Living Innovation with eMould

Injection Moulding Application

- Solution offering for injection moulding
- Validated Process Chain
- Examples
- DLP Technology

Traditional tooling	EnvisionTEC Solution
Long start-up phase until the commercial launch	Revolutionarily faster market launch
Long design process	Allows design changes any time - decisive competitive edge
Expensive tool development / manufacturing	Printed tools are fast and cost effective
Mass production	Ideal for short series production
High storage costs	No expensive stock keeping / Just in time tools

Continuously evolving market requirements and fast technological change ask for solutions

Traditional Tooling

Innovative EnvisionTEC Tooling

Problems with traditional tooling

envisionTEC

- Long time to produce
- Expensive to produce

This is cost effective for big series of production

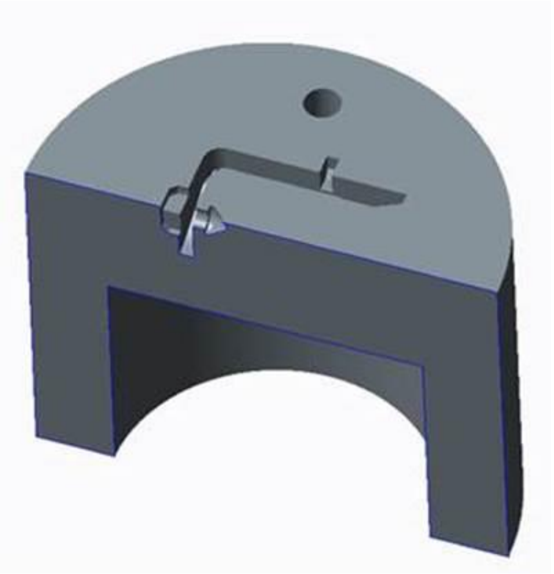
Solution provided by the 3D printed eTools with eMould

- Inexpensive tool ready to be used in few hours allowing:

1. Many design changes possible in a record time which will speed up the design phase and cut R&D cost.
2. Production of small series parts (such as vintige parts, limited edition parts…)
3. Production of Pilot parts with the final production material to be tested in a functional environment.

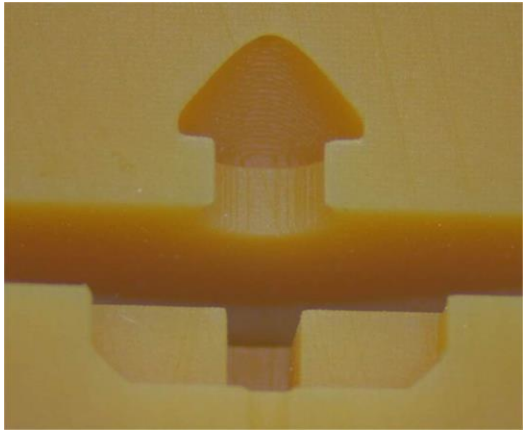
Why Rapid Prototyping?

- Every day, prototypes are used to perfect the design of injection molded parts. This simple, fast and affordable measure protects companies from costly production delays, tooling rework and design flaws. It has been stated that what costs 1,00 € to fix in the design phase costs 1.000,00 € to rectify once manufacturing begins.



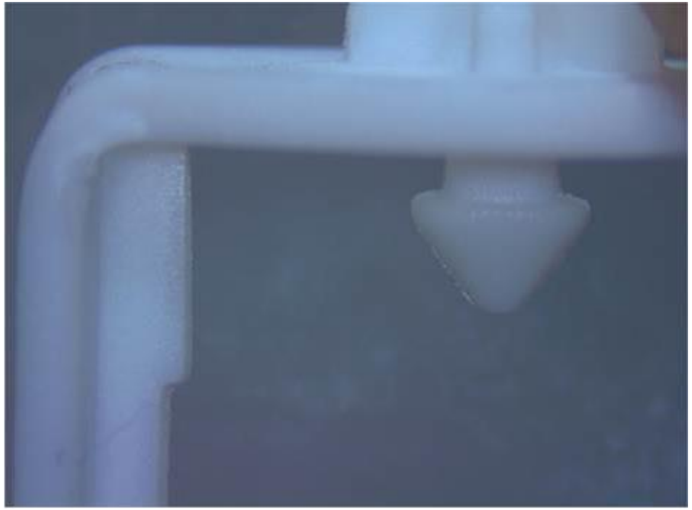
Why Rapid Prototyping?

