for how the 3D printed plate would be created, along with how it would perform on press were confirmed. Due to the operator's lack of expertise and the limitations of the Hyrel 3D printing device, the quality of the 3D printed plate was inadequate for use on a flexographic press. The printed 3D plate is shown in Appendix B, where the lack of quality is evident. It was expected that the thick solid line widths and shapes, along with the large reverse text would have the greatest capability to be accurately reproduced on the Hyrel. However, it was unexpected that the printing device would be incapable of producing fine line widths and all text. This was a result of the nozzle being too large and therefore not being able to produce any element that was smaller than 0.5 mm. Due to this limitation, all text and small images were indistinguishable and printed as dots and pools of flexible filament, as shown in Appendix C (page 32).

The quality of the 3D printed plate was also affected by the heat used for the filament. The thermoplastic elastomer filament can only withstand so much heat when it is being made at a temperature of 125 °C. Therefore, it is possible that the temperature was too high, thereby melting the filament and affecting its ability to print images of a certain height (Plastic & Thermoplastic Elastomer Materials, 2003).

The recorded data resulted in a variation of density, L*a*b*, and ΔE values for each colour and the associated plate. In order to determine the accuracy of colour produced by each plate, the recorded results were compared against the standards set out by the FIRST guidelines (Flexographic Image Reproduction: Specifications & Tolerances, 2014).

Photopolymer Plate and Black Ink

Based on the results for this pairing, the sample printed on Supreme Gloss produced the highest quality and most accurate proof. The calculated ΔE between the Supreme Gloss print and FIRST standards was 2.55, illustrating an excellent colour and density match. This accurate colour reproduction also illustrates that Supreme Gloss has similar characteristics to the paper used to create the FIRST standards. Based on this, it was also concluded that the anilox roller attached to the Perfect Proofer device consisted of a high lines per inch (LPI) and low billion cubic microns (BCM) volume due to the crisp imagery and lack of smudging and smearing. It was also presumed that this coated paper would produce the best overall quality because, according to Paper Types (n.d.), coated stocks have surface coatings that allow the paper to have higher receptivity for the reproduction of text and images in order to achieve sharper detail and improved color density.

The synthetic paper stock was the second best substrate for reproduction when compared to FIRST standards, with a ΔE of 10.56. Cardstock ranked next with a ΔE of 18.95, followed by the film drafting paper, corrugated cardboard, and Earnscliffe Linen Bond at ΔE values of 21.74, 23.4, and 32.56, respectively. Surprisingly, cardboard did not produce the worst results although Print Types (n.d.) states that due to the highly absorbent nature of corrugated material, it is not recommended for the printing of high definition graphics. This result can be explained through the characteristics of the uncoated Earnscliffe stock. The porosity of this paper is high and the metered amount of ink was not substantial enough to create a thick ink film across the surface of the substrate.

In regards to the printed text and images, the photopolymer plate resulted in prints with clear and concise edges around each element. While the clarity of the image edges varied between substrates, all stocks produced acceptable quality results. However, the unevenness of printing can be caused by the vibration of the plate, which can be minimized or controlled by balancing uniform images across the plate (Reece, 2012). This information states that in order to get the most clear and precise imagery, it is important to place a balanced set of elements across the printable area to minimize the bouncing of the plate.

Appendix J (page 35) illustrates the print made over Supreme Gloss. While the edges of the element appear to bleed, the excess ink surrounding the print is a result of the halo effect caused by the process of relief printing. Similar effects can be seen in Appendix K, where the print was produced over another coated substrate, 3.5 MIL Synthetic. Further, the print made over the film drafting paper appeared to produce the best results at a microscopic level. Looking at the images in Appendix I, the substrate produced the smoothest lines and most uniform ink reproduction. However, the density of the print does not present to have a strong pigmentation of colour.

The uncoated substrates have more ink bleed surrounding the edges of the prints. Appendix G (page 34) demonstrates the printing capabilities over cardstock, while Appendix H shows the unevenness of ink over the Earnscliffe substrate. The porosity and absorptivity of these substrates contributes to the uneven distribution of ink across the paper surface. The variation in ink density is caused by the inconsistency of paper fibers throughout the substrates. Corrugated cardboard could only be printed on using the flexographic plate, and it produced the worst overall image quality. Corrugated cardboard is extremely absorbent, causing the ink to quickly penetrate the printing surface. This property makes it difficult for the quality of printing to be high due to the unevenness of the ink film, which can be seen in Appendix F (page 33). In order to achieve better ink coverage over a porous substrate, an anilox roller with a low LPI and high BCM should be used.

3D Plate and Black Ink

The calculated ΔE value between the 3D printed plate and the FIRST standards ranged from 16.58 to 49.73. These results were equivalent to those made with the photopolymer plate, where the substrate with the lowest recorded ΔE was Supreme Gloss and the highest ΔE value was produced on the Earnscliffe uncoated substrate. Unlike the photopolymer plate, film drafting paper was the second closest match with a ΔE of 27.84, followed by the synthetic substrate at 30.36 and then the cardstock at 33.05. A proof on corrugated cardboard was unable to be obtained for use with the 3D plate due to its thickness. In reference to the film drafting paper, it should be noted that this substrate is clear. Therefore, the lower ΔE value could be contributed partly by the fact that a paper white that was similar to that set by FIRST standards was placed behind the sample, making the ink appear to be a more accurate colour.

Overall, all of these measurements are unacceptable ΔE values, as a ΔE of 5 or above demonstrates a very obvious colour difference between the two compared data sets (Delta E, Delta H, Delta T: What Does It Mean?, n.d). These subpar results could be attributed to the poor execution during the 3D printing platemaking process. It is possible that there was inadequate ink coverage across the relief surface of the plate due to the inconsistent texture and fill of the filament over image areas (Appendix C, page 32).

In reference to the durability of the plate, it is important to note that the thin line widths (running in the direction of the press) began to break and fall off throughout the course of the run. This illustrates the poor durability of the flexible filament when it is not applied in thick amounts.

The edges of all the elements printed using the 3D printed plate appears to be less precise, as the ink bleeds into the surrounding paper pores. Similar to the proofs made using the photopolymer plate, the 3D plate created the best results over the coated substrates of Supreme Gloss and the 3.5 Synthetic (Appendix J and K, page 35). The coated surface gives the illusion that ink is perceptually uniform relative to the other samples, but the results still lack in quality when compared to the flexographic plate. The result that differed the most was the proof made over the film drafting paper. The ink coating was uneven and appeared to repel the entire amount of ink and bleed across the substrate. This is most likely due to the fact that the film was not suitable for printing. As the image shows in Appendix I (page 35), the edges of the print were rough due to the lack of persistency throughout the printing process.

The uncoated substrates performed even more poorly than the coated substrates. The prints were not perceptually uniform because only minimal amounts of ink were retained and applied to the substrate. As seen in Appendices G and H (page 34), the prints produced over cardstock and Earnscliffe absorbed a large amount of ink, which resulted in large gaps of white space across the substrate surface. These results may have been due to the lack of coating and also could have been caused by the wearing of the plate under constant printing pressure. Additionally, the overall lower quality of the prints may have been due to the insufficient way the 3D printed plate acted as an image carrier, along with its inability to properly hold and release appropriate ink films.

Photopolymer and 3D Plate and Purple Ink

In addition to the process black ink that was tested, a purple spot colour ink was used to visually compare the printed densities. When comparing the solid circle on both the flexographic plate and the 3D plate, it is evident that the 3D plate was uneven, as illustrated in Appendices A and C (page 32). The outer line of the circle is fine and precise whereas the line on the 3D plates is very rough and uneven. This is because the filament was not able to produce the sharp quality that flexographic plates can produce due to the lack of skill of the operator and the low quality of the machine.

General Comments on 3D Plate

Fine lines were not accurately reproduced, whereas thicker, straight lines could be printed precisely. Bolded reverse text was the most readable and legible, which is due to the fact that it did not use many fine lines. The reverse text is comprised mainly of solid shapes with holes it in; the Hyrel printer was able to produce it relatively well because of the low level of complexity. Also, due to the fact that no halftones could be produced, the expectation that only a solid colour with no tints was confirmed both in the black and the purple inks. Looking at Appendix E (page 33), it is clear that the ink was only prominent on the thick line widths and the reverse DOG text. Although the ink adhered to the failed attempts at printing text, no print was created because of the lack of consistency in height and printing pressure.

Compressibility also affects the overall quality of both the flexographic plate and the 3D plate, which changes based on how often it is used in printing and how much squeeze is used while printing. The flexographic plate had an original relief of 0.0650 thou and when printing was completed had a relief of 0.0645 thou. The slight change in relief partially explains why the results were so consistent. If the thickness had drastically changed then the quality would have been much lower due to ghosting and very low densities. The same goes for the 3D printed plate, which had no change in relief when the printing was complete.

Weaknesses

The main weakness of this test was the method chosen to print the 3D plate. In order to improve plate quality, the plate should have been printed by professionals rather than student apprentices who were just learning how to use the machine. By outsourcing the platemaking, the execution of the 3D plate regarding the smoothness of all elements could have been improved. The use of a low-end 3D printing machine made it difficult to obtain high quality results for the plate, which consequently made it problematic to compare the quality of the 3D printed plate to a high quality laser-ablated plate. In order to maximize plate quality, it was critical to find an operator who had previous experience with working the machine in order to get the best possible results. However, even with a qualified operator, the machine was still incapable of printing fine lines, thereby limiting designs for use on high-end packaging.

Another weakness that affected this test was that multiple 3D plates could not be printed. Due to this, there was no way to compare the printing abilities of plates with different thicknesses and fills. Doing this would have enhanced the test because it would have shown which plate thickness worked best for each substrate, but due to the limitations of the machine, it was not possible. There was no corrugated cardboard tested for the 3D plate because the squeeze was too high, so no printed image was produced on the corrugated stock. It was too difficult for the cardboard to push through the machine. If this test was to be done again, a foil should be used rather than corrugated material. Not only is foil one of the main substrates used in packaging, but it is also of similar caliper to the other substrates, allowing it to fit through the unadjustable Perfect Proofer.

“

COMPRESSIBILITY ALSO AFFECTS THE OVERALL QUALITY OF BOTH THE FLEXOGRAPHIC PLATE AND THE 3D PLATE, WHICH CHANGES BASED ON HOW OFTEN IT (AND HOW MUCH SQUEEZE) IS USED WHILE PRINTING.

RECOMMENDATIONS:

PRINTABILITY

Many aspects cannot be compared between the 3D printed plate and the photopolymer plate. Firstly, the 3D plate did not have a consistent, flat image area, causing an immeasurable proof. The 3D plate was also not capable of printing halftone dots, which limits the plate's ability to print detailed work. Since the method of 3D printing plates has only been tested and not proven to work, computer software has not yet been developed to replicate printing halftone dots on the plates (Wong, n.d.). Due to the low quality of the 3D plate, the levelness of the plates and image were not as consistent as the photopolymer plate.

The plates' printability becomes a huge indicator of quality since two methods of plate making are compared. Based on the results, the photopolymer plate printed the proofs exactly as expected to. It was able to handle multiple substrates while printing an even layer of ink. The 3D printed plate did not have the same capabilities as the photopolymer plate did. This was mainly due to the texture of the plate and how the plate turned out after printing it on the Hyrel. The ability to print a perfect reproduction of the intended image is highly important; if the plate does not emulate the same quality, it is not comparable to or usable in flexographic printing.

When examining the 3D plate after printing, it did not absorb much of the ink and had good pay-off when printing multiple proofs at a time. The plate was printed with a 100% infill, meaning that the volume of the plate was printed with the highest percentage of material. This allowed for a lower absorption of the ink since there was nowhere for the ink to absorb into. However, there was poor ink spread on the substrates. This could be due to the texture of the plates themselves, as 3D printing with flexible filaments does not print a smooth, even surface. This would not be acceptable, as the image is not printing correctly. However, based on the results, any smooth, flat section printed on the 3D plate did print correctly and appeared of quality. From this observation, it is understood that the current technology used to 3D print flexographic plates can be used to produce very basic, solid tone images both accurately and consistently.

RUNNABILITY

When deciding whether or not to use a traditional flexographic plate or a 3D printed plate, the operator must keep in mind the thickness and evenness of the plate, as this affects both the runnability of the job and the outcome of the final product. The skill of the operator is extremely important when 3D printing. In this test's case, the 3D printer we used was of lower quality and the operators were students that were not experienced with Filaflex. The plate did not print any clear images and had uneven thicknesses, causing the printed images to be unclear and unpredictable.

The 3D plate was perfectly flexible using the Filaflex and was able to wrap around the plate cylinder with ease; however, it was thicker than the photopolymer plate. The thickness of the plate should be considered, as too thick of a plate may begin to peel off the cylinder due to the stickyback mounting tape's limited adhesiveness. Appendix E shows the 3D plate lifting from the stickyback when cleaning with water. A thinner base would have made the plate even more flexible, avoiding this issue. If the plate lifts off during a run, it will slow down production, as well as waste paper and ink due to potential misregistration. If the plate does not easily wrap around a cylinder, makeready could become harder due to the difficulty of accommodating the material. However, this can easily be changed while creating the plate on the modeling software, which allows the operator to adjust the height of the plate and its relief. These are attributes a photopolymer plate cannot change, where additional height is controlled through use of different thicknesses of stickyback (3M, 2009).

At 100% infill, the plate was not compressed and was able to endure the pressure over many substrates and impressions. More infill increases the amount of time spent printing the plate, affecting the overall cost due to more material being used (3D Matter, 2015). A 100% infill is recommended, especially for heavier substrates like corrugated board.

The operator must also consider how warm the 3D plates will get from the constant friction while running. If the plates get too hot, they will start to melt, leaving the paper with rubber melted on it. It is recommended that the operator consistently monitor the press' temperature – making sure it is under 125° C – to ensure it is cool enough to prevent the 3D plate from melting (Plastic & Thermoplastic Elastomer Materials, 2003).

“

HIGHER QUALITY PRINTERS CAN PRINT MORE QUICKLY, SO INVESTING IN A HIGHER QUALITY PRESS WOULD MEAN A QUICKER TURNAROUND TIME, AS WELL AS AN OVERALL BETTER PRINTED IMAGE.

END-USE

It is important to determine the product's end-use before choosing how to print the plate, as the method chosen affects the quality of the printed piece. Based solely on the results of this test, press operators should choose to use a flexographic plate when printing flexible substrates to print of the highest quality. 3D printing technology is not yet suitable to properly mimic a photopolymer plate.

When printing products for brands like Cheerios, Pizza Pizza, and Cadbury, press operators should continue to use conventional flexographic plates because they currently produce the best quality. However, if a company is shipping goods to businesses that sell products in corrugated cardboard boxes, a 3D printed plate would produce acceptable results if the image is solid with no text. Based on this test, the low quality 3D printed plate still had smooth, solid patches. The plate could also handle printing on cardboard substrate without the image area being too worn (depending on the infill of the plate).

Time and cost are two factors that must be considered. Ultimately, it could take anywhere from half an hour to days to print a 3D plate depending on the printer and image. Higher quality printers can print more quickly, so investing in a higher quality machine would mean a quicker turnaround time, as well as a better printed image. However, they are considerably more expensive. As a material, filament is expensive but appears to be more cost effective than traditional photopolymer plates. While a photopolymer plate costs approximately $20 per plate, a 3D plate at a 3”x6” size was estimated at $5-10. When comparing the two plates, the 3D printed one took 3 hours on a low quality press while the photopolymer plate took about an hour and a half. Additionally, a higher quality 3D printer has a smaller footprint than the equipment needed to create a laser ablated photopolymer plate.

Whether or not this technology develops into a true alternative to photopolymer plates, the press operator must weigh the pros and cons to the specific work they print. 3D printing is complex and requires training to understand the process and software. Skilled workers must be brought in or trained; for a small to medium-sized workplace, this may not be feasible relative to their budget.

The need for this technology must be justifiable in order for it to work effectively. A strategy must be put in place to attract new customers, as well as inform existing customers of the need, benefit, and added value that could be accomplished with use of 3D printed flexographic plates.

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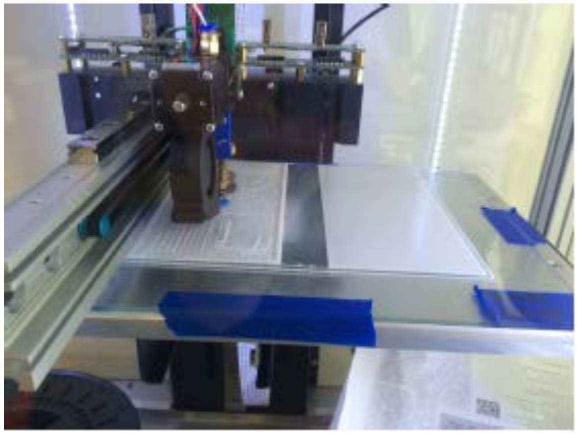
APPENDICES:

Appendix A:
Photopolymer plate

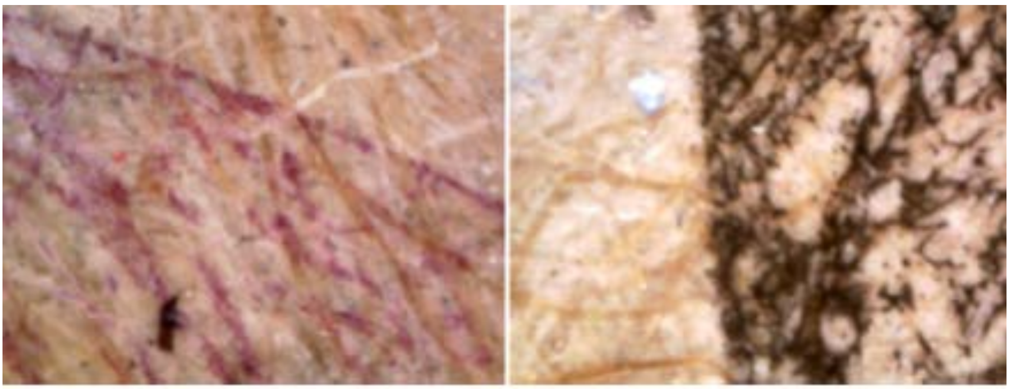
Appendix B:
3D printer with plate



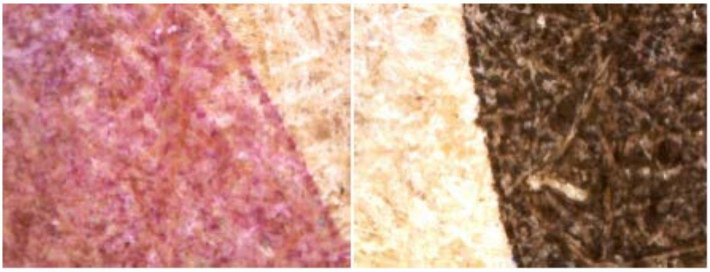
Appendix C:
Before testing the 3D printed plate

Appendix D:
After proofs were printed

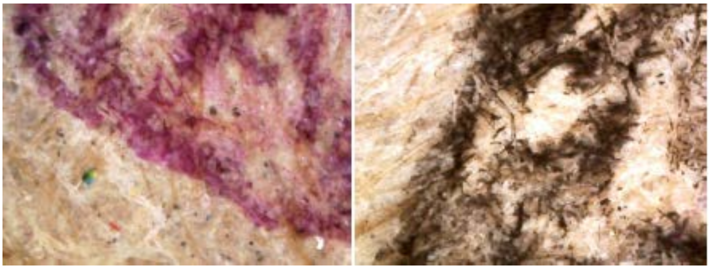
Appendix E:
3D plate on the proofer



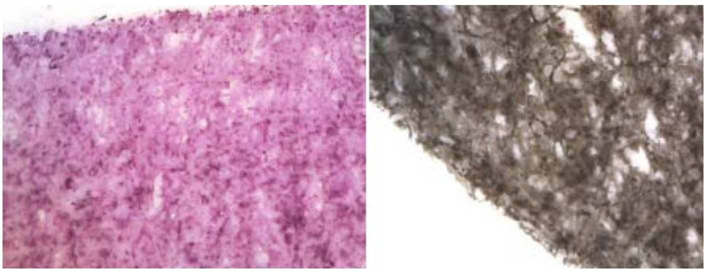
Appendix F:
Cardboard: Photopolymer



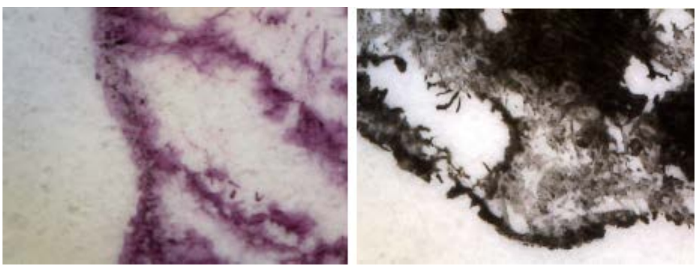
Appendix G:
Cardstock: Photopolymer



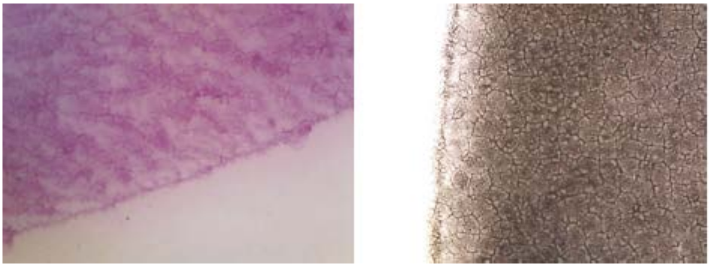
Appendix G:
Cardstock: 3D plate



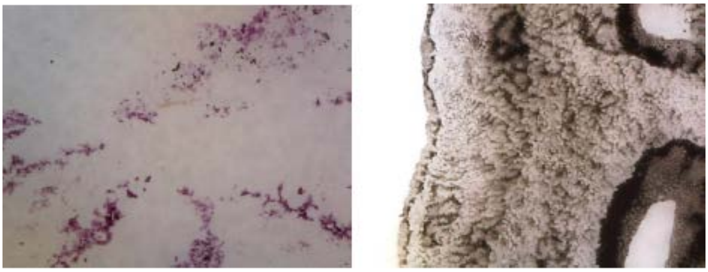
Appendix H:
Earnscliffe: Photopolymer



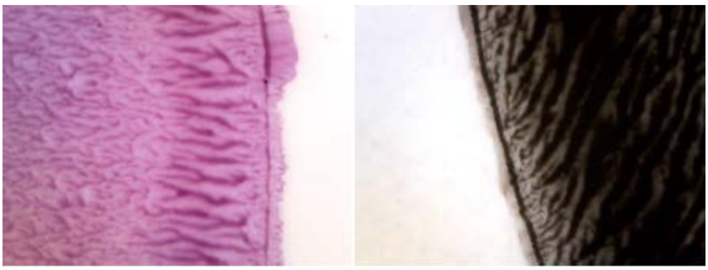
Appendix H:
Earnscliffe: 3D plate



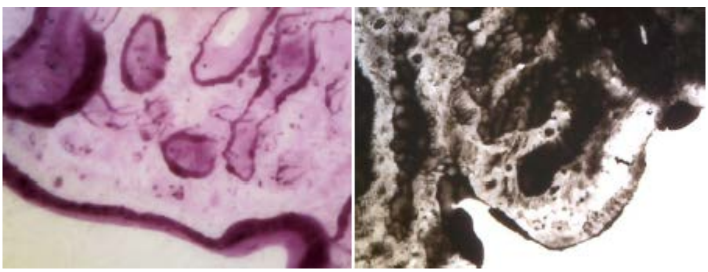
Appendix I:
Film Drafting Paper: Photopolymer



Appendix I:
Film Drafting Paper: 3D plate



Appendix H:
Earnscliffe: Photopolymer



Appendix J:
Supreme Gloss: 3D plate

2

ALISON KROUSE
FITZ MORALES
BODIN PUNYAPRATEEP
ALBERT SZELIGA

SCOPE:

In this report, differences in print quality in relation to 3D printed type infill percentage were tested. Structural integrity is directly related to print quality but was not testable due to equipment restraints. The purpose of this test was to determine the best infill percentages to use for commercial purposes for both quality and timeliness.

LETTERPRESS MEETS 3D PRINTING:
Old Dog, New Tricks

INTRODUCTION:

Letterpress has always been viewed as a specialty printing process that is suitable for niche markets, such as wedding cards, postcards, and other small products that require a vintage, rustic look. However, with rising costs of letterpress type and fewer printers using this process, letterpress has remained a niche process with little growth. With recent advances and availability of 3D printing, this test aims to assess if it would be a viable strategy to replace commercial letterpress type with 3D printed type. This would save companies the cost of buying commercial type, and would make the process of obtaining type quick and affordable. It would allow companies to customize their own type, as they would not be restricted to what type suppliers offer. The expected educational benefits to this test are to see how 3D printed type affects printability (the overall quality of the printed piece and if it is suitable to pass for a finished product) and runnability (the ability for the 3D printed material to run through a letterpress without problems and errors).

SUMMARY:

After testing 100 impressions, all of the 3D printed types survived; however, those of the weaker varieties (e.g., 5% PLA) started to degrade. Density for each of the types stayed neutral or decreased slightly after 100 impressions, with wooden type at the highest density. ABS plastic followed with slightly lower density, and PLA plastic type had the lowest density recorded.

The thinnest pieces on the type (mainly strokes and serifs) showed the most degradation, as pieces fell off at approximately 90 impressions for both plastic types. All of the PLA plastics degraded the quickest, while ABS plastic was the most resilient with only 5% showing visible degradation. This was highly dependent on the narrowness of the letters printed; if the text had a stroke or line that was thinner than the nozzle of the 3D printer that created it, then that line would not be produced or present at all. This resulted in blank spaces and voids on some of the images printed.

It is recommended to use ABS plastic, as it showed higher density readings and was more resilient than its PLA counterpart. Additionally, it is recommended to use higher infill percentages, as this allows ink to be a continuous film on the type and create a smoother image.

DEFINITIONS:

FILAMENT:
A tube-like material that is used by 3D printers; it is typically made of plastic or other meltable materials and is heated into a liquid polymer to form the 3D shape (Ryerson Digital Media Experience Lab, personal communication, 2016).

G-CODE:
The specific instruction file for a 3D printer that contains descriptions of how the STL file will be printed and created (3D Printing for Beginners, 2014).

INFILL:
The amount of a 3D printed object that is solid; for example, a 10% infill signifies that 10% of it is solid, and the other 90% is hollow (Ryerson Digital Media Experience Lab, personal communication, 2016).

STL:
Stands for STereoLithography, the file format used for 3D design software.

3D AXIS:
The dimensions of the width (x-axis), the height (y-axis), and the depth (z-axis).

TESTING PRINCIPLES:

The two quality components measured in this test are image ink density and presence of visible defects. Ink density is measured to determine how effective the type is at transferring ink. It should be known that colour quality cannot be controlled to the same strict standards of lithographic or flexographic printing since letterpress printing is seen as a craft or art process. Visible defects, like hickeys, puncturing, and large variance in image quality will be noted.

In a production environment, it is expected that the same (or similar) steps be taken to produce type or images for customers. It is likely that other companies attempting to use 3D printed type in production will face similar problems that the group experienced.

In regards to inking, a brayer was used to manually re-ink the type after each impression. The reason for this is that the Vandercook used is an old piece of equipment and the inking rollers would not provide a consistent inking throughout the entire layout. In order to provide consistency to the test, the ink had to be manually applied. The brayer is made of the same rubber that the press' actual inking rollers are made of, making it an adequate simulation for the purpose of this test.

The 3D printing software used to create the type was one that resembles industry programs. This was to ensure that the results gathered were accurate and applicable to real world scenarios. Sanding down the type was also necessary since 3D printing created an uneven, flat surface on raised planes; this was expected and is a precaution that companies would have to take. Thus, the manual sanding of the type was an adequate simulation of the quality expected in an industry setting.

The infill levels of 5%, 10%, and 20% were used. Higher infills were not used because the increase in strength and durability of type beyond a 20% infill is negligible (Ryerson Digital Media Experience Lab, personal communication, 2016).

A sample of both PLA and ABS plastic will be soaked in cleaning solvent to determine if the filament has a negative reaction to the solvent. According to the Ryerson Digital Media Experience lab (personal communication, 2016), some filaments cannot be mixed with certain solvents. Testing this will determine whether or not the plastic can be cleaned with solvent, which will determine its reusability.

MATERIALS TESTED:

- ABS 200 mm Light Blue Filament (Filaments.ca)
- PLA 1.75 mm Solid Light Blue Filament (Filaments.ca
- Wood 2.85 Natural Wooden Filament
- Blue Stickyback Double Sided Tape
- FXB223900 Arroweb Mid Tack Process Cyan
- 80 lbs C2S Tabloid Oversize Press Sheet (12.5” x 19”)

EQUIPMENT USED:

- Pittsburgh 6” Digital Caliper Model 68304
- Standard Sans-Serif Wooden Type (36 pt.)
- Hyrel System 30M 3D printer
- Printrbot 3D printer
- Vandercook SP-15 Letterpress
- Autodesk 123D Design Software
- Slic3r software
- Wooden Plywood Block (0.764” thickness)
- IHARA R710 Color Reflection Densitometer, Serial No. 074836
- Dino-Lite Digital Microscope, DPM03
- Denver Instrument Scale
- Tamiya Finishing Abrasives (320 grit sandpaper)

3D PRINTING SOFTWARE:

Autodesk 123D Design: a free PC or Mac downloadable software that allows users to create 3D objects in STL format (Autodesk, 2016).

Slic3r software: 3D printing software that allows the user to convert digital 3D models into G-code printing instructions for the 3D printer (Slic3r, 2015).

