

Material Cut Capability

Cricut Explore versus Silhouette Cameo

by



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Date: 11/14/2014

Table of Contents

1	Introduction.....	5
1.1	Scope	5
1.2	Description	5
1.3	Assumptions.....	5
1.4	Company Restricted Information.....	5
1.5	Abbreviations / Acronyms / Definitions	5
1.6	Executive Summary.....	6
1.7	Test Configurations	7
1.8	Test Entrance Criteria	7
1.9	Test Exit Criteria.....	7
2	Material Cut Capability Test	8
2.1	Cricut Explore Cut Capability Results:	11
2.2	Cricut Experimental Portion	13
2.3	Silhouette Cameo Cut Capability Results:	19
2.4	Silhouette Experimental Portion	22
3	Cutting Defects.....	25

Table of Figures

Figure 1: Results Summary of Material Cuts Capability	6
Figure 2: Suggested Cut Settings for Cricut Explore.....	11
Figure 3: Suggested Settings Results for Cricut Explore EUTs	13
Figure 4: Experimental Results from Cricut Explore	14
Figure 5: Suggested Cut Setting – Foam Material	14
Figure 6: Foam with ragged edge	15
Figure 7: Compared with Sample.....	15
Figure 8: Success With Foam	15
Figure 9: Close Up Foam Success	15
Figure 10: Cork not Cut Through EUT #2.....	16
Figure 11: Top side of Cork on EUT #2.....	16
Figure 12: Cork Cut Through.....	16
Figure 13: Success with Hard Leather	17
Figure 14: Close up Successful Hard Leather	17
Figure 15: Chipboard, regular, not cut through	17
Figure 16: Regular Chipboard Success.....	17
Figure 17: Dense Chipboard with suggested settings	18
Figure 18: EUT 2 did not cut through with ideal settings	18
Figure 19: Magnet material not cut through	18
Figure 20: Experimental Magnet Success.....	18
Figure 21: Suggested Cut Settings for Silhouette Cameo	19
Figure 22: Results for "Suggested Cut Settings" on Cameo EUT #2.....	21
Figure 23: Results for Experimental Tests on Cameo	22
Figure 24: Debris from poor tracking	23
Figure 25: Experimental Chipboard with Cameo	23
Figure 26: Tracking corrected – bottom	23
Figure 27: Tracking corrected – top	23
Figure 28: Broken Silhouette blade from Aluminum.....	24
Figure 29: Cricut Carbide blade with Aluminum	24
Figure 30: Jagged edge	25
Figure 31: Defective corners.....	25

1 Introduction

1.1 Scope

The “Cricut Explore Material Cut Capability Test Report” defines test requirements and methodologies that were performed using the Cricut Explore of Provo Craft & Novelty, and the Silhouette Cameo of Silhouette America. The testing is a competitive analysis test to determine how the Cricut Explore compares to the Silhouette Cameo.

The tests and procedures defined in this document were developed by Percept Technology Labs LLC, an independent product test and development firm located at 5541 Central Ave., Ste #110, Boulder, Colorado 80301.

1.2 Description

The products being tested are consumer-grade personal electronic cutting machines.

1.3 Assumptions

The samples Percept Technology Labs LLC purchased are representative of the configurations being investigated.

1.4 Company Restricted Information

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1.5 Abbreviations / Acronyms / Definitions

EUT — Equipment Under Test

1.6 Executive Summary

The material cut capability test compared the Cricut Explore electronic cutting machine to the Silhouette Cameo. After testing eight different materials, the results indicate the Explore's capability surpasses the Cameo's. Six out of the eight materials tested were over Explore's cutting depth specification. Although Explore had initially failed four of the eight types of materials using the client's recommended settings, ideal settings were derived experimentally that successfully cut all materials. Instrumental to that success was the deep cut blade.

The Cameo failed to cut completely through seven out of the eight materials, even after experimental attempts at finding ideal settings. The experimental attempts included maximizing all settings of the machine, except for speed. Seven out of the eight materials were thicker than the Cameo's cutting depth specification; however the one material within the cutting depth specification was the aluminum. In one instance of cutting the aluminum material, the tip of the blade was broken off.

Even though the hard leather material was more than twice the thickness of both company's cutting depth specifications, the Explore was not only able to load this material; it was able to cut through it. The Cameo, on the other hand, could not load the material into the machine due to a lack of clearance between the rollers and the mat.

Figure 1: Results Summary of Material Cuts Capability

Cricut Explore				Silhouette Cameo			
Material	EUT #1	EUT #2	EUT #3	Material	EUT #1	EUT #2	EUT #3
Foam	Passed	Failed	Passed	Foam	Failed	Failed	Failed
Cork	Passed	Failed	Passed	Cork	Passed	Passed	Passed
Leather, soft	Passed	Passed	Passed	Leather, soft	Failed	Failed	Failed
Leather, hard	Passed	Passed	Passed	Leather, hard	Could not be loaded		
Chipboard	Passed	Passed	Passed	Chipboard	Failed	Failed	Failed
Chipboard, dense	Passed	Passed	Passed	Chipboard, dense	Failed	Failed	Failed
Magnet sheet	Passed	Passed	Passed	Magnet sheet	Failed	Failed	Failed
Aluminum	Passed	Passed	Passed	Aluminum	Failed	Failed	Failed

1.7 Test Configurations

The Cricut Explore and Silhouette Cameo were purchased through the retail channel.

