3D PRINTED INJECTION MOLDS

CAN YOUR BUSINESS BENEFIT?

MARK BASHOR

WE ARE

THE 3D PRINTING SOLUTIONS COMPANY

FROM SYSTEMS TO SERVICE

stratasys

Today's Event

Presenter

Mark Bashor, Applications Engineer
Stratasys

AGENDA: 3D PRINTED INJECTIONS

Where Do 3D Printed Molds Fit?

Business Rationale

Customer Stories

Technical Tips and Tricks for Success

Q&A

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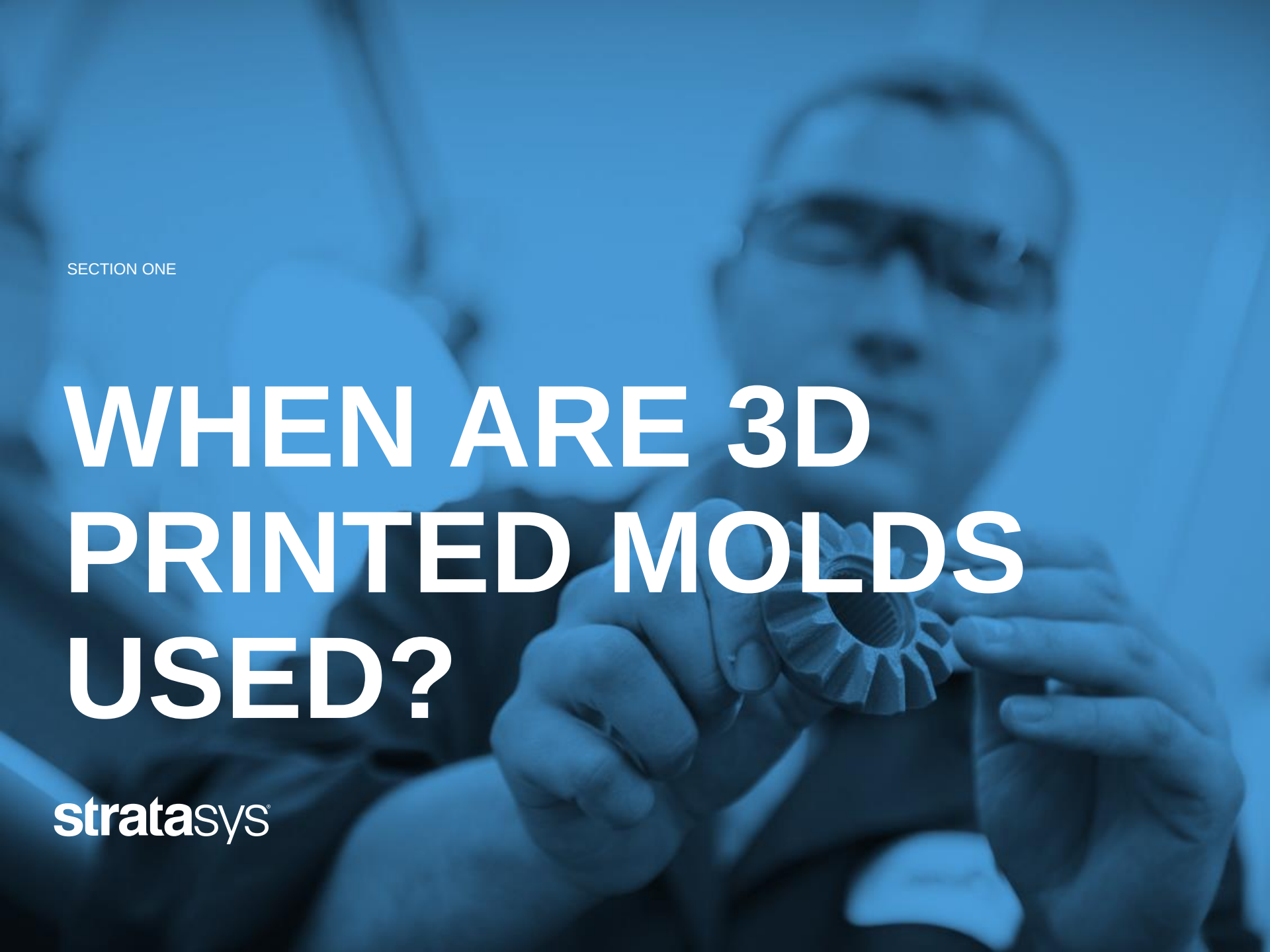

SECTION ONE

WHEN ARE 3D PRINTED MOLDS USED?