PROCEDURES:

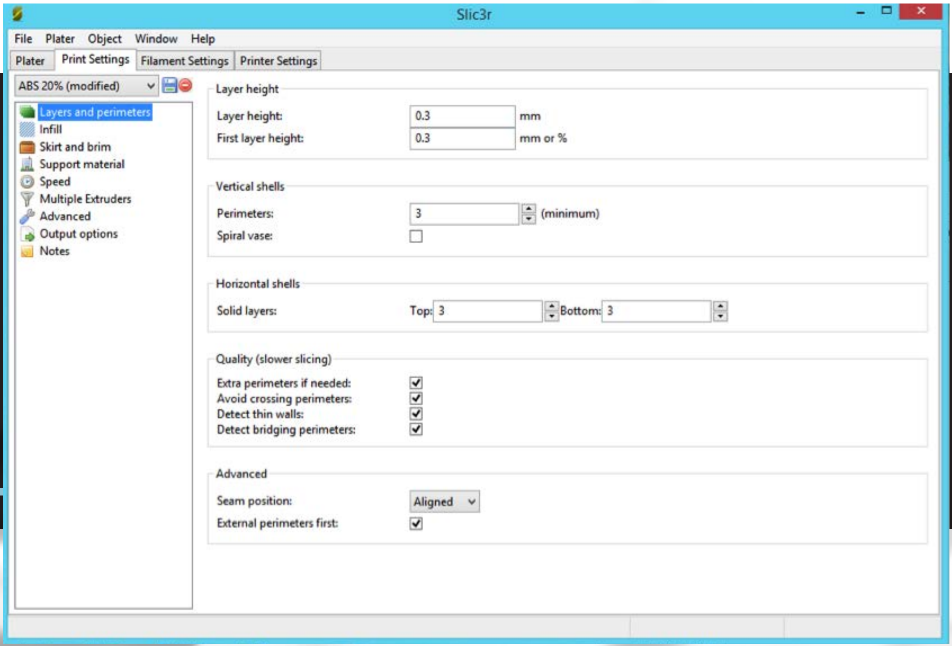
3D PRINTING: CREATING .STL FILE WITH AUTODESK 123D DESIGN

1. Use Autodesk 123Design program to create a .STL file for 3D printing. Using the text button, type G with Arial typeface, C with Niagara Engraved typeface, and M with Baskerville Old Face typeface. After creating the GCM letters, adjust their depth (Z-value) to 1” to make the types’ heights uniform. Select all of the letters and reverse by 180° to simulate letterpress type (Transform > Move/Rotate).
2. Select Primitives and create a base for the letters by clicking the box button. Create a rectangular prism and envelop the created GCM letters. The values of the prism are: width (x-axis) = 3.1500”, height (y-axis) = 0.30015”, and depth (z-axis) = 1.4570”. Move the base so the letters are centered.
3. In the file menu, click export as 3D and select the .STL file format. Transfer the file to the system connected to the Hyrel 3D printer via USB.

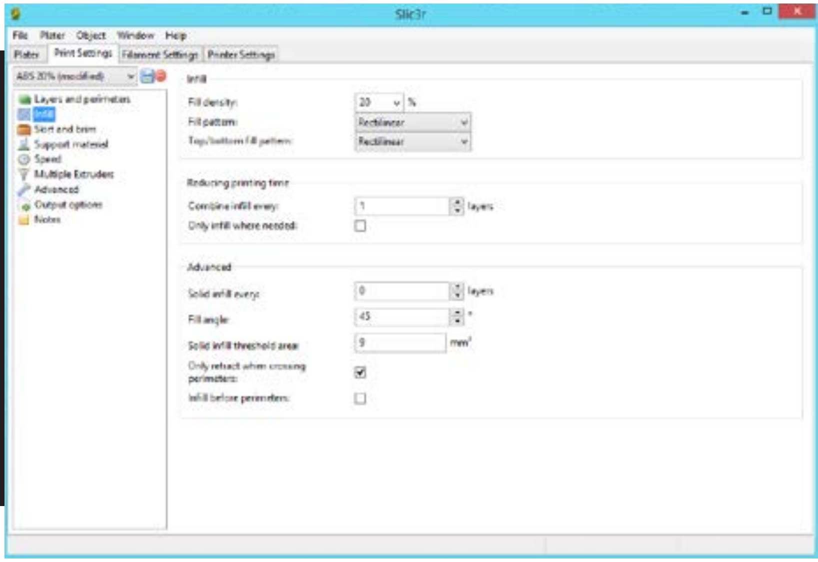
3D PRINTING:
CONVERTING .STL FILES TO G-CODE WITH SLIC3R SOFTWARE.

1. Open the .STL file using the Slic3r program. The file should appear on the Plater tab.
2. In the print settings, select Layers and Perimeters. Adjust the layer height (and first layer height) to 0.3mm. Keep all other default settings.
3. In the print settings, select Infill. Adjust the fill density to 20%, and fill top and bottom pattern as rectilinear. Save this print setting by clicking the save button below the print setting tab. Name the print setting ABS 20%.
4. In the Plater tab, select the ABS 20% as print settings. On the Filament tab, select the Hyrel ABS 230c AutoFan and set them on the four tabs. Export G-code and name it as GCM_Letterpress_ABS_20%. Use this naming convention for the other G-codes.

STEP:
4

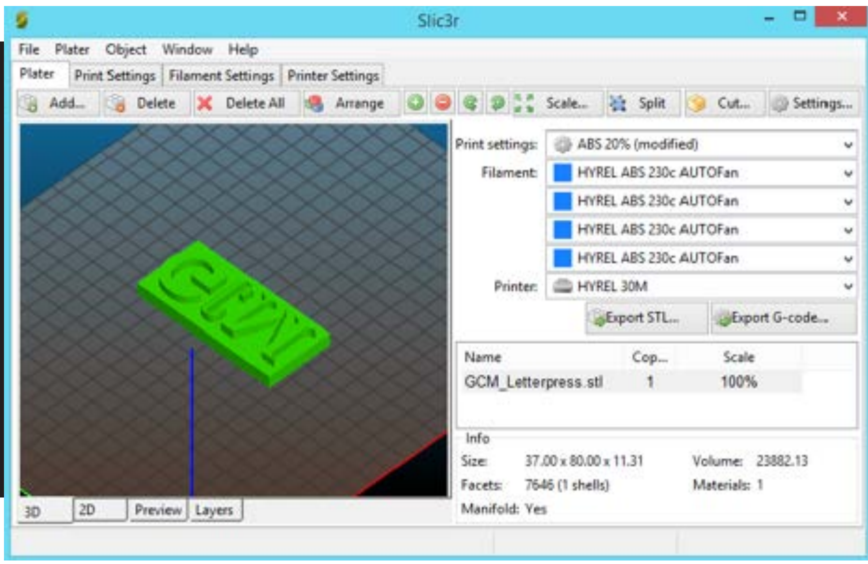


5. Repeat steps 1–4; change the fill density to 5% then save and change the fill density to 10% then save to have a total of three G-Codes for ABS.



STEP:
5

6. For the remaining three PLA G-codes, repeat steps 1–5. This time, save names with PLA and change the four dropdown menus of the Filament (as seen above) to Hyrel PLA 210c Fan100 (since the PLA melting temperature is different from ABS) before exporting.



STEP:
6

3D PRINTING:
PRINTING THE G-CODES WITH THE HYREL 30M PRINTER

1. Transfer all files to the Hyrel 30M Printer. On the tablet connected to the Hyrel 30M Printer, calibrate the printbed (piece of glass where .STL file will be resting on when printed) by pressing the Enable Z-calibrate and adjust the printbed until it almost touches the extruder (nozzle that prints plastic). This method is done with a piece of paper and pushing it in between the hotbed and extruder until the paper cannot be pushed anymore. Once the paper cannot be pushed anymore, press the Z-calibrate to set the initial position of the printer. Press Enable Z-calibrate again to disable it, and then press X/Y park to center the hotbed. This step is important since it will ensure the extruder will print properly and not stop in mid-air.
2. Loosen spool so the filament will not get stuck and disable the printer. Turn on the temperature and load the G-Codes. Once the temperature reaches 190°C, the G-Code can then be printed by pressing the Start Job.
3. When the Hyrel 30M Printer finishes printing, take the hotbed off by removing the tape using a cloth (hotbed will be hot). Use an ink knife to carefully remove the 3D printed piece. Place the printbed back on the Hyrel using masking tape.
4. Remove previous G-code from queue by pressing Delete Job, then load the next G-code. Print remaining G-codes one by one by repeating Step 1–3.

SANDING - SMOOTHING OF THE 3D PRINTED LETTERPRESS BLOCKS

1. Once all six 3D printed letterpress blocks are printed, cut Tamiya Finishing Abrasive (320 grit sandpaper) into (roughly) 1cm strips with scissors.
2. Tape sandpaper strips on Popsicle sticks to create sandpaper sticks. This will provide a flat surface so sanding remains flat and consistent.
3. On a table with newspaper, sand 3D printed letterpress blocks with sandpaper sticks until the surface of all 3D printed pieces becomes flat and levelled. Sand away from face to avoid inhaling sanded plastic dust. The newspaper will catch plastic dust for easier clean-up.
4. Clean 3D printed pieces by washing off plastic dust with water. Use a piece of cloth to remove plastic dust that cannot be washed away. Dry blocks with paper towel.

LETTERPRESS PRINTING PROCEDURE

1. Place all 6 pieces + 1 extra on plywood block. Attach stickyback tape to bottom of 3D printed letterpress blocks and arrange in order of infill and material (5%, 10%, 20% and PLA next to ABS).
2. Put plywood block with the 3D printed blocks on the Vandercook SP-15 letterpress. Include Wooden Type on letterpress, as it will become a basis of quality. To fill the remaining spaces, use extra wood blocks of varying sizes, then use the metal clamp to lock the plywood block and extra wood blocks into place.
3. Using the brayer, apply cyan process ink to 3D printed letterpress blocks.
4. Place the paper on the register and rotate the rollers' lever to run paper into 3D printed letterpress blocks. Make sure to support the paper so it will stay on roller. Remove paper and label it.
5. Repeat steps 3–4 until 100 page run has been done. Let papers/ink dry for one hour.
6. Pour 800 mL cleaning solvent into two 500 mL beakers (400 mL in each).
7. Place an ABS test sample into one beaker and a PLA test sample into the other.

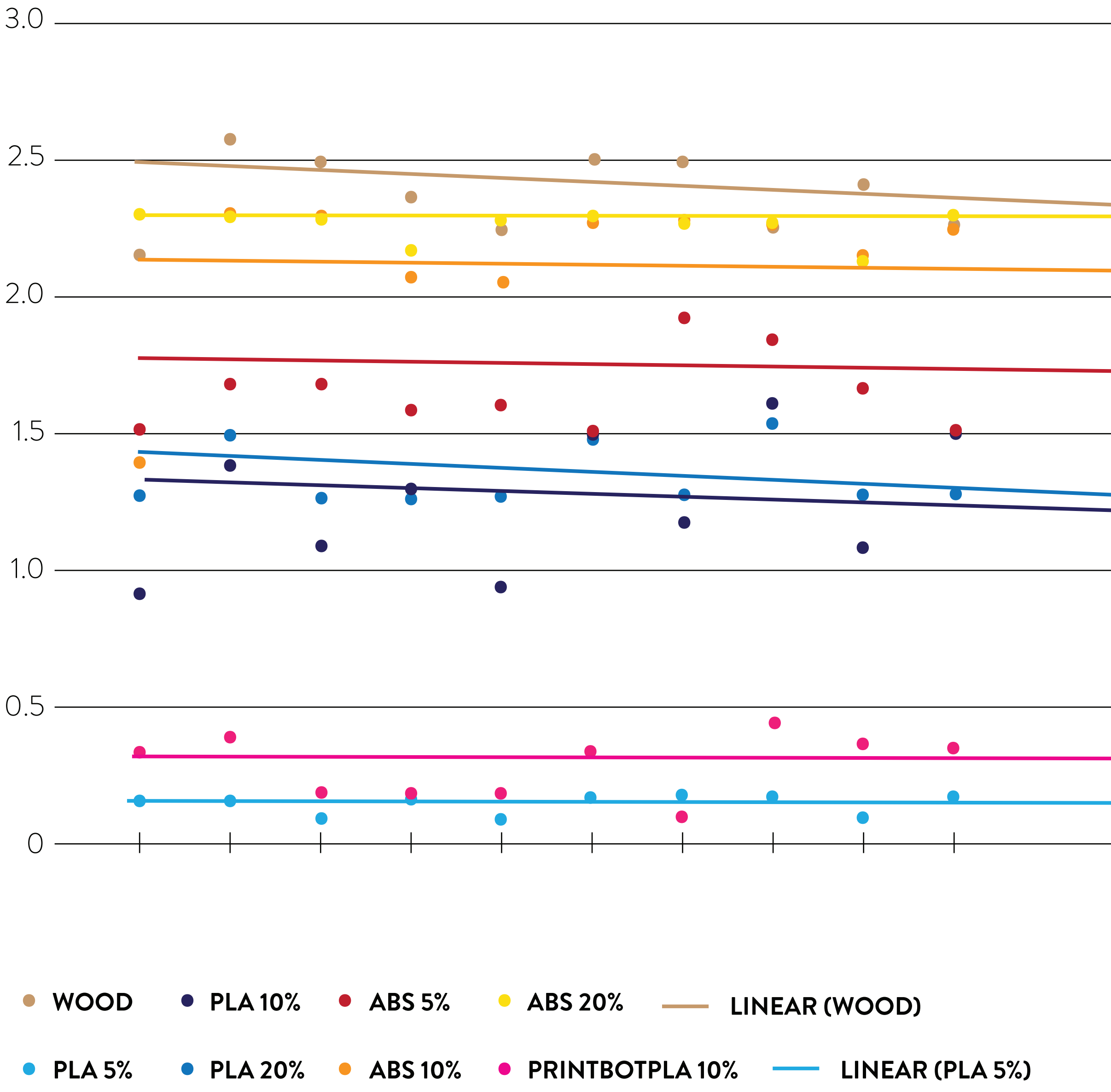
RESULTS:

PAPER #	WOOD	PLA 5%	PLA 10%	PLA 20%
1	2.23	0.20	0.96	1.32
5	2.62	0.20	1.47	1.54
10	2.51	0.17	1.11	1.31
15	2.41	0.20	1.35	1.33
20	2.28	0.19	0.94	1.34
25	2.58	0.23	1.52	1.56
30	2.53	0.25	1.28	1.38
35	2.38	0.24	1.61	1.59
39	2.47	0.19	1.10	1.37
45	2.35	0.25	1.56	1.38
50	2.36	0.13	1.08	1.21
55	2.33	0.20	1.10	1.30
60	2.20	2.23	1.41	1.38
65	2.23	2.23	1.38	1.35
70	2.36	0.23	1.28	1.01
75	2.03	0.18	0.91	0.91
80	1.77	0.15	1.12	0.97
85	2.48	0.22	1.42	1.27
90	2.42	0.21	1.10	1.08
95	2.32	0.23	0.99	0.48
100	2.05	0.13	0.92	1.20
AVG	2.33	0.20	1.22	1.30
MIN	1.77	0.13	0.91	0.91
MAX	2.62	0.25	1.61	1.59
STANDARD DEVIATION	0.20	0.03	0.22	0.18

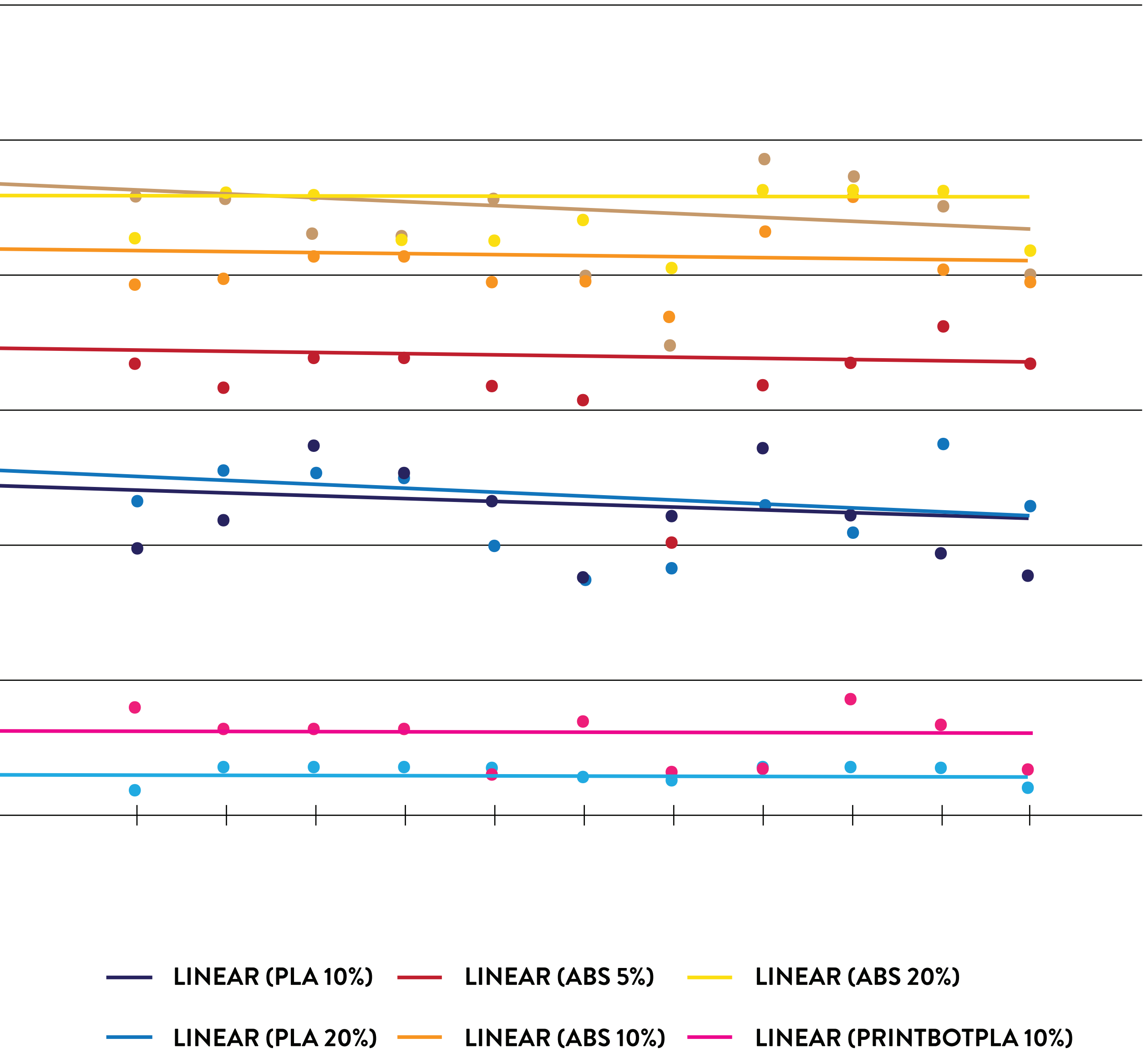
FIGURE 1:
Density readings gathered for every 5-page sample with various materials of type

ABS 5%	ABS 10%	ABS 20%	PRINTRBOTPLA 10%
1.52	1.41	2.33	0.39
1.76	2.35	2.34	0.45
1.74	2.32	2.30	0.27
1.63	2.09	2.28	0.28
1.68	2.06	2.30	0.25
1.54	2.37	2.37	0.39
1.97	2.39	2.34	0.19
1.81	2.33	2.35	0.47
1.75	2.23	2.18	0.38
1.52	2.25	2.30	0.34
1.75	2.30	2.26	0.40
1.68	1.98	1.31	0.32
1.70	2.15	2.30	0.33
1.77	2.14	2.26	0.32
1.68	1.93	2.21	0.19
1.59	1.97	2.28	0.37
1.01	1.73	2.08	0.22
1.63	2.26	2.31	0.28
1.77	2.38	2.33	0.46
1.83	2.06	2.30	0.31
1.70	1.98	2.15	0.22
1.67	2.13	2.28	0.33
1.01	1.41	2.08	0.19
1.97	2.39	2.37	0.47
0.18	0.24	0.07	0.08

FIGURE 2:
Graph showing trends in density of various materials of type



The results below show each type material tested roughly had an equal density throughout the testing, or showed a slight decrease in density further into the test. These results also show that the highest density was achieved by wooden type, followed by ABS plastics, and then PLA type.



DISCUSSION:

For this test, different typefaces were used in order to test the limits of the Hyrel 30M printer. The printed letters include ‘G’ with an Arial typeface (solid, thick text); ‘C’ with Niagara Engraved typeface (hollow, thin text); and ‘M’ with Baskerville Old Face typeface (serif text with thick and thin strokes). A PLA prototype was created from the Printrbot 3D printer with a 10% infill to get a see how strong and break resistant the 10% infill is. The prototype surpassed the expectation, as it did not crack or show stress on the plastic. This led to the group deciding to use 5%, 10% and 20% for the infill for the ABS and PLA 3D type. Having lower infill percentages also helped to conserve time when 3D printing the letterpress blocks.

After completing the test, it was discovered that the 5% infill (the thinnest infill possible) could withstand the pressure of the Vandercook, but only when the type was thick. The removal of the serifs and thin lines was a result of being pulled during the inking process. The tack of the ink pulled the pieces from the type and onto the brayer. It should be noted the serifs and thin lines were not properly formed during the actual printing of the 3D type, since the size of the thin lines on the ‘C’ and ‘M’ letters were smaller than the Hyrel’s printing nozzle. This resulted in weak, deformed lines. Comparatively, the 10% PLA prototype that was printed on the Printrbot had properly formed thin lines and withstood the pressure of the impression cylinder and the inking brayer.

The quality of the 3D printed type would have likely been improved with the use of a higher quality 3D printer. However, the primary issue is higher quality printers and filaments can be quite costly. This lead the group to determine that high quality 3D printing is not cost effective in comparison to the price of regular photopolymer plates.

In regards to reusability, both the ABS and PLA filaments were unaffected by the cleaning solvent. Since they were submerged for 72 hours, it can be determined that solvent (and the clean-up process) will not affect the integrity of 3D printed type over time.

RECOMMENDATIONS:

PRINTABILITY

When looking at the unsanded 10% PLA sample made on the Printrbot in comparison to the rest of the type, it is clear that all 3D printed type must be sanded on the type's face prior to printing on the letterpress. The reason for this is that 3D printers leave a pattern on flat surfaces when printed, which produces an uneven surface on the face of the type; in turn, this results in a poor print that is not fully solid. This can be seen below, where the images demonstrate the difference that sanding the type's face made regarding image quality. As can be seen in figure 3, sanding results in a smoother face, which permits the transferring of ink to paper more consistently. Thus, it is recommended that a letterpress operator sand down 3D printed type prior to printing.

In the type's thinner areas that were able to be printed on the 3D printer, the final printed products were not clear. The data gathered for density readings also showed a clear correlation between the density and material of the 3D type. PLA type (at all infill percentages) had lower density than the ABS type. As a result, ABS type produced whole, clearer quality prints, as shown in the pictures below (figure 3). It is recommended that 3D printed type be produced using ABS plastic, as it yields smoother lines and more continuous planes than PLA filament. For example, if a letterpress printer is creating postcards using 3D printed type, then using PLA plastic would often leave blank voids on text; thus, it is more desirable to use ABS plastic for enhanced quality and higher print density.

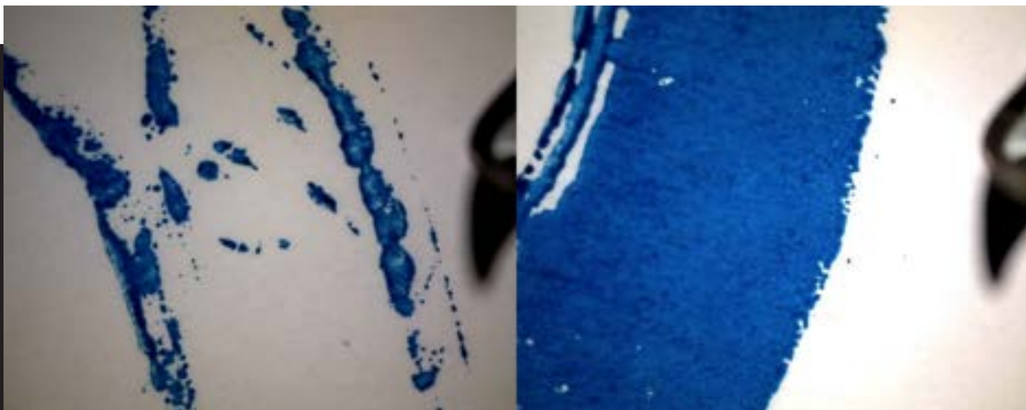


FIGURE: 3

Electronic loupe image of 10% PLA Printrbot prototype compared to a 10% ABS type piece

RUNNABILITY

The pressure from the impression cylinder did not have an effect on even the weakest 5% infill test samples. Surprisingly, it was the inking cylinder that caused the most problems with the type. The inking rollers ripped serifs and fine lines from the ABS type due to the ink tack, causing the weaker 3D pieces to stick to the inking roller. Not only is this a problem because the resulting print will lose some image area, but the ripped off pieces could cause damage to the inking rollers. If the press operator does not notice the ripped pieces and remove them immediately, they could be pushed into the rubber inking rollers' surface and cause dents on the surface. These dents would result in uneven inking of future jobs. The replacement of these rollers is expensive. Thus, it is recommended that 3D printed type not have thin lines or small parts on the image area (e.g., small serifs) that are freestanding and left unsupported by other wide pieces of image area.

In terms of letterpress inks, many inks on the market are manufactured in a similar fashion as offset inks (Henry, 2012). However, offset inks should have a lower tack than letterpress inks. The reason for this is on higher speed printing processes (e.g., offset lithography and web offset) the tack increases over time (i.e., the higher the speed, the more the tack increases). To compensate for this issue, offset inks are made with a lower tack (DeJidas & Destree, 2005). Since ink needs a certain level of tack to transfer, a higher tack must be used in letterpress printing (Podhajny, 2002). The press' slow speeds will not increase ink tack, so the ink must have a sufficient amount of tack to begin with. In other words, this means that a lower tack ink cannot be used to compensate for the high tack ink ripping off small pieces of the 3D print.

As previously mentioned, it is recommended that ABS filament be selected when considering the runnability of the 3D printer. According to the Ryerson Digital Media Experience lab (personal communication, 2016), PLA filament has a higher failure rate than ABS. This was confirmed with the amount of failures that occurred when printing type on the Hyrel press using PLA filament. All three ABS test samples printed without failures, whereas three failures occurred with the PLA plastic before any acceptable samples were printed. Since the job must be completely restarted when a failure occurs, it is recommended that ABS filament be used to avoid potential failures. ABS filament is also more durable than PLA plastic, meaning that ABS has less potential runnability problems regarding printing on a letterpress (3D Printer Filament Comparison, 2016).

It should be noted that regardless of the filament used, always loosen the filament in the plastic spool prior to 3D printing. If the filament in the spool is tight and gets stuck, then the extruder cannot stretch the plastic, resulting in an unsuccessful print job due to the 3D printer floating midair.

END-USE

The 3D type's image quality is subpar in comparison to the regularly used wooden type. Due to this, 3D printed type is not recommended when high quality is valued in a job. For high quality jobs, it is recommended to use 'real' letterpress type and photopolymer plates for complex images. However, the thicker, solid areas of the 3D type produced a high enough quality that could permit the use of 3D printed type in some print scenarios. For example, press operator could print a 3D proof of an image that will eventually be printed on photopolymer plates. This will provide the operator with a physical proof that imitates the impression of the final print, which is not possible in a digital mock-up.

If a letterpress owner/printer is hesitant when purchasing type, they could 3D print select letters of certain typefaces to test how well the type will print. This would allow the printer to see what the type will look like on paper before a full lead or wooden set is purchased. Additionally, 3D printed type could also be used for artistic letterpress applications where quality is subjective. A skilled artist or designer could incorporate the imperfections of the type into the art. A letterpress print made with 3D type could also be sold as novelty products for print customers who are interested in 3D printing technology.

If 3D printing is used, it is recommended that large images with thick, solid lines or type be used. For example, large titles or images with simple shapes could be printed. Conversely, 3D printed type should not be used to print small type or detailed images with fine lines.

Since both the PLA and ABS plastic were unaffected by the cleaning solvent, 3D printed type is reusable. This means that the press operator can design a 3D print and add it to their collection of type and ornaments permanently.

IMPROVEMENTS:

To improve the accountability of this test, it is recommended that the press operator know the capabilities of the 3D Animation software and the 3D printer itself. When the .STL file is created using Au todesk 123D Design, some fonts are restricted and not all compatible in the program; thus, it is recommended that more common fonts are used when creating .STL files in this software. Prior to completing this test, the group did not know that the Hyrel 30M printer could not produce thin lines (as demonstrated by the letter C) and thin serifs (as demonstrated by the letter M). In order to print 3D pieces properly, the operator should know the diameter of the extruder prior to printing so minimum line thicknesses could be printed.

Due to time restrictions, letterpress blocks were 3D printed in a rectilinear pattern. In the future, other types of patterns would have been applied and tested to determine the best, most optimal pattern for 3D printed type. Additionally, the group would have liked to test other types of plastic (like polycarbonate and photopolymers) and substrates (like wax and metals) that can be used for 3D printing (3ders, 2016); however, this could not be tested due to limited resources and the costliness of the aforementioned materials.

In terms of the letterpress print process, the test could be improved by sanding the type using a more automated process. Although the type appeared and felt smooth after sanding, there is no way to confirm this without measuring the type. The print area was still affected even with only microns of difference; the 20% ABS type demonstrated this, as the group expected the print to appear similar to the 5% and 10% ABS letterpress blocks. After completing the letterpress print, it was determined that the pieces may be uneven and potentially not raised properly due to the inconsistently seen in the print area. The 3D printed letterpress block should have been all raised equally.

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APPENDIX:

FIGURE:

4

Configuration of the type for printing. Picture taken before printing begun. Wooden type is on the left. PLA plastic is the top left three type, ABS plastic is the top right three, and Printrbot PLA is the bottom centre type

FIGURE:
5

Press configuration, taken after all 100 impressions. Notice degradation of type in key zones like PLA plastic 10%. Wooden type was moved to fit onto press sheet.

