Report
On Behalf of

Roger Bromley of Anikto Ltd

The Conceptual Design of a Blister Pack opening tool

Ertu Unver PhD, MSc, BSc
David Swann, PhD, MA, BA

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University of Huddersfield

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Introduction

With growing government initiatives in waste-reduction & recycling, the demand for environmentally friendly packaging materials & techniques using minimized disposal is experiencing a significant rise. Consumers are taking increasing interest in contributing to food & packaging waste reductions with achieved reductions of 270,000 t/annum. Plastics, as one of the most energy efficient, robust & cost effective packaging materials, represent high growth in the market: Blister & clamshell packaging represents strong growth, accounting for 56% of high-visibility packaging in 2003 with sales of nearly $4.2 bn in 2008.

However, blister & clamshell packaging pose a number of significant limitations, i.e. excessive material, waste & complex opening procedures. This causes significant concerns to end users, regarding the safety & practicality of the packaging. Figures from the US show that over 6000 consumers are hospitalised annually due to packaging-related accidents, indicating an important issue to be addressed.

Anikto's 'Easy Open' aims to focus on the current issues related to blister & clamshell through a novel design & opening technique. When company owner Prof. Roger Bromley approached to 3D staff at the University of Huddersfield, he showed his initial ideas which were used as a starting point to design develop and create a working prototype.

Summary

The study evaluates the feasibility of developing a novel packaging solution contributing to easing consumer packaging opening issue for the UK's waste reduction targets.

Project phases include:

- Concept stage
- Material selection
- Prototyping

    - Number of 3D printout using stereolithography
    - Laser cutting of cutter blades
    - Manufacturing of a number of VAC form mouldings
- Testing

Conceptual Design Exploration

Most packaging techniques require complementary opening tools (scissors/knife) which cause significant safety risks to the user. 'Easy Open' provides users the flexibility to access the purchased product at any time. The technique is based on advanced materials/typology, caused by highly localised pressure resulting in polymer melt enabling a slice-through. The company provided an idea of using vacuum-formed guide groove where the plastic packaging walls are intentionally thinned, contributing to the reduction of waste materials in current packaging. The design take into account the increasing requirement for safer & simplified solutions for consumers of special needs, i.e. elderly, infirm or disabled.

Design Approach, Considerations and Decisions

After the initial meeting 3D team started concept development where a number of ideas were discussed and freehand drawings created. These ideas converted in 3D using Solidworks software. Prof. Roger Bromley also provided some blister pack samples as seen below from the manufacturer.