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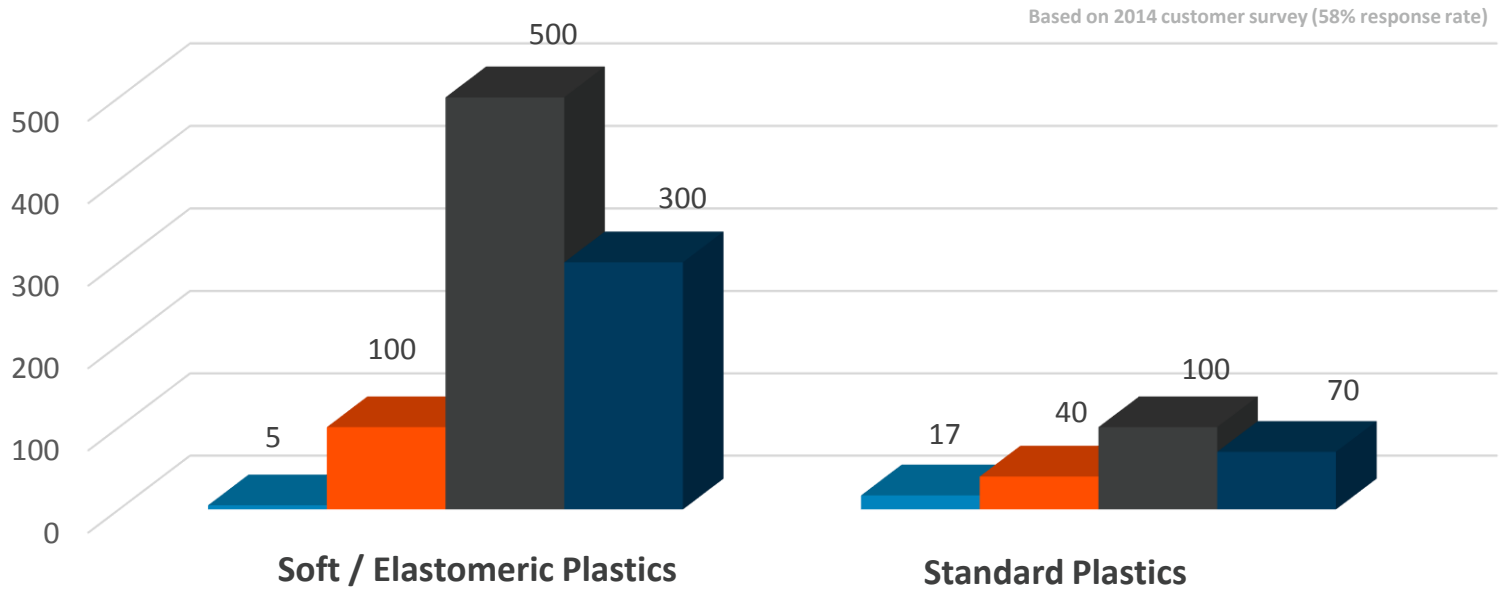
WHICH STAGE?

CAD software

Concept modeling
Rapid prototyping
Simulation

3D Printed Injection Molds
Functional
Real End Material*
Full Range Tests
Mold Verification

WHICH PLASTICS?



Uses

Instances of Use

The number of times survey respondents used PolyJet molds for this type of plastic

Min.

Minimum Part Yield

The minimum number of parts survey respondents reported producing per tool.

Max.

Maximum Part Yield

The maximum number of parts survey respondents reported producing per tool.

Avg.