FIGURE:

6

Comparison image of ABS 10% (bottom) to PLA 10% (top). Notice the limitation of PLA plastic with missing strokes and degraded type.

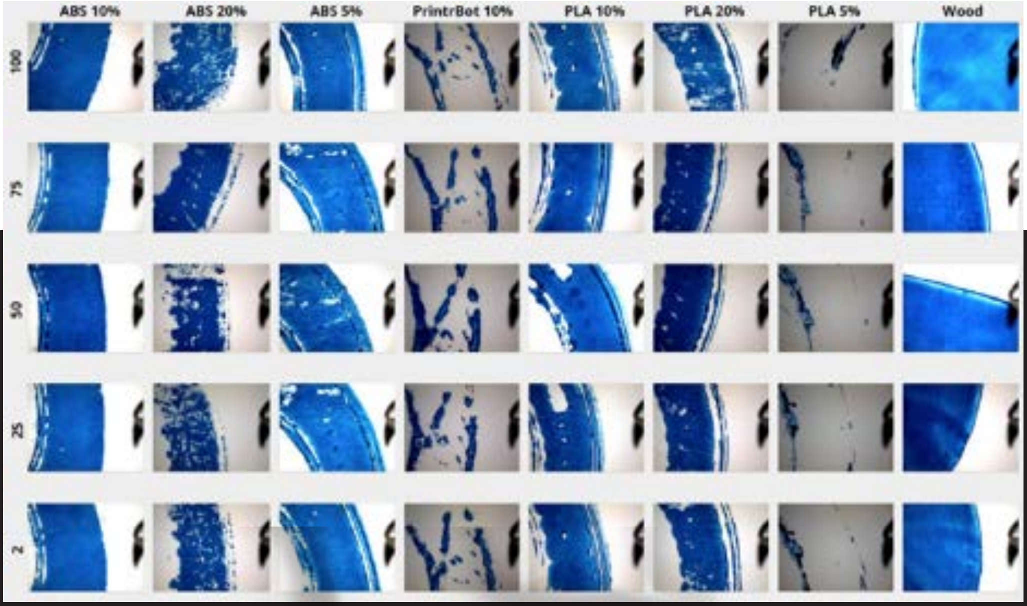

FIGURE: 7

The electronic loupe sample images from each material tested. Notice the difference in colour from start to finish.

3

MARGAUX KOCSIS
NELSON NETZEREAB
EVAN PALANGIO

SCOPE:

The main properties tested in this report were abrasion resistance of UV cured inks and temperature of glass substrates. Abrasion resistance, as it relates to UV cured inks and packaging, is important since it is often used as a substitute for traditional labels that are printed in the flexographic print process. According to ASTM International (2004), ink is much harder to rub or chip off on glass. There are other variables that contribute to this attribute; however, the group focused on the importance of condensation build-up on the container itself.

ABRASION RESISTANCE OF INK:
Glass vs. Temperature

It is important to note that the composition of UV cured inks – which contain certain additives like stabilizers, slip agents, and extenders – may negatively influence ink adherence on glass bottles. Varnishing with UV-curing overprint varnish (containing slip agents) can improve scratch resistance.

The purpose of this test was to decide if printing with UV cured inks on glass substrate is a viable packaging option for companies who sell consumer products like juice, beer, wine, or spirits, where the containers used are often transparent. This information is useful to marketers and packaging designers that want to market products in a new or interesting way but are unaware of what variables must be considered when using these types of inks.

DEFINITIONS:

ABRASION RESISTANCE:
The ability of a printed surface to resist mechanical destruction (ASTM International, 2004).

CONDENSATION:
Water that collects as droplets on a cold surface when humid air is in contact with it (Merriam-Webster, n.d.).

UV CURING:
UV curing is a speed curing process in which high intensity ultraviolet light is used to create a photochemical reaction that instantly cures inks, adhesives and coatings (Heraeus Noblelight America LLC., n.d.).

REVOLUTION:
An instance of revolving (Oxford Dictionaries, n.d.).

SUMMARY:

Nine glass juice containers from three different companies that use UV cured inks on their containers were tested. Three identical containers from each company were tested by putting two in the fridge and one in the freezer; one of the containers would be taken out of the fridge and left to sit for one hour prior to being tested. After completing the test, it was discovered that the cooler containers – the ones containing significant condensation – had a lower resistance to sandpaper. In some instances, the UV ink was completely erased by sandpaper before the twentieth revolution. The containers that had been left out of the fridge for one hour showed signs of stress, but not nearly as much as the containers tested immediately after being removed from the fridge and freezer.

HYPOTHESIS:

The fluctuation in temperature from freezer temperature to room temperature, and from fridge temperature to room temperature, will have a greater impact on the abrasion resistance of the bottles compared to room temperature bottles. The cooler the temperature, the more likely the bottles will scratch and scuff.

Upon completing this test, the group determined that the condensation added to the bottle (rather than the temperature itself) caused less abrasion resistance.

INTRODUCTION:

The marketing of packaged products has quickly become one of the primary focuses for companies that attempt to stand out in competitive marketplaces. Nowadays, there is higher demand to be innovative and set trends when it comes to packaging. UV cured inks are an emerging trend in the packaging industry due to the minimalist feel it can add to packaged products. Local companies that have succeeded at using UV cured inks on glass packaged products include The Good Press, Belmonte Raw, and Great Lakes Olive Oil Co. Printing directly on bottles delivers a stylish, sleek aesthetic that traditional labels do not.

However, there are concerns for companies that wish to use this ink-print process to be aware of. One of these concerns includes the ink chipping off from the containers, resulting in an unattractive looking product. Chipped ink could be the consequence of a product being handled improperly or rubbing against other bottles during shipping. Therefore, it is important to use high quality materials when considering the use of this print process (Carter, 2013). With this information, understanding abrasion resistance relative to UV cured inks is extremely important when considering the end-use application of a job.

TESTING RESULTS:

In order to recreate the effect of bottles rubbing against each other, the group used sandpaper weighed down by a 0.5lb weight. This combination offered enough friction for ink to chip off of the glass without being rubbed off within the first couple revolutions. However, the group also had to ensure that the sandpaper was not too rough and that the weight was not too heavy. Bottles were tested under three different temperatures: room temperature (20°C), straight out of the fridge (4°C), and straight out of the freezer (-18°C). This helped recreate situations where the bottles would be transported to the store and where customers would be transporting them after purchase.

To test the rub resistance of bottles, a piece of sandpaper attached to a weight is rubbed onto the ink on the glass bottle. After twenty revolutions, the bottle is photographed, and is then photographed again after another twenty revolutions. This way, it can be seen how resistant ink is after a certain amount of friction is applied to it.

When being transported, bottles can potentially rub against each other. They can also rub against other objects when the customer transports them. By using a light weight and sandpaper, the group can replicate friction that is rough enough to produce true results. It should be noted

> **Bottles were tested under three different temperatures:**
> 1. **Room temperature (20°C)**
> 2. **Straight out of the fridge (4°C)**
> 3. **Straight out of the freezer (-18°C)**

that the sandpaper was replaced after each bottle was tested for consistency, and because the condensation affected the sandpaper. The bottles had been put in the fridge or freezer for a few hours before the experiment to ensure that they were at the right temperature. The test was completed in a temperature-controlled environment of 20°C to replicate the average room temperature that the bottles are likely to be in.

Another way this abrasion test could have been conducted is by using equipment specifically made to test rub resistance. This equipment removes the impact that human error can have on results. The variables would be more controlled, producing more consistent results. However, due to limited resources, the group did not have access to a machine capable of testing abrasion resistance on bottles, resulting in manual testing.

This test replicates different (average) temperatures that the bottles are likely to be in, whether during production, shipping, in store, or with the customer. Although the bottles will not likely go through as much abrasion as tested, this test still helps recreate possible long-term damage that could be made to the bottles if they are being reused by the company or at home.

EQUIPMENT USED:

- 150 Norton-- Grit Fine Surface Sandpaper #02638
- 0.5 lb. weight

MATERIALS TESTED:

- 3 Belmonte Raw Juice glass containers
- 3 Buda Juice glass containers
- 3 The Good Press glass containers

PROCEDURE:

1. Fill containers with water. Place one from each company in the freezer, fridge and keep one at room temperature.
2. Using a 0.5lb weight and sandpaper, scratch the area of the container with the label, attempt to apply no extra force.
3. After 20 revolutions, stop and inspect the container, take a photograph.
4. 20 more revolutions, inspect the container, take photograph.
5. Repeat steps 2-4 for each of the room temperature, chilled and frozen containers until all containers have been tested. Replace the sandpaper after having tested each bottle.

RESULTS:

Nine glass juice containers from three different companies that use UV cured inks on their containers were tested. Three identical containers from each company were tested by putting two in the fridge and one in the freezer; one of the containers would be taken out of the fridge and left to sit for one hour prior to being tested. After completing the test, it was discovered that the cooler containers – the ones containing significant condensation – had a lower resistance to sandpaper. In some instances, the UV ink was completely erased by sandpaper before the twentieth revolution. The containers that had been left out of the fridge for one hour showed signs of stress, but not nearly as much as the containers tested immediately after being removed from the fridge and freezer.

BELMONTE RAW

1A

IMAGE 1A: Belmonte Raw bottles after 40 revolutions tested at room temperature (left), out of the fridge (middle), and out of the freezer (right).

After evaluating all three tested bottles from Belmonte Raw, it can be seen that most of the ink has rubbed off on all of them. The bottle tested at room temperature has more text left on it than the other bottles tested; however, this may have been due to the uneven surface of the bottle. Since the weight and sandpaper were flat surfaces, they did not mold to the slight changes in the height and surface of the bottle. One reason why the ink from this bottle was so easily removed is likely due to the thin weight of the type, as well as the thin ink film. According to Ukena (n.d.), UV ink deposits are relatively thin to begin with; this, in combination with thin weight and type thickness, results in ink being rubbed off more easily. When comparing all three temperatures, the text on the bottle at room temperature stayed more intact than the text on the cooler bottles that were in the fridge and freezer.

ROOM TEMPERATURE

1B

IMAGE 1B:
Belmonte Raw bottles tested at room temperature before (left), after 20 revolutions (middle), and after 40 revolutions (right).

As previously mentioned, this bottle's type rubbed off very easily. This can be seen when comparing the photos taken before, during, and after the abrasion test was completed. Prior to starting this test, the group noticed that part of the logo was already slightly scratched off (letters B, E, L, and M). This further proves how applicable this test is to real life scenarios. After twenty revolutions, the edges of the logo were scratched but still legible. After forty revolutions, the edges of the logo are illegible; however, the middle of the logo was still intact, which may have been due to the bottle's uneven surface.

FRIDGE

1C

IMAGE 1C: Belmonte Raw bottles tested out of the fridge before (left), after 20 revolutions (middle), and after 40 revolutions (right)

Again, most of the text rubbed off of the bottle. However, after twenty revolutions, the logo is already illegible. After 40, the logo is almost completely rubbed off.

FREEZER

1D

IMAGE 1D: Belmonte Raw bottles tested out of the freezer before (left), after 20 revolutions (middle), and after 40 revolutions (right).

The bottles tested straight out of the freezer were also abraded very easily, which is likely due to the bottle's condensation once taken out of the freezer. Although there were still areas that had ink, the text that was in contact with the sandpaper was completely gone.

THE GOOD PRESS

2A

IMAGE 2A:
The Good Press bottles after 40 revolutions tested at room temperature (left), out of the fridge (middle), and out of the freezer (right)

The majority of the text printed on The Good Press bottles is very thick, which should mean that the ink does not rub off as easily as thinner text would (like the Belmonte Raw bottles). However, by the end of the forty revolutions, a large majority of text was still rubbed off of the bottle, proving that ink film thickness also plays a part in rub resistance. There was also thinner text at the bottom of the bottle that was rubbed off, and done so more easily than the large text.

ROOM TEMPERATURE

2B

IMAGE 2B: The Good Press bottles tested at room temperature before (left), after 20 revolutions (middle), and after 40 revolutions (right)

The bottles that were tested at room temperature were fairly resistant to the sandpaper abrasion. After forty revolutions, parts of the text were rubbed off; however, it can be seen that after both twenty and forty revolutions, the edges of the text were still visible on the bottle.

FRIDGE

2C

IMAGE 2C: The Good Press bottles tested out of the fridge before (left), after 20 revolutions (middle), and after 40 revolutions (right).

Although there is still a large portion of text left on this bottle, it is very likely that the sandpaper was not in contact with that portion of ink due to an uneven surface. Upon evaluating the abraded type, it can be seen that the type was almost completely rubbed off with no visible outlines left (as seen on the bottles at room temperature).

FREEZER

2D

IMAGE 2D:
The Good Press bottles tested out of the freezer before (left), after 20 revolutions (middle), and after 40 revolutions (right).

This bottle's ink had limited abrasion, which the group associates with the fact that its surface was not completely flat. This resulted in a small portion of text being exposed to sandpaper; some of the ink was rubbed off but there were still outlines showing. This bottle could be considered an outlier since the amount of text in contact with the sandpaper was minimal and was not a true representation of the abrasion resistance for that object.

BUDA PRESS

3A

IMAGE 3A:
Buda Juice bottles after 40 revolutions tested at room temperature (left), out of the fridge (middle), and out of the freezer (right).

The bottles from Buda Juice had a large ink surface for the logo, thick type, as well as a thin ornament at the bottom. This helped to show that a smaller design or type surface (such as the ornament) would get rubbed off of the bottles a lot quicker than a larger ink surface would. Out of the three bottle companies, these had the best rub resistance.

ROOM TEMPERATURE

3B

IMAGE 3B:
Buda Juice bottles tested at room temperature before (left), after 20 revolutions (middle), and after 40 revolutions (right).

The bottles tested at room temperature had little effect to the abrasion. However, the sandpaper only affected a small portion of the bottle. After all forty revolutions, the text was still legible and only the ornament was predominantly rubbed off.

FRIDGE

3C

IMAGE 3C:
Buda Juice bottles tested out of the fridge before (left), after 20 revolutions (middle), and after 40 revolutions (right).

Similar to the bottle in room temperature, the text on the Buda Juice bottle was still fairly legible after all forty revolutions. A larger portion of the ink rubbed off but did not completely disappear.

FREEZER

3D

IMAGE 3D:
Buda Juice bottles tested out of the freezer before (left), after 20 revolutions (middle), and after 40 revolutions (right).

Although this bottle broke while in the freezer, there was still enough ink on the surface to be tested. This time, a large portion of ink rubbed off the bottle when rubbed with sandpaper, which left blank areas at the top of the logo, as well as on the text in the centre of the bottle. Additionally, it can be seen that the ornament is almost completely rubbed off.

DISCUSSION:

In all instances, it was noticed that the thinner the ink design (whether it is type or ornaments), the more likely it is to rub off. The Belmonte Raw bottles (images 1A-D) were excellent examples of this since the type rubbed off almost completely on all three temperature conditions. Since UV ink deposits are thin, a smaller printed surface will erode more quickly (Ukena, n.d.). This is noticeable around the ornament at the bottom of the Buda Juice bottles (images 3A-D), as well as around the small type on the Good Press bottles (images 2A-D).

These results can be explained similar to wet sanding a vehicle, where this is completed in a controlled manner to flatten and level out new paint. Unlike wet sanding a vehicle, this test was not conducted for the same purpose; however, this test yielded the same results and conclusion. The excess water vapour condenses to form droplets on the outside of the bottle – taking a closer look shows that water acts as a lubricant to remove ink from the surface (Wright, 2013). It is concluded that this is why the cooler the glass container became, the more ink that chipped off with the same amount of pressure and revolutions. This is largely due to the fact that the temperature difference enabled more condensation, which resulted in more wetness (rather than the coolness of the bottle itself).

Generally, one of the advantages of screen printing is its resistance to abrasion, as it has heavier deposits of ink compared to other forms of printing. However, this is untrue when using UV cured inks. A paper by the Printers' National Environmental Assistance Center (2016) states, "of all screen printing inks, UV inks' ink deposits are among the thinnest, meaning that in an abrasive environment, they will erode more quickly than other screen ink systems." This experiment's results are in line with this statement, as ink particles are gradually removed from the bottle's surface after each revolution when subjected to an abrasive environment (in this case, sandpaper).

Prior to completing this test, the group's general hypothesis was that the cooler the temperature of the glass, the more scuffs and scratches the bottle would have by the test's completion. The results are in line with its theory, as it was predicted that the temperature variation would result in condensation on the cooler bottles and in turn, facilitate abrasion.

Although the group aimed to standardize the test, there were some weaknesses that may have flawed the results. Since automated machinery was not used to test the abrasion resistance of the glass bottles, the group relied on one individual's hand to push the weight back and forth (making one full revolution) and another individual's hand to firmly hold the bottle in place. This left room for human error, where weight may have shifted even though it appeared to be consistent.

Working in a scientific and technical environment requires consistency. To minimize errors during this test, the group ensured to have an additional supply in materials. The bottles' dimensions varied based on its retailer, so it was important to adjust each bottle accordingly. Prior to starting the test, the group had designated roles to ensure the pressure and speed of each revolution was consistent. During the trial period (before starting the test), the group realized that it would be in this experiment's best interest to use a new sheet of sandpaper per glass bottle.

RECOMMENDATIONS:

PRINTABILITY

One way to lessen abrasion is to print a thicker ink film onto the glass container. This would make it considerably more difficult for ink to chip off as it rubs against other bottles during shipping and while being handled. A thicker ink film would also ensure that even if some ink does chip off, it will not greatly affect the integrity of the design. Companies that pay designers to produce these cured labels should be aware that using thin type or intricate designs can easily rub or chip off simply by the product being shipped. Using thicker type is optimal, as small chips in the wording will still leave the label readable and attractive looking.

Generally, poor adhesion is seen in non-porous substrates. Unlike most paper and board substrates, glass does not have pores in its surface that allow ink to penetrate. It is important that the surface tension of the ink is lower than the substrate to permit proper adhesion (Bread, 2013). An effective way to increase the ink's surface tension is to use the Corona treatment. This treatment generates high-frequency discharge, which passes through the substrate and increases its surface energy (Dr. Lahti & Tuominen, n.d.). Although the results may look the same, the bottle's surface will be more receptive to ink and other coatings after conducting the Corona treatment.

It is suggested that with other materials, increasing UV curing power will increase the inks' bond with a substrate (ASTM, 2004). This is especially true when printing more than one coat of ink, as it is imperative that the first printed layer be fully cured before the second is printed. Once the uppermost layer has been applied, the bottom layer has little opportunity to continue curing. However, there is a point on some materials where over-curing may cause ink to become more brittle and flaky.

The ideal method of improving adhesion is to reduce print speeds. This can be achieved by having a high lamp power at the slowest print speed. Although this will affect quantity produced during production, it will help improve abrasion resistance and image quality.

END-USE

Abrasion resistance plays a crucial role relative to end-use, as glass beverage bottles printed with UV cured inks require preeminent adhesion to prevent scuffs and scratches. It is important to note that when dealing with any consumable products, there are many factors to consider and standards to adhere to so as to not affect organoleptic properties of the contents inside the glass bottles.

In the graphic arts industry, the importance of consistency and repeatability is often emphasized; in this case, a brand's image or logo can potentially be tarnished through the delivering of inconsistent packaged quality. According to in-class discussions, consumers will not purchase a product based on the external packaging if they have reason to believe the internal contents are affected (Kular, personal communication, 2016). For this reason, it is important to ensure that the end-user (in this case, the consumer) receives a juice bottle that is free of any scuffs or scratches. As previously mentioned, the Corona method, alongside thicker ink films and bolded designs, can help reduce abrasion on glass substrates. Logistically, it is important to consider the use of secondary and tertiary packaging, as these forms of packaging can completely prevent any contact (or rubbing) against other glass bottles and external packaging.

It is noted that temperature is another key factor contributing to abrasion, as the condensation produced in cooler temperatures increases the abrasion tendency of the bottle. Therefore, it is important to transport glass bottles using temperature-regulated methods to avoid increased condensation and in turn, abrasion.

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4

SCOTT MORGAN

MODIFYING TRADITIONAL PRINT WORKFLOWS TO INCLUDE INTERACTIVE COMPONENTS

ABSTRACT:

Near Field Communication (NFC), is a budding technology that is slowly gaining momentum. While there is currently a lack of mainstream awareness, technology acceptance appears imminent in the long term. NFC has potential to bridge the physical and digital platforms.. This project thoroughly examines and defines NFC technology. To deepen understanding, NFC technology has been implemented into an advertising campaign, whereby the process and workflow for using the technology is documented and its effectiveness is explored. The campaign is a real application of the technology in a consumer setting. Results of this campaign indicate there is still a lack of NFC awareness among consumers. This project offers insight on how to improve awareness through education. Overall this project presents a case as to whether NFC is an effective tool to link consumers to digital campaigns, while examining the necessary modifications required for a print workflow to include the technology.

INTRODUCTION:

Near Field Communication (NFC) is a powerful chip technology that is currently gaining momentum towards mainstream adoption. In traditional print-based advertising there is limited real estate for information to be presented. In a world where advertisers have 3-5 seconds to capture someone's attention, it is difficult to maintain focus when asking consumers to navigate away from the initial advertisement (Young, n.d.). Near Field Communication provides an opportunity to easily link consumers from a physical platform to a digital one, thus extending the limited space problem.

NFC can be used by tapping an enabled mobile device to a physical object embedded with an NFC chip. Mobile is highly relevant as Canadians are increasingly turning to their mobile devices for leisure and work. Studies have indicated that Canadians are spending more time on their mobile devices and less time on other media such as televisions, radio, and printed materials ("In Canada, Mobile Drives", 2015). In contrast, advertisers continue to spend money where their customers are not spending most of their time. As mobile usage continues to grow, advertising dollars should also be allocated accordingly.

This project explores NFC as a viable and effective tool for mobile advertising. Working from the advertiser's perspective, current workflows of traditional print campaigns are identified and a roadmap for implementing interactive elements is developed. Using an established brand in the beverage sector, Lamb's Rum, with an established market in St. John's Newfoundland, a campaign has been created, implementing NFC technology in beverage coasters. A total of 2,500 coasters were manufactured and placed in bars and restaurants for data collection.

WHAT IS NFC:

HOW IT WORKS

In its simplest form, NFC can be described as a technology that allows for the exchange of information between two devices, at close range. In order for a NFC data exchange to occur, two NFC enabled devices are required (Ortiz Jr., 2006). One object requires an "active" NFC chip that is connected to a supplementary power source. This power source enables the chip to emit a radio frequency signal. In the case of a mobile device, the power source would be its internal battery. The second object requires a NFC chip that is considered passive, which is a chip that is not connected to a power source and cannot independently emit signals. The active chip emits a radio frequency field, which powers a passive chip when in proximity. This connection allows for the transfer of information, known as the process of inductive coupling (McHugh et. al. 2012).

Since passive NFC tags do not require an internal power source, this makes them easier to produce. Tags can come in the form of read-only and rewrtitable, have varying storage capacities and data transfer rates. These features can manipulate the cost of the chip, which can currently range from a few cents to a few dollars (McHugh et. al. 2012). These costs vary based in the storage capabilities, transfer speeds and the materials used to make the tag (Want, 2011). NFC chips can be hidden and embedded into objects for a seamless design.

NFC ENABLED DEVICES

NFC readers can exist within a variety of devices. For example, debit/credit terminals which allow consumers to tap to pay are NFC enabled. The focus of this project is on delivering consumer focused advertising. As such, mobile devices are the predominant reading technology of interest. There are numerous mobile devices on the market that are NFC enabled. Presently, NFC can be found in almost all modern Android, Windows and Blackberry devices. In regards to Apple mobile devices, only the iPhone 6, 6s, 6 Plus and 6s Plus have NFC capabilities ("NFC Phones", 2016). However these capabilities are limited, as Apple only allows usage of their Apple Pay native application.

Apple has a significant portion of the mobile market share with 38.3% Canadians and 43.9% Americans using iOS devices (. Android devices represent 50.5% of Canadian mobile users, while it represents 52.7% of American mobile users. The remaining 11.2% Canadian and 3.4% American mobile users belongs to other operating systems. Apple's significant portion of the market poses a risk to NFC adoption. A current NFC campaign would be inaccessible to users with Apple devices, and there has yet to be any indication as to whether Apple will open up development in this area (Hein, 2014). Even with the risk that Apple poses to an NFC campaign, there are still hundreds of millions of potential users that have an Android device, or other NFC enabled device.

CONCERNS AND LIMITATIONS

NFC can be susceptible to privacy and security concerns. It is important to establish secure and private practices to address these potential issues when implementing an NFC campaign. These are double-sided, prevention can occur at the manufacturing level and also through user awareness.

AWARENESS

With new technology there is often a limited amount of users who are familiar with the technology. A cross Europe survey with over 5,000 respondents found that only 8% of urban consumers were aware of NFC (Smith-Strickland, 2013). As the technology continues to get used, adoption progresses and people growingly become more familiar with the technology. When companies try to act as innovators they need to be wary of the level of education required for people to understand how to use the technology. In these cases an education component may be required until the technology is widely adopted.

PRIVACY AND SECURITY

Near Field Communication technology does have innate security features. The most duly noted being the short proximity that NFC possesses. Interactions can only be made when a device is in an approximate 3-4 centimeter range of another device or tag. This would mean that any potential attack conducted would have to be done within the personal space of the device owner (Ortiz, 2006). This close proximity would make it difficult to conduct unnoticed attacks.

Many NFC tags are manufactured as read/write tags, meaning that the tags can be read and rewritten as many times as the user desires. If left unchanged, this feature poses a risk in itself. Anyone with an NFC enabled device could read the tag and write content to it. This raises the possibility of having nefarious content being written to the tag, posing a risk to the next person who comes along and taps the tag. This potential risk is important to address at the manufacturing stage, as read/write chips have the ability to be locked after content is written to the tag. Once the tag is marked as locked, the tag can no longer be written to, resulting in the tag only containing the original content written to it.

In a well-executed campaign, an NFC tag should be embedded into the product or advertising medium. Not only does this allow for increased design aesthetics, but there is also inherent security from a user perspective. In this case anyone could place an opposing NFC tag on top of the original. Users could be able to spot this type of attack if the medium was visually tampered with through the tag being removed, replaced or duplicated if made aware of these concerns. For additional security devices should be able to detect the presence of multiple tags in proximity of the device and provide a warning (Fischer, 2009).

PRIVACY AND SECURITY

It is important to see where NFC is currently being used to understand where it is performing. Current uses allow for the forecasting of where the technology may fit in the future. Those already using the technology provide insight on how the technology is being adopted and if it can be set to becoming a mainstream technology.

NFC AND MOBILE PAYMENT

NFC is currently thriving in payment. With tap and pay options at the terminal, consumers can use their bank or credit card to speed up checkout. The NFC reader that detects the chip in the cards is the same reader that can be used to tap and pay using a phone, which also has a chip. This area is rapidly growing as consumers continue to favour their mobile device for many applications. A large majority of retailers already have the proper pay terminals to accept mobile payment. From the user perspective, mobile payment can now be set up in most banking applications.

Alternatively, applications like Google Wallet or Apple Pay can be used (Profis, 2014). Mobile payment has become a secure and quick way to make a transaction.

NFC USE CASES

Cognac brand, Remy Martin debuted an NFC enabled cap to prevent tampering in its products in 2015. The cap connected to an application to tell consumers if the bottle had been previously opened or tampered with. Upon an initial tap, the bottle would register in the application as authentic and untouched. As soon as the bottle had been open, the connected cap is able to change its status and reflect that the bottle has been previously opened in the application. NFC enabled Remy Martin to guarantee authenticity of a premium product to their consumers ("Remy Martin CLUB", 2015).

In 2012, Lexus debuted an NFC enabled print ad in Wired Magazine. Users were directed to place their NFC enabled phone on the page, and they were linked directly to a video demo of a vehicle media center. The user's phone simulated the Lexus media center and after the video, users were able to push a button that further simulated the media center ("Lexus Magazine Print", 2012). JCDecaux and Kinetic, an advertising firm and media agency launched the first large-scale NFC enabled advertising campaign in March of 2012. This campaign was to serve as a trial in the British town of Reading. The two teamed up with giants such as H&M, Mercedes and EA games (along with others) to create NFC enabled bus shelters and posters. This four week project featured different advertisements each week that provided a variety of different content such as special offers, vouchers, games and music. The campaign had over 3,000 people read the NFC tags. Some key findings from the project included:
The trial ultimately showed that the key for success was to relate to the consumer experience and build upon the existing brand relationship (Clark, 2012). NFC demonstrated the potential for successful interactive engagement in this application.

- 78% of users cited positive results associated with the ease-of-use of the campaign

- Positive interactions occurred through a combination of relevance, dynamic content and a strong call-to-action

- 87% of people with NFC-enabled devices said they were likely to repeat the experience. Those who didn't have an enabled device, 80% said they would like to use it in the future.
- Download conversion rates were relatively strong, an average of 28% for video content. This percent increased to 49% when the content was new and previously unseen.

FUTURE APPLICATIONS

Imagine sitting at a bus stop and seeing an ad for a movie you have been wanting to see. With the application of NFC, that poster could offer you an easy way to connect and purchase tickets (Sacco, 2012). In another scenario, you could be walking through the mall and see a nice pair of shoes on display. Tapping the display with your mobile device could lead you to the exact location of the shoes or even alert a sales associate to grab you a size.