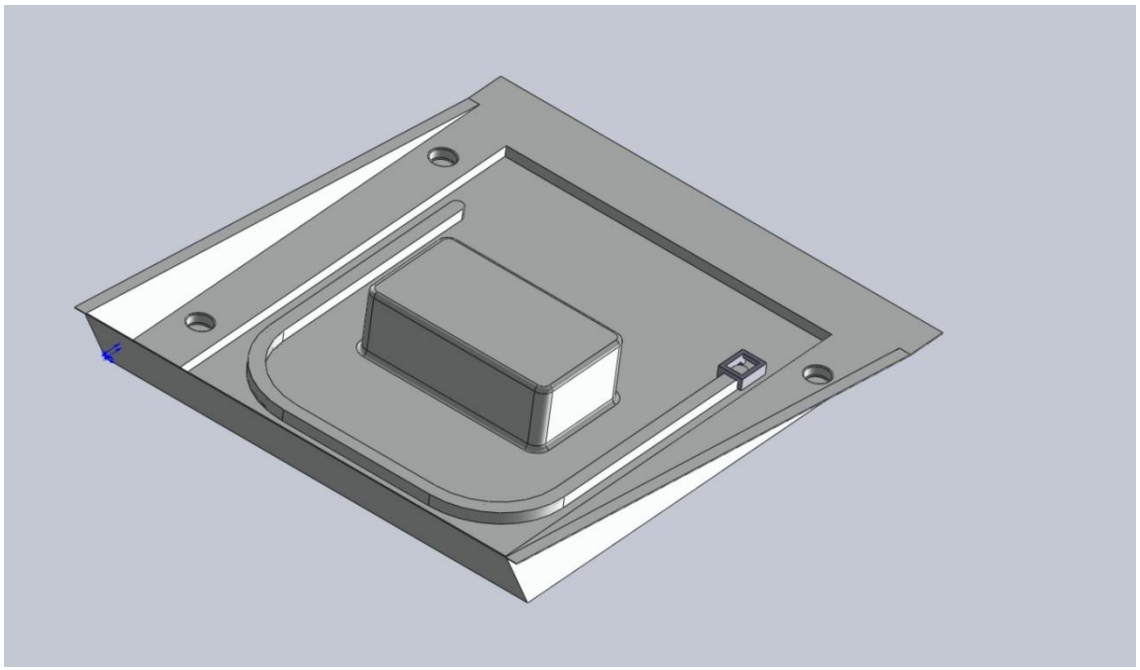


Figure: Computer model of supplied blister pack

Initially a sample 3D model is made using STRATASYS FDM machine and used for testing material properties of the blister pack and also Stratasys machine. Unfortunately material properties of the rapid prototype model were not as tough enough as intended a cutter material.

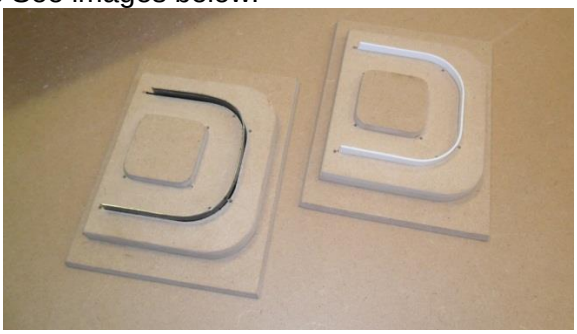
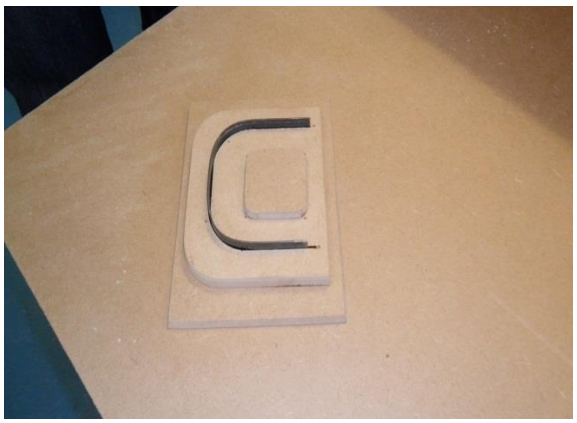
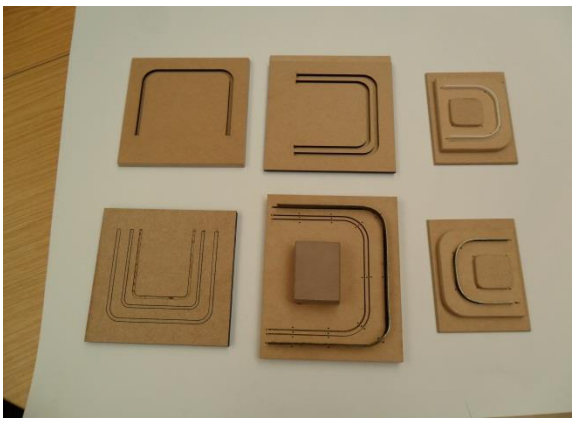
Material Specification and Selection:

The study aimed to identify the most mechanically efficient materials in relation to the 'Easy Open' packaging concept, incl. Polycarbonate Resin Thermoplastic (PRT), Acrylics & Nylon, in order to reduce the overall cost & environmental impact. One of the key challenges was

to test will be to fully understand the ‘material science’ in relation to different types of materials. This enables the most cost-efficient & environmentally-friendly material combination to be used. A range of suitable materials for the design & technique are considered with the help of Dave Tancock who is the material expert for the 3D courses.