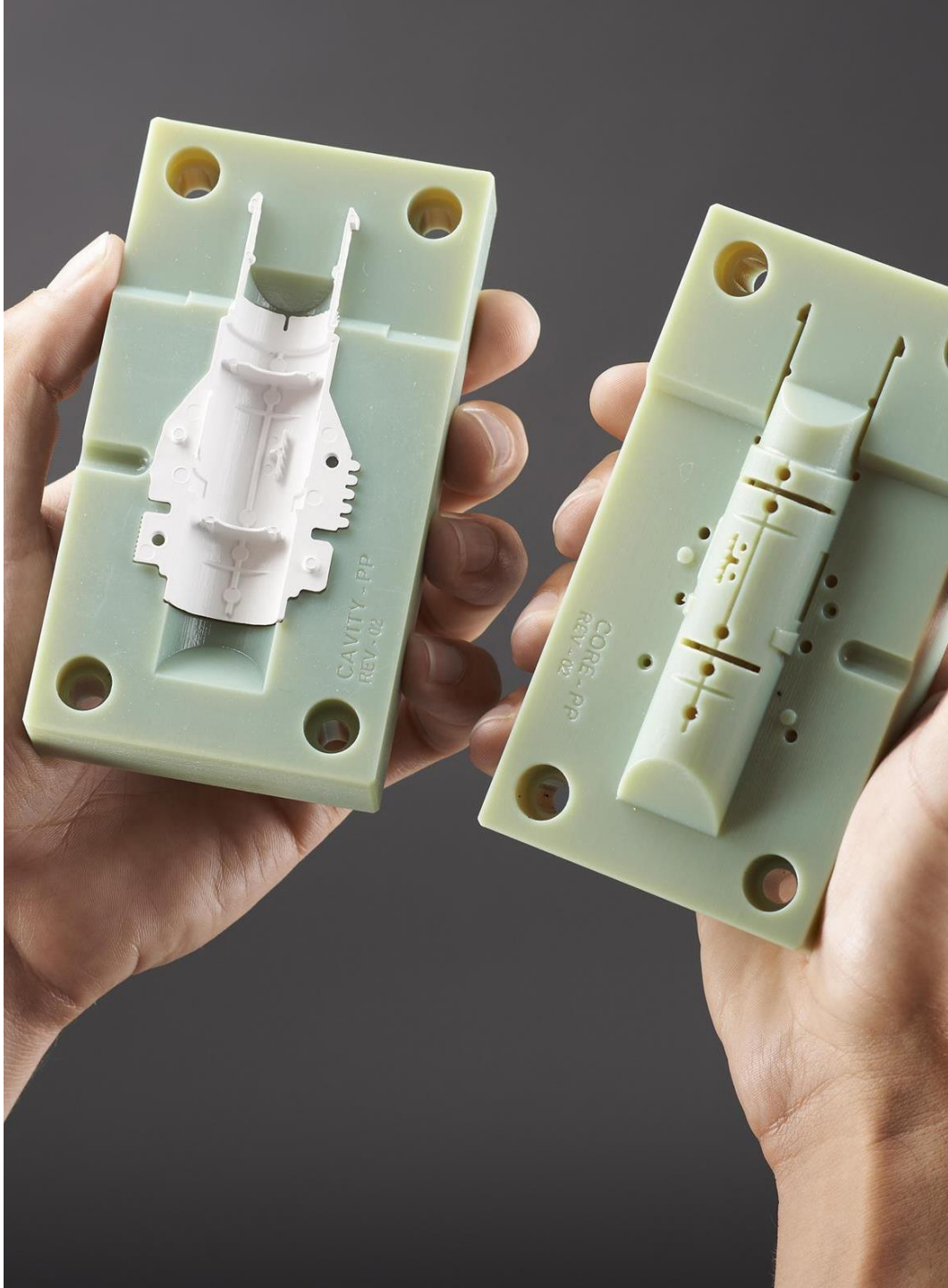
Average Part Yield

The average number of parts survey respondents reported producing per tool.