- Three (3) Cricut Explore samples.
- Three (3) Silhouette Cameo samples.

1.8 Test Entrance Criteria

- All necessary product-related materials and support documentation required for Percept Technology Labs LLC to execute this project.
- Packaged samples of the product for testing.
- Access to a technical resource (person) for operational questions.

1.9 Test Exit Criteria

- Completed testing.
- All data collected for specified test cases.
- Completed Test Report.

2 Material Cut Capability Test

Objective:

Determine how well the EUTs cut several different materials available from sources other than their respective manufacturers.

Test Configuration:

- Three (3) Cricut Explore samples.
- Three (3) Silhouette Cameo samples.

Test Equipment:

- Boreal Digital Research Microscope
Model: 57900-03
- Mitutoyo Micrometer
Model CD-6" CS
- Dell Laptop
Model: Latitude E5510
- "Experimental" Cut Machines
One (1) Cricut Explore
One (1) Silhouette Cameo

Cricut Suggested Test Materials:

Material	Measurement	Brand	Where Purchased	Blade	Mat
Chipboard Dense	1.17mm	Mixed Media by Paper Studio	Hobby Lobby	Deep Cut	Strong Grip
Aluminum Metal Sheet	0.32mm	Create with Metal Roll	Hobby Lobby	Standard	Strong Grip
Magnet Sheet with Adhesive Back	0.58mm	5"x8" Treehouse Studio	Hobby Lobby	Standard	Strong Grip
Chipboard	1.07mm	Unknown	Unknown	Standard	Strong Grip
Craft Foam	2.10mm	Unknown	Hobby Lobby	Deep Cut	Strong Grip
Corkboard with Adhesive Back	1.15mm	Imagination Station Cork Roll	Hobby Lobby	Deep Cut	Strong Grip
Hard Leather	2.11mm	Unknown	Hobby Lobby	Deep Cut	Strong Grip
Soft Leather	1.61mm	Unknown	Hobby Lobby	Deep Cut	Strong Grip

NOTE: Standard blade refers to the Cricut German Carbide Blade.

Cricut Material Cut Capability Test Report

Silhouette Suggested Test Materials:

NOTE: The Silhouette Cameo does not have a "strong grip" mat like the Cricut Explore. Also, the Silhouette has only a "standard blade," and a "fabric blade." The fabric blade is not recommended for paper products.

Material	Measurement	Brand	Where Purchased	Blade	Mat
Chipboard Dense	1.17mm	Mixed Media by Paper Studio	Hobby Lobby	Standard	Standard Grip
Aluminum Metal Sheet	0.32mm	Create with Metal Roll	Hobby Lobby	Standard	Standard Grip
Magnet Sheet with Adhesive Back	0.58mm	5"x8" Treehouse Studio	Hobby Lobby	Standard	Standard Grip
Chipboard	1.07mm	Unknown	Unknown	Standard	Standard Grip
Craft Foam	2.10mm	Unknown	Hobby Lobby	Standard	Standard Grip
Corkboard with Adhesive Back	1.15mm	Imagination Station Cork Roll	Hobby Lobby	Standard	Standard Grip
Hard Leather	2.11 mm	Unknown	Hobby Lobby	Standard	Standard Grip
Soft Leather	1.61 mm	Unknown	Hobby Lobby	Standard	Standard Grip

Cuts:

Each EUT will cut an object of the following shape and size for each material being tested. Each EUT will cut one (1) page of each material for the shape and size denoted below:

1. Hexagon – Cut one (1) 76.2mm (3”) per page of material tested (Maximum diameter 76.2mm or 3”).

Method:

The EUTs will be setup according to advanced settings and/or experimentation. Each EUT will perform cuts on eight different types of materials.

1. Install appropriate cutting mat.
2. Place a page of the test material sample on the cutting mat.
3. Select blade type, cut pressure, and blade depth (where applicable), using advanced settings and/or experimentation.
4. Perform cuts.
5. Remove cut material from mat.

Test Comparison:

The following areas will be compared.

1. Quality and consistency of cut setting on all materials tested.
 - a. Cut quality—cut edges will be examined to determine quality of cut (see Section 3 *Cutting Defects*).
 - b. Determine whether the cut went all the way through the material or not (see Section 3 *Cutting Defects*).