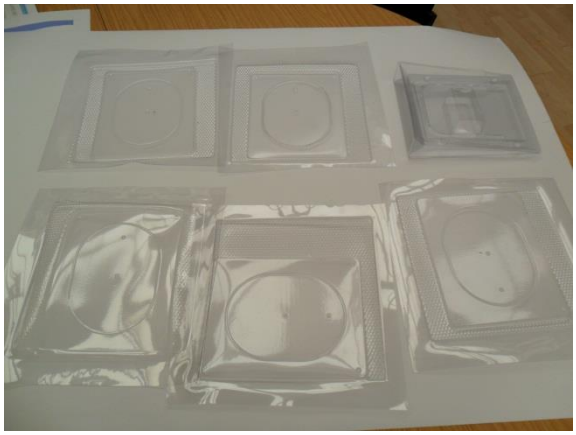
Blister packs are pre-formed plastic packaging used for consumer goods, foods, and pharmaceuticals. Blister pack materials are generally PVC, PCTFE, (COC) or similar depending on what the units are used. (for example medical, hardware, food etc) The material needs to be easily formed to the required shape using a thermoformed plastic. The packaging usually has a backing of paperboard or seal.

In this project two materials are chosen. A number of blister pack prototypes were manufactured in the workshop. Various types of sample vac formed models were created using VAC forming machine in the workshop See images below.

Moulds Design, VAC forming

After the initial test it was clear that the thickness of the material on the groove is required to be reduced around 70% to be able to easily cut with the blade. The practical experiments showed 4x4 mm groove produced the optimal thickness for the material to be able to cut easily. The company supplied us with a roll of material which was formed to create blister pack moulds used in the process (Around 50). See figure below for a selection of the formed parts.



Selected VAC formed prototypes

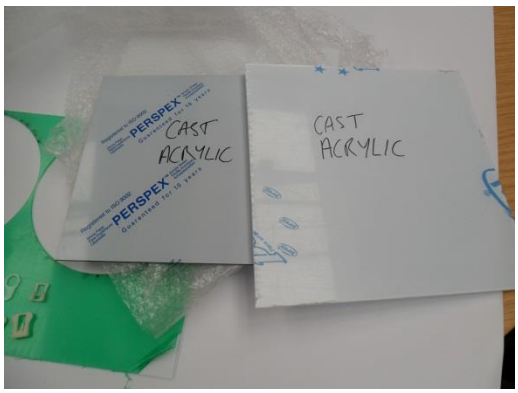
Cutter Design:

Second phase of the process is to create the cutting tool (blade / cutter)

Prototyping: Stereolithography

A range of prototypes were created to address the issues of cutting process. Initially 3D printed parts created directly using Stratasys 3D printer. A selection of these printouts shown below.