- The worst case, without prototyping in the design phase, is that the tooling has to be redesigned and rebuilt. The more likely case happens 60 percent of the time, is that the tool requires rework. For less than 100 € and in less than one day, a rapid prototype could protect against rework of production tools that could easily cost 10.000 € or more and take weeks to resolve.



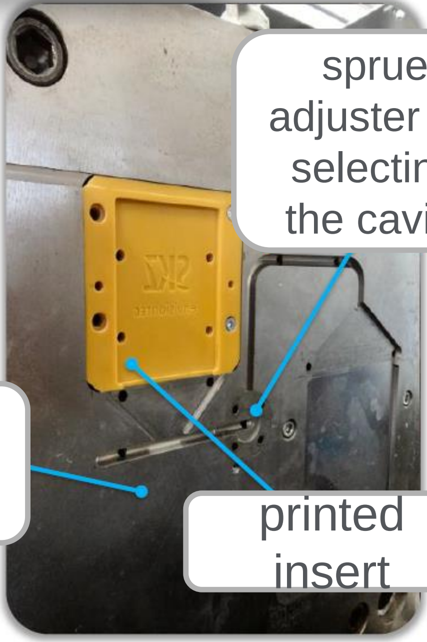
Why Rapid Prototyping?

- Used early in the product development process, tools such as rapid prototyping are used to validate performance, avoid rework, protect investment and preserve schedules.



Strong Cooperation between envisionTEC and SKZ Das Kunststoff-Zentrum

Fitting Situation



sprue adjuster for selecting the cavity

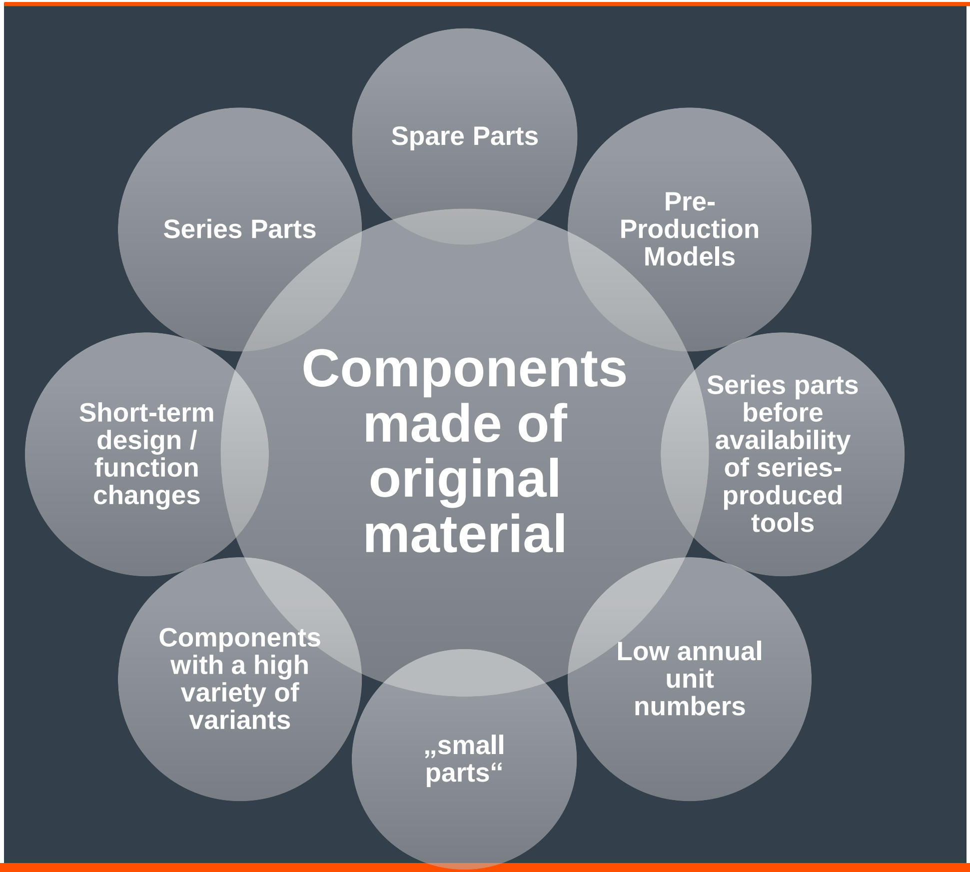
mould plate (ejector side)