IDEAL CONDITIONS

- Use plastics with molding temperatures up to 300° C (570° F). Candidates include:

  PE, PP, PS, ABS, TPE, PA, POM, PC-ABS and glass-filled resins
- Produce mid-sized parts up to 165 cubic centimeters (10 cubic inches)
- Use up to 200-ton molding machines



SECTION TWO

BUSINESS RATIONALE

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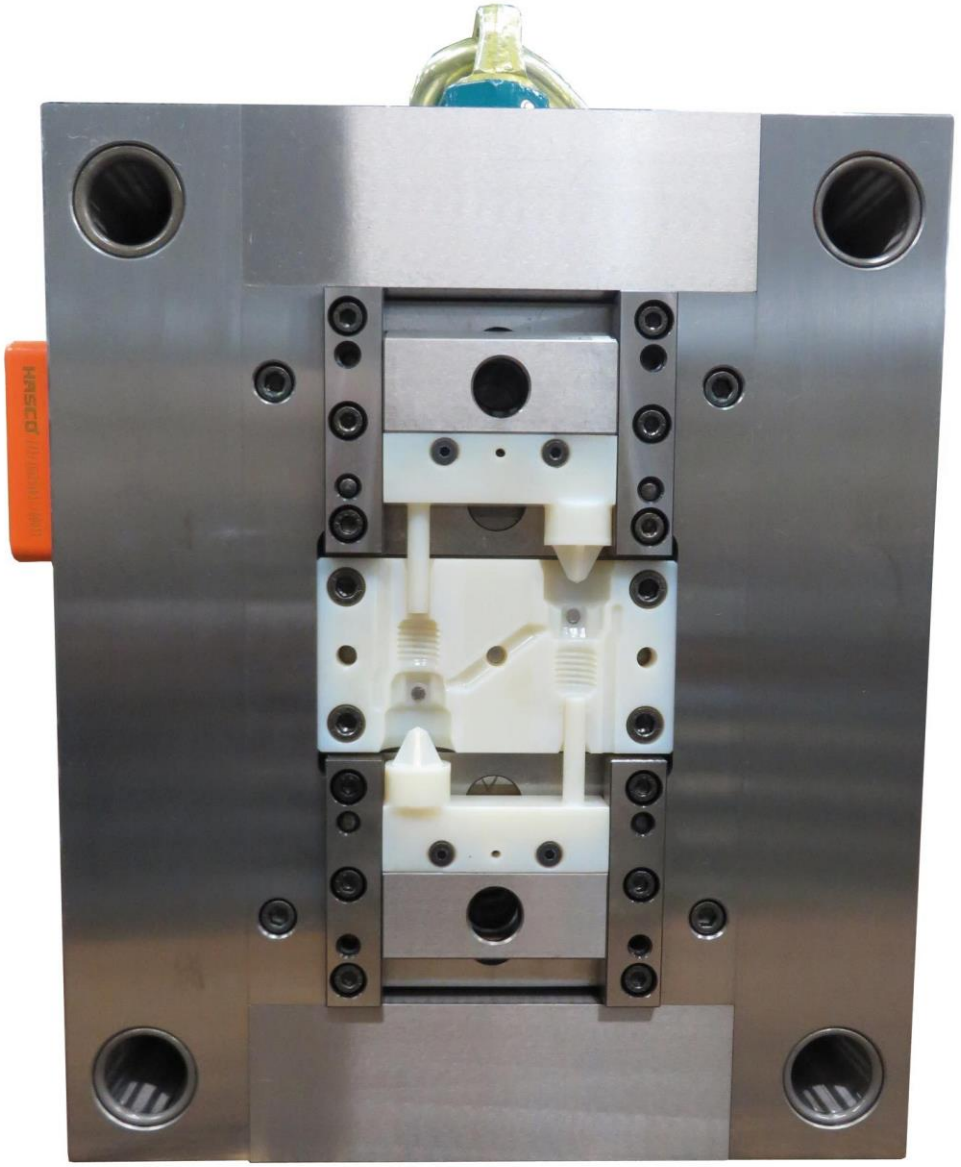
Return on Investment