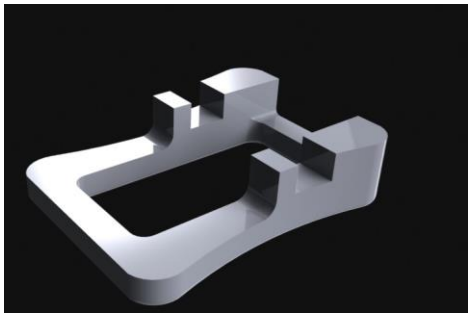
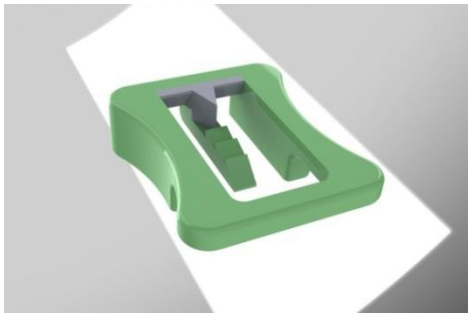
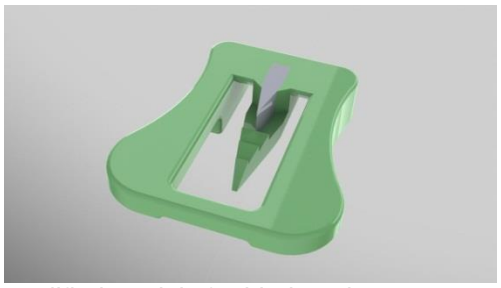
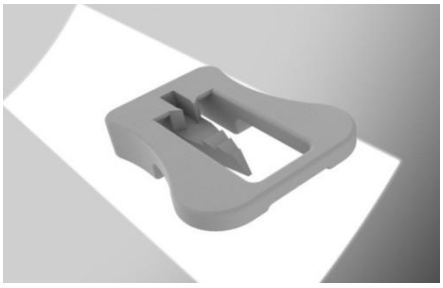
3D printouts and models of selected cutters

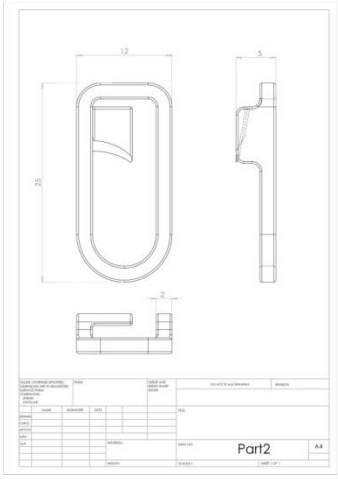


Material for blade: Cast Acrylic

The experiments showed that material selection of the blade / cutter required further testing. After the literature review, team discussions and initial testing it was clear a tough material “Cast Acrylic” material was chosen as a cutting blade. A number of sheets with thickness of 1mm, 1.5mm, 2mm, 3mm, 4mm were obtained. This material is very tough and brittle but easy to cut in laser cutter.

As we do not have facility to produce 3D prototypes from the selected cast acrylic material, the 3D models were modified to enable the blade to be inserted as seen in the picture below. Also 2D drawing were created.

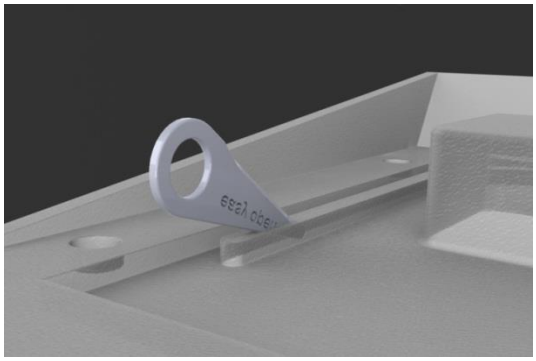




Modified models for blade to insert



2D technical drawings:

Prototyping: Laser Cut

A number of physical models were created and tested with the cast acrylic materials, there were issues when cutting the blister pack using the groove as guide. The reason might be the 3D models using stereolithography method required blades manually machined, inserted and fixed. The properties of 3D printed parts are not strong enough to apply the required force. Also manual blades are not as high tolerance as we hoped which caused the Blister pack materials to partly cut. Another type of blade was considered as shown below.




Laser Cut blades

Laser cut blades were designed together with Hugh, Roger and Ertu shown above. After the initial test this method proved to be very successful. The advantages are:

- larger area for the user to hold
- Easy to move the blade around the corner of the blister pack.
- Easy to manufacture and test

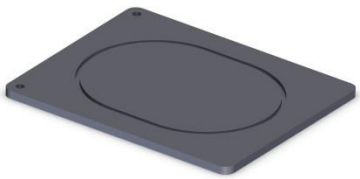
Over 20 laser cut cast acrylic blades were manufactured with various thicknesses. The optimal thickness was found 2mm with the cutting edge manually sharpened with a secondary operation. 1mm and 1.5 mm thickness blades are sometimes broken when excessive loads applied. Materials with over 3 mm thicknesses required excessive force to cut the blister pack.