printed insert

thermo camera

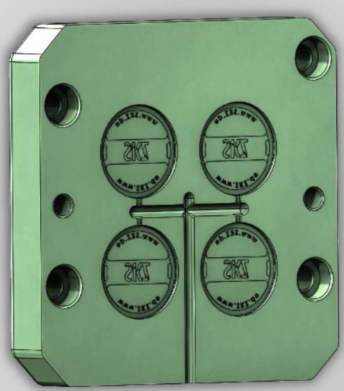
air nozzles

Usage and Requirements of mould inserts

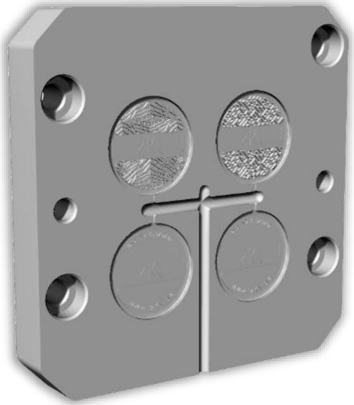


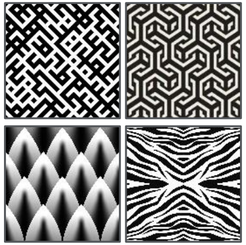
- Long service life & short cycle time
- Avoidance of demoulding aids
- Suitable for PP to
- Good surface quality
- Accurate and reproducible printing of inserts
- Imageability of filigree structures (eg. labels)
- No „aging“ of the operations over the production time
- Integration of moving tool elements (eg. Slides / jaws, cores…)
- Inserts can be used directly after 3D printing without reworking
- …

Validated Process Chain



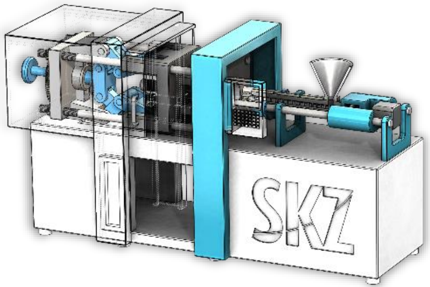
Construction of the tool inserts





Incorporation of the structures into the 3D model

Print tool inserts & post-processing

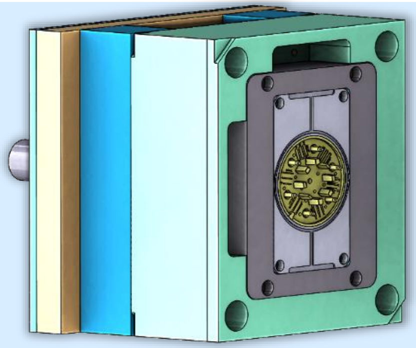


Installation of the insert in a master mold & injection molding of the components