2.1 Cricut Explore Cut Capability Results:

Starting with the Cricut Explore (EUT #2) and using the following settings suggested by the client (the order of materials that were cut are indicated below as well):

Figure 2: Suggested Cut Settings for Cricut Explore

Material #1	Foam
Retailer/Brand	Michael's / "Creatology"
Material Thickness (mm)	2.10
Cut Setting	Craft Foam
Cut Pressure	123
Iterations	1
Multi-cut Setting	4
Blade	Deep-cut
Mat	Strong grip

Material #2	Corkboard with Adhesive Back
Retailer/Brand	Michael's "Art Minds" Cork Roll
Material Thickness (mm)	1.14
Cut Setting	Corkboard
Cut Pressure	135
Iterations	1
Multi-cut Setting	4
Blade	Deep-cut
Mat	Strong grip

Material #3	Soft Leather
Retailer/Brand	Michael's / "Art Minds"
Material Thickness (mm)	1.49
Cut Setting	Leather, Heavy 2 mm
Cut Pressure	290
Iterations	1
Multi-cut Setting	5
Blade	Deep-cut
Mat	Strong grip

Material #4	Hard Leather
Retailer/Brand	Michael's / "Art Minds"
Material Thickness (mm)	2.41
Cut Setting	Leather, Heavy 2 mm
Cut Pressure	290
Iterations	1
Multi-cut Setting	5
Blade	Deep-cut
Mat	Strong grip

Cricut Material Cut Capability Test Report

Material #5	Chipboard
Retailer/Brand	Hobby Lobby; "Paper Accents"
Material Thickness (mm)	1.08
Cut Setting	Chipboard, Heavy 0.7 mm
Cut Pressure	331
Iterations	3
Multi-cut Setting	3
Blade	German Carbide
Mat	Strong grip

Material #6	Chipboard, Dense
Retailer/Brand	Hobby Lobby; "Mixed Media" by Paper Studio
Material Thickness (mm)	1.05
Cut Setting	Chipboard, Heavy 0.7 mm
Cut Pressure	331
Iterations	4
Multi-cut Setting	3
Blade	Deep-cut
Mat	Strong grip

Material #7	Magnet Sheet with Adhesive Back
Retailer/Brand	Chalkboard Magnet Sheet by "ProMag"
Material Thickness (mm)	0.84
Cut Setting	Magnet Sheet 0.5 mm
Cut Pressure	323
Iterations	3
Multi-cut Setting	OFF
Blade	German Carbide
Mat	Strong grip

Material #8	Aluminum Metal
Retailer/Brand	Hobby Lobby; "Create with Metal" roll
Material Thickness (mm)	0.19
Cut Setting	Aluminum Metal 0.14 mm
Cut Pressure	327
Iterations	2
Multi-cut Setting	2
Blade	German Carbide
Mat	Strong grip

Figure 3: Suggested Settings Results for Cricut Explore EUTs

	Foam	Cork	Leather, soft	Leather, hard	Chipboard	Chipboard, dense	Magnet	Aluminum
EUT #2	F1	P2	P	F2	P	P	F2	P
EUT #1	F2	P	P	F2	F2	P	F2	P
EUT #3	P	P	P	P	F3	P3	F2	P

NOTES:

- 1 **Failed** using suggested settings.
- 2 **Failed** using suggested settings (~80–90% cut through).
- 3 Blade remains in material; does not lift up.

2.2 Cricut Experimental Portion

Experimental cuts were performed on a separate Cricut Explore that was not a part of the EUTs proper.

According to the test plan, it was required that the tests be performed based on advanced settings and/or experimental settings. The samples pages received from the client—which included suggested settings and multiple iterations for cutting the materials—was used as a starting point. In those cases where the suggested settings failed to cut the material, the settings were adjusted by trial and error until either the material was successfully cut, or until further change in settings were exhausted. This included multiple iterations, or passes of the material through the EUT, and use of the Deep-cut blade.

Due to the fact the number of iterations was not mentioned online or in any published instructions material, it was also decided to run experiments on some of the materials that had several iterations. The objective was to see if a successful cut through could be achieved in a single iteration.

Figure 4: Experimental Results from Cricut Explore

Material	Result:			Comment
	EUT #2	EUT #1	EUT #3	
Foam	Failed	Passed	Passed	Ideal setting: 145 cut pressure, 4 X multi cut, 1 iteration, Deep-cut blade. See Note # 1 below
Cork	Failed	Passed	Passed	See note #2 below
Leather, hard	Passed	Passed	Passed	Ideal setting: 315 cut pressure, 6 X multi cut, 1 iteration, Deep-cut blade. See note #3 below
Chipboard	Passed	Passed	Passed	Ideal setting: 320 cut pressure, 4 X multi cut, 1 iteration, Deep-cut blade. See note #4 below
Chipboard, dense	Passed	Passed	Passed	Ideal setting: 334 cut pressure, 7 X multi cut, 1 iteration, Deep-cut blade. See note #5 below
Magnet	Passed	Passed	Passed	MUST USE Deep-cut blade for magnet sheet. Ideal setting: 335 cut pressure, 4 X multi cut, 1 iteration, Deep-cut blade. See note #6 below

NOTES:

1. This initial trial at the client's suggested settings did not cut the foam all the way through. It was about 30% cut through.

Figure 5: Suggested Cut Setting – Foam Material



The blade pressure was doubled to 246. All other settings were kept the same. This time the material was cut all the way through, however, the edges were ragged and not smooth.