Result and recommendations:

A number of design ideas, prototyped created & tested. The final recommended solution is laser cut blades. Initial test with a range of prototypes enabled the selection of correct thickness and material as seen below.

Further work recommended as:

- Design of new blades for injection moulding with the integrated customer logo, colour shape.
- Addressing the requirements/needs of different end-users as well as the full integration of the production process into a range of manufacturing & packaging environments, ranging from small to large-scale integrations (hand-packaged & operation tool/automated packing line & food environment)
- It was agreed that Roger Bromley will arrange new type of Blister packs manufactured by using a commercial machine using the round guide grove supplied, which will be tested with the blades created



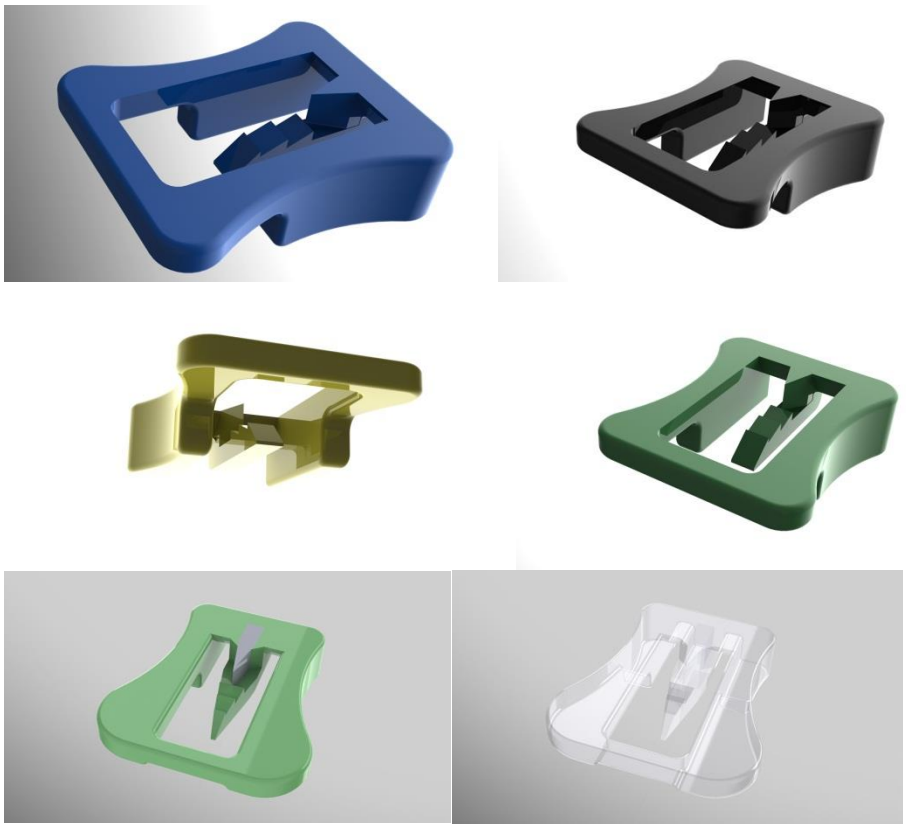

Round Groove **New cutter**

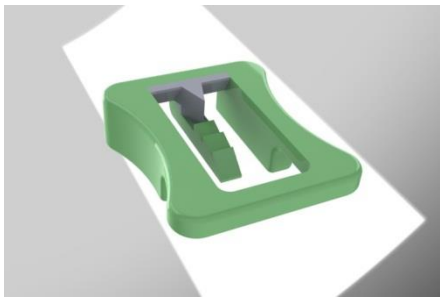
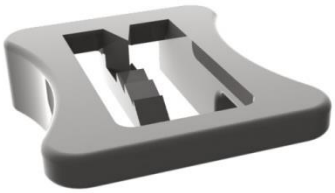
Contact:

Dr Ertu Unver, Senior Lecturer
Tel 01484483848
Email: e.unver@hud.ac.uk

University of Huddersfield
School of Art, Design and Architecture
Huddersfield, HD1 3DH
MA 3D Digital Design course leader
3D Subject Area - BA/BSc Product, Transport
Web sites:
www.huddersfield3d.co.uk
www.hud.ac.uk

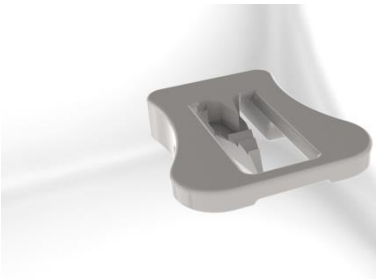
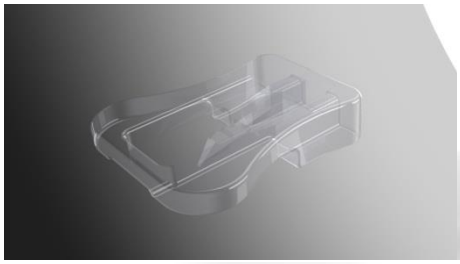
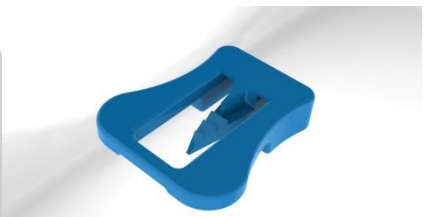
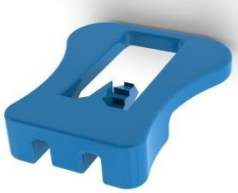
IMAGES:

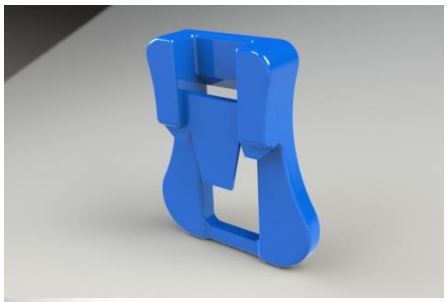


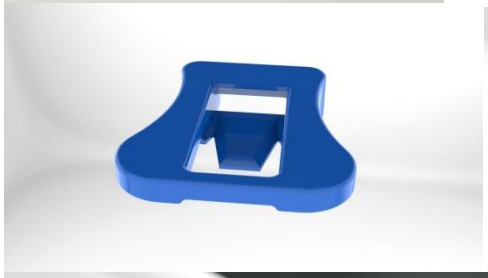
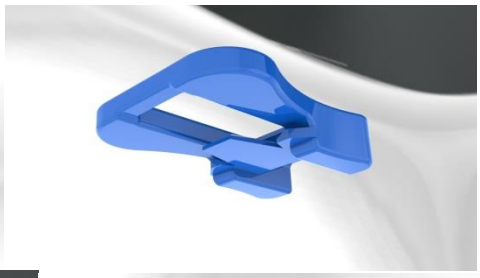
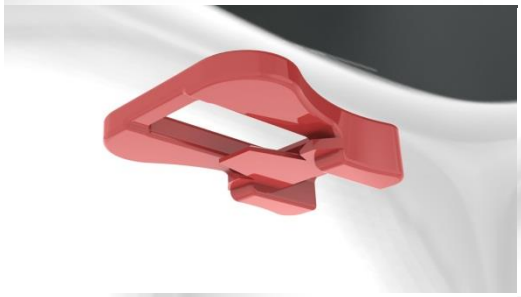
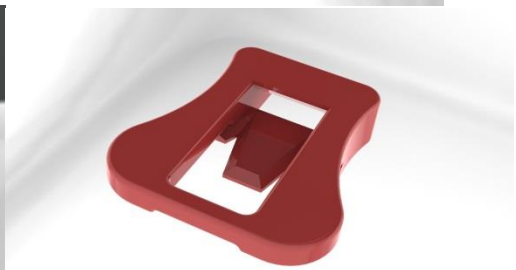