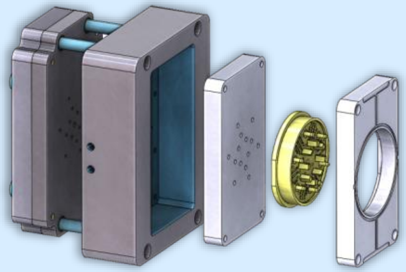
Test Component

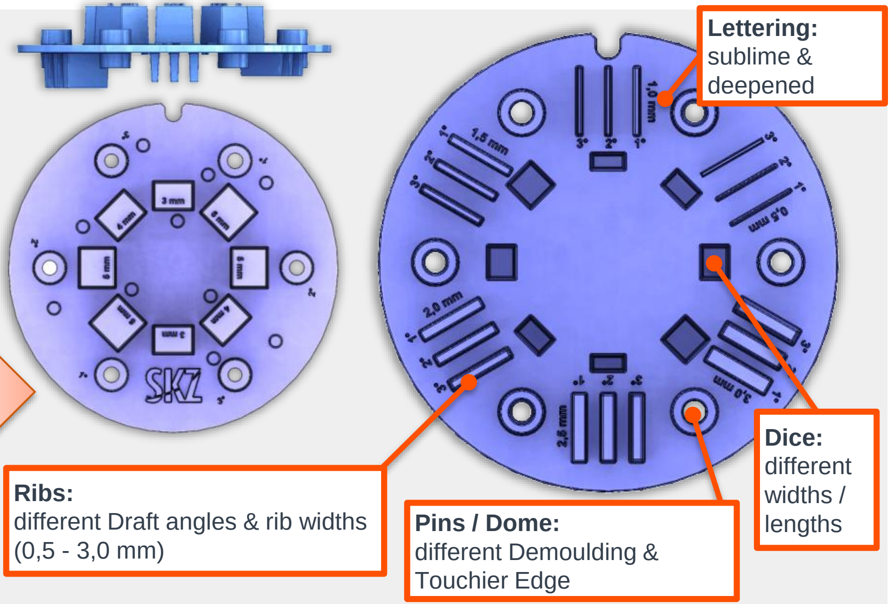
Insert AS

Insert DS



Master Tool (FW-Aufbau, Meusburger)

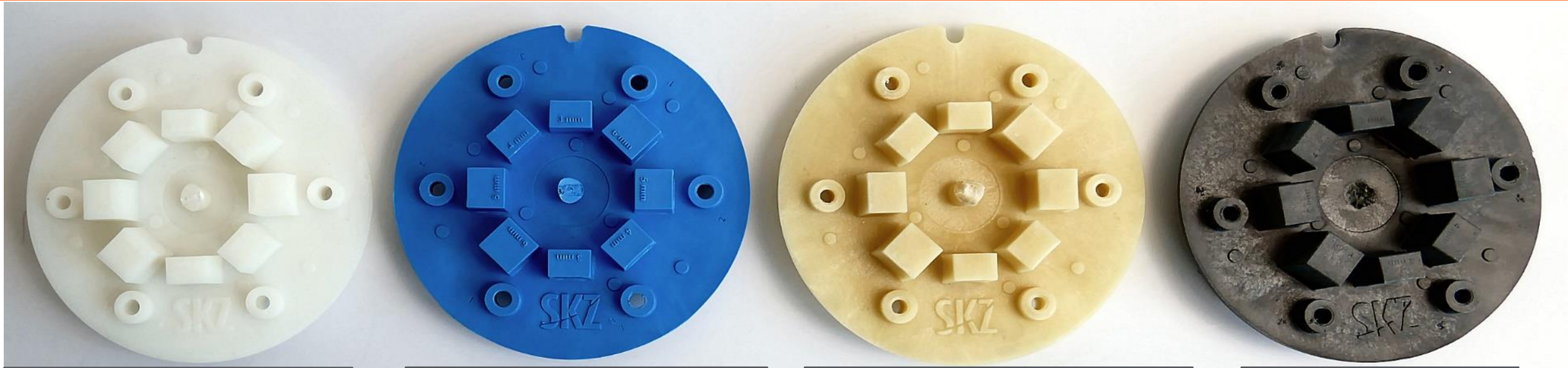




Test geometries

- Illustration / removal of (fine) structures
- Swelling / demolding
- Bending load (melt pressure)
- Touchiergeometry