Figure 6: Foam with ragged edge

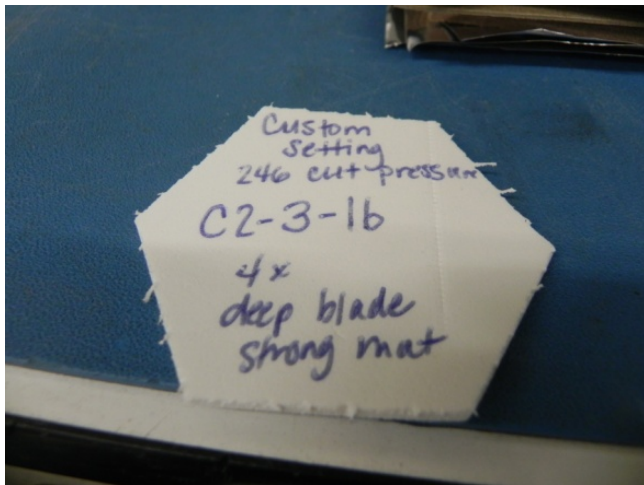
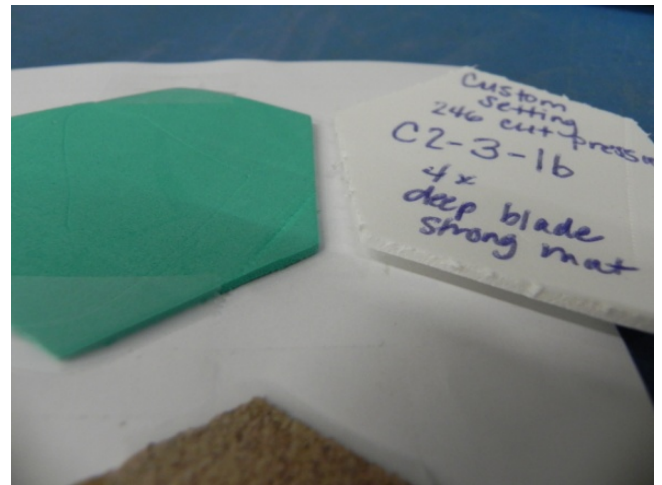


Figure 7: Compared with Sample



Using a fourth Cricut Explore dedicated to experimental trials (to relieve the "production" EUTs of excessive wear), ideal cut settings were eventually arrived at. At that point the settings were applied to the three Cricut EUTs, however, EUT #2 did not completely cut through the material (~90 to 95% cut through). It is thought this failure may be within the bounds of machine-to-machine variability or blade-to-blade variability.

Figure 8: Success With Foam

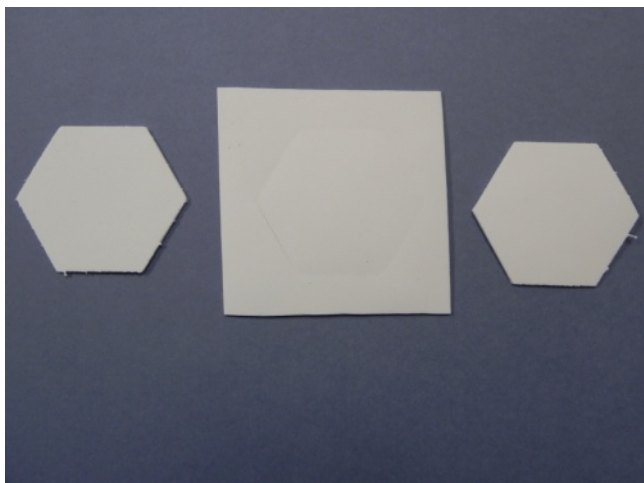
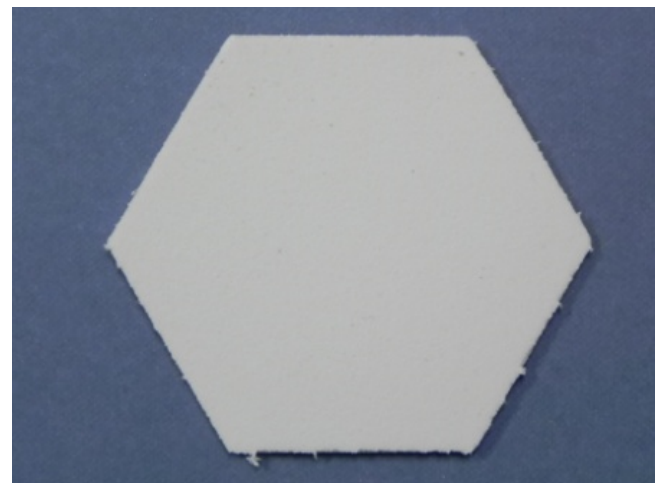


Figure 9: Close Up Foam Success



2. The cork material was not entirely cut through using the client's suggested cut settings on EUT #2 (about 95% through). Being so close to cutting through on EUT #2, it was decided to try the client's suggested cut settings on the remaining EUTs. The other two EUTs had no problem cutting through all of the way. With this result, and that of the foam material, it appears that EUT #2 is exhibiting machine-to-machine or blade-to-blade variability.