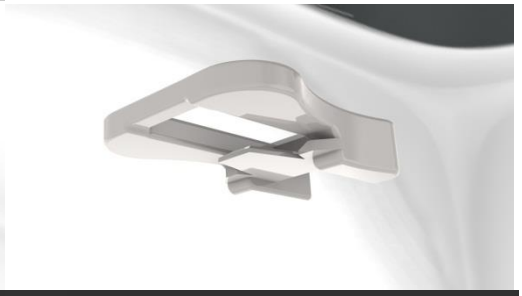
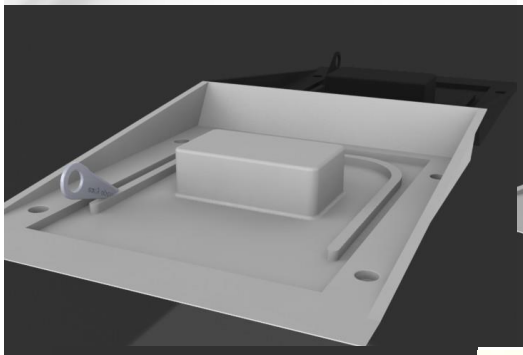
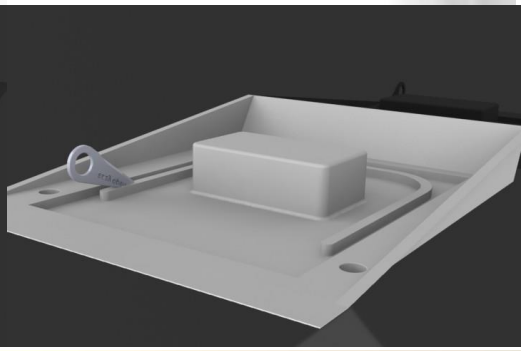
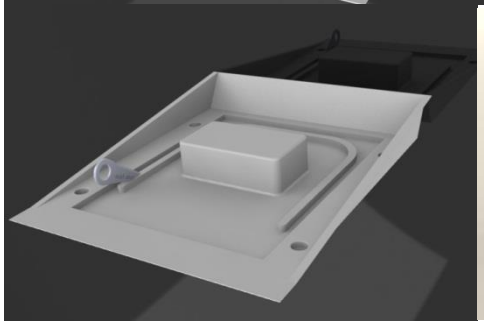




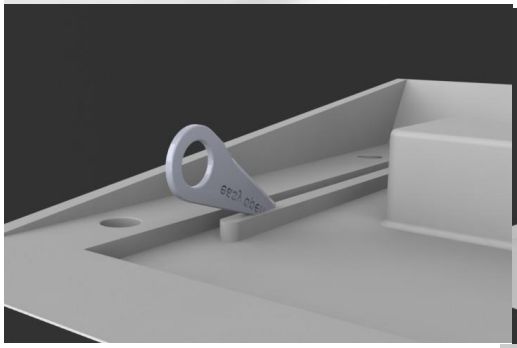
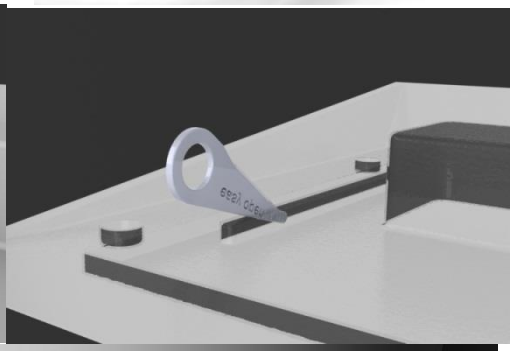
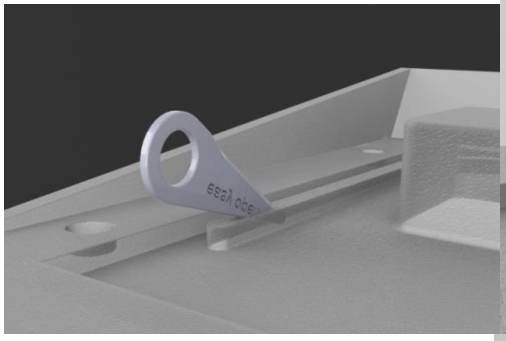