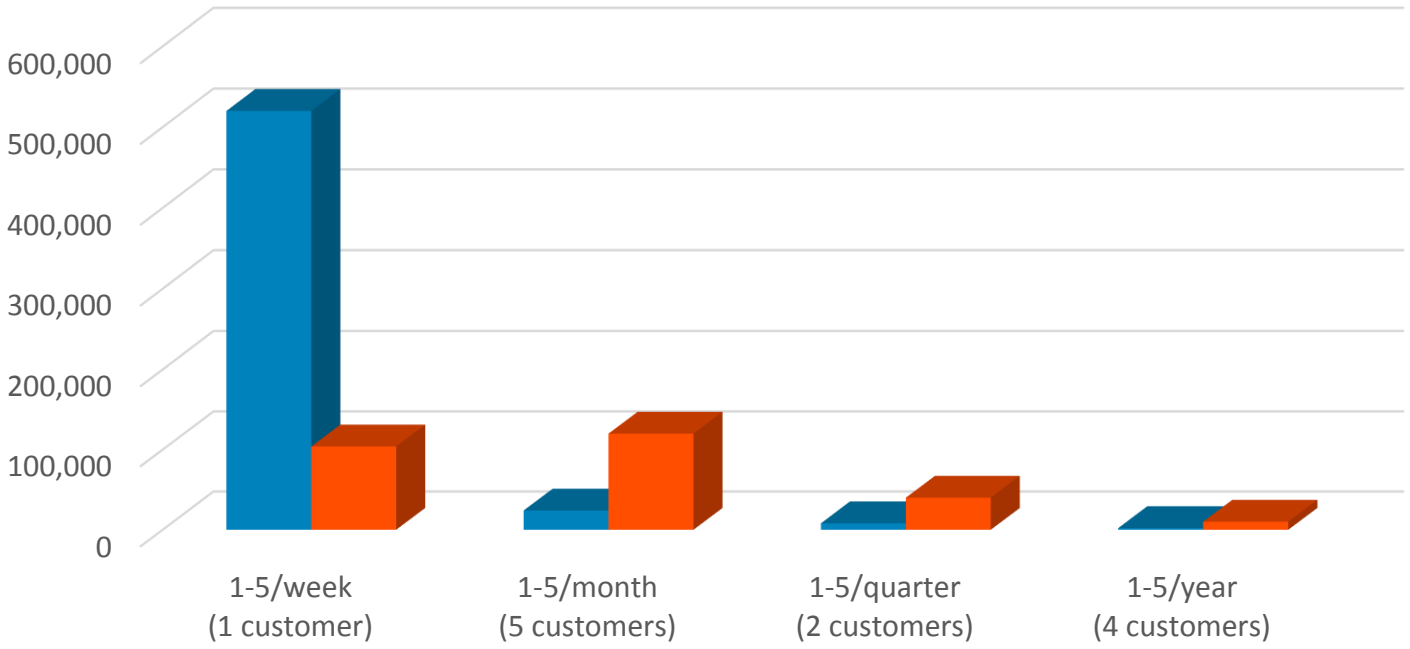
Very attractive ROI on small, complex molds when compared with machined aluminum molds.



This 3D printed HASCO standard mold insert empowers low-cost rapid prototypes.

Savings vs. Frequency of Use

Based on 2014 customer survey (58% response rate)



MAX.

Estimated Savings

$2,000 USD per tool

MIN.

Estimated Savings

$2,000 USD per tool

SECTION THREE

CUSTOMER STORIES

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Diversified Plastics

Diversified Plastics, Inc.
PRECISION INJECTION MOLDING SINCE 1977

3D Printer:
Objet260 Connex

Industry:
Custom molding

Need:
Small series production and prototypes from end-product material.