Figure 10: Cork not Cut Through EUT #2

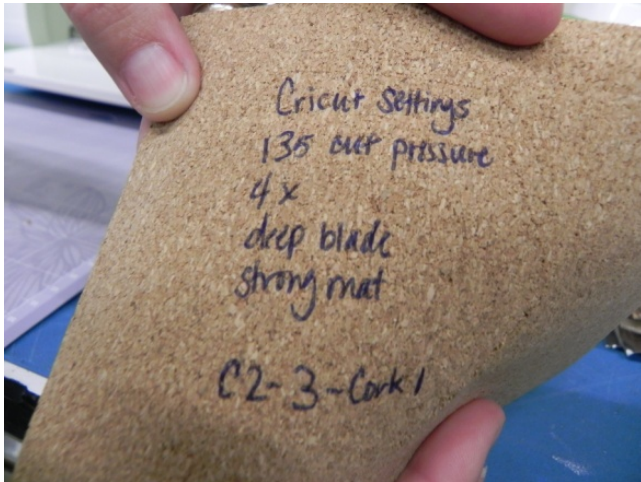


Figure 11: Top side of Cork on EUT #2.

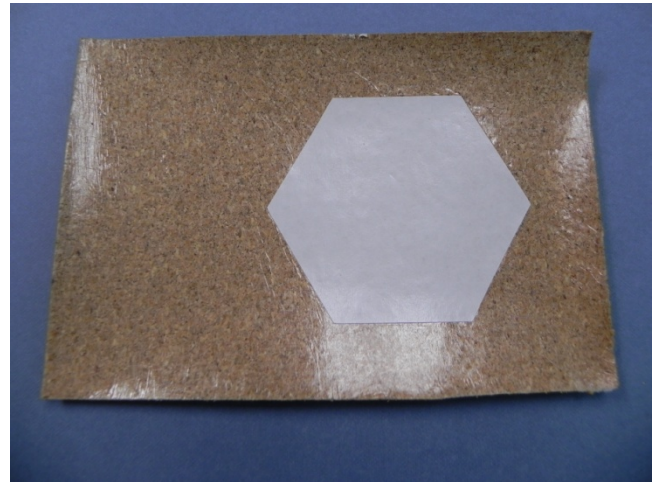
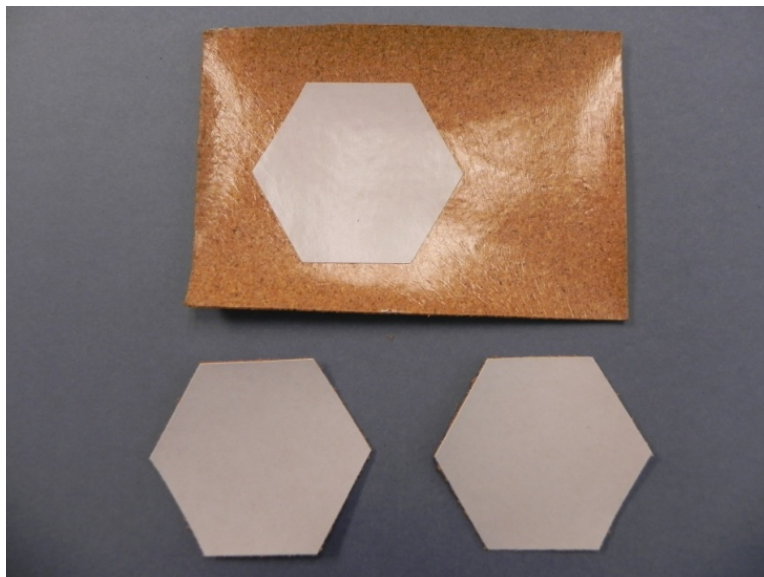


Figure 12: Cork Cut Through



3. The hard leather was not cut through with the client's suggested settings (80% to 90% cut through). However, after a couple experimental attempts, successful cut settings were arrived at and applied to each of the three EUTs.

Figure 13: Success with Hard Leather

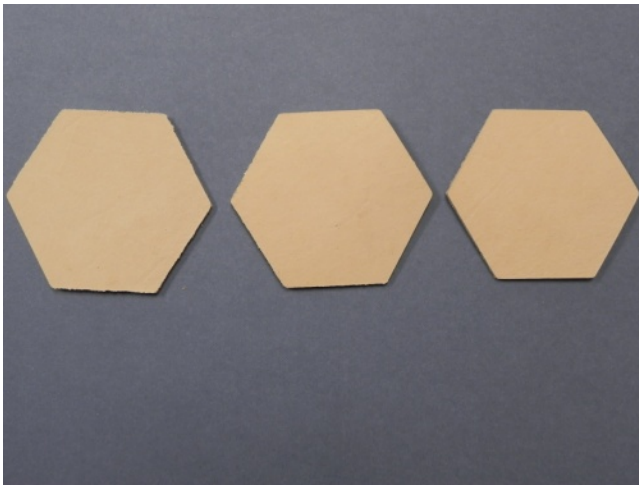
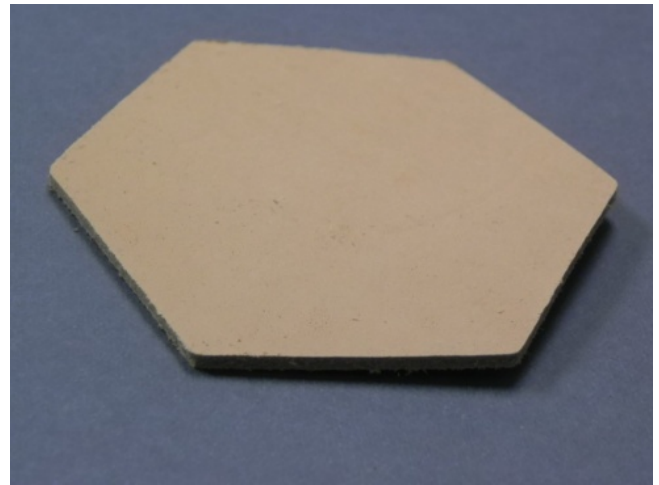