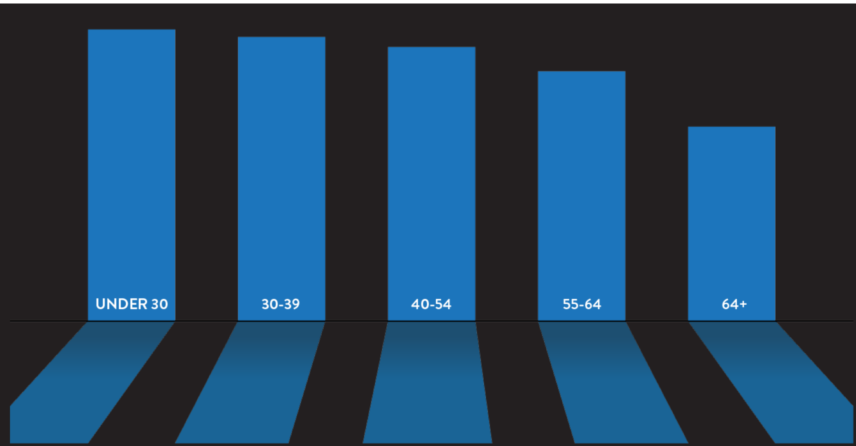
NFC technology is also currently undergoing trials in hospitals. The technology is being implemented in patient's wristbands, where a NFC tag stores the patient's information and can be updated with new information like current medications. Doctors can tap their device to the patient's wristband to instantly receive all updated information. Previous methods had nurses carrying around computers and scanning barcodes to link patient information. This method was time consuming and involved extra work for the nurses, which was non-optimal (Swedberg, 2014). NFC is a cost effective method of linking users from the physical to the digital world. Potential applications extend far beyond the likes of just advertising, where opportunity is immense.

MOBILE ADVERTISING:

As NFC acceptance relies on users having mobile phones, understanding the current state of the mobile technology landscape is critical to projecting NFC growth. This project results in a live campaign that is geographically situated in Canada. As such, the focus will remain in said market.

CURRENT STATE

In Canada alone, an overwhelming majority of people own mobile devices. As of 2013, there is an estimated 13,819,964 households in Canada. 84.9% of these households reported having a mobile device. Shown below is an age breakdown of mobile device ownership per household.



F1 AGE BREAKDOWN

FIGURE 1:
Age Breakdown of Mobile Device Ownership per Household ("Canada's Digital Divides", 2015)

Showing the highest percentage in ownership are households represented by those aged under 30, at 96%. The lowest are those aged 65 and over at 65% ("Canada's Digital Divides", 2015). Not only are the ownership rates growing, but expenditures are as well. As of 2014 expenditures have risen to $79.08 (from $60.92 in 2011) for mobile wireless services ("Canadian Media in a", 2016).

From 2010 to 2014, the Canadian mobile sector has experienced a cumulative annual growth rate of 2.5% ("Communications Monitoring Report", 2015). Not only are Canadians spending more money on their devices, but also more time. In 2011, Canadians spent an average of 29 minutes on their mobile device each day (excluding voice calls). Time spent has increased at a cumulative annual growth rate of 46.1% to 2 hours and 12 minutes in 2015 ("In Canada, Mobile Drives", 2015). Although there is a significant increase in time spent on mobile devices the advertising dollars are not being spent accordingly. Looking at media as a whole (mobile, desktop, TV, radio and print), mobile occupied 22.6% of time spent on a digital device. This number is up from 2014 and 2013, with the time spent being 19.4% and 15.5% respectively. Spending by advertisers is not in step with the increase, as only 12.5% of total media and advertising dollars is allocated for mobile ("In Canada, Mobile Drives", 2015). It is expected that the growth continue throughout 2016 to become more representative of the rapid growth of time spent on mobile devices.

	2013		2014		2015	
	TIME SPENT SHARE	AD SPENDING SHARE	TIME SPENT SHARE	AD SPENDING SHARE	TIME SPENT SHARE	AD SPENDING SHARE
DIGITAL	36.80%	29.80%	40.30%	33.20%	43.20%	36.40%
MOBILE (NON VOICE)	15.50%	3.70%	19.40%	7.90%	22.60%	12.50%
DESKTOP/ LAPTOP	21.30%	26.00%	20.90%	25.30%	20.60%	23.90%
TV	38.50%	28.40%	36.60%	27.50%	35.00%	26.70%
RADIO	18.80%	13.60%	17.90%	13.50%	17.20%	13.10%
PRINT	5.90%	28.20%	5.20%	25.80%	4.60%	23.70%
NEWSPAPER	4.30%	22.60%	3.80%	20.30%	3.40%	18.60%
MAGAZINES		5.70%	1.40%	5.50%	1.20%	5.10%

AVERAGE TIME

T1

TABLE 1:
Share of Average Time Spent per Day With Select Media by Adults in Canada vs. Spending Share in Canada, 2013-2015 ("In Canada, Mobile Drives", 2015)

INTERACTIVE DESIGN

With the growth that is taking place in mobile commerce, there is a desire among advertisers to target this platform. An opportunity lies with the integration of mobile devices in traditional print advertisements. With traditional print advertisements it is difficult to capture consumers with engaging content. Current practices employ the use of laborious technologies like quick response codes that require multiple interactions or use of other applications to engage with additional content. The customer's interest is often lost in this process.
NFC offers a more streamlined interaction. The technology is already embedded in many mobile devices. With a simple tap to another NFC tag, the user is instantly brought to the additional content. It is here where the opportunity lies. NFC provides an efficient means of connecting the physical world to the digital world, through the basic interaction of tapping two tags together.

THEORETICAL FRAMEWORK:

Now that we better understand the mobile landscape in Canada, we establish the theoretical framework through which we can examine NFC adoption. When working with a newer technology like NFC, this framework assists in providing an estimation of how far along the technology is in terms of being adopted.

DIFFUSION OF INNOVATION THEORY

Gabriel Tarde is widely considered the founding father of the Diffusion of Innovation theory. The French sociologist designed the theory to explain social behaviour as it pertains to individual acts as well as developing cultural acts (Kinnunen, 431). The Diffusion of Innovation theory was popularized by Everett Rogers, with the help of his book Diffusions of Innovation. Rogers defines an innovation as an idea, practice, or object that is perceived as new by an individual or other unit of adoption (Rogers, 11). Noting that if this idea, practice or object is perceived as new, it can then be considered innovative. Diffusion is defined by Rogers as the process by which an innovation is communicated through certain channels over time among the members of a social system (Rogers, 5). Diffusion of Innovation can then be defined as the process in which social systems adopt new ideas, objects or practices over time.

Rogers mapped out social adoption categories as individuals acclimated these new ideas, practices and objects over time. The initial few individuals who adopt are categorized as the innovators. As the innovators become comfortable with the innovation, word spreads and a new group, known as the Early Adopters gains interest. This process continues until a critical mass is reached. Post critical mass, the adoption becomes more conventional and mainstream as time progresses (Kaminski, 2011).

The five adopter categories that Rogers maps out are Innovators, Early Adopters, Early Majority, Late Majority and Laggards.

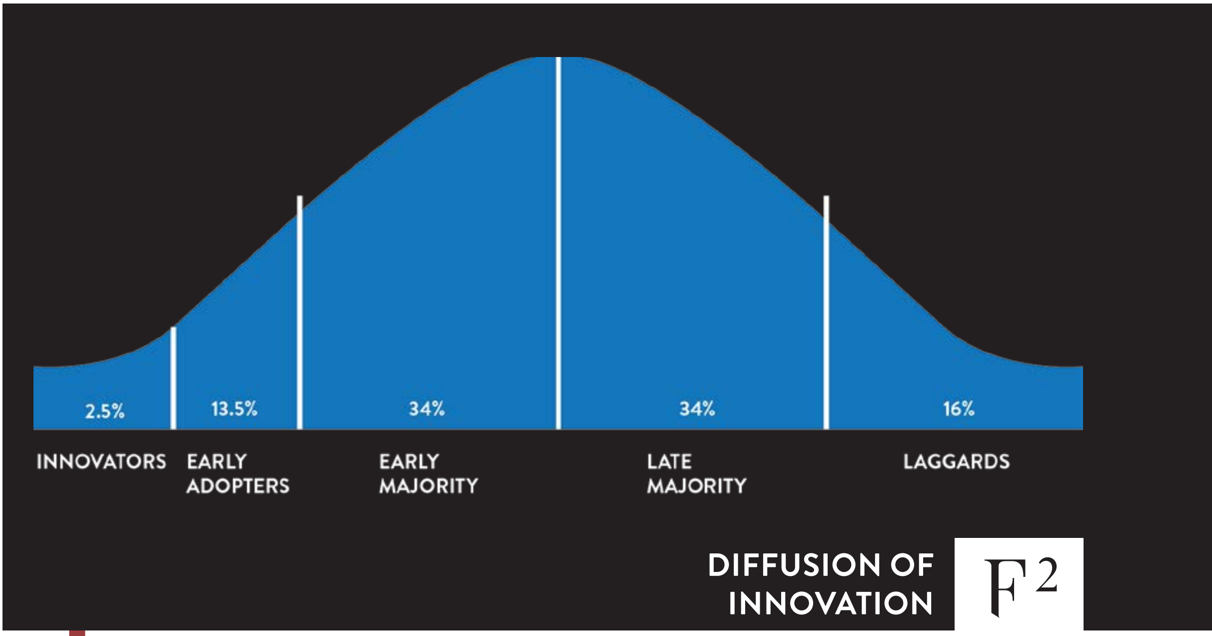


FIGURE 2:
Roger's Diffusion of Innovation Bell Curve (Rogers, 247)

INNOVATORS

Innovators are those eager to try new ideas. It is common for innovators to be involved in social cliques even at great geographical distances. Innovators often have ample financial resources to support potential losses in unprofitable innovation. Innovators accept a high risk of uncertainty, but in doing so play an important role as a gatekeeper in the adoption of innovation (Rogers, 248).

EARLY MAJORITY

Early Majority tend to adopt new ideas right before the average individual. The Early Majority interact frequently with their peers, but often lack the leadership that Early Adopters possess. The Early Majority spend more time adopting an innovation as their decision period is usually longer. The Early Majority willingly follow to adopt innovations but rarely lead (Rogers, 249).

EARLY ADOPTERS

Early Adopters generally have the greatest degree of opinion leadership among the social systems. The remaining adoption categories look to the Early Adopters for advice and information on the innovation. They serve as role models and are respected by their peers, often dictating the success or failure of an innovation. Early Adopters decrease uncertainties present in an innovation by adopting it and giving peers an evaluation (Rogers, 249).

LATE MAJORITY

The Late Majority are considered skeptics. They do not adopt until a large portion of their social system have followed suit. They are often pressured by their peers to adopt innovation. They are scarce on resources and must be certain in the innovation before adopting (Rogers, 250).

LAGGARDS

Laggards are the last group in the social system to adopt innovation. They possess next to no opinion leadership. Laggards act in traditional manners and follow what the previous generation conducted. By the time the innovation reaches the Laggards there is often a new idea that has superseded and gained traction from the innovators. Laggards resist innovation and approach adoption with extreme caution due to their limited resources (Rogers, 250).

Using the Diffusion of Innovation theory, the aim should be to streamline the innovation so that the needs are met within each adoption category (Kaminski, 2011). To do so, the adoption process should be understood. The adoption process starts with the awareness stage. In this stage, the individual has exposure to the innovation but lack knowledge or complete information. The second stage is the interest stage, where the individual has a raised awareness and seeks additional information. The third stage is the decision stage, where individuals envision the innovation in their present and future to evaluate whether or not the innovation should be tried. The fourth stage is the implementation stage, where the individual makes full use of the innovation. The final stage is the adoption stage, where the individual continues to make full use of the innovation (Kaminski, 2011).

Rogers (1983) also identified 5 characteristics in which influenced innovation's rate of adoption:

1. Observability, which he defined as the degree to which the results of an innovations are visible to others.

2. Relative advantage, the degree to which the innovation is perceived as being better than the idea it supersedes.

3. Compatibility, the degree to which the innovation is perceived as consistent with existing values, past experiences, and needs of potential adopters.

4. Trialability, the degree to which the innovation can be experienced on a limited basis.

5. Complexity, the degree to which an innovation is difficult to use.

These 5 characteristics will be used throughout the project in an attempt to develop an engaging NFC advertising campaign (See section 5.2.1.1).

METHODS:

For the purpose of this project, three methods were used. The first method was the design process. This process was used throughout the project in order to develop the campaign, which revolves around a set of NFC beverage coasters. This process was an efficient means of developing an idea into a working product. The second method used was ethnography, which allows for natural observation. This method requires the observer to watch the natural interaction with the created beverage coasters to see the impact on social interaction. The observer does not interfere with those participating in an interaction allowing for the collection of natural social behaviour data (Reeves, et.al. 2008). The final method was web analytics. Since the beverage coasters are NFC enabled and direct to web based links, this opens up the possibility for the collection of web data to be analyzed.

DESIGN PROCESS

Throughout the creation of the project, the design process was implemented in various stages to ensure a successful design. The Design Process is a 6 step cyclical method for creating a successful design. Detailed below are the 6 steps of the design cycle that were derived from Bryan Lawson (34):

1. Define - In this step a problem must be defined that can be solved through design.
2. Collect - This step involves collecting all the necessary information before beginning to design a solution.
3. Brainstorm and Analyze - This is where idea generation occurs.
4. Develop - The develop step requires the building of a model to test the problem with.
5. Feedback - In this step your ideas should be presented to others to gain feedback and further insight on the design/model.
6. Improve - This step involves using the feedback collected to improve the design.

This process should be repeated as many times as necessary to create a successful design.

The design process was directly applied to this project for the creation of the beverage coaster. Each step created a guideline to follow for what needed to be done to efficiently design a real product. This process is further explained in the section below.

ETHNOGRAPHY

Ethnography is a method used to study of groups of individuals. The practice looks at the social interactions, behaviours, and perception that occurs within these groups of individuals. There is a strong emphasis on examining individual social actions in detail in ethnographic studies. The data that is collected is generally in the form of descriptions and explanations of the functions and actions that are taken by human participants (Reeves, et.al. 2008).

Spradley (10) suggests that ethnographic studies can be conducted around the basis of 9 observational dimensions, they are as follows:

- Space - The physical layout of the area the study is being conducted
- Actor - The varying people involved in the observation
- Activity - a set of related activities that occur
- Object - the physical items that are present in the surrounding area
- Act - a single action that the observed individual partake in
- Event - activities people carry out
- Time - The chronological order of events that occur
- Goal - accomplishments the individuals are trying to achieve
- Feeling - The resulting emotions that are felt and expressed

During periods of observations, there is often a lack of initial interaction with the participants. This allows the researcher to view natural and candid actions. Being immersed in the setting of observation typically uncovers a more in depth understanding of social actions (Reeves et. al, 2008). Ethnography was an appropriate choice for this project because it is important to understand how individuals will interact with the advertising campaign in their natural state.

For this project, observation took place in St. John's Newfoundland at a variety of bars and restaurants along George Street, during George Street Festival. The setting of each bar was analyzed to assess how many people can fit in the bar as well as the presence of interactive advertising. A range of males and females of all ages were observed. Their actions were looked at in terms of how they interact with the beverage coaster, as well as what factors affect that interaction. These factors include whether the server included a coaster with the ordered drink, if the server mentioned the coaster at all, if the customer placed their drink on the coaster, what mobile device the customer had and if the customer was at all intoxicated. These observations will help understand if customers were aware when they are in the presence of interactive advertising and willing to engage in an interaction.

WEB ANALYTICS

Each NFC enabled coaster features web links that can be tracked through analytics. Every NFC tag directs to a specific bit.ly link to allow for separate tracking of those who were directed to the website directly through the NFC tag versus inputting the web link of a separate device. The primary indicator of success for the NFC tags are the number of hits to the various pages. Secondary indicators are length of time spent on the page as well as navigation to other pages. Tertiary indicators are mentions or engagement through social media networks.

RESULTS AND DISCUSSION:

The researcher's interest in NFC led to developing a project centered on the technology. To gain a better understanding, the theory of innovation was used to shape the literature review. In the section below, NFC enabled advertising and payment are placed on the adoption curve based on discoveries through the work. Following NFC Adoption, The Project section describes the design process used to develop the campaign, working alongside an industry partner. The entire process is detailed below. Lastly, the outcomes of the advertising campaign were measured through an ethnographic study as well as web analytics. These results are also detailed in this section.

NFC ADOPTION

From looking at the current uses of NFC and comparing them with the theoretical framework popularized by Everett Rogers, one can place NFC technology upon an adoption curve pictured below.

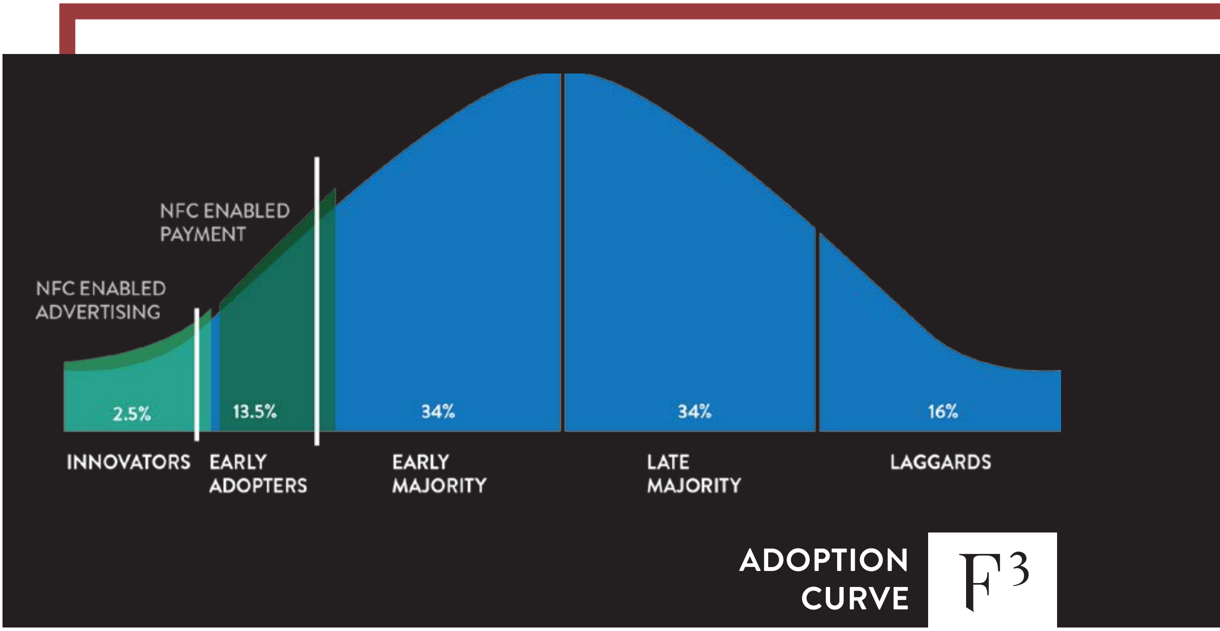


FIGURE 3:
NFC on the Adoption Curve

Analysis of the literature places NFC enabled advertising as entering the Early adopters stage, while NFC enabled payment is slightly further ahead, and just entering the Early Majority stage.

We know that NFC advertising and payment is past the first stage of Innovators based on its usage. Innovators are generally few and far between in terms of those who use them but in both cases there are examples of use across multiple countries. NFC enabled payment is just entering the Early Adopter stage because we are seeing many devices enabled with this technology and many banks starting to offer this service in collaboration with retailers, but the user base is currently fairly small and slowly growing. Based on US statistics, mobile payment has only penetrated approximately 12.7% of mobile users in 2015 and that is forecasted to jump to about 19% throughout 2016 ("Mobile Payment will Triple", 2015).

As mentioned, NFC enabled advertising companies appear to still be experimenting with it the technology. A lack of awareness on the capabilities of the technology still appear to be impacting usage. A study based in the UK indicated that only 18% of marketers are aware that NFC can be used for out of home marketing campaigns (Boden, 2015). Bigger companies with larger budgets have the space to experiment, in a similar fashion as to the definition of an Innovator. An increasing amount of companies are beginning to experiment with NFC enabled advertising as the cost of the tags continue to fall, suggesting that the technology is moving out of the Innovators stage and into the Early Majority. Further usage will determine whether NFC enabled advertising will continue to grow or drop off at this point.

THE PROJECT

For the purpose of mapping the process and outcomes of this advertising campaign, the project will be described using the design process that was used throughout to implement it.

IDEATION

This campaign started out with an opportunity to pitch an NFC enabled project to Corby Spirit and Wine Ltd. and their Lamb's Rum brand. Three different ideas were analyzed for the campaign, the details of each are explained below. Pitch collateral can be found in Appendix D.

Prior to the pitch, the rum brand's social channels were analyzed, as social was going to be an initial target for the NFC tags to link to. Upon analysis of the brand's social channels, there was an identification of a weak social following, which could indicate a lack of brand awareness. This part of the process refers to the define step of the design process. A problem was identified that could be solved through a designed campaign. The pitch revolved around creating an in store campaign that linked rum bottles to social through the NFC implementation in the bottle's label.

Featured on the front of a Lamb's Rum bottle could have been a NFC tag linking to YouTube or Facebook. In keeping with trends, creating a short video recipe tutorial was explored. Videos in this category can carry upwards of 10 million views and therefore, an attractive vehicle for engagement. Lamb's Rum already has a variety of videos detailing how to make many of their drinks. These videos, however, lacked a wide viewership and struggled to gain traction. Listed are potential reasons as to why these videos may not have gained the success they potentially deserve. The setting of these videos was in a bar, which is not where the consumer would be if they were to make the drink themselves. The lack of relation creates an intimidating environment. The ingredients used in the videos, like Benedictine, green chartreuse, and angostura bitters are not common household items. The average consumer may not have these in their home or even know what it is or where to get it. The final reason could be the length of the videos, as many of the videos lasted upwards of 2 minutes. In this timeframe, the attention of the viewer can easily be lost if they have to watch a 2 minute video to make a beverage. Current popular videos are often less than one minute and feature segments that have been sped up, so as to not waste the viewer's time.

The pitch had gone successfully and Corby and Lamb's wanted to work towards creating an NFC enabled campaign, however, not through the suggested retail platform. Potential budgetary allocations, as well as changes to the current workflow restricted the possibility of this campaign. By talking with the team, it was found that Lamb's has a large presence at George Street festival in St. John's Newfoundland. This festival became the new target for the campaign. This information became available through the collect step of the design process. Budgetary restrictions were elaborated on and limitations were unraveled through launching the campaign on George Street.

Through another round of ideation based on the third step in the design process, two more possible campaigns had been developed. The George Street Festival is a 6-day event that takes place on one of the busiest entertainment districts in Canada. The festival features performances by numerous bands throughout the week. One campaign idea would be creating a connected cup for individuals at the festival. The NFC cup could link to a social media contest, enticing participants to share their experiences at George Street Festival. What challenged this campaign was the lifespan of the cup relative to its cost. Integrating a NFC tag in a plastic cup substantially raises the unit cost. A plastic cup is generally used one time, so for a trial campaign it was difficult to justify the cost. The second campaign involved the creation of a retail ready display that linked consumers to a contest of monetary value. The challenge around this campaign was the timeline and efforts already in place. Currently in retail locations, Lamb's bottles featured promotional content relating to the contest. At the time of conception, the contest had already been running. This campaign would launch nearing the end of the contest, which would sacrifice potential gains from collected metrics. Additionally, the campaign would be difficult to quickly deploy in a retail setting, as retail ready displays require approval at the store level, with planographs only completed a few times per year.

After several brainstorming sessions, Lamb ultimately decided that they wanted to create a campaign around beverage coasters. Lamb's decided to initiate a test campaign and committed to distributing 2,500 coasters to bars/restaurants along George Street for the festival. The greatest challenge at this stage was the development of what would happen in the campaign. In a bar/restaurant location, it is not conventional to find a lot of consumer directed marketing and advertising that actively engages the consumer. The majority of advertising currently present is simply passive advertisements with non-engaging content. The challenge was how to do this effectively and implement a campaign that seamlessly fits into the experience of being at a bar/restaurant. What was created was a multi-platform campaign that linked to a variety of networks aimed at solving small problems that may occur in a bar/restaurant setting.

5 CHARACTERISTICS OF INNOVATION RELATIVE TO THE PROPOSED IDEAS

The chart below compares 2 of the previously proposed ideas along with the selected campaign to the 5 characteristics of innovation that were previously defined in section 3.1. Successful ideas will ideally show benefits in all five categories, which could indicate that the idea is indeed innovative. Important takeaways were the trialability and compatibility of the coaster campaign. The combination of these two stood out to Corby making the campaign more ideal than the other proposed ideas.

	INTERACTIVE COASTER	CONNECTED CUP	RETAIL LABEL
RELATIVE ADVANTAGE	- Entices the user to interact with the coaster - Seamlessly connects to a digital platform - New interaction when compared to a conventional coaster	- Entices the user to interact with the cup - Seamlessly connects to a digital platform - New interaction when compared to a standard plastic cup	- Entices the user to interact with the label - Seamlessly connects to a digital platform - New interaction when compared to a conventional label - Bottle serves as a multi-purpose tool, delivering a beverage and recipe
OBSERVABILITY	- Those with NFC enabled devices can view the full experience - Those with non NFC enabled devices share a limited experience - Shared experience among those at the table	- Those with NFC enabled devices can view the full experience - Those with non NFC enabled devices share a limited experience - People in a crowd can see the interaction take place	- Those with NFC enabled devices can view the full experience - Those with non NFC enabled devices share a limited experience - Other shoppers may notice the experience taking place, enticing them to try
COMPATIBILITY	- Aligns with bar/restaurant experience - Looks to solve problems encountered in a bar/restaurant	- Becomes a platform to connect to the event that the user is at	- Introduces new beverage creations - Ties in directly with the purpose of the beverage
TRIALABILITY	- Can only be found in selected bars/restaurants - Lifespan of approximately 10 customer uses	- Lifespan of only 1-2 uses per customer - Only found at select events	- Same lifespan as the bottle it is placed on, which could be up to a few months - Found at every location where sold
COMPLEXITY	- Easy to use with NFC enabled device. A simple tap to the coaster enables the interaction - Non NFC enabled devices must input a web link	- Easy to use with NFC enabled device. A simple tap to the cup enables the interaction - Non NFC enabled devices must input a web link	- Easy to use with NFC enabled device. A simple tap to the display enables the interaction - Non NFC enabled devices must input a web link

INNOVATION

T2

TABLE 2:
5 Characteristics of Innovation Relative to the Proposed Ideas

COASTERS

F4

FIGURE 4:
Developed Beverage Coasters

The image above illustrates the final three coasters which were produced and distributed for this project. The first coaster targeted individuals that were left alone by their peers, which occurs most often when a bathroom break is needed. Lone individuals typically turn to their phones to pass the time in which their peers left them. Upon tapping the user's mobile device to the coaster, they would be linked to a web page featuring an HTML based game to pass the time. Using Lamb's Rum branding within the game subconsciously increases brand awareness.

The second coaster targets those struggling to place a drink order. In this case, the coaster directly links to a drink suggestion featured on Lamb's website. All of the drink suggestions feature the use of Lamb's Rum, with the idea being to provide an opportunity for the consumer to try the product being marketed to them.

The final coaster targets those enjoying their time out that may also take pictures. The coaster encourages the users to tweet a photo of their time out. The coaster directly links to twitter and begins composing a tweet. The user can easily add their photo and tweet at Lamb's Rum.

PRODUCTION

Once the ideas were designed once they were approved and finalized. Corby outsources their design work so multiple agencies had to be on the same page with the idea. When working with an interactive campaign, there needs to be a focus on the interactive element. In this case the focus was the NFC tag. This meant that the coaster's design and body text all had to support the message being conveyed. The coaster's simplicity and cohesiveness were extremely important, as there is not much room to provide instruction or convey a message. In this case, large text was featured on one side, posing a question to the viewer. Following the question, underneath was an image that would be on top of the NFC tag. Within the image was a visual icon indicating there is an action at hand, as well as text telling the user there is a NFC chip present and to tap their phone to the chip to activate it. The reverse side of the coaster had instructions on how to engage with the coaster. The instructions contained two steps to minimize confusion and ensure the user could easily interact with the coaster.

Using the correct text and verbiage was essential for this campaign as it was centered on directing the user to the NFC tag. It had to be made sure that the correct language was being used to reduce the chance of misconveying the message.

An important note is that not all devices (at the time of writing) are compatible with NFC interactions. To counteract this, all coasters also feature a short URL to have a similar interaction with the coaster. This makes everyone with a mobile device and access to Internet capable of interacting with the coaster in some form.

For the purpose of this test campaign, the link that the NFC tag used and written link on the coaster were both unique of each other. This is so that separate metrics can be collected to indicate the more successful usage method.

Producing a traditional beverage coaster is an inexpensive option to promote a product. To produce 2,500 conventional coasters, the cost ranges from approximately $340 USD to approximately $440 USD. This results in a unit cost of about 14–18 cents per coaster. The prices vary based on the shape of the coaster, the quantity, thickness and number of colours printed ("Pulpboard Coasters", n.d.). Production is usually done by a third-party facility. The coasters are made out of a wood pulp board substrate that has been pressed to the designated thickness and cut to the size of a press sheet. The sheets are run through an offset printer and then trimmed to the final size. The completed coasters can then be packaged and shipped off.

Creating a NFC coaster adds complexity to the production process. Since the technology is not frequently used in beverage coasters the cost is quite high in comparison to the conventional coasters. In this campaign Lamb's used a custom shaped coaster, printed double sided using 4 colours. This alone carried a unit cost of 50 cents CAD per coaster. Integrating a NFC tag only further increased the cost. The tags alone carried a unit cost of $2.65 each as the manufacturer had to outsource to purchase them as well as integrate them into the coaster. This brings the total cost of 2,500 coasters to $7,875 CAD, or a unit cost of $3.15 per coaster.

The NFC enabled coasters are produced in a similar fashion as conventional coasters. The coasters are also made out of a wood pulp board substrate that have been pressed to the designated thickness and cut to the size of a press sheet. The sheets are run through an offset printer to print both the sides. To integrate the NFC tag two separate sheets need to be adhered together. The NFC tag is placed in between the two sheets and then the entire coaster is laminated together to seal it. The sheets can then be trimmed to size. Supplied to the customer is a spreadsheet in which they have to fill out the instructions for how the NFC tags will be programmed, in this case it was in the form of links. This sheet is returned to the manufacturer so the coasters can be programmed. The coasters are run through an NFC reader/writer which programs the tag. The completed coasters can then be packaged and shipped off, with total production taking about 15 days.