Worrell

3D Printer:
Objet500 Connex

Industry:
Medical device design house

Need:
Speeding time to market in medical device product development for their customers

Worrell: MedTG

Time (Days)

Traditional Tooling

56

3D Printed Tooling

2

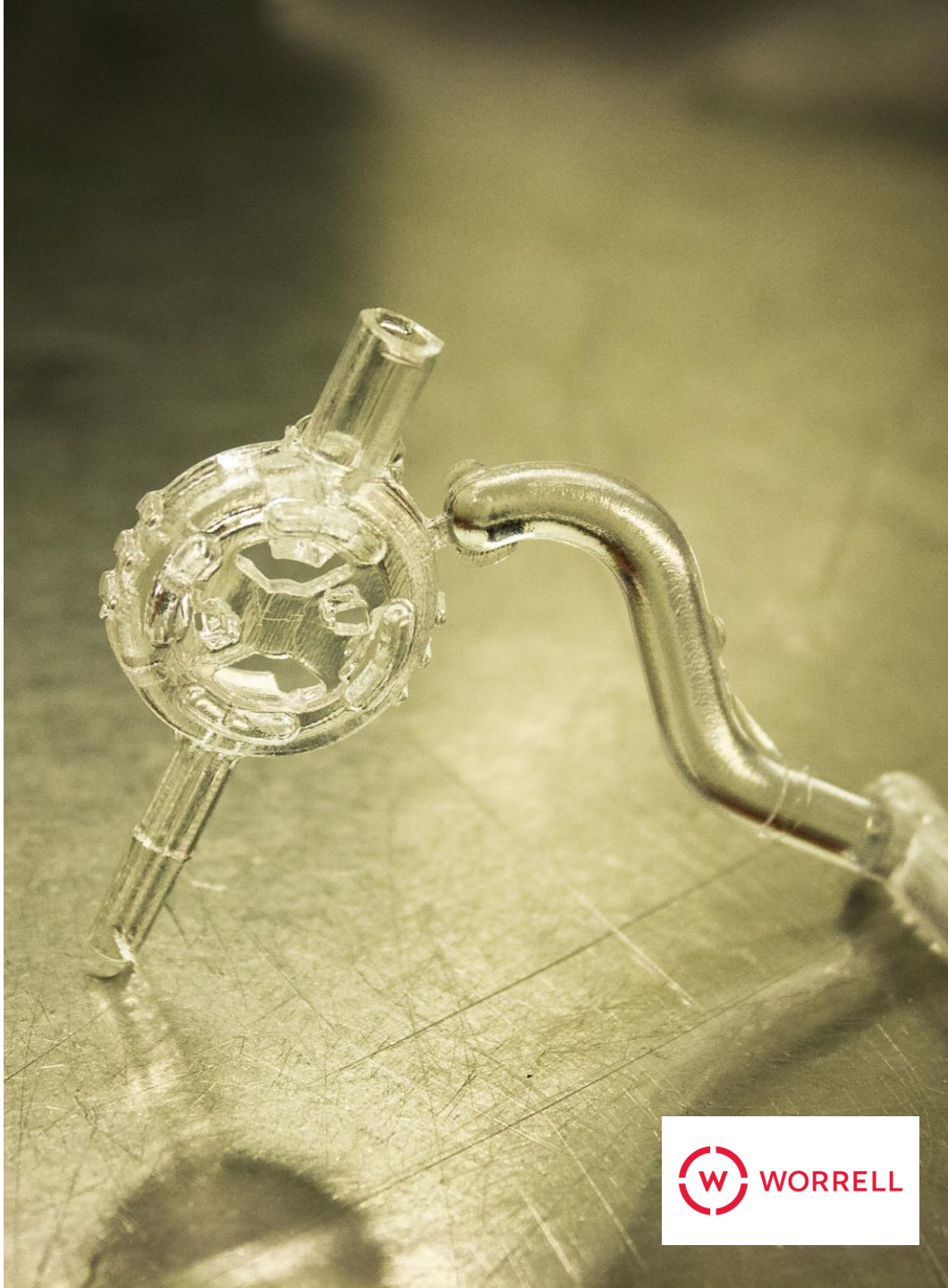
Cost (USD)

Traditional Tooling

11,000

3D Printed Tooling

2,600



Worrell: OBMedical

Time (Days)

Traditional Tooling

84

3D Printed Tooling

3

Cost (USD)