Figure 14: Close up Successful Hard Leather

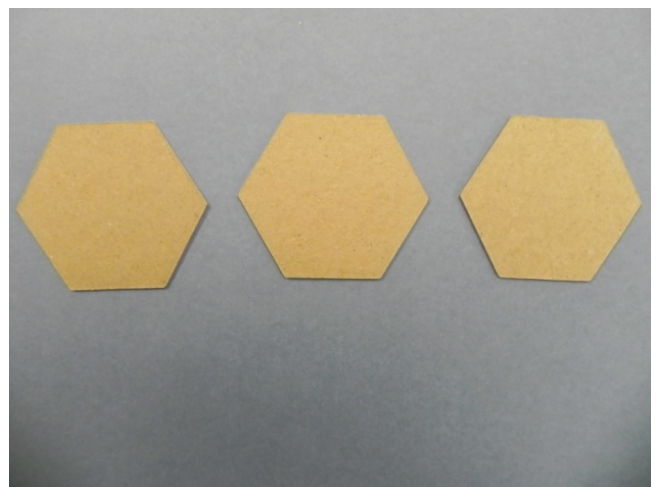


4. The regular chipboard suggested settings required the use of the regular German carbide blade, but the material was not cut all the way through. Several attempts changing the cut pressure, multi-cut setting, and iterations were not successful at cutting completely through the material. It was decided to change out the German carbide blade for the Deep-cut. With a slight increase in cut pressure and the blade change, successful cuts were obtained on all Cricut EUTs.

Figure 15: Chipboard, regular, not cut through



Figure 16: Regular Chipboard Success

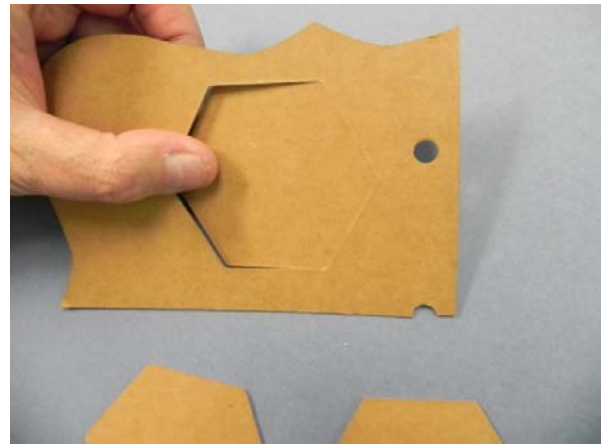


5. Although successful cuts through the dense chipboard were obtained with the client's suggested cut settings on all three EUTs, eliminating the multiple iterations of the suggested cut settings was of interest. After a couple experiments, ideal settings were arrived at resulting in successful cuts on two out of the three Cricut EUTs. This is another example of machine variation. EUT #2 did not cut completely through.

Figure 17: Dense Chipboard with suggested settings



Figure 18: EUT 2 did not cut through with ideal settings

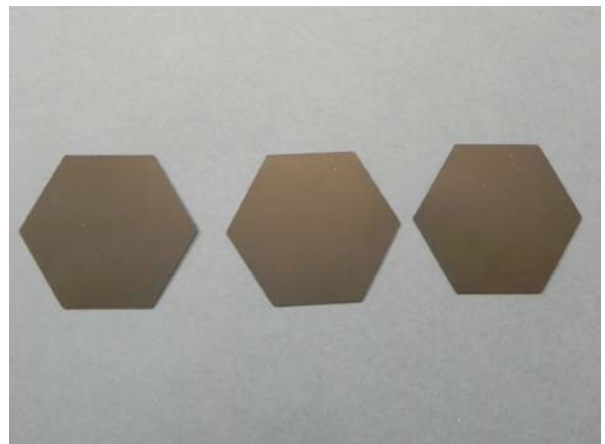


6. The magnet material did not cut all the way through with the suggested cut settings. Several experiments were performed and the conclusion was to use the Deep-cut blade.

Figure 19: Magnet material not cut through



Figure 20: Experimental Magnet Success



2.3 Silhouette Cameo Cut Capability Results:

After completing the initial run through with the client's suggested cut settings on the Cricut EUTs, those settings were translated to the Silhouette EUTs. Silhouette has slightly different settings compared with Cricut. For example, Cricut uses a setting called "Cut Pressure," whereas Silhouette uses a setting called "Thickness." It was surmised that the "Thickness" setting of the Silhouette equates with the "Cut Pressure" setting of the Cricut. Another difference with the Silhouette is that the blade depth is adjustable. In all instances for this initial run through with the client's suggested cut settings, the Silhouette blade depth was set to its maximum setting of 10. For the sake of consistency, the materials were cut in the same order as that of the Cricut EUTs.