Examples of Inserts with eMould

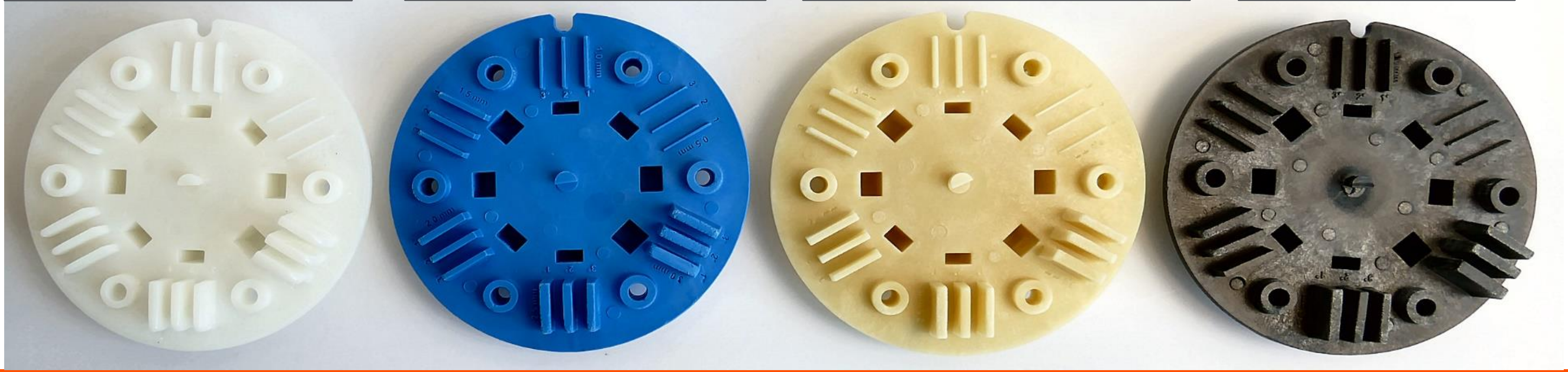


ABS (Ineos Styrolition)

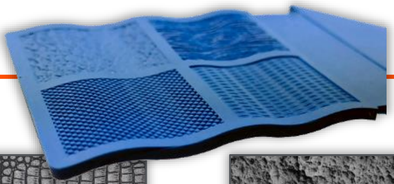
PP GF30 (ALBIS PLASTIC)

PK GF30 (AKRO-PLASTIC)

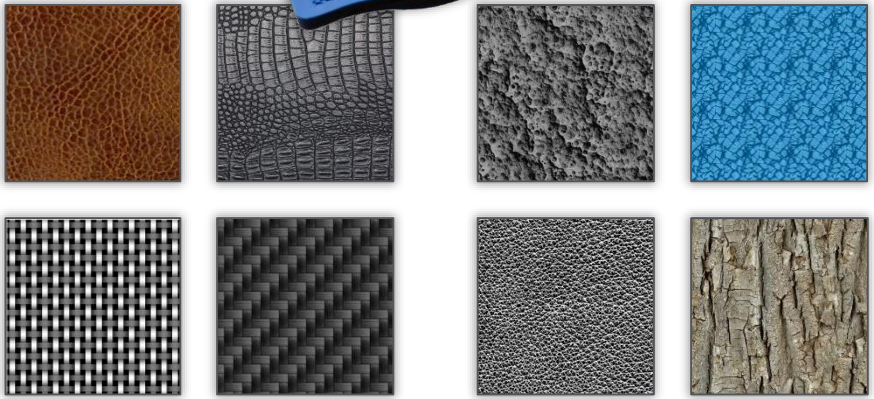
PBT GF30 (BASF)



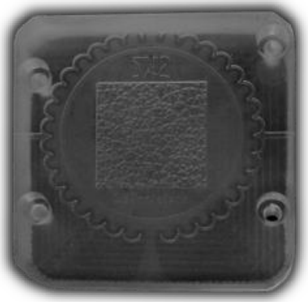
Printed surface structures
Examples „Wave Plates“ & „Underlay“



