envisionTEC

Injection Molding from 3D Printed Molds

Company Overview: History of Innovation, Rapid Growth

- Launched in 2002 with first commercial DLP printer
- Consistent rapid growth in key markets
  - Medical
  - Professional
  - Industrial
- Six distinct process technologies today
- Global footprint, large installed base (5,000+ machines)
- Technology is reliably being used for volume production, end-use parts and more
- 140+ pending and granted patents

Today —At a Glance

EnvisionTEC is a market leader in the fast-growing non-metals Additive Manufacturing world. We are highly profitable with a focus on production of superior end-use parts

- **Headquartered** in Dearborn, Michigan
- **Other major operations** in Gladbeck, Germany / Gardena, California
- **Technology platforms** focused on Medical, Professional and Industrial verticals
- Extensive portfolio of original **patented 3D printing** technologies, software, and materials
- Strong focus on **high volume and high value-added professional grade** products

40+
printer configurations
6
technology platforms

144
patents
(awarded/pending)
170
materials

Injection Molding Traditional vs. Innovative EnvisionTEC 3D Printed Tooling

Why the Need for Innovation?

Traditional Tooling:
Long start-up phase until the commercial launch
Long design process
Expensive tool development/manufacturing
Mass production
High storage cost

EnvisionTEC Solution:
Faster market launch
Allows design changes any time
Printed tools are fast and cost effective
Ideal for short series production
No expensive stock keeping/Just in time tools

Why 3D Printing

- 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.

- Every day, prototypes are used to perfect the designs 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 could cost $1,000.00 to rectify once manufacturing begins

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

Customer Success Story

Psi POWERsonic Industries

POWERFUL INNOVATIONS & SOLUTIONS

POWERsonic is a global company, driven by innovation and customer service. With expertise in the manufacture of custom cable assemblies, wiring harnesses, electro-mechanical assemblies, they provide rapid speed to market and cost savings solutions.

POWERsonic Industries

POWERFUL INNOVATIONS & SOLUTIONS

SPECIALISING IN THE FOLLOWING INDUSTRIES

AUTOMATION

AUTOMOTIVE

CONSTRUCTION

COMPUTER AND ELECTRONICS

DEFENSE

HOUSEHOLD APPLIANCE

MEDICAL

ROBOTICS

TELECOMMUNICATIONS

POWERsonic Industries
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“Our company has many years of injection molding experience and primarily our injection molded products have been produced in the conventional fashion using stainless steel tooling. We strive to not only produce products requested by our customers, but to also become partners in developing solutions through integrated research & development. Until now, most design proposals have been illustrated and evaluated through CAD mockups and technical documentation.
Our customers expressed the desire to evaluate prototypes that would vary little from the final production quality counterpart.
In the past, in our industry the only way to evaluate a physical sample was through committing to a design and investing thousands into having it machined from steel. Moving to the present, through our internal design and manufacturing process, coupled with the accuracy and reliability of the Vector and superior performance of E-Rigid we can offer a physical sample at a fraction of the cost.”

Phil Mam – Engineering Manager

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The Solution From EnvisionTEC

Vector 3SP

E-RigidForm Charcoal

POWERsonic Industries
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The E-Rigid tooling has proven to withstand around 100 shots when used in an over-molding application. This process allows for the option to accept low volume injection molding runs that could be used in production. So far we have injection molded PVC and have seen very positive results both from part removal and little wear on the tool. Molding with the values below has not dimensionally changed the end product when kept within the 100 shot limit.

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We have learned the following when working with E-RIGID:

- Repetitive injections past the 100 shot mark will cause the tooling to thermally crack.
  - Our final temperature zone was around 365F when this occurred.
  - Slower cycle times with air cooling may extend the life of the tool, we are still experimenting.
- Vent lines need to be added manually by scoring the tooling strategically after UV curing.
- Oversized shots will crack the tool so there needs to be a pressure relief added to the tooling.
  - Decreasing settings may work but that usually leads to knit lines or voids in the molded part.

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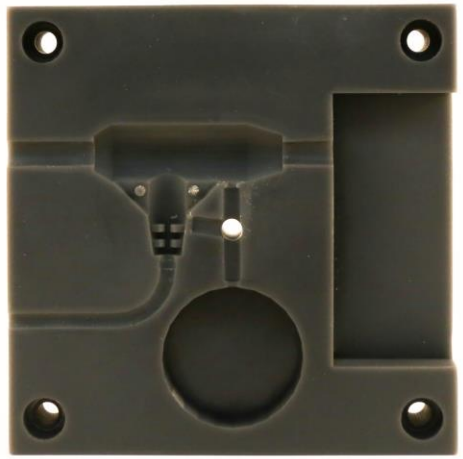
The 3D Printed Tooling



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The Results

The image on the left shows a splice that normally joins 10awg wire to 14awg with a crimped splice covered with heat shrink. In the image on the right you can see that we were able to over-mold the splice.

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General specs on injection molding unit:

- Clamping force Max: 550kN
- Clamping force Min: 200kN
- Mold closing force: 24.4kN
- Mold opening force: 38.0kN
- Injection force: 171kN
- Injection speed limit: 140mm/sec
- 55ton vertical

Data on machine settings for molding with E-Rigid:

- Final temperature zone: 365F
- Clamping force: 200kN
- Beginning injection pressure 1000psi
- Final injection pressure 250psi
- Final injection velocity 37%

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Thank you.

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