Figure 21: Suggested Cut Settings for Silhouette Cameo

Material #1	Foam	Material #2	Corkboard with Adhesive Back
Retailer/Brand	Michael's / "Creatology" Craft foam	Retailer/Brand	Michael's / "Art Minds" Cork Roll
Material Thickness (mm)	2.10	Material Thickness (mm)	1.14
Cut Setting	Custom	Cut Setting	Custom
Cut Thickness	33	Cut Thickness	33
Iterations	2	Iterations	6
Double-cut	ON	Double-cut	ON
Blade setting	10	Blade setting	10
Speed	2	Speed	2
Mat	Standard	Mat	Standard

Cricut Material Cut Capability Test Report

Material #3	Soft Leather
Retailer/Brand	Michael's / "Art Minds"
Material Thickness (mm)	1.49
Cut Setting	Custom
Cut Thickness	33
Iterations	3
Double-cut	ON
Blade setting	10
Speed	2
Mat	Standard

Material #4	Hard Leather
Retailer/Brand	Michael's / "Art Minds"
Material Thickness (mm)	2.41
Cut Setting	Custom
Cut Thickness	33
Iterations	3
Double-cut	ON
Blade setting	10
Speed	2
Mat	Standard

Material #5	Chipboard
Retailer/Brand	Hobby Lobby / "Mixed Media" by Paper Studio
Material Thickness (mm)	1.08
Cut Setting	Custom
Cut Thickness	33
Iterations	3
Double-cut	ON
Blade setting	10
Speed	2
Mat	Standard

Material #6	Chipboard, Dense
Retailer/Brand	Hobby Lobby; "Paper Accents"
Material Thickness (mm)	1.05
Cut Setting	Custom
Cut Thickness	33
Iterations	4
Double-cut	ON
Blade setting	10
Speed	2
Mat	Standard

Cricut Material Cut Capability Test Report

Material #7	Magnet Sheet with Adhesive Back	Material #8	Aluminum Metal
Retailer/Brand	Michael's / Chalkboard Magnet by "ProMag"	Retailer/Brand	Hobby Lobby; "Create with Metal" roll
Material Thickness (mm)	0.84	Material Thickness (mm)	0.19
Cut Setting	Custom	Cut Setting	Custom
Cut Thickness	33	Cut Thickness	33
Iterations	3	Iterations	2
Double-cut	OFF	Double-cut	ON
Blade setting	10	Blade setting	10
Speed	2	Speed	2
Mat	Standard	Mat	Standard

Figure 22: Results for "Suggested Cut Settings" on Cameo EUT #2

	Foam	Cork	Leather, soft	Leather, hard	Chipboard	Chipboard, dense	Magnet	Aluminum
EUT #2	F1, 6	F2, 6	F1, 6	F6, 7	F1, 6	F3, 6	F4, 6	F9
EUT #1	F4, 6	P6	F3, 6	F6, 7	F5, 6, 8	F5, 6, 8	F3, 6	F9
EUT #3	F1, 6	P6	F1, 6	F6, 7	F5, 6, 8	F1, 6, 8	F1, 6	F9

NOTES:

- 1 **Failed** using suggested settings. (~60% through)
- 2 **Failed** using suggested settings (cork-side down).
- 3 **Failed** using suggested settings. (~70–80%).
- 4 **Failed** using suggested settings (~80–90%).
- 5 **Failed** using suggested settings (~30–40%).
- 6 Material is over specifications limit of 0.8 mm.
- 7 Material cannot physically be loaded into the machine—too thick to pass under rollers.
- 8 Tracking issues during test.
- 9 Blade gets stuck in this material and "chatters"—threatening damage to the blade.

2.4 Silhouette Experimental Portion

Experimental cuts were performed on a separate Silhouette Cameo that was not a part of the EUTs proper.

The Silhouette EUT was mostly set to its maximum settings for the initial run through of the client's recommended settings for the Cricut Explore. Only "Thickness" (cut pressure) and numbers of iterations were left to experiment with. Because of poor tracking issues—successive cuts not lining upon one another—with the maximum settings for two of the materials (dense chipboard and magnet material), a procedure of incrementing the "Thickness" and blade ratchet setting (blade depth) over a number of cut iterations was attempted, but without success.

Figure 23: Results for Experimental Tests on Cameo

Material	Result:			Comment
	EUT #2	EUT #1	EUT #3	
Foam	Failed	Failed	Failed	See note #1 below.
Cork	Passed	Passed	Passed	See note #2 below.
Leather, soft	Failed	Failed	Failed	See note #3 below.
Chipboard	Failed	Failed	Failed	See note #4 below
Chipboard, dense	Failed	Failed	Failed	See note #4 below
Magnet	Failed	Failed	Failed	See note #5 below
Aluminum	Failed	Failed	Failed	See note #6 below

1. After changing the "Thickness" setting three times, maximum settings were reached (except for speed). This was only able to cut down about 60%. This foam material is double the specified limitations for Silhouette.
2. The cork material was cut in the same fashion as with the Explore – with the cork–side down on the mat.
3. All cut parameters were at maximum for the soft leather material, except for the speed setting (set at 2). Only able to cut through about 60– 70%.
4. Both chipboard materials are just over the 1 mm limit. However, the cuts were not close to cutting through. It was noted that the tracking of successive cuts was poor, even with the Silhouette's "Track Enhancement" setting enabled. This caused significant debris to be generated. It was

decided to try starting with the blade at 5 and the “Thickness” at 16. After each cut the blade depth and thickness setting were increased until six iterations were performed—the last iteration at the EUT's maximum settings (except for speed). Although this procedure was able to correct the tracking issues, the cuts only went about 90% of the way through. It is surmised that the blade is restricted by the white cover piece and cannot go any deeper into the material.