- Insert pairs with various structures
- Any structures are transferable

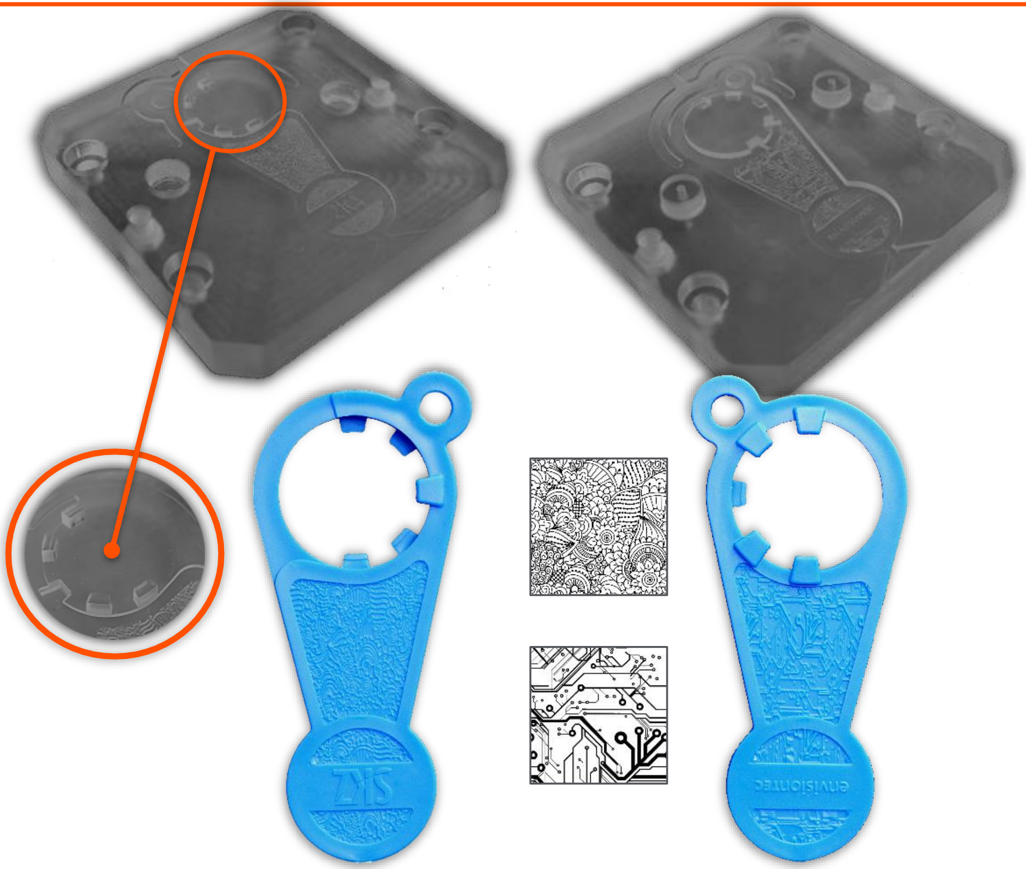


Printing process:	DLP *(envisionTEC)*
Resin:	eMould
Polymer:	PP-GF30 & TPE-S *Altech PP-H A 2030/100 (Albis)* *ALLRUNA W 55 S 120 LM (Allod)*



Printed surface structures
Example „Key Chain“

- Inserts with intermeshing, touching geometries for forming the chip pads
- Floating mounted inserts with automated centering

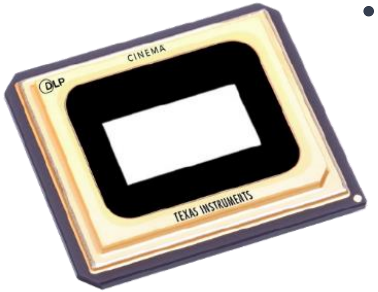


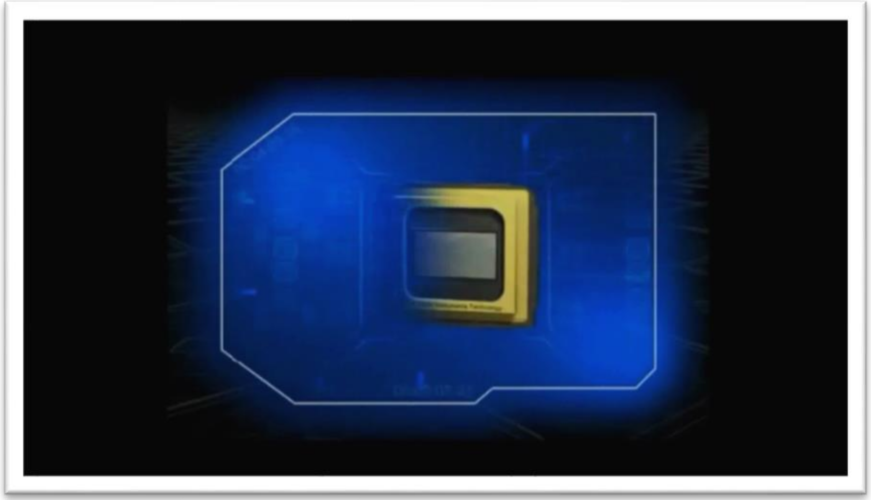
Printing process:	DLP *(envisionTEC)*
Resin:	eMould
Polymer:	PP *Bormod BJ 368 MO (Borealis)*