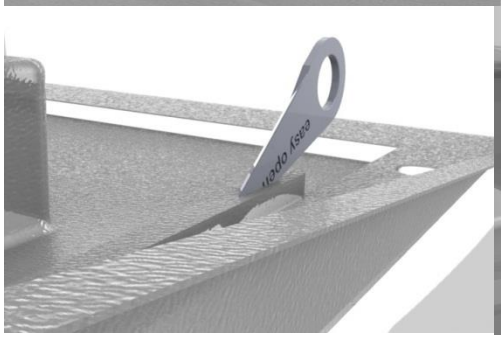





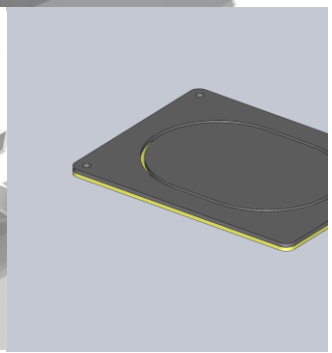





easy open



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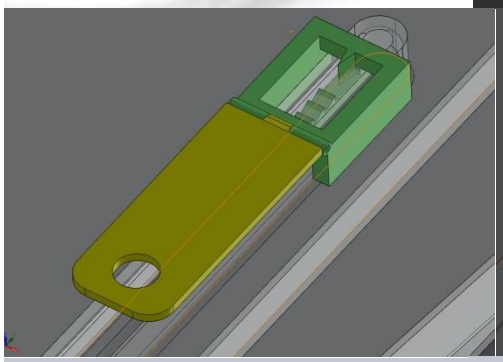

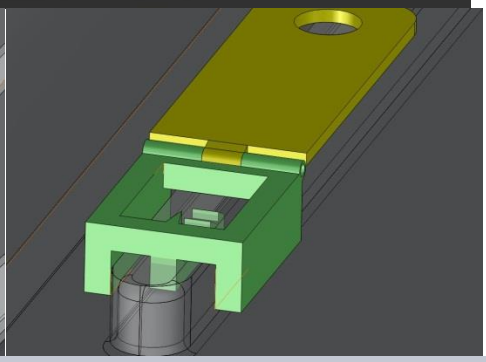

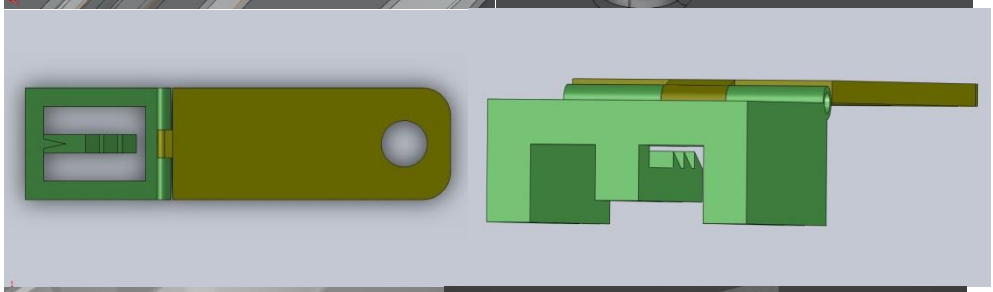


easy open