Figure 24: Debris from poor tracking



Figure 25: Experimental Chipboard with Cameo



Figure 26: Tracking corrected – bottom



Figure 27: Tracking corrected – top



5. Although the magnet sheet thickness was within the specified limits, several attempts to cut through it were unsuccessful. The best result obtained could only make it 90–95% of the way through using the incremented adjustments procedure described under the chipboard material notes.

6. The aluminum material caused the blade to get stuck. Once the blade sticks the cut head/blade holder would jump up and down (chatter). In one instance, attempts to cut the material caused the tip of the blade to break off. Note the aluminum build-up at the tip of the broken blade. This build-up occurred on the Cricut blade also, but did not break the blade.

Figure 28: Broken Silhouette blade from Aluminum

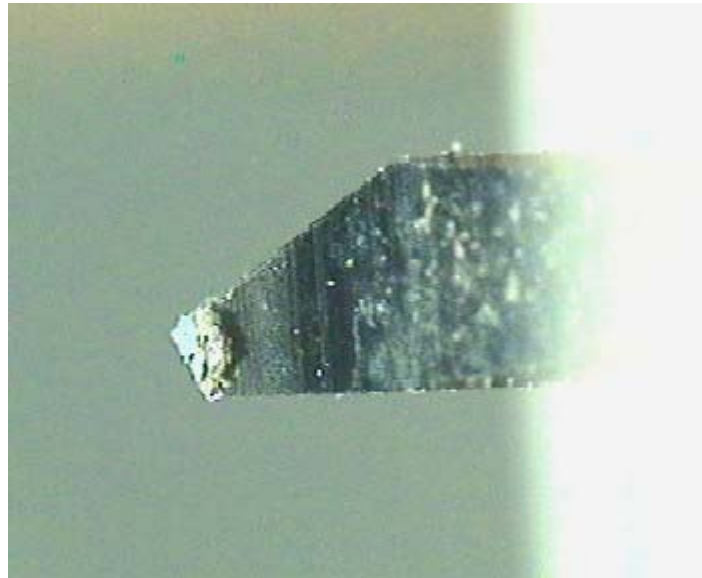
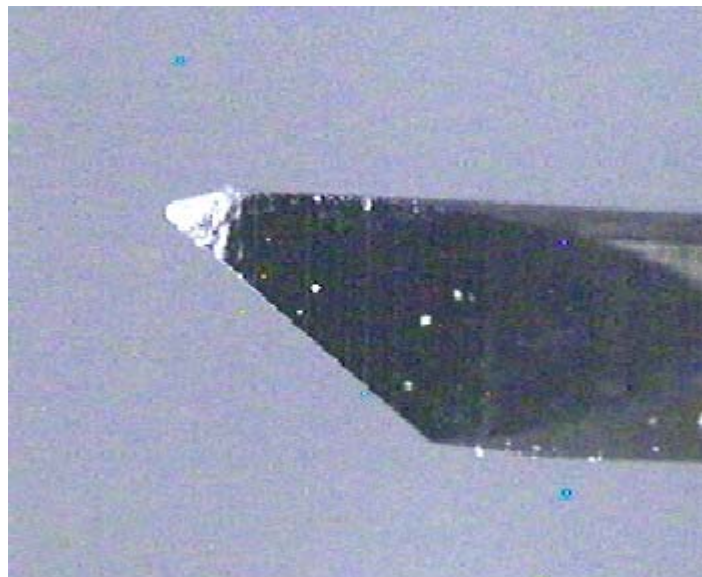


Figure 29: Cricut Carbide blade with Aluminum



3 Cutting Defects

Given that one has a sharp blade to begin with, some defects can be categorized as follows:

- Jagged edge (see Figure 30).
A cut edge that is not smooth, has "cupped" or "jagged" features, or discontinuity of the cut. This defect can be brought about by the blade "tugging" on the material being cut—lack of adherence of the material to the cutting mat, or material that is too dense to be cut properly.
- Corners that have a cusp, or overshoot, or not square (see Figure 31).
Corner is not at the proper angle, i.e., 90° corner doesn't meet cleanly, has cusp, is rounded or squared with an intermediary angle, or shows unintentional overshoot at the vertices.
- **The only material for this cut capability test that included adhesive backing was the cork. It was suggested to place the adhesive side up in order to successfully cut this material.**
~~For adhesive materials with backing (such as vinyl and iron-on, or heat transfer materials), cuts should make it completely through the material. A cut depth of up to 30% into the backing is acceptable.~~
- Failure to cut all the way through the material (for materials lacking backing).

Figure 30: Jagged edge Figure 31: Defective corners