DLP Printing Process

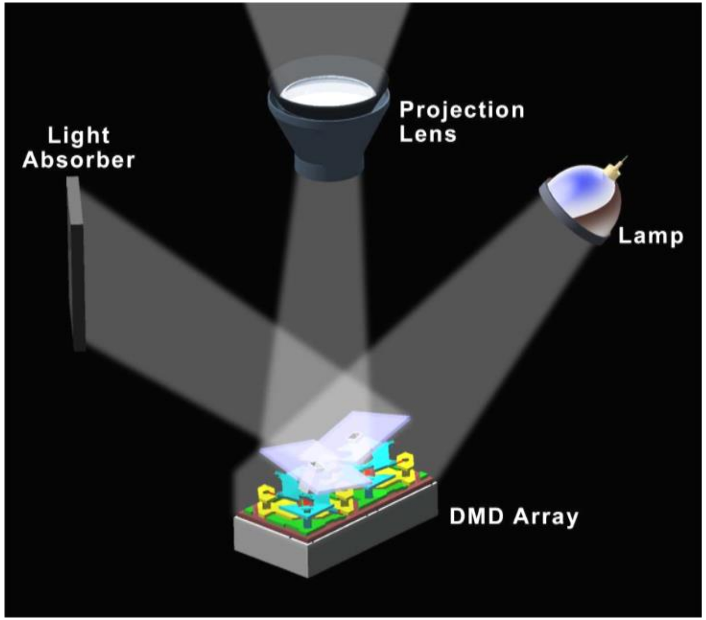
Digital Light Projector (DLP)

- DLP Chip invented by **Dr. Larry Hornbeck** in 1987 (Texas Instruments)
- Each chip contains more than 2 million hinge-mounted microscopic mirrors
- Originally developed for the TV





Digital Light Projector – The Process



Digital Light Projector (DLP)

- Voxels are volumetric Pixels
- **EnvisionTEC** Printers use voxel technology to print objects
- Objects are therefore printed at high accuracy and surface quality

DLP - Technology

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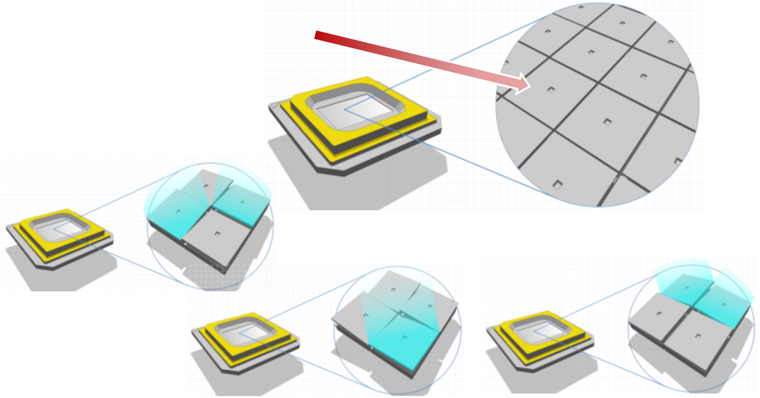
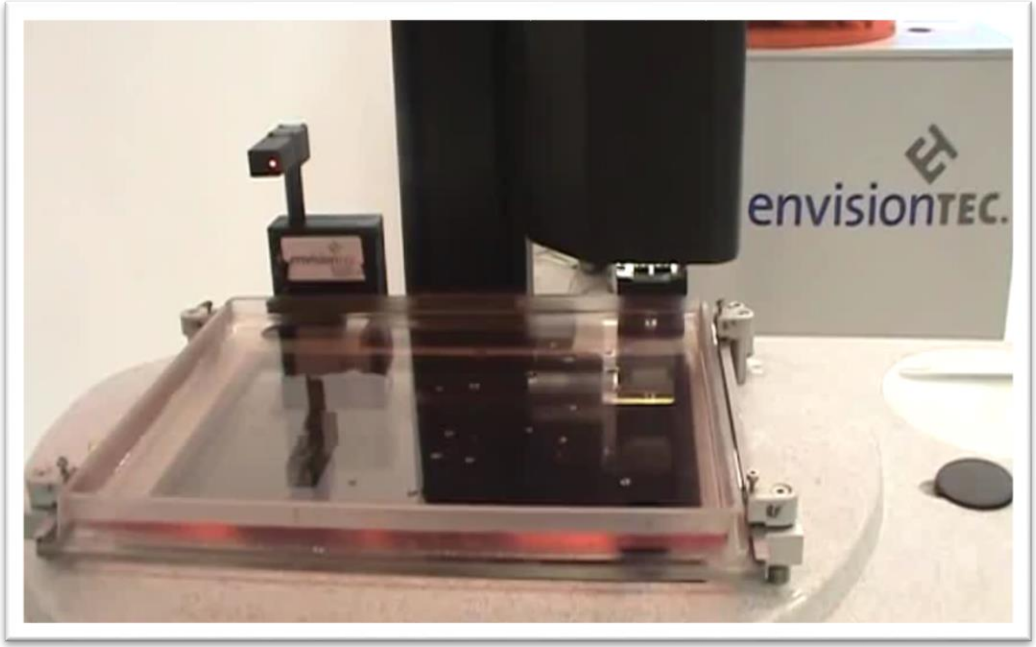
- DLP chip's micro-mirrors either tilt towards or tilt away from the light source
- The reflected image creates either a light or a dark pixel on the projection surface
- The data entering the chip directs each mirror to switch on and off up to several thousand times per second**.**
- A mirror is switched on more frequently than off reflects a light grey pixel. A mirror that's switched off more than on reflects a darker grey pixel.
- In this way, the mirrors in a DLP projection system can reflect pixels in up to **1,024 shades of grey** which converts the data entering the DLP chip into a highly detailed grayscale image.