LAUNCH

Upon completion of production, the coasters were shipped to Corby's head office in Toronto, where those involved could see the coasters before they were finally shipped to St. John's, Newfoundland. Final testing occurred where samples of each of the three different coasters were confirmed to have their NFC tags functioning. This included testing the NFC range from tapping on each side of the coaster and testing the coaster after is has been used and been in contact with moisture. Next the links were tested to confirm proper function. The coasters had worked as expected and were given the all clear to be shipped to Newfoundland.

The coasters were delivered to Lamb's Rum sales representatives who then distributed them to the bars along George Street. There are 21 bars/clubs/restaurants along George Street, giving it the title of the street with the most bars per square foot in North America (George Street Association, n.d.). This makes the street a good location to get a lot of potential coverage. The representatives were the first point of contact between the bars and the coasters, making this an opportunity to educate the bars and staff about the campaign.

An ethnographic study was conducted at 2 bars during the festival. The first bar attended was Christian's Bar. This was a smaller bar that had space for a maximum capacity of approximately 75 people. This bar only served drinks and not any food. The bar itself occupied a large majority of the space with its u-shape, allowing space for multiple customers to approach. There were currently not any other engaging or interactive advertisements present in the bar; there were tent cards that showed drinks, posters of various beers and televisions that would play sports with the occasional advertisements. The coasters were distributed to the few tables that were present in the bar, but since the bar did not serve any food, this meant that the tables were not getting maintained throughout the night. If coasters were taken by customers or fell on the floor, there was nobody going around to replenish the tables. At the bar, coasters were placed in stacks for customers to take at their discretion; staff was not handing them out. Coasters became scattered across the bar throughout the night as customers took them to place their drinks on. In total, 33 customers were observed throughout the evening, 18 of which were female and 14 male. Approximate ages ranged from 24-60 of those observed with the average age being in the range of about 32-34. Of this group only 3 people or about 9% had any form of interaction, varying from playing with the coaster in their hand to reading the coaster. One individual took the coaster and kept it for himself. From what could be visibly observed, 13 individuals had iPhones, 1 had a Blackberry and 3 had Android devices. About 61% of this group had a coaster present for their drink where 48% actually used the coaster for their drink. Most importantly, 0% of catalogued observations included a server explaining the coaster, which will be discussed later in analysis. For complete results, see Appendix A.

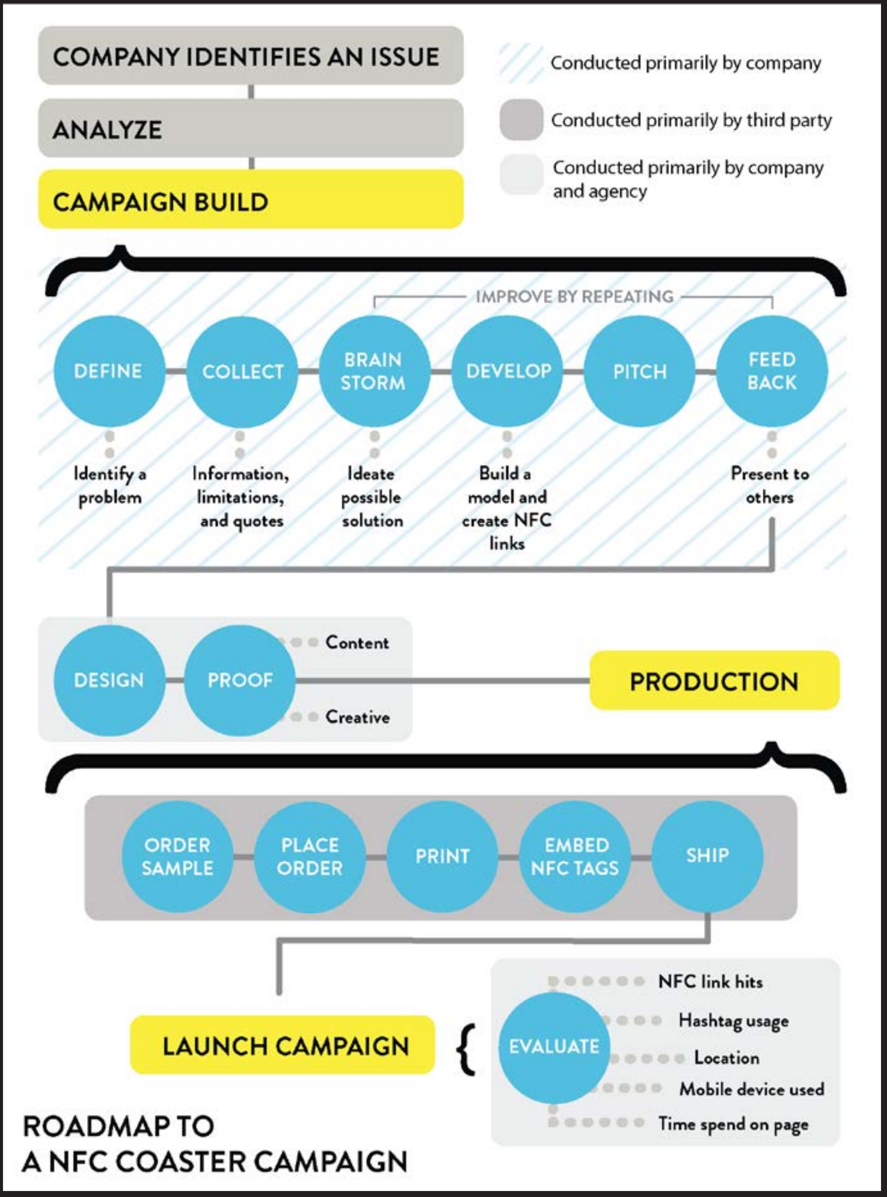
The second bar visited was called Birdie Molloy's. This was a much bigger bar, featuring a capacity of an estimated 200 people. Upon entry of this bar, the coasters had not yet been put out and this was already the second day of the festival. After a short while, coasters were distributed to the tables but none were placed at the bar. Similar to the previous bar, this bar did not have any engaging or interactive advertising present. Advertisements included tent cards featuring food and drinks and various beer posters. This bar did serve food so there was a greater chance of customers remaining at the tables for prolonged periods of time. This bar was advertised as the closest bar to the main stage of the festival, so there was a lot traffic coming in to use the bathroom and replenish their beverages. 27 individuals were observed at this bar, 15 of which were female and 12 were male. The age ranged from approximately 24-50, with the average age being in the range of 33-37. When visibly available, 12 individuals were recorded having iPhones. Similar findings were observed at this bar as compared to the previous one, Christian's Bar. There was very low engagement, sitting at 3% of individuals having any type of interaction with the coaster. 85% of people had a coaster available for them to use at their table. Of the people who had a coaster available for use, 67% actually placed their drink on the coaster. Again, there was no effort on the part of the staff to educate the customers about the coasters. For complete results see Appendix B.

Following the ethnographic study, customers were asked to volunteer their opinions on the coasters and NFC technology for product development purposes. Responses from 20 people in total were taken, including 11 males and 9 females. Ages ranged from 20-48 with the average estimated age being approximately 28-30. Once introduced to the campaign there was a very positive response with 80% of those interviewed showing positive enthusiasm towards the campaign, indicating that they liked the idea or thought the application of NFC was interesting. 60% continued on to either try the campaign for themselves or asked to see it on a device. 70% of those spoken to did not know what NFC was, but were more familiar when explained that the coaster utilized similar technology to tap and pay for credit cards. For complete results, see Appendix C.

As of August 11th, 2016 there have been a total of 28 taps on the NFC enabled coasters. Looking at the social engagement, there is no apparent evidence that the coaster was able to drive engagement from the use of the hashtag #largetimes. There are numerous questions that have been raised due to these limited results. The coasters were provided to the bars, free of charge, meaning that the bars are under no obligation to use them. As the campaign launched on August 4th, 2016, the usage could pick up, especially with less distractions in the environment. People may not be expecting an interaction from a beverage coaster. Traditional beverage coasters are not interactive. If customers do not read the messaging on their coasters they are very unlikely to know that an interaction is possible. The campaign could be too simple. People might be expecting a contest entry or some other additional benefit if they spend their time engaging with the coaster. The most popular coaster so far has been the one that links to Twitter with 46% of the total taps. This could be because it utilizes a familiar hashtag (#largetimes) that people can relate to, despite not driving further social engagement.

NFC PROCESS MAP FOR INTERACTIVE ADVERTISING PROJECTS

Having completed an interactive campaign from start to finish, a process map for the project can now be produced. Pictured below is a flowchart that details the processes that took place during the development of this campaign. This process map was developed to identify the different steps that occur when an interactive campaign is being used as opposed to a traditional campaign. Four parties were involved in this campaign, which included the researcher, Corby Spirit and Wine Ltd., Direct Focus Marketing Communications and a third-party print manufacturer.



ROADMAP

F5

FIGURE 5:
Roadmap to a NFC Coaster Campaign

To produce an interactive campaign, there are adjustments that need to be made to a traditional workflow. In the case of this campaign a modified design process was followed. First, a problem was identified that could be addressed or potentially resolved by an advertising campaign. The second step required the collection of data. This is where limitations to potential campaigns would be gathered, quote inquires and other costs would be formulated and general information on the campaign would all be collected. The third step was to brainstorm potential solutions and ideas. In the fourth step there is the first occurrence of one of the important steps for implementing NFC. When building a model of a campaign or design it is important to understand how each component will work and the roles they will play. In this case, NFC tags are not native to many traditional print campaigns, which is why it is crucial to develop where every used NFC tag will link to. In the circumstance of the coaster campaign there were over 10 different links that the coasters would direct customers to, so finalizing this for each tag is important early on in the creation of the campaign. Once a model is built it can be pitched to the various stakeholders for feedback, which allows for campaign improvement.

After the idea is finalized it goes to design. For the coaster campaign this process was handed off to a marketing agency. Remaining in constant communication ensures the idea remains transparent and gets created in the manner that was initially conceptualized. Once the design is complete it is important to have both the company and design team proof not only the content but also the creative and images. When implementing a campaign with interactive components, the focus has to be directed towards the interactivity. Text should be concise and simple for anyone to understand how to interact.

Production is the stage in which adjustments to workflow can create savings for interactive components. For a component like NFC, it often has to be embedded into the printed elements to restrict tampering. The cost of NFC tags continues to decrease as popularity increases and purchasing tags in bulk also creates additional savings. Print production facilities should stock NFC tags for implementation in such campaigns. As evidence has shown that people spend more time on their mobile devices one can only predict that advertising campaigns targeting mobile devices will increase. With regards to large scale production, NFC tags are similar in nature to that of an adhesion label. NFC Tags are usually shipped in rolls and have an adhesive backing, so they can be mounted on a web for application to another material. In the case of the coaster campaign, the NFC tags had to be implemented mid-way through production. For a coaster printed two sides, each side has to be printed individually and then the tag can be embedded before the sides are merged and laminated.

The final step in the campaign after launching is to evaluate. With an interactive campaign there are more indicators that can be measured to determine success. The use of different links allows for individual tracking to see where popularity lies. Hashtags can be tracked on social media, web analytics can be used to see what devices people are using, from where they are accessing the NFC tags and for how long they are spending on the page.

LIMITATIONS AND RECOMMENDATIONS:

There were many external factors that played a role in this campaign. The number one factor was the fact that the coasters were launched at the same time as a music festival. The primary focus for those attending the festival was to attend the concerts. People were allowed to drink in the streets so their focus was to remain in the streets and only go into bars to use a washroom or purchase another beverage.

Secondly, there was also a lack of awareness of the technology itself. Servers and bar staff were not aware that the coasters were interactive or knew how to use them. This also affected how the bar staff treated the coasters. Many of the bars treated them like regular coasters, which meant that there was not much attention paid to them. In many cases, servers were observed cleaning tables and removing the coasters but not returning the coasters to the table for the next guest. During busy periods, some tables could go the whole night without a coaster on them. The coasters themselves could have proven beneficial to bars, as some of the coasters promoted the purchase of premium beverages. If the servers were aware of the technology they could teach customers how to interact, finding a mutual benefit for both the server and consumer. This could potentially add further costs, as more training time is required as well as additional time spent with the customer. However, if this paid off if it would mean more engagement with the campaign. This is one issue that is present when dealing with newer technology. An education component becomes necessary before the technology can become widely adopted.

Given the cost of the campaign in combination with the produced results to date (28 taps, with no social engagement as a result of the coaster), this would not be a recommended approach at this time. Success in this case would be defined as 1,000 taps and 50 uses of the #largetimes hashtag, over the life of the distributed coasters.

Individuals who offered their opinions for product development commented on the coaster size, and colour. Many felt that the coaster was too small, so when a drink is placed upon it the interaction is covered and not visible. The coasters also primarily featured darker colours, which negatively impacted visibility in a traditionally dark setting.

Once individuals become aware of the technology there is evidence that the interest level and enthusiasm towards the campaign is increased. The fascination with new technology among people can be seen as a driving factor to continue work with NFC enabled campaigns.

To conclude, when implementing an interactive campaign, the setting can be crucial to the success. The interactive elements need to be a primary focus as external distractions will decrease the chance of people noticing the campaign. For an interactive coaster in a bar, live bands or other entertainment draw focus and make the customer less likely to notice the coaster in front of them. An education element is important to make sure people who are new to technology can understand how to use it. Instructions may be present on the coaster or other campaign but that does not necessarily mean that they will be read. For something small like a coaster, bar/restaurant staff should be briefed on how to use the coaster and they should be aware that the coaster can bring benefit to them. If they perceive that the coaster can bring value to them, there is an increased chance that they will take the time to educate those around them on how to use the technology. Interactive campaigns should have clear and large call to actions, have a plan for an education component and have elements that remain visible and stand out in their surroundings.

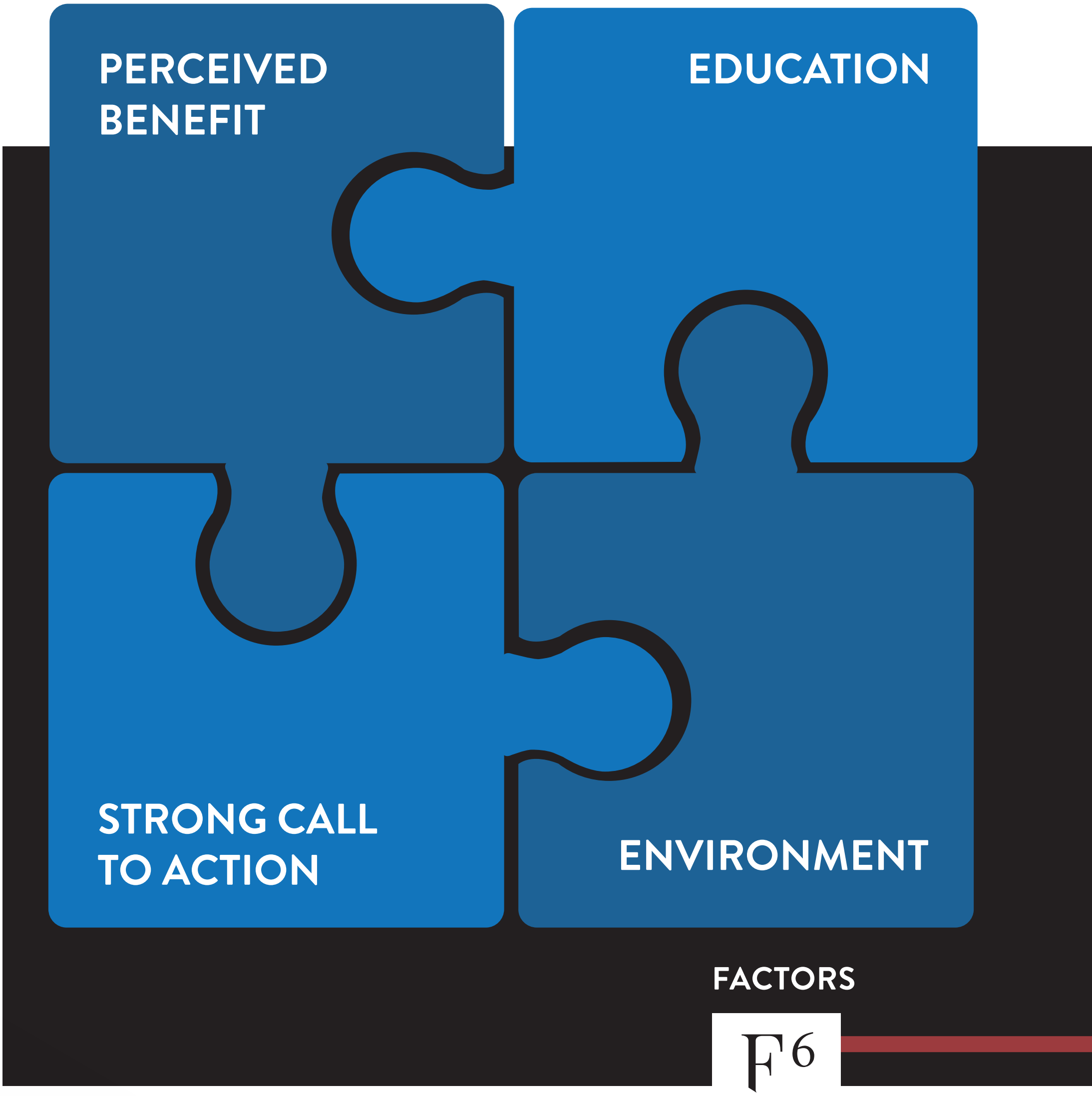


FIGURE 6:
Factors Impacting NFC Advertising Campaigns

*Like Colours Indicates People who Attended the Bar in a Group

SEX	AGE	INTOXICATED (0-5)	CELLPHONE	HAS COASTER FOR DRINK
M	45-60	0	Blackberry	✓
M	45-60	0	iPhone	✓
M	45-60	0	iPhone	✘
F	45-60	0	Android	✓
W	45-60	0	iPhone	✘
F	45-60	0	iPhone	✓
W	45-60	0	iPhone	✓
F	45-60	0	iPhone	✘
F	45-60	0	iPhone	✘
M	25-30	0	Android	✘
F	35-40	0	iPhone	✓
F	24-29	1	?	✓
F	24-29	1	?	✓
M	24-29	1	?	✓
M	24-29	1	?	✓
F	24-29	1	?	✓
F	24-29	1	?	✓

ETHNOGRAPHY RESULTS FROM CHRISTIAN'S BAR

SERVER DISTRIBUTE COASTER	SERVER EXPLAIN COASTER	DRINK ON COASTER	COASTER INTERACTION	COASTER FACEUP
✓	✗	✓	None	✓
✓	✗	✓	None	✓
✓	✗	✗	None	N/A
✓	✗	✓	None	✗
✓	✗	✗	None	N/A
✓	✗	✓	None	✗
✓	✗	✓	None	✓
✓	✗	✗	None	N/A
✓	✗	✗	None	N/A
✗	✗	✗	Played with stack	N/A
✗	✗	✓	Picked up briefly	✗
✗	✗	✓	None	✓
✗	✗	✓	None	✓
✗	✗	✓	None	✓
✗	✗	✓	None	✓
✗	✗	✓	None	✓
✗	✗	✓	None	✓

SEX	AGE	INTOXICATED (0-5)	CELLPHONE	HAS COASTER FOR DRINK
M	24-29	3	iPhone	✓
F	24-29	3	iPhone	✓
F	24-29	3	?	✓
M	30-34	2	?	✓
M	30-34	2	?	✓
F	30-34	2	?	✘
F	30-34	2	iPhone	✘
M	30-34	4	?	✘
M	30-34	4	?	✘
M	30-34	4	?	✘
F	30-34	4	iPhone	✘
F	26-32	3	?	✓
F	26-32	3	iPhone	✘
M	26-32	3	?	✓
M	36-42	3	Android	✓
M	26-32	3	?	✘

SERVER DISTRIBUTE COASTER	SERVER EXPLAIN COASTER	DRINK ON COASTER	COASTER INTERACTION	COASTER FACEUP
✘	✘	✘	None	✓
✘	✘	✓	None	✓
✘	✘	✘	None	✘
✘	✘	✓	None	✓
✘	✘	✘	None	?
✘	✘	✘	None	?
✘	✘	✘	None	?
✘	✘	✘	None	N/A
✘	✘	✘	None	N/A
✘	✘	✘	None	N/A
✘	✘	✘	None	N/A
✘	✘	✓	None	✘
✘	✘	✘	None	N/A
✘	✘	✓	None	✓
✘	✘	✘	Read coaster, put in pocket	N/A
✘	✘	✘	None	N/A

*Like Colours Indicates People who Attended the Bar in a Group

SEX	AGE	INTOXICATED (0-5)	CELLPHONE	HAS COASTER FOR DRINK	SERVER DISTRIBUTE COASTER
M	40-49	0	?	✓	✗
F	40-49	0	iPhone	✓	✗
M	24-35	1	?	✓	✗
M	24-35	1	iPhone	✓	✗
F	24-35	1	iPhone	✓	✗
F	24-35	1	?	✓	✗
F	24-35	1	?	✓	✗
F	24-35	1	?	✓	✗
M	45-50	0	?	✗	✗
F	45-50	0	iPhone	✗	✗
F	40-49	1	iPhone	✓	✗
F	40-49	1	iPhone	✓	✗
F	40-49	1	iPhone	✗	✗
M	32-38	0	?	✓	✗
M	32-38	0	?	✓	✗

ETHNOGRAPHY RESULTS FROM BIRDIE MOLLOY'S

SERVER EXPLAIN COASTER	DRINK ON COASTER	COASTER INTERACTION	COASTER FACEUP	ORDERED FOOD
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✓	None	✓	✓
✘	✘	None	N/A	✓
✘	✘	None	N/A	✓
✘	✘	None	✓	✘
✘	✘	None	✓	✘
✘	✘	None	N/A	✘
✘	✘	Play with coaster in hand	✓	✓
✘	✘	None	✓	✓

SEX	AGE	INTOXICATED (0-5)	CELLPHONE	HAS COASTER FOR DRINK	SERVER DISTRIBUTE COASTER
F	36-40	1	?	✓	✗
F	36-40	1	?	✓	✗
F	36-40	1	?	✓	✗
M	24-29	1	?	✓	✗
M	24-29	1	?	✓	✗
M	24-29	1	?	✓	✗
M	24-29	1	?	✓	✗
M	24-29	3	?	✓	✗
M	24-29	2	?	✗	✗
F	24-29	2	iPhone	✓	✗
F	40-46	2	iPhone	✓	✗
F	40-46	2	iPhone	✓	✗
F	40-46	2	iPhone	✓	✗

SERVER EXPLAIN COASTER	DRINK ON COASTER	COASTER INTERACTION	COASTER FACEUP	ORDERED FOOD
✗	✗	None	✓	✗
✗	✗	None	✓	✗
✗	✗	None	✓	✗
✗	✓	None	✓	✓
✗	✓	None	✓	✓
✗	✓	None	✓	✓
✗	✓	None	✓	✓
✗	✗	None	✓	✗
✗	✗	None	✓	✗
✗	✗	None	✓	✗
✗	✓	None	✓	✗
✗	✓	None	✓	✗
✗	✓	None	✓	✗

APPENDIX C: INDUSTRY PARTNER PITCH COLLATERAL:


THOUGHTS ON TASTY'S SUCCESS
SIMPLE - USE BASIC COOKING METHODS AND INGREDIENTS
+
SHORT VIDEOS - MEALS/DRINKS ARE GENERALLY MADE UNDER A MINUTE
+
WIDE AUDIENCE- SIMPLICITY OF THE VIDEOS CATER TO ALL STYLES AND TASTES
=
MASSIVE FACEBOOK SUCCESS
EASILY SHAREABLE WITH FRIENDS AND FAMILY
VIDEOS AVG 30 MILLION VIEWS

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5

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SCOPE:

Today, companies attempt to create their products so they are more easily accessible. Global brands can be seen selling their products online in order to expand their customer base. In Europe, Braille has become a mandatory requirement on some packaging to increase brands' reach and aid the visually impaired.

EXPLORATION OF BRAILLE
in the Food Packaging Industry

Food packaging has a number of challenges, some of which are legal requirements. In Canada, all food packaging must be bilingual, meaning that it must read in both the French and English language. It also must be food safe and protect the contents of the package, as well as visually attract consumers.

Many companies these days are 'going green' by producing environmentally friendly products that help sustain the earth. In this report, sustainable packaging will be tested on whether it can support the printing of Braille on its material. Is there noticeable cracking and/or bursting when Braille is printed on the substrate? Does the printed Braille easily rub off from the substrate? If so, how easily and is it still legible for the average Braille reader to read? What happens to the raised surface and so on.

DEFINITIONS:

BRAILLE:
A system of raised dots that can be read with the fingers those that are blind or have low vision. It is not a language but a code that may be written and read ("What is Braille?", n.d.).

CALIPER:
The thickness of a sheet of paper expressed in thousandths of an inch ("Paper weight comparison and more", n.d.).

EMBOSS:
An impression of some kind of design, decoration, lettering, or pattern on another surface like paper, cloth, metal, leather, etc. The pressing raises the surface, which adds new dimension to the object ("What Is Embossing", n.d.).

SUMMARY:

The food packaging industry in North America should consider Braille for the visually impaired. Approximately half a million Canadians live with vision loss. These include people who have been born with vision loss, are legally blind, or have insufficient vision. Residents with vision loss or partial sight by province/territory include: Ontario (186,954), Quebec (109,560), British Columbia (64,546), Alberta (52,899), Manitoba (17,244), Saskatchewan (14,256), Nova Scotia (12,946), New Brunswick (10,308), Newfoundland and Labrador (6,865), Prince Edward Island (1,982), Northwest Territories (605), Yukon Territory (465) and Nunavut (453) ("Global Navigation," n.d.).

Integrating Braille in the production workflow can be costly. For example, the machine itself is an added expense, with small-volume printers ranging from $1,800-$5,000 and large-volume printers ranging from $10,000-$80,000 ("Braille Technology," n.d.). There are numerous articles that disagree with using Braille on food packaging due to the added expense compared to the low ratio of visually impaired consumers in the world (Chadwich, 2010). However, Braille is supported on pharmaceutical products compared to food packaging since consumption of the incorrect dosage or type of medication can be deadly (Lyftingsmo, 2013). Despite this opinion, Braille is important on food

packaging, as food consumption is an everyday occurrence. Overall, whether the percentage of blind individuals in the world is low or high, these consumers deserve security through products; they must know what ingredients are used, what they are purchasing, and what is stored around the house.

The group researched how Braille is printed on sustainable paperboard and plastics within the food packaging industry. If Braille is achievable, then the industry can appeal to the visually impaired and eco-friendly consumers, while increasing profits and building positive testimonials.

EQUATIONS:

AVERAGE (MEAN) =
Sum of all values ÷ Number of values

CONTROL LIMITS =
Horizontal lines drawn on a statistical process control chart (±3 of statistic's mean) (Control Limits", n.d.)

DIFFERENCE = Floor - Shoulder

STANDARD DEVIATION =
X-bar ± (Standard deviation x 3)

INTRODUCTION:

Braille is linked to many products within the printing and packaging industry; however, its environmental and sustainable aspects are not often highlighted. Braille text is similar to embossed finishing, as it requires the surface of the substrate to be raised. In order to create this raised surface, the substrate needs to be strong enough that the embossing does not burst the paper. For example, Braille cannot be printed on newsprint, as it will puncture the substrate. Consequently, Braille requires the use of potentially expensive paper stock that is thick and strong enough to withstand this pressure.

At the same time, food packaging must be food safe and be able to protect the contents of the product inside the package. This process makes it challenging for a company that would like to market their product, as the diversity of the substrates they can choose from are limited. If a company chooses to take this a step further and present themselves as an environmentally green company, the substrate choices to choose from become quite limited, as some materials (like cardboard) are thick and cannot sustain Braille embossing.

The application of Braille in the food packaging industry contributes to product accessibility. Braille has become a legal, standard packaging feature in Europe, which is similar to Canada's necessity for bilingual languages on their packaged products. Braille is important for those that are visually impaired in some way, as they often have trouble seeing what they are buying and using in everyday life. For example, a visually impaired person may have difficulty telling the difference between a can of tuna and a can of ham. This could lead to complications further down the road if, for example, a visually impaired consumer was allergic to an ingredient in the product and consumed it.

Printkote are coated bleached paperboards designed for high performance and versatility for all types of packaging and printing applications. CartonMate and Printkote are both available with polyethylene coating for increased barrier properties ("Consumer Packaging", n.d.).

TESTING PRINCIPLES:

DURABILITY

The durability of Braille on different types of food packaging materials will be tested throughout this experiment. It is important that the Braille dots do not alter when excessive weight is applied. The height of the Braille dots must stay consistent to ensure proper quality standards are met (PharmaBraille, 2014). There must be an appropriate balance between the Braille's height and its surface breaking. The dot height is an important consideration, as it could 'make or break' a product's accessibility for visually impaired users.

ABRASION RESISTANCE

When Braille is applied on the substrate, its rub resistance can be tested to evaluate print quality. The Sutherland Ink Rub Tester is used to evaluate the length of time the Braille dots stay intact before its shape distorts. Braille's rub resistance is especially important during the shipping and receiving [goods] process, as packages are constantly moved around. It is critical to ensure that the Braille dots can withstand a specific amount of abrasion before they wear out (Pmpnews.com, 2011).

Although not all of the tested paperboard packaging materials were 100 percent recyclable, the group chose to test materials that are well known in the food packaging industry. This is indispensable, as it allows companies that use these substrates to consider integrating Braille into their production workflow. When researching popular food packaging materials, the group used the student design scholarship site generated by the Paperboard Packaging Alliance (Paperboard Packaging, n.d.).

Two types of material were chosen: Solid Bleached Sulfate (SBS) and Coated Unbleached Kraft Paperboard (CUK). The major market segments that use SBS substrates include medical packaging, milk and juice tabletop cartons, aseptic drink boxes, cosmetic and perfume packaging, frozen food packaging, and candy boxes (Paperboard Packaging, n.d.). The major market segments that use CUK substrates include frozen food packaging, beverage cartons and carrier containers, and pharmaceutical packaging (Paperboard Packaging, n.d.). These materials were not accessible at Ryerson University, so the group reached out to a reputable packaging company called WestRock (located in Etobicoke, Ontario). WestRock generously provided the samples required to conduct this experiment.

The two stocks WestRock provided fall between SBS and CUK substrates. Below is the information supplied by their website:

"Printkote are coated bleached paperboards designed for high performance and versatility for all types of packaging and printing applications. CartonMate and Printkote are both available with polyethylene coating for increased barrier properties ("Consumer Packaging", n.d.). Coated Natural Kraft® (CNK)/Coated Unbleached Kraft (CUK) is WestRock's coated unbleached kraft paperboard, engineered to perform in a variety of applications. Custom Kote is a high-performing Coated Natural Kraft® (CNK®) paperboard engineered for outstanding performance in stressful environments throughout the supply chain, such as freeze-thaw cycles. Custom Kote is suited for folding carton applications including food, food-service, home and garden, media and electronics, and other folding carton applications ("Coated Unbleached Kraft (CUK)", n.d.)."

The second material used were different types of plastics. Plastics are used in the food packaging industry and are a well known median in this case. After researching different types of plastics, the group chose to test food safe grades 2, 4, and 5. Since plastics are commonly used, the group was able to find the specific aforementioned plastics by checking the grade content on the package and company sites.

EQUIPMENT USED:

- Viewplus SpotDot
- ASUS laptop
- Digital Micrometer
- Sutherland Ink Rub Tester

PROCEDURE:

1. Obtain food packaging substrates for testing.
2. Use the VP Spot Dot Embosser to print Braille dots. Print the English Braille alphabet on all samples.
3. Use a digital micrometer to measure and record three readings per each sample. Take readings of both the floor and paper caliper in millimeters (mm).
4. Calculate the Braille dot height (shoulder) by subtracting the difference between the Braille and the floor (paper caliper).
5. Calculate the average Braille dot height for each sample, as well as the mean of the average braille height (x-bar) and standard deviation for all samples. Use the standard deviation to calculate the upper and lower control limits.
6. Calculate the average paper caliper for each sample. Graph the results for average paper caliper, average Braille height, standard Braille height, and x-bar Braille height in Excel.
7. Test substrate for abrasion resistance (substrate-to-substrate). Use the Sutherland Ink Rub Tester and 4 pound weight. Set the stroke to 60 and place Braille sample underneath.
8. Measure and record three readings for each Braille sample using a digital micrometer. Calculate the new average Braille height of each sample and the x-bar.
9. Graph the results including the average Braille height, standard Braille height, and x-bar Braille height lines in Excel.

1 - PETE OR PET (Polyethylene Terephthalate)

RECYCLABLE?	✓	**USED FOR:**	**RECYCLED INTO:**
FOOD SAFE?	✓	Soda bottles, water bottles, beer bottles, salad dressing containers, mouthwash bottles, and peanut butter containers	Tote bags, furniture, carpet, paneling, fiber, and polar fleece
REUSABLE?	✗		

2 - HDPE (High Density Polyethylene)

RECYCLABLE?	✓	**USED FOR:**	**RECYCLED INTO:**
FOOD SAFE?	✓	Milk jugs, household cleaner containers, juice bottles, shampoo bottles, cereal box liners, detergent bottles, etc.	Pens, recycling containers, picnic tables, lumber, benches, etc.
REUSABLE?	✗		

3 - V OR PVC (Vinyl)

RECYCLABLE?	✓	**USED FOR:**	**RECYCLED INTO:**
FOOD SAFE?	✗	Shampoo bottles, clear food packaging, cooking oil bottles, medical equipment, piping, and windows	Paneling, flooring, speed bumps, decks, and roadway gutters.
REUSABLE?	✗		

4 - LDPE (Low Density Polyethylene)

RECYCLABLE?	✓	**USED FOR:**	**RECYCLED INTO:**
FOOD SAFE?	✓	Squeezable bottles, shopping bags, clothing, carpet, frozen food, bread bags, and some food wraps	Compost bins, paneling, trash can liners and cans, floor tiles, and shipping envelopes.
REUSABLE?	✓		

5 - PP (Polypropylene)

RECYCLABLE? ✓

FOOD SAFE? ✓

REUSABLE? ✓

USED FOR:	RECYCLED INTO:
Yogurt containers, ketchup bottles, syrup bottles, and medicine bottles	Brooms, auto battery cases, bins, pallets, signal lights, ice scrapers, and bicycle racks.

6 - PS (Polystyrene)

RECYCLABLE? ✓

FOOD SAFE? ✗

REUSABLE? ✗

USED FOR:	RECYCLED INTO:
Compact disc cases, egg cartons, meat trays, and disposable plates and cups	Egg cartons, vents, foam packing, and insulation

7 - Other

RECYCLABLE? ✓

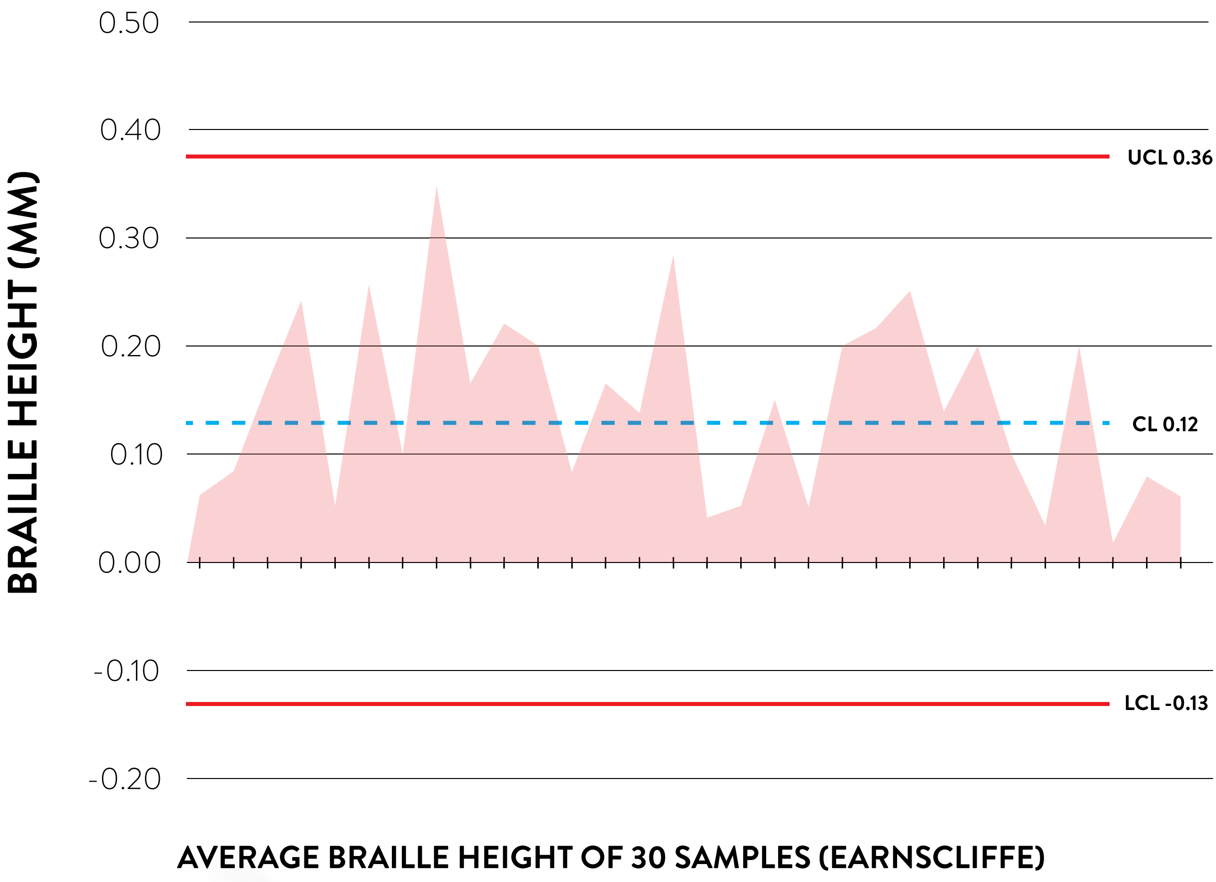
FOOD SAFE?

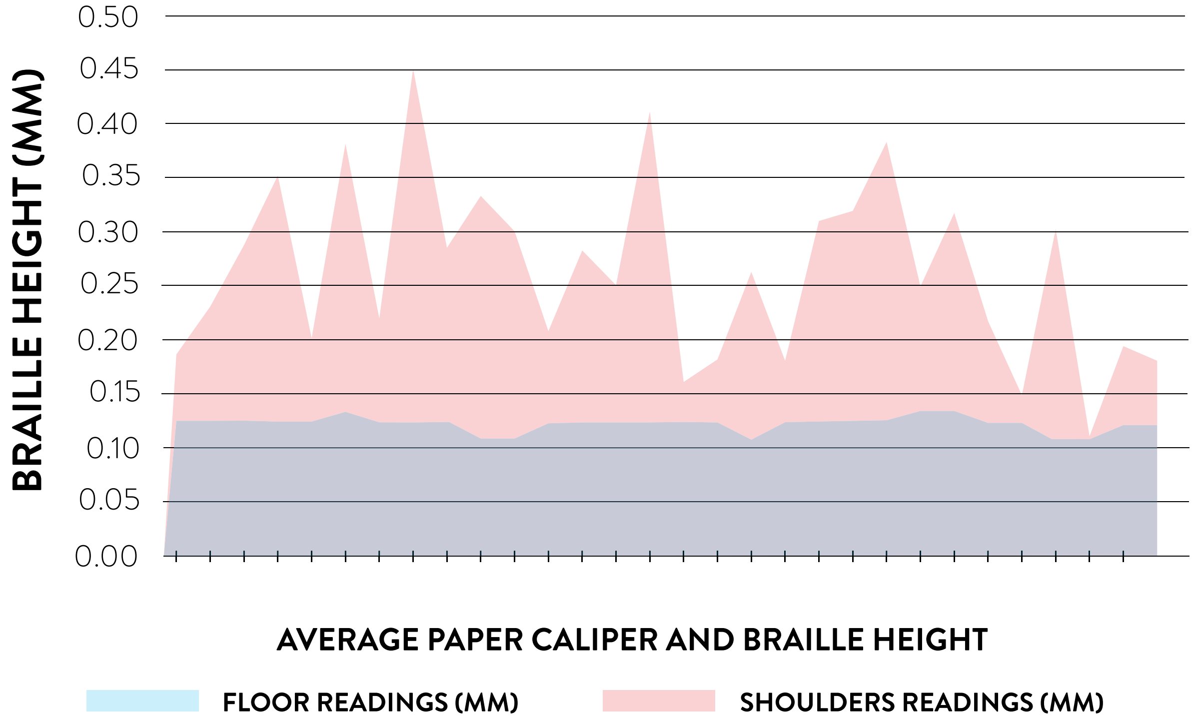
Use with caution.
Is a mix bag of plastics that includes polycarbonate which contains the toxic bisphenol-A (BPA).

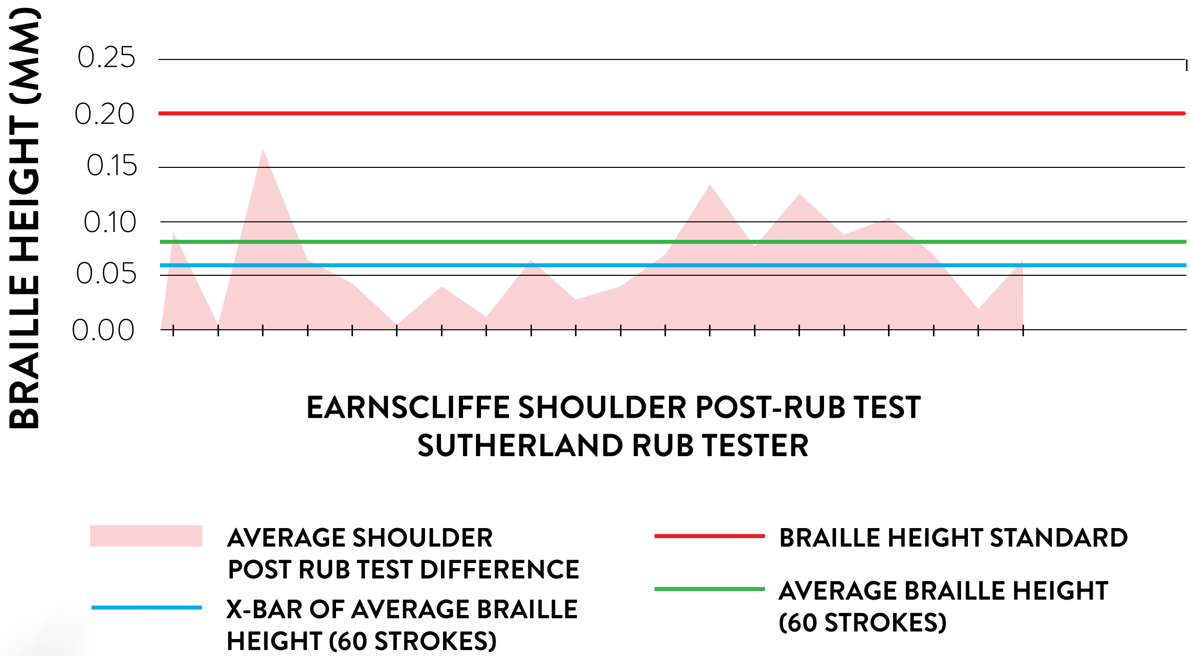
REUSABLE? ✗

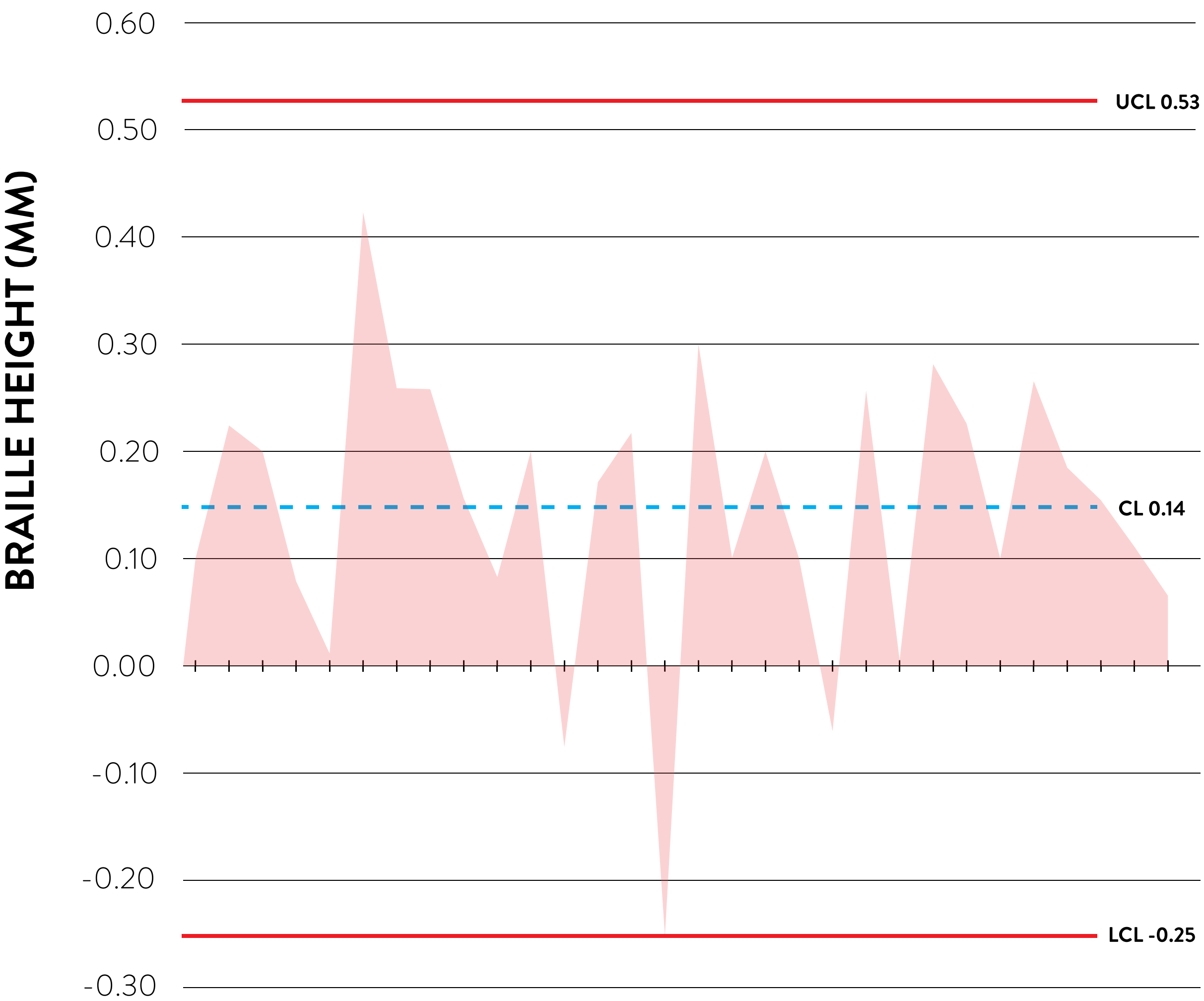
USED FOR:	RECYCLED INTO:
Sunglasses, iPod cases, computer cases, nylon, 3- and 5-gallon water bottles, and bullet-proof materials	Plastic lumber and other custom-made products.

(Barret M., 2013) & ("Safe Plastic Numbers (Guide)", 2011) & (Suzuki D., n.d)

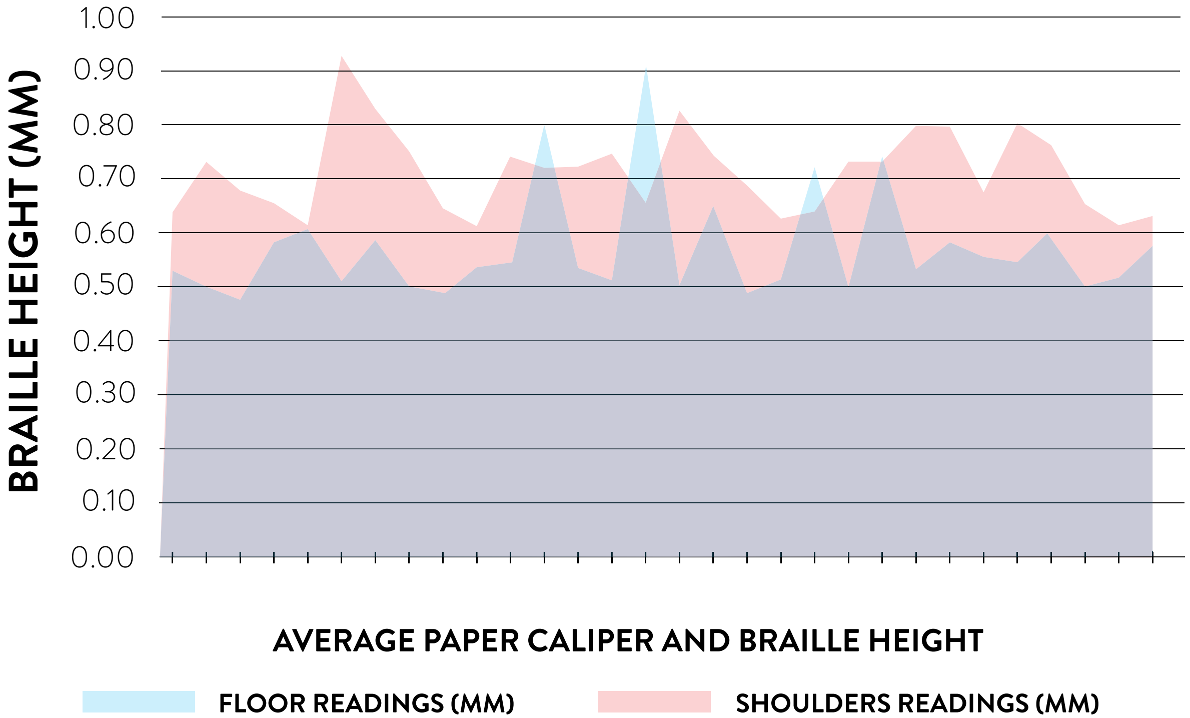

BRAILLE HEIGHT (MM)
0.50
0.40
0.30
0.20
0.10
0.00
-0.10
-0.20
UCL 0.36
CL 0.12
LCL -0.13
AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (EARNSCLIFFE)

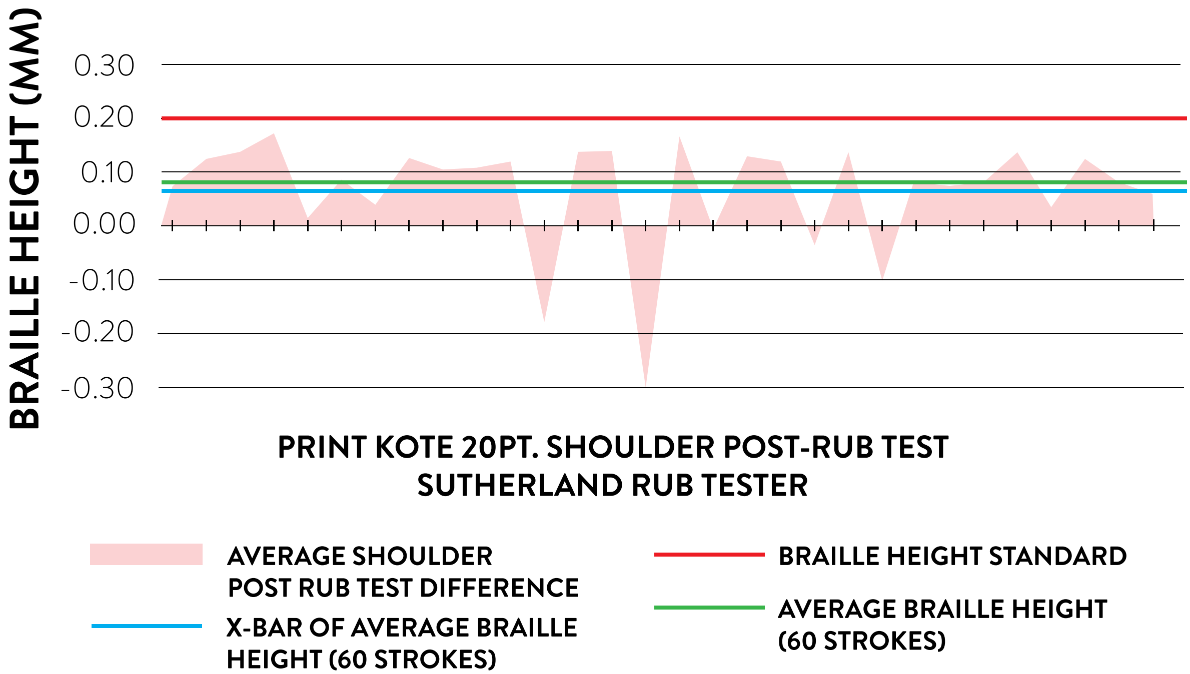

BRAILLE HEIGHT (MM)
0.50
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
AVERAGE PAPER CALIPER AND BRAILLE HEIGHT
FLOOR READINGS (MM)
SHOULDERS READINGS (MM)

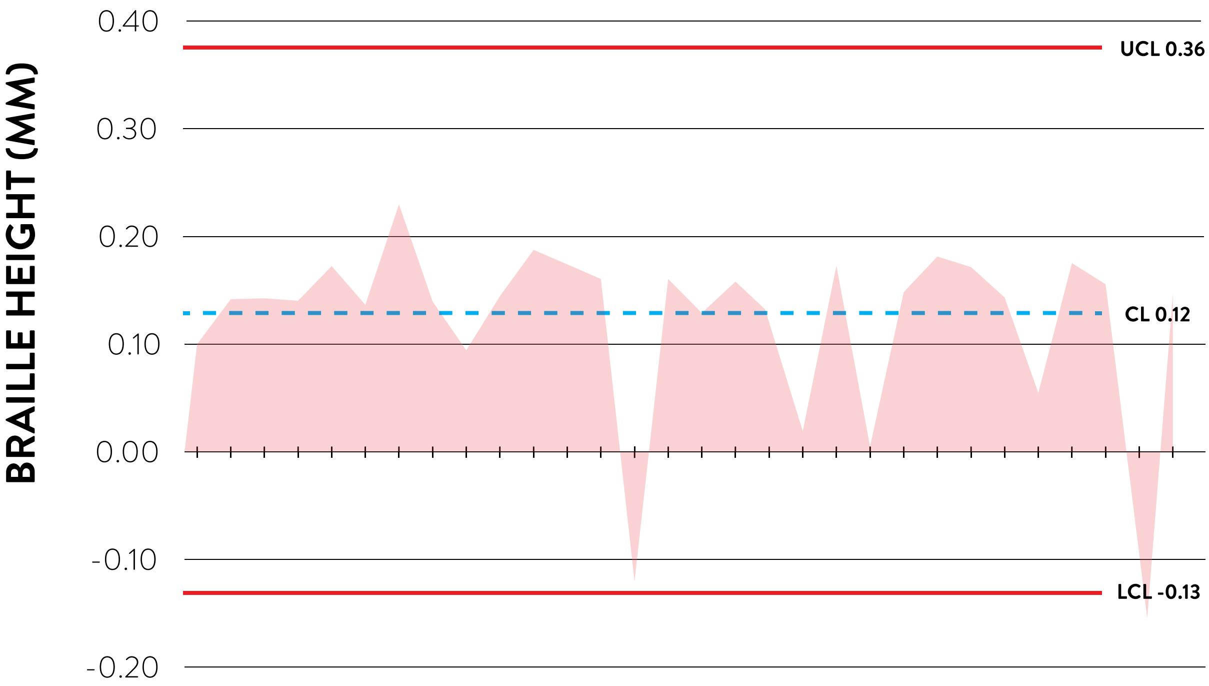

BRAILLE HEIGHT (MM)
0.25
0.20
0.15
0.10
0.05
0.00
EARNSCLIFFE SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER
AVERAGE SHOULDER POST RUB TEST DIFFERENCE
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)
BRAILLE HEIGHT STANDARD
AVERAGE BRAILLE HEIGHT (60 STROKES)



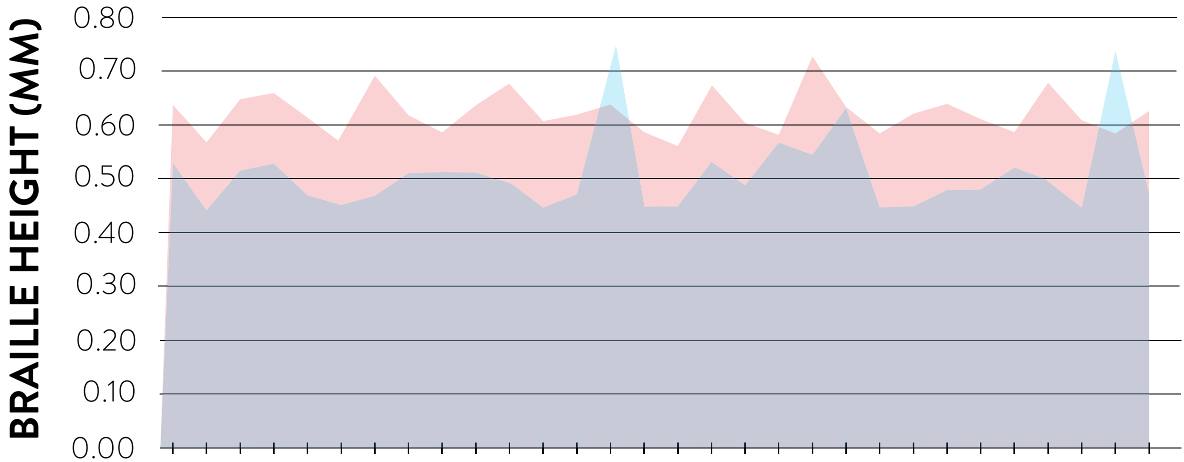
AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (PRINT KOTE 20PT.)


BRAILLE HEIGHT (MM)
1.00
0.90
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
AVERAGE PAPER CALIPER AND BRAILLE HEIGHT
FLOOR READINGS (MM)
SHOULDERS READINGS (MM)


BRAILLE HEIGHT (MM)
0.30
0.20
0.10
0.00
-0.10
-0.20
-0.30
PRINT KOTE 20PT. SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER
AVERAGE SHOULDER POST RUB TEST DIFFERENCE
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)
BRAILLE HEIGHT STANDARD
AVERAGE BRAILLE HEIGHT (60 STROKES)

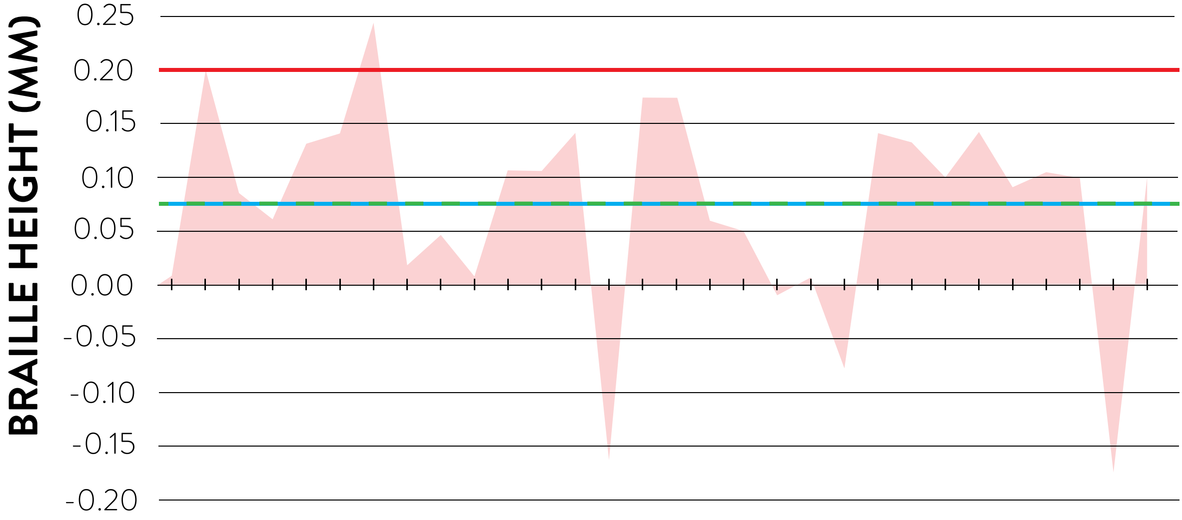


AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (CNK CUSTOM KOTE 18PT.)