The Greyscale Image

DLP- Building Process

How do **EnvisionTEC** Printer produce parts?



How to change materials on **EnvisionTEC DLP** Printers?

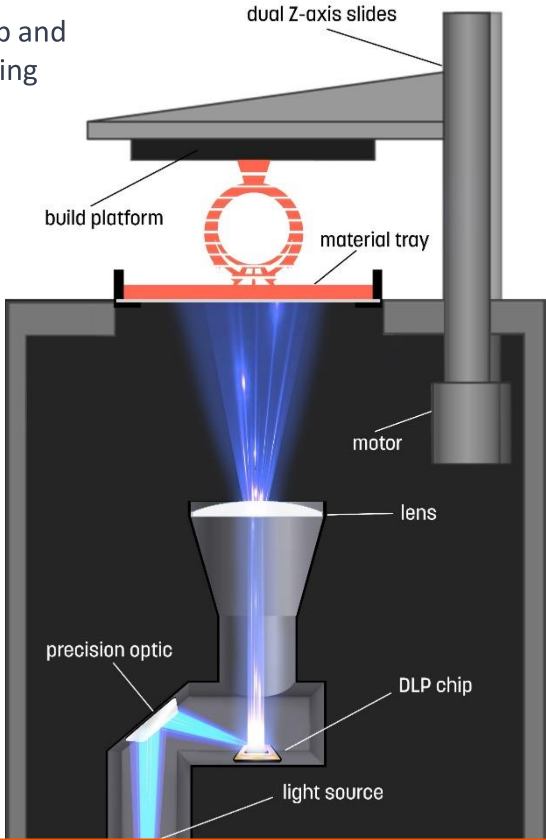
Key Strength of EnvisionTEC: R&D and Intellectual Property

With 15 years of experience in additive manufacturing, EnvisionTEC has led the way in thought leadership and R&D of core AM engineering principles. EnvisionTEC's intellectual property includes more than 100 pending and granted patents and 70 proprietary materials.

As such, EnvisionTEC aggressively protects its valuable intellectual property.

Key DLP Patents:

- **Method and process for 3D printing using DLP process**
- **Grayscaling/method for creating a 3D object using mask illumination to smooth inner/outer contour surface**
- **Method for producing a 3D object using pixel shifting**
- **Brightness uniformity control compensation**
- **Continuous generative process for producing a 3D object**
- **Multiple exposures patent**
- **DLP printing multiple materials**
- **Data voxelization patent**
- **Separation layer between baseplate and layers of cured polymer during 3D fabrication**
- **Camera image calibration**
- **3D printing with polymers and fillers**
- **Multi-projector calibration**
- **Methods for the non-destructive release of a product made of hardened layers on plate**
- **Contourless path generation for linear solidification**



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Thank you.