AVERAGE PAPER CALIPER AND BRAILLE HEIGHT

FLOOR READINGS (MM) SHOULDERS READINGS (MM)



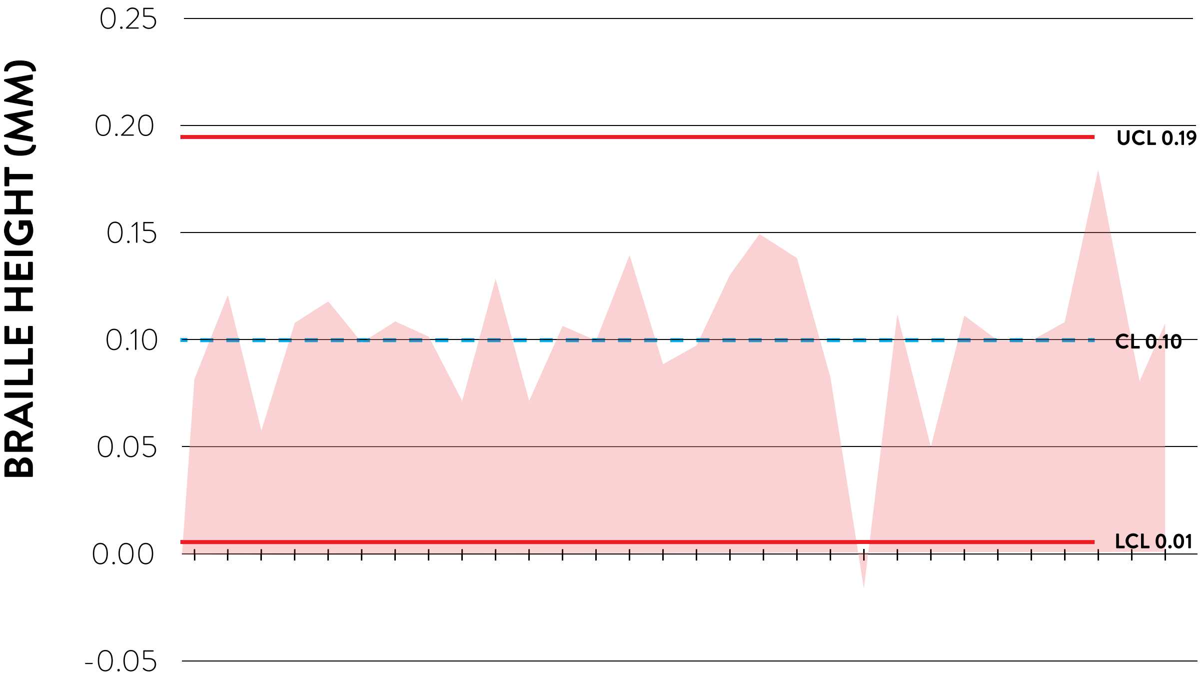
CNK CUSTOM KOTE 18PT. SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER

AVERAGE SHOULDER POST RUB TEST DIFFERENCE

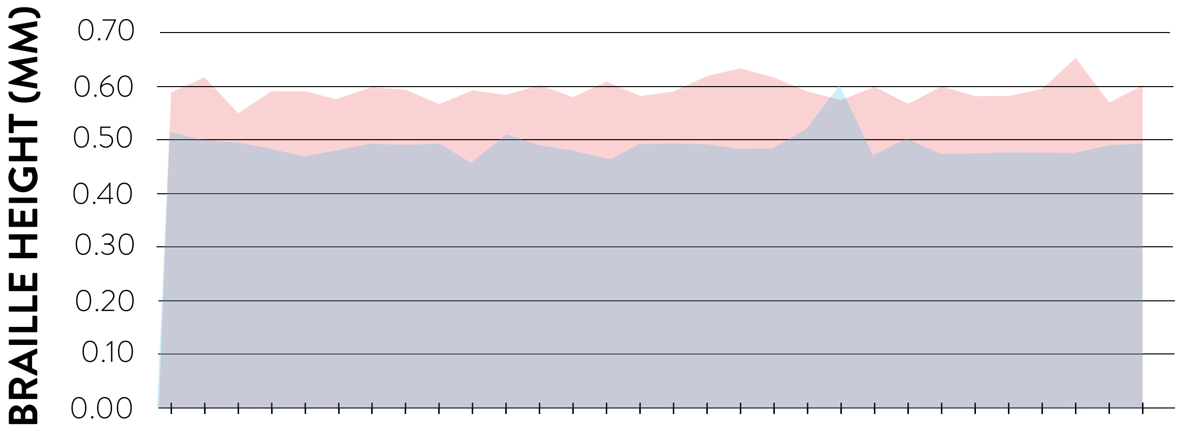
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)

BRAILLE HEIGHT STANDARD

AVERAGE BRAILLE HEIGHT (60 STROKES)



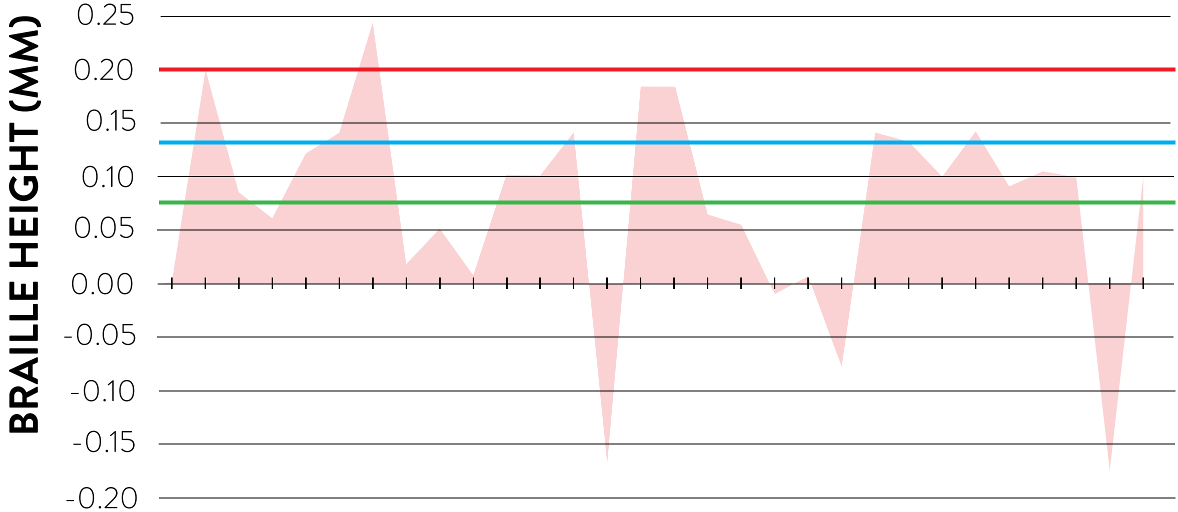
AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (CNK CUSTOM KOTE 20PT.)



AVERAGE PAPER CALIPER AND BRAILLE HEIGHT

FLOOR READINGS (MM)

SHOULDERS READINGS (MM)



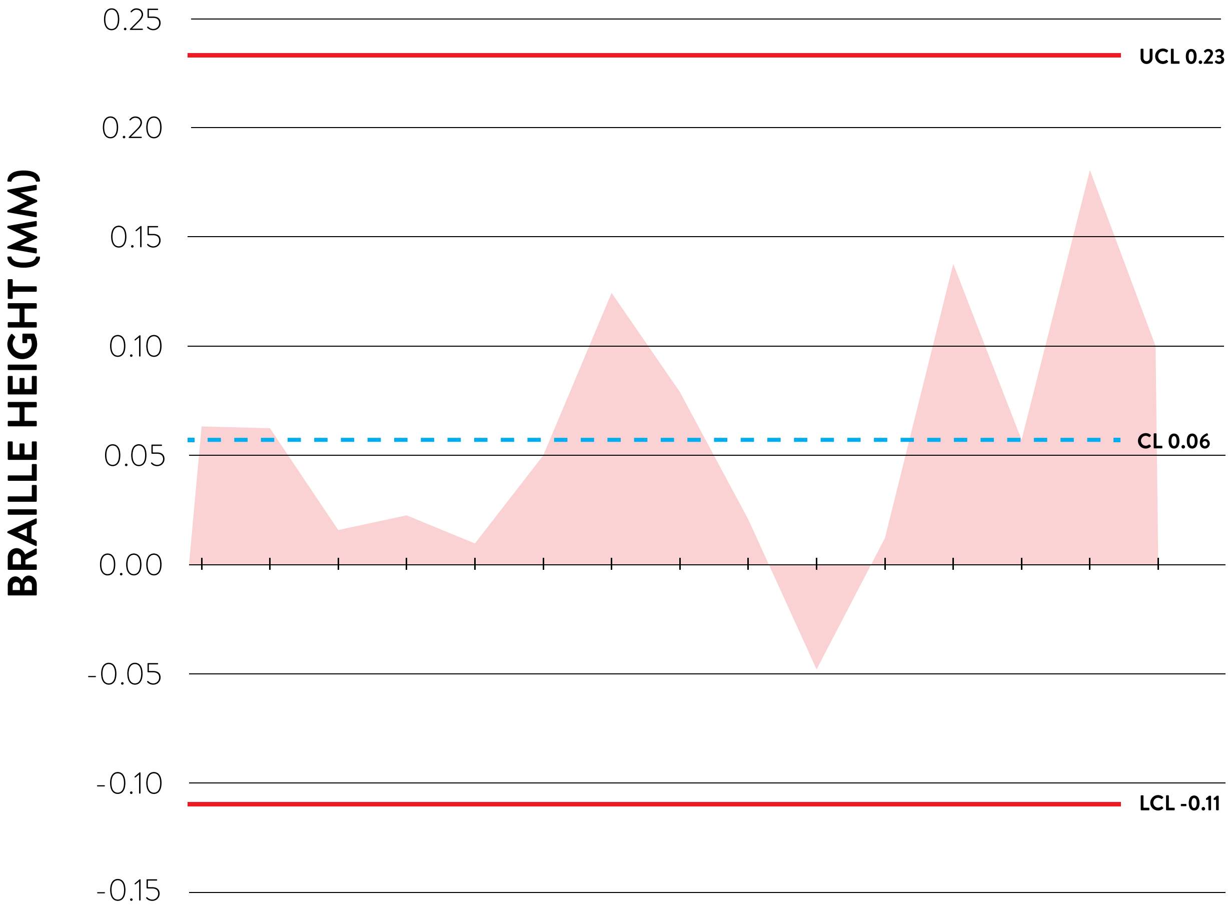
CNK CUSTOM KOTE 20PT. SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER

AVERAGE SHOULDER POST RUB TEST DIFFERENCE

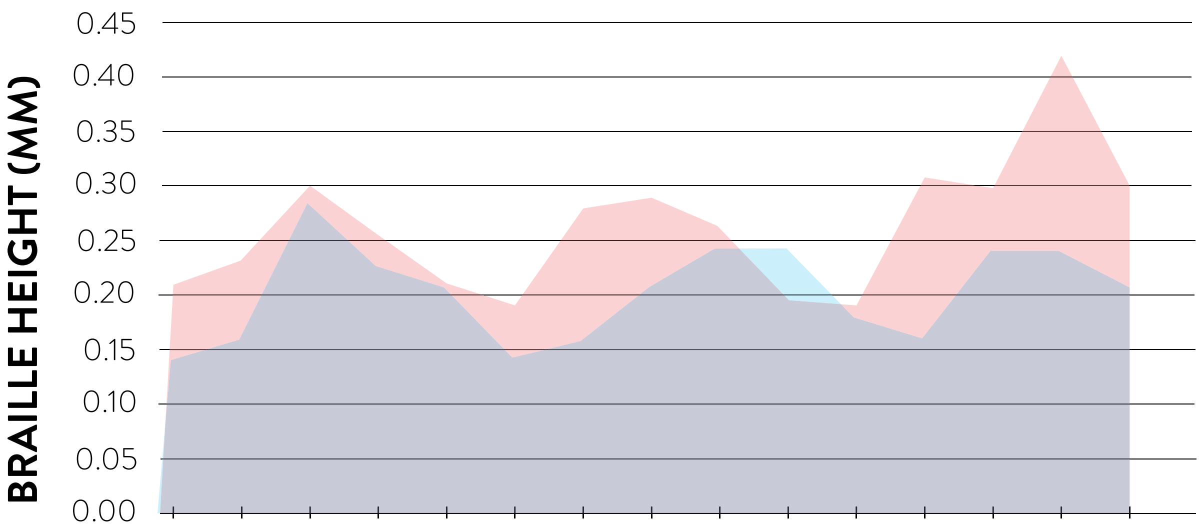
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)

BRAILLE HEIGHT STANDARD

AVERAGE BRAILLE HEIGHT (60 STROKES)

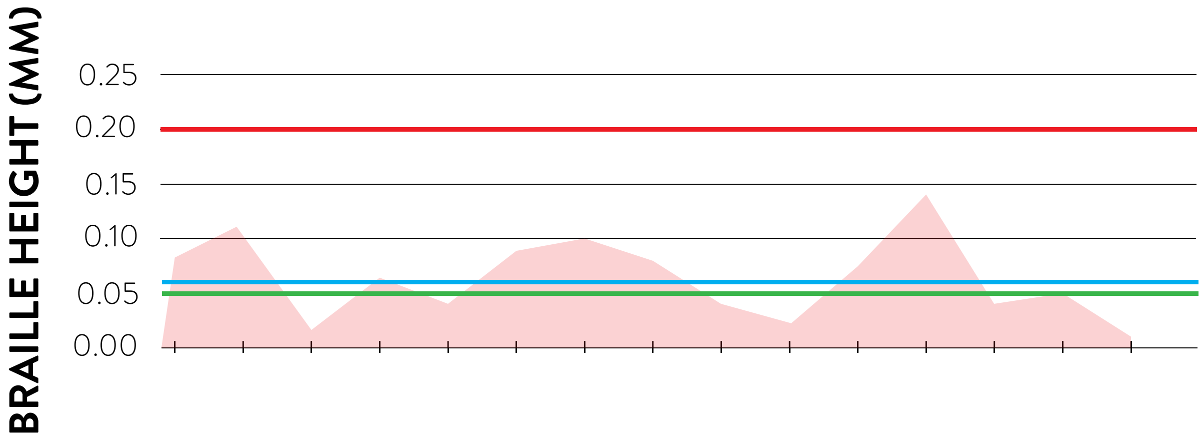


AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (PLASTIC GRADE 5)



AVERAGE PAPER CALIPER AND BRAILLE HEIGHT

FLOOR READINGS (MM) SHOULDERS READINGS (MM)



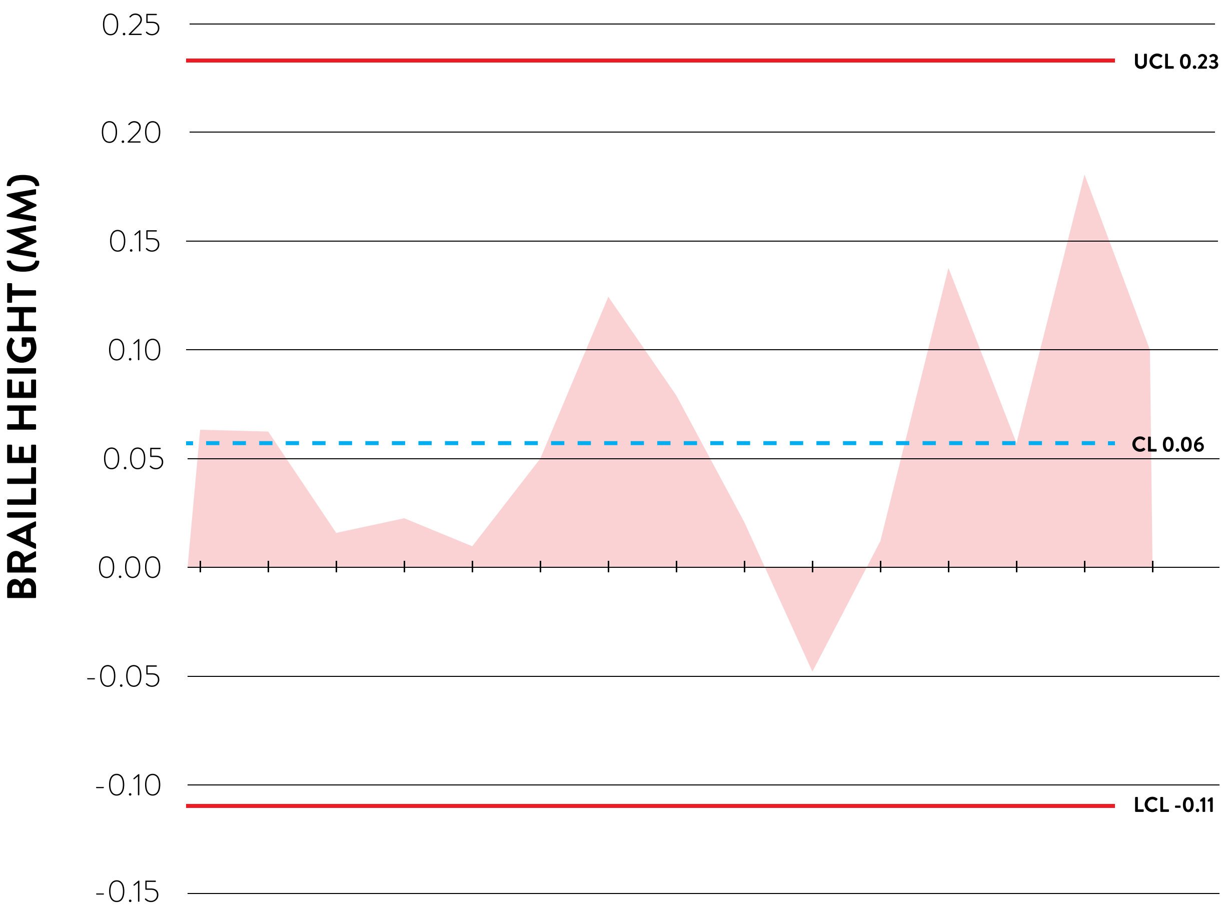
PLASTIC GRADE 5 SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER

AVERAGE SHOULDER POST RUB TEST DIFFERENCE

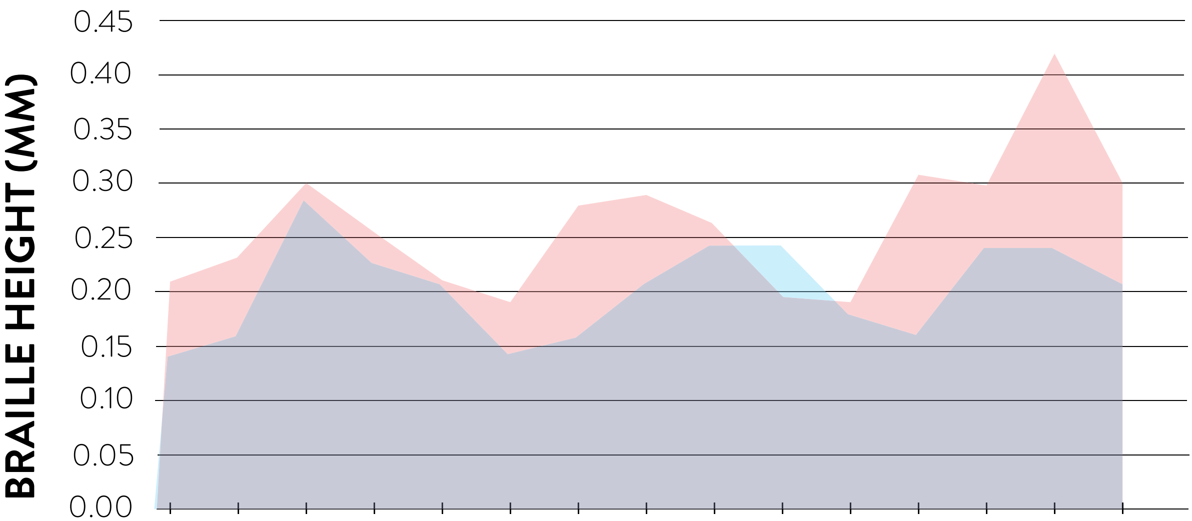
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)

BRAILLE HEIGHT STANDARD

AVERAGE BRAILLE HEIGHT (60 STROKES)



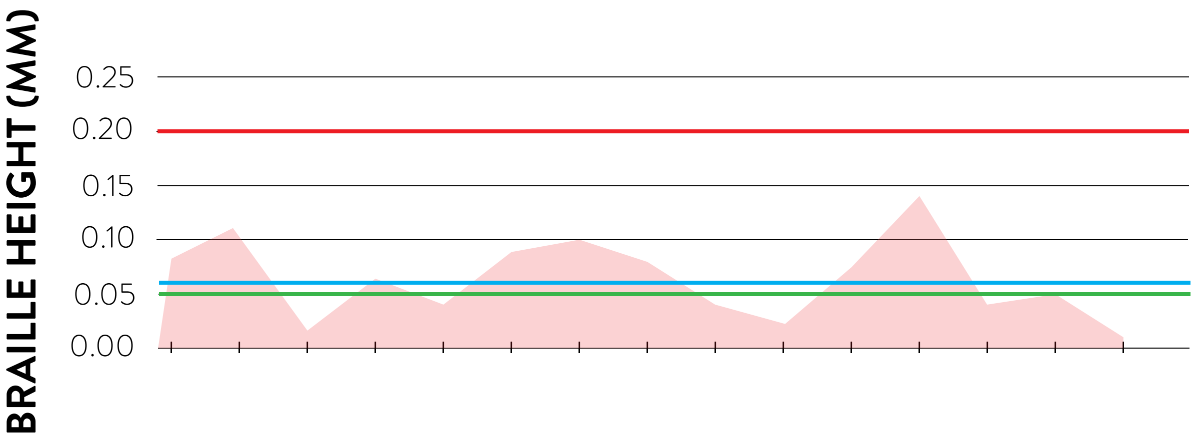
AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (PLASTIC GRADE 5)



AVERAGE PAPER CALIPER AND BRAILLE HEIGHT

FLOOR READINGS (MM)

SHOULDERS READINGS (MM)



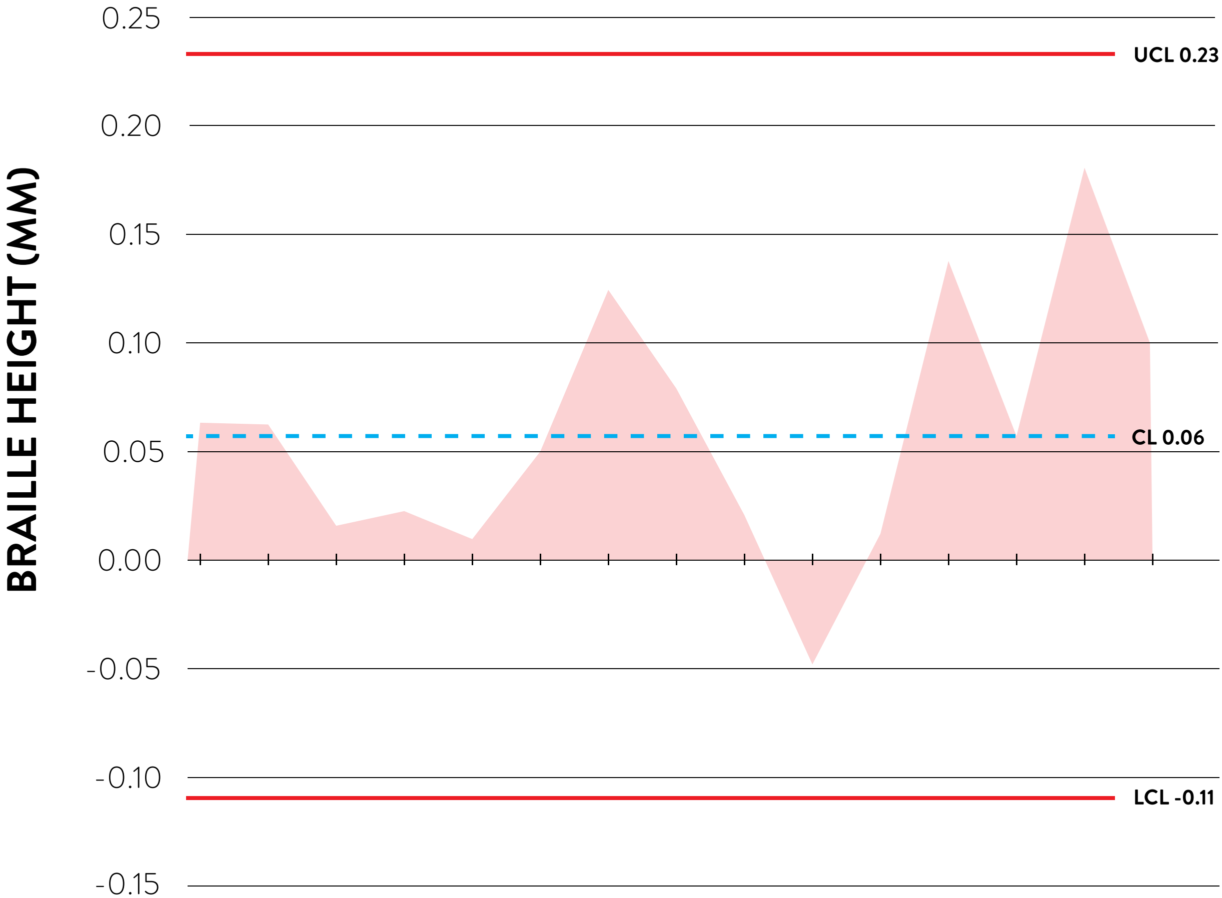
PLASTIC GRADE 5 SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER

AVERAGE SHOULDER POST RUB TEST DIFFERENCE

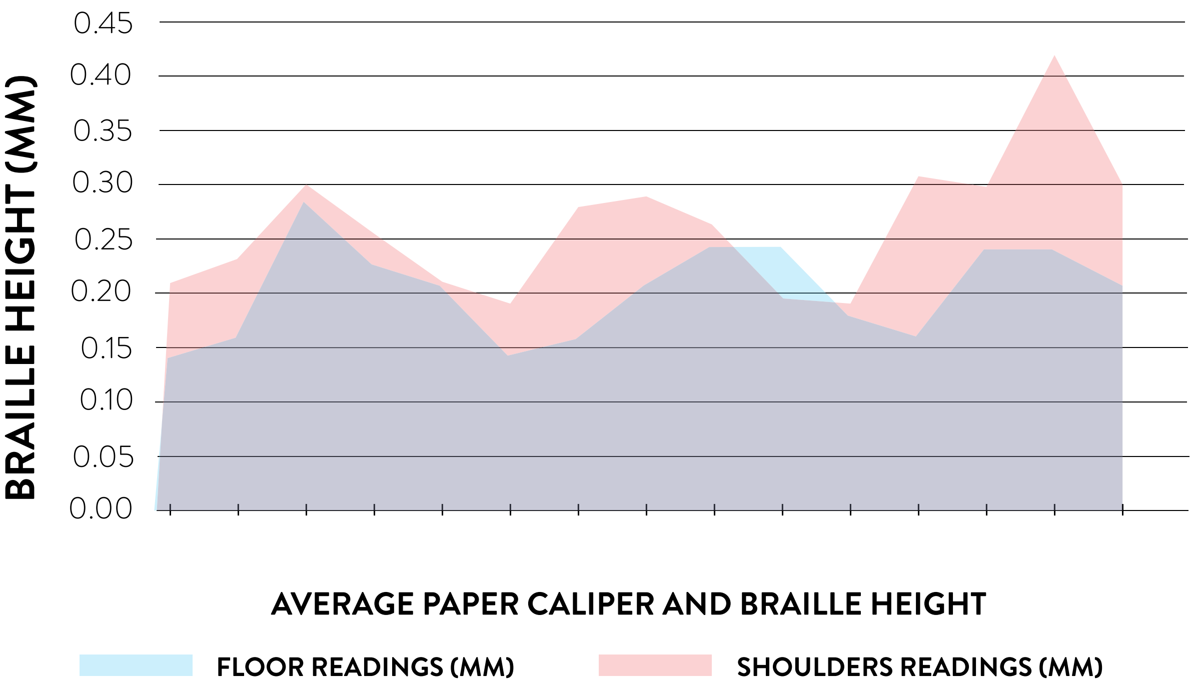
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)

BRAILLE HEIGHT STANDARD

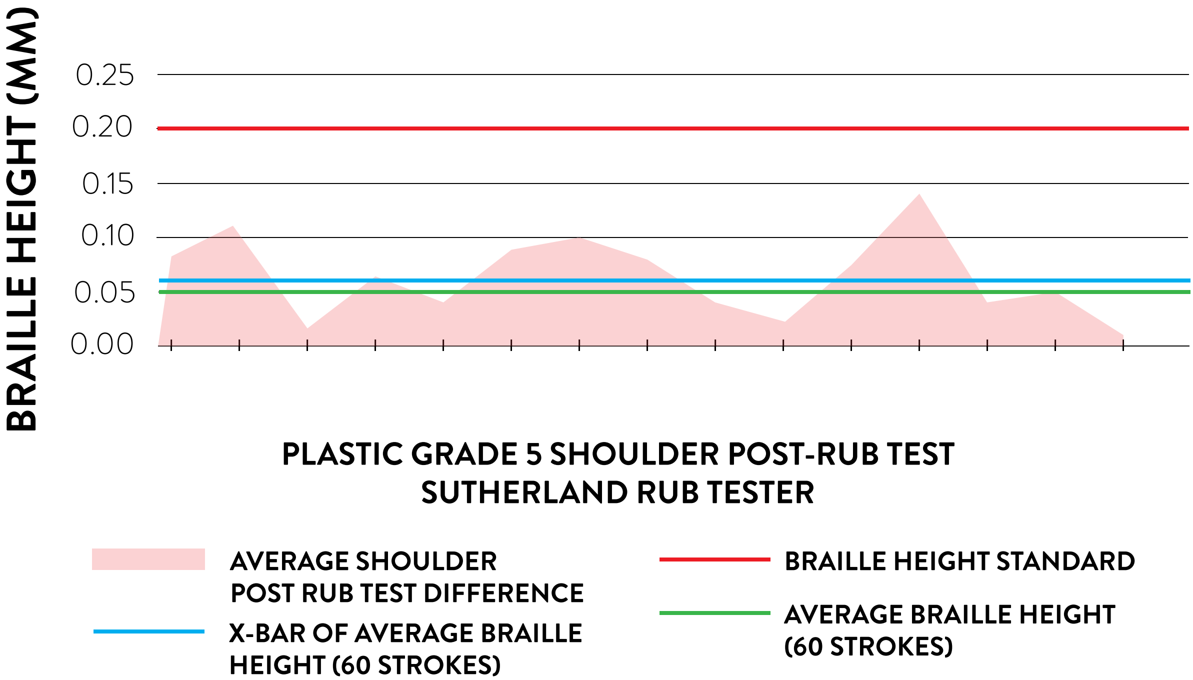
AVERAGE BRAILLE HEIGHT (60 STROKES)



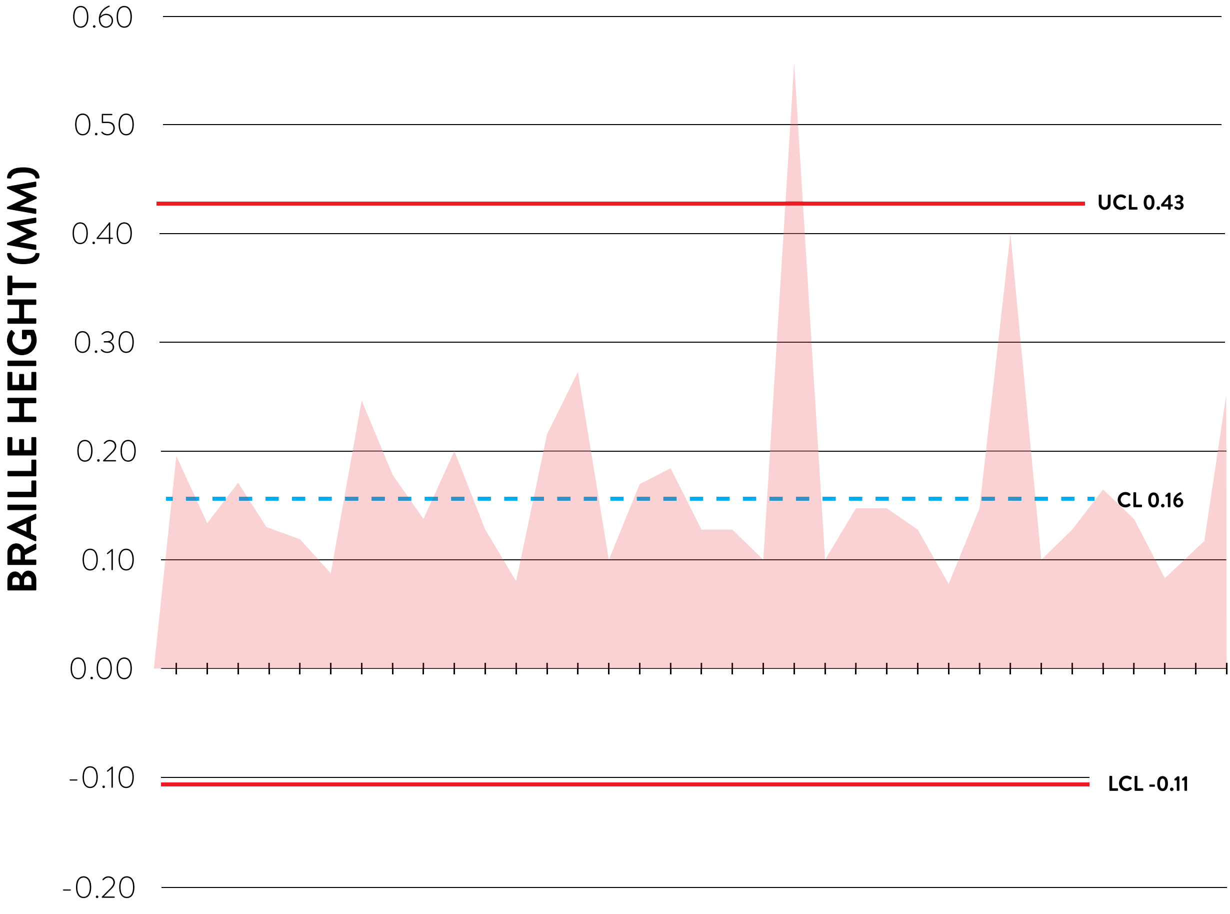
AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (PLASTIC GRADE 5)



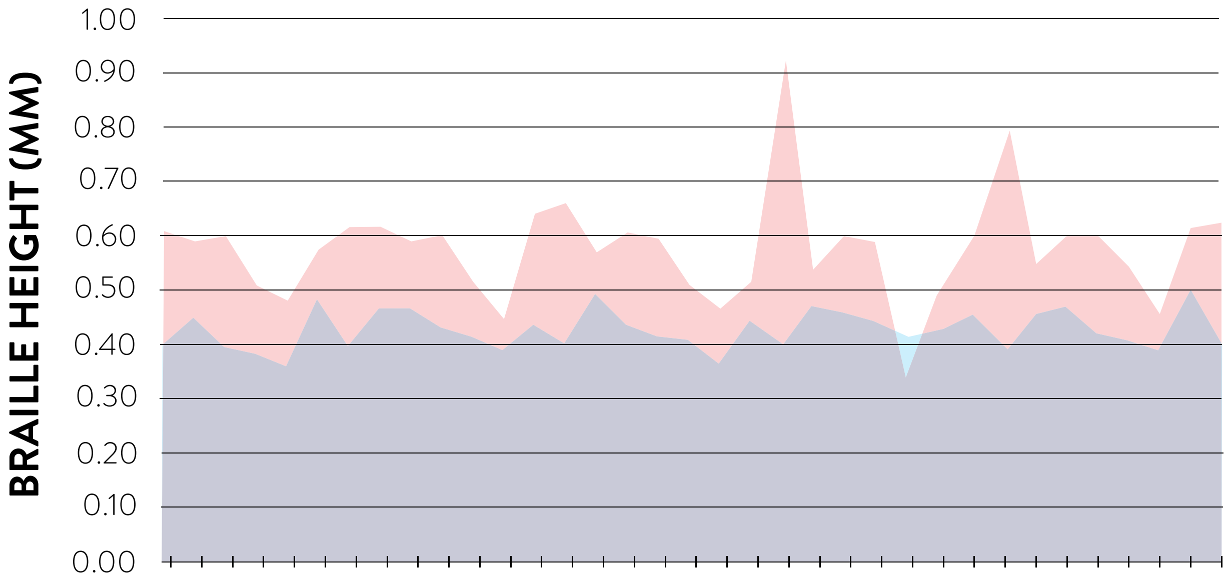
BRAILLE HEIGHT (MM)
0.45
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
AVERAGE PAPER CALIPER AND BRAILLE HEIGHT
FLOOR READINGS (MM)
SHOULDERS READINGS (MM)



BRAILLE HEIGHT (MM)
0.25
0.20
0.15
0.10
0.05
0.00
PLASTIC GRADE 5 SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER
AVERAGE SHOULDER POST RUB TEST DIFFERENCE
BRAILLE HEIGHT STANDARD
X-BAR OF AVERAGE BRAILLE HEIGHT (60 STROKES)
AVERAGE BRAILLE HEIGHT (60 STROKES)

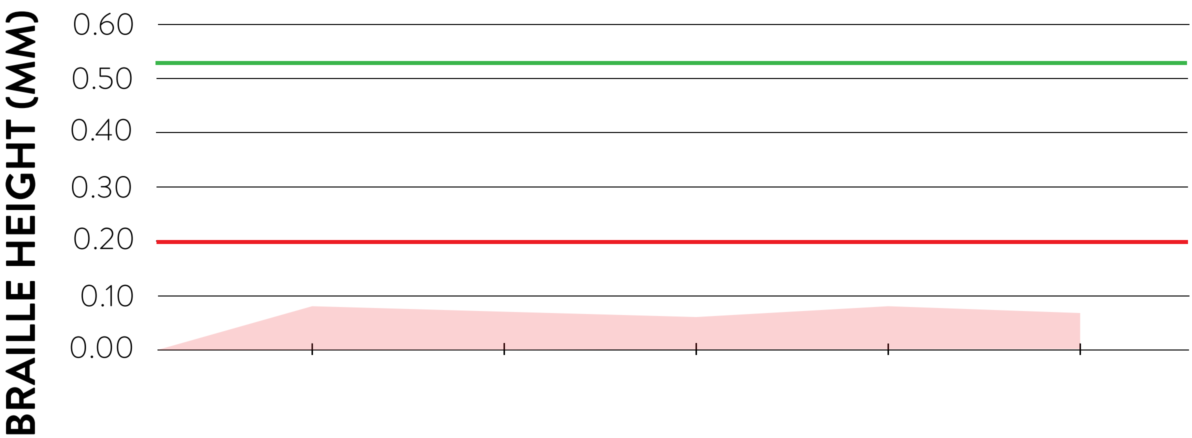


AVERAGE BRAILLE HEIGHT OF 30 SAMPLES (REAL LIFE SAMPLES)



AVERAGE PAPER CALIPER AND BRAILLE HEIGHT

FLOOR READINGS (MM) SHOULDERS READINGS (MM)



REAL LIFE SAMPLES SHOULDER POST-RUB TEST
SUTHERLAND RUB TESTER

AVERAGE SHOULDER POST RUB TEST DIFFERENCE

BRAILLE HEIGHT STANDARD

AVERAGE BRAILLE HEIGHT (60 STROKES)

EXPECTATIONS:

The group's initial goal for this research project was to gain a more in depth level of understanding regarding the integration of Braille technology in commonly used food packaging materials. These materials include various weighted paper and paperboard, as well as various grades of plastics (specifically grades 2, 4, and 5). Once the experiment commenced, the group hypothesized how each food packaging substrate would behave in relation to its surface's embossed Braille.

Based on the Viewplus SpotDot's specifications, the group originally believed that the thickness of the substrates used would exceed the capabilities of the machine. The machine's recommended substrate is 10 points, whereas some of the tested substrates were 20 points (Viewplus SpotDot User Manual, n.d.). Another initial concern was that some of the substrates tested did not have entirely flat surfaces; an example of this can be seen in the grade 2 plastic sample, as it once enclosed cereal. The group believed that there would be difficulty printing Braille on these substrates due to its lack of rigidity and folding tendency. Lastly, it was predicted that of the two types of packaging material being tested, the paper would withstand a higher level of tension from the initial Braille production, as well as the sustainability testing that followed. This is due to the composition of the paper-based packaging materials' fibres, which allow it to have a higher capacity and ability to expand, and therefore more easily accepting the Braille.

By testing these materials, the group hopes to gain a better understanding of Braille application, as well as discover which types of substrates are more suitable for Braille technologies. This includes how Braille can be effectively produced in the most cost efficient method without jeopardizing the quality of the final product. A major concern is whether or not Braille is worth investing in based on the demographics of the visually impaired population if the food packaging industry would ultimately benefit from Braille technologies being printed on its substrates.

DISCUSSION:

Before testing the sustainability of food packaging substrates with the Sutherland Rub Tester, a digital micrometer was used to measure the paper and plastic caliper, as well as the Braille height. The average height of the paper substrates were between 0.102 mm and 0.142 mm, with CNK Custom Kote 20 point having the lowest height (0.102 mm) and Printkote 20 point having the highest height (0.142 mm). The average height of the plastic substrates ranged between 0.003 mm and 0.162 mm, with grade 4 plastic having the lowest height (0.003 mm) and the Real Life Nestea sample having the highest height (0.162 mm). Although plastic substrates were rigid and harder to pass through the Viewplus SpotDot, the paper food packaging materials were able to accept the Braille technology closer to what is considered the Braille standard. However, the reason the plastic substrates obtained an overall higher average is due to the caliper of the materials themselves prior to the Braille embossing.

Next, the substrates were tested to see how well the Braille could withstand being rubbed against the same substrate taped under a 4-pound weight. This process was used to simulate the abrasion that products may have withstand when being shipped in either their primary, secondary, or tertiary packaging. This factor is important to test, as packaged food products must undergo copious amounts of shipping and handling when being transported from the supplier to the retailer and ultimately, in the hands of the consumer. Upon testing each material with a 4 pound weight for 60 seconds each (one second per stroke), the paper-based material that resisted the pressure of the weight the most was CNK Custom Kote 20 point with the average caliper of the Braille being only 0.022 mm less than the caliper before the rub tester. The plastic-based material that resisted the pressure of the weight the most was the grade 5 plastic sample (the Chatime Cup), which had a Braille difference of only 0.001 mm. The materials that resisted the abrasion at a higher level were the thickest materials, including the grade 5 plastic (thick plastic cup) and the CNK Custom Kote with the highest thickness of 20 points. Despite the minimal differences seen after the rub test, the samples did not have a height that would meet the ideal Braille standards of 0.6 mm (including the substrate thickness) (Quick Reference Guide to ADA Signage, 2012). These standards were developed for the pharmaceutical industry; however, these standards could be adapted for food packaging due to the assurance of each package being readable. This being said, the material that would be most ideal from those tested for Braille in food packaging applications is Earnscliffe Linen Bond.

The Earnscliffe Linen Bond material is composed of a high cotton volume, which allows the material to be more pliable due to the longer and stronger grain fibres. When the Braille alphabet is embossed on these types of materials, the grain fibres are less likely to break and rupture the surface of the paper. This is vital for the durability and readability of the Braille alphabet. However, this was a common occurrence in the materials tested, as some were unable to withstand being stretched. This was moreso seen in the plastic materials, as they are not composed of paper grains. When the plastic substrates were embossed, there were no grain fibres that allowed the substrate to expand, hence why many of the plastic materials bursted more easily than the paper substrates. The Earnscliffe material is also the most similar to that of what Braille paper is comprised of. Ideally, Braille is printed on paper that is 100 percent cotton, as this ensures that it has the required amount of strength for the dots remain firm for a longer period of time (Braille Paper, n.d.). Comparatively, the Earnscliffe paper has a cotton content of 50 percent (Why Cascades' Paper?, n.d.). Cotton fibre is longer than wood fibre and is flat and twisted, which produces a higher and more durable quality of paper (About Paper, n.d.).

There are several different factors that may have affected the results obtained in regards to the caliper measurements. The first factor includes the machine's recommended caliper thickness of 10 points (Viewplus SpotDot User Manual, n.d.). Many of the materials used were over the recommended thickness, which explains why they had difficulty passing through the machine. It took several attempts to pass the thicker materials through the machine to be embossed. The embossing machine is not meant to puncture materials over 10 point thickness, which explains why the group's Braille height was not as high as the Braille standard. Additionally, the Viewplus SpotDot machine is used mostly for educational purposes and thus, would not be used in industry to produce Braille technologies. This is due to the machine not being ideal for large-scale projects that require thousands of copies based on its speed, variety of substrate size, and lack of automation (materials must be fed into the machine). Another factor that could have affected the caliper measurements were that certain plastics were taped to mylar to be passed through the machine, like the grade 2 plastic and the Real Life Nestea sample. This is because the plastics were thin and could not lie flat without reinforcement. If the samples were not taped to the mylar, they would cause jams within the machine and prevent the Braille from being embossed to the substrate. This would have affected the dot height because the machine had to emboss not just the sample alone, but also a piece of mylar residing underneath.

RECOMMENDATIONS:

PRINTABILITY

In terms of producing Braille as a whole and not specific to the capabilities of the Viewplus SpotDot, how well the Braille is embossed onto the material is based on how susceptible the material is to being stretched. Embossing Braille on paper-based materials, such as cotton-based paper or paperboard, will result in a finer printed Braille as opposed to a graded plastic material. This is because paper-based materials are composed of paper fibres, which are less likely to rupture when stretched during the embossing of Braille dots. However, thick plastics in food packaging, such as grade 5 plastic, would require a machine that is capable of producing these dots without bursting the surface of the material. By conducting this experiment, the group learned that the Viewplus Spotdot is not ideal for grades of plastic materials and is more so intended for thin sheets of uncoated paper.

RUNNABILITY

Depending on the machine being used, the ease at which a substrate is passed through the machine varies. The Viewplus SpotDot is ideal for thinner substrates under 10 points that lay flat so they will be picked up by the rollers and roll around the cylinder at the rear end of the machine without causing a jam in the process. Another factor that affects how well substrates pass through the machine is whether or not the substrates are prone to bursting under pressure. If the substrate bursts while being embossed, it will likely cause jams during the press run, which will increase the cost of materials and cause downtime for the overall job itself. Lastly, the speed at which the machine runs may also affect how materials run through the machine. The speed of the Viewplus SpotDot was relatively quick in comparison to the size of the machine. This, in turn, is the cause of several thinner substrates folding and crumpling

> The group found that the Kongsberg C press (by Esko) is capable of producing Braille by drilling a hole, then placing Braille beads with great accuracy ("Braille tool for Kongsberg cutting tables - Esko", 2013).

inside the machine, which caused the machine to come to a full stop.

END-USE

When determining if producing Braille is a worthwhile investment based on the quality at which one is able to produce the Braille alphabet, it is highly important to consider the capabilities and limitations of the machine so that the substrate is able to be embossed with Braille dots. Food can be packaged in a wide array of materials with various thicknesses and flexibilities, all with the necessary written information printed on the package for those that are not visually impaired. It is important to consider the capability at which the machine can print on a wide variety of substrates in order to produce high quality Braille embossing without any jams or material surface ruptures. Surface ruptures would not only degrade the quality of the Braille, but also the other printed information included on the packaging, which could potentially result in that specific package being an automatic write-off. These write-offs can be visually noticeable, as consumers may be able to see that the printed surface has been ruptured and that some cracking occurred.

It is important to ensure that the machine is capable of producing dots that meet the requirements of Braille standards. Through research, the group found that the Kongsberg C press (by Esko) is capable of producing Braille by drilling a hole, then placing Braille beads with great accuracy ("Braille tool for Kongsberg cutting tables - Esko", 2013). This is done to ensure that the Braille is legible to the visually impaired and that the right information is conveyed to the end user.

The Braille must be produced accurately and be able to withstand the environment that it is handled in. It is imperative that those that rely on the Braille alphabet are able to understand any important information that may be included on the package, like nutrition, ingredients, and allergy warnings. If there is damage to the Braille, or if the Braille does not accurately convey the information, there could potentially be health risks for those using it. For example, if the Braille for a product that contained peanuts had lost the allergen warning label in Braille due to it rubbing off during shipping, someone with peanut allergies may consume the product and suffer their allergen side effects. There are also legal concerns for the companies using and producing Braille technologies. A visually impaired person may be able to argue that the product did not specify that it contained allergens and may sue the company for misinformation.

There are many cases that involve lawsuits against companies that do not accurately represent the information of product even when Braille is not included. One of the most popular cases is the Liebeck versus McDonald's case. Although it is apparent when ordering a hot beverage (like coffee) will be hot, a woman was able to successfully sue McDonald's when hot coffee spilled on her lap in 1992. This is why consumers see messages like 'Caution: hot beverage' on the sleeves and/or coffee cups as companies use this as a way to mitigate risk.

To conclude, Braille must follow certain standards in order to meet visually impaired consumers' expectations. As mentioned, there are many factors that can affect the legibility of Braille. As seen in the results, not all materials allow the embossing of Braille as the surface of it may burst. This makes it difficult for a company that may want to become more environmentally friendly, as well as serve the visually impaired. If the Braille on the packaging has been ruptured, it can distort the visual information presented to a person that is visually impaired, as the information is no longer conveyed accurately. This can cause a health and legal concern to both the company and the end user.

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JEREMY PAGÉ
PRESIDENT

Over the last year, I have had the irreplaceable opportunity to work as part of a team as diverse and effective as RyeTAGA – from our early morning meetings to late night messages, it has been an absolute honour to watch this team develop from a group of people who have scarcely met each other, to one whose progress cannot be measured in charts and spreadsheets, but one whose dedication is seen in the work we accomplish together. Despite our challenges, we have come out stronger, and that brings a smile to my face like nothing else. I know that each and every member of this team will go on to do great things, and it has been nothing but a pleasure to serve as a leader to them over this year. Despite our challenges, we have come out stronger, and that brings a smile to my face like nothing else.

JAMES LAI
CREATIVE DIRECTOR

As a fourth year student in the Graphic Communications Management program, I am excited to take on the role of the Creative Director once again with RyeTAGA. With these experiences, I seek to grow as a professional individual and develop a skill set that will set me above from the rest. This year I will strive to breathe life into a new journal that will set the legacy of RyeTAGA in stone. With the creation of this journal, I hope to inspire more people to take on positions in RyeTAGA and continue the legacy passed down from those who aspired for perfection before us.

JESSICA ROCHA-DA SILVA
PRODUCTION DIRECTOR

Throughout my four years at Ryerson University for Graphic Communications Management, I have learned quite a lot about my industry; gaining a passion for it immensely. With all that I have learned and worked hard for, I was given the great opportunity to show my acquired skills as an Executive member with the title of Production Director for the RyeTAGA 2016-2017 journal. I cannot wait to deliver a physical journal through the hardworking and talented team of this year's RyeTAGA. I will make sure to produce everyone's hard work throughout this book as well as keeping up with RyeTAGA tradition in delivering the best journal!

CELINE GENGA
MARKETING DIRECTOR

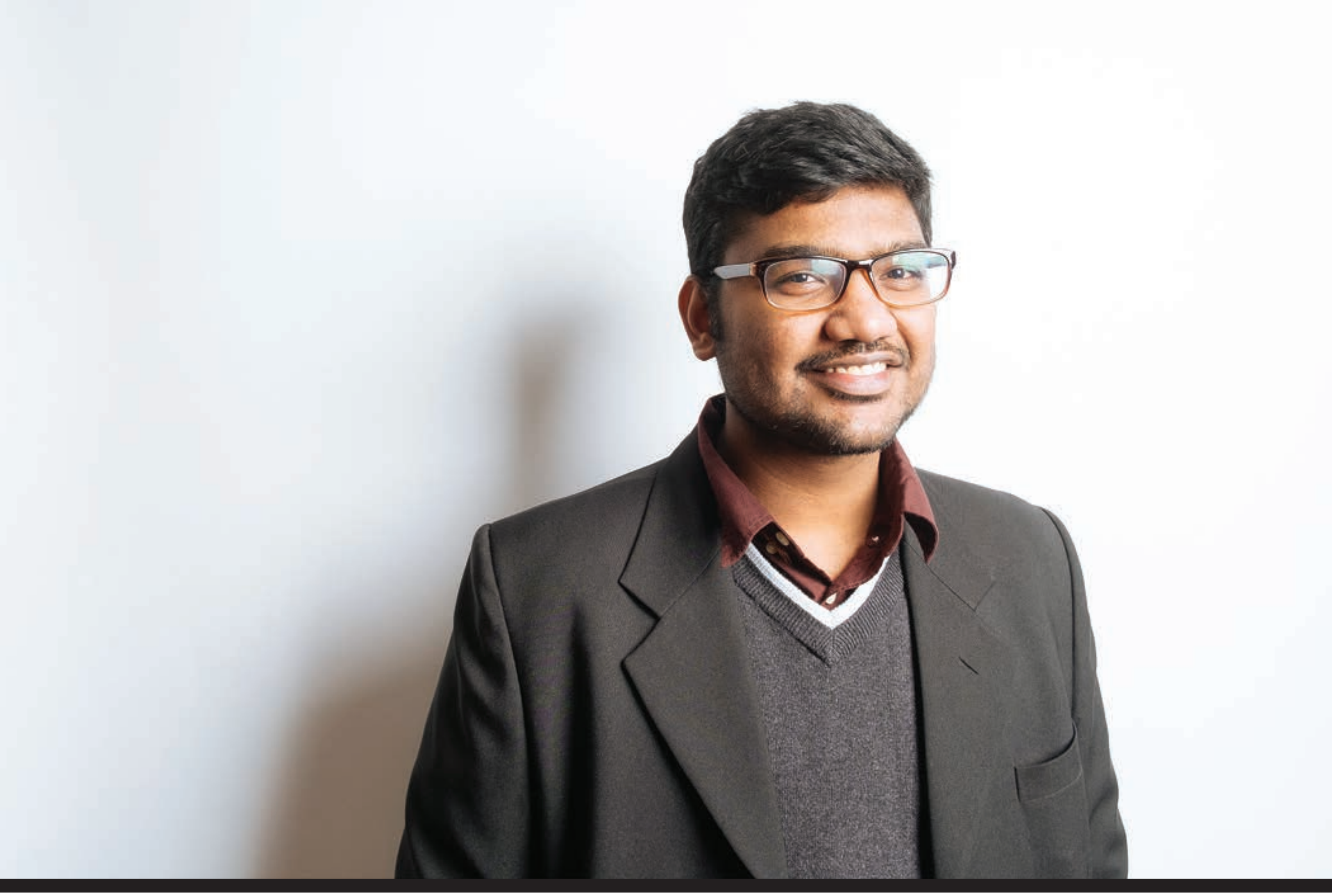
RyeTAGA is more than just a student group here at Ryerson University. It is a collaborative, unique, and rewarding experience to be apart of such a hard working and dedicated team. As a passionate second year Graphic Communications student, I decided to join RyeTAGA as an executive member. I was initially intrigued because it allows students to thoroughly explore different aspects of the Graphic Arts industry, all while producing a tangible student-made journal. Overall, I am able to strengthen my university experience by applying concepts learned in class, just as I would in industry. From creative concept planning, to editing and production – we as a team are able to see a concept develop from an idea to an amazingly executed journal, and that experience itself is priceless.

JANNA GUYATT
EDITORIAL DIRECTOR

Entering my fourth and final year at Ryerson University, I joined RyeTAGA as an executive member after having joined the team as a general member the previous year. Joining RyeTAGA has been an enriching experience, as it has allowed me to utilize my academic and professional skills within a distinctive team environment. This group also facilitated and heightened my involvement within the Graphic Communications Management program's community. I am thankful to have had the opportunity to work with such hard-working and dedicated team members throughout the production of this journal. Seeing the amount of work it took for this journal to be built from a general concept to a detailed, tangible product has been an eye opening and fulfilling experience. As a graduating student, I hope that I have been able to inspire younger students to join RyeTAGA and continue to support the graphic arts industry.

RUBAB ASHRAF
FINANCE DIRECTOR

I am a fourth year student studying Graphic Communications Management (GCM). I have been involved in many extra-curricular activities throughout my years in GCM. However, RyeTAGA offers a valuable experience by applying the knowledge and skills learned in the classrooms. It has been a pleasure working with a team of hardworking and motivating individuals to strive for a common goal. I hope this year, it will be a successful year for us again!



KARAN PATEL
OPERATIONS DIRECTOR

As a third year student I feel extremely fortunate to be a part of RyeTAGA executive team and work with wonderful people. RyeTAGA has given me an opportunity to get involved in the process of planning and producing the annual TAGA journal which involves professional and organizational skills. Being a part of this incredible student group was not only a great learning experience for me but it also challenged me to work hard to achieve team goals. I believe the group attempt to foster team identity which goes far beyond individual goals is what makes RyeTAGA a successful student group and I love to be a part of this organization in the Graphic Arts Industry.

TAYLOR ALDERDICE
CORPORATE RELATIONS DIRECTOR

As a second year student enrolled in Ryerson's Graphic Communications Management Program, I have already been exposed to many great opportunities both academically and within Industry. Being part of the 2016-2017 RyeTAGA team as the Executive for Corporate Relations allows me to meet and interact with respected Industry members. I am excited to show off this year's journal to broadcast the RyeTAGA team's hard work and dedication!

NIDHI KATRI
MULTIMEDIA DIRECTOR

Being a part of RyeTAGA has been a wonderful experience that allowed me to discover my interests and develop useful skills for the graphic communication industry. As a Multimedia Director, I have been able to learn more about digital publishing and all the new technology that can be used to make a great ePub, which helped me discover where my true passion lies. RyeTAGA provided me with the opportunity to work with an amazing team and create something that we can truly call our own, an invaluable experience that I will never forget. I have always been the type of person to take risks and try new things and joining and extra curricular activity as an exec member was taking a step outside of my comfort zone. I am very glad to have taken this step because RyeTAGA has shown me new insights to the graphic communications industry and opened new doors for my future. I hope RyeTAGA continues to do the same for future team members and continue to provide invaluable experiences.

TRUNG NGUYEN
FACULTY ADVISOR

RyeTAGA has been instrumental to kickstarting my career in print. As a student member with RyeTAGA under my belt, I have been so lucky to have received many job offers and working opportunities upon graduation. It really is a microcosm of what it is like to work in industry. From marketing to production, I gained experience working cross-functionally with internal and external stakeholders, to build the RyeTAGA brand as we prepared for the annual conference. I know that this experience will be invaluable to all the current and future members, and know that it will benefit their own careers as it did mine.