Traditional Tooling

12,000

3D Printed Tooling

4,000

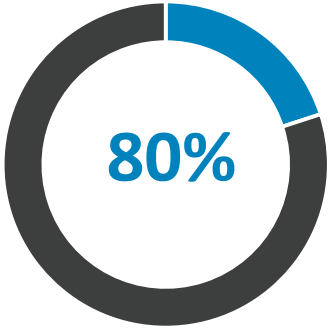
Unilever

Printer:
Objet500 Connex

Industry:
Consumer Goods

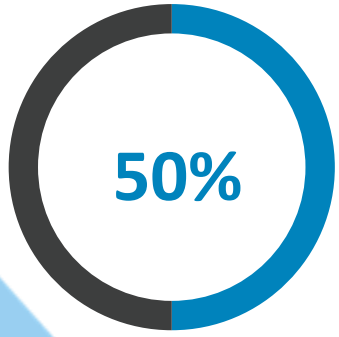
Need:
Prototypes from end-product material; functional testing on living hinges, caps and bottles.

Unilever



Cost Savings

Unilever was able to produce prototypes at 20% of the usual cost.



Time Savings

Unilever can deliver iterations 50 percent faster than traditional model making methods.

Unilever

“By 3D printing the injection molds with Digital ABS, we’re able to achieve the high quality associated with traditional manufactured prototypes, while ensuring that the high temperatures and pressures of the injection molding process can be sustained.”

Stefano Cademartiri
R&D, CAP and prototyping specialist at Unilever

Seuffer

Printer: Objet30Pro, Objet500 Connex

Industry: Automotive

Need:

- Prototypes from final material
- Functional tests for snap fits
- Electrical components over-molding

Seuffer

Time (Days)

Traditional Tooling

56

3D Printed Tooling

2

Cost (Euros)

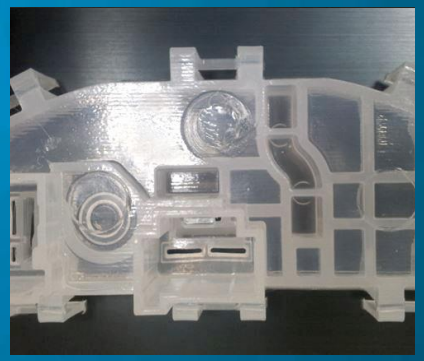
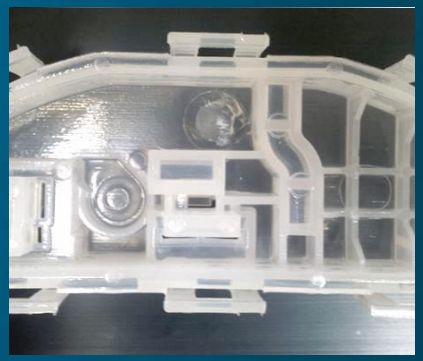
Traditional Tooling

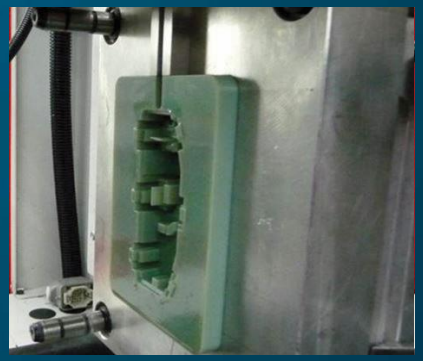
40,000

3D Printed Tooling

1,000





Grundfos

Printer: Objet500 Connex3

Industry: Pump manufacturing

Need:

- Production-ready prototypes
- Complex mold design with best surface finish

Grundfos

Injection molded part inside PolyJet mold

Side view of part with mold and sprue

Final part produced from the PolyJet mold

Whale

3D Printer: Objet500 Connex3

Industry: Water and heating systems for mobile applications

Need:

Prototyping in production-grade materials for faster time to market

Whale

“This is revolutionary… I estimate we’ve shortened our R&D process up to 35%, and this is on top of the 20% we’re already saving on ourdesign work. For me, it’s fantastic.”

Patrick Hurst
Managing Director, Whale

PolyJet molds produce intricate details.

Pump diaphrams created using PolyJet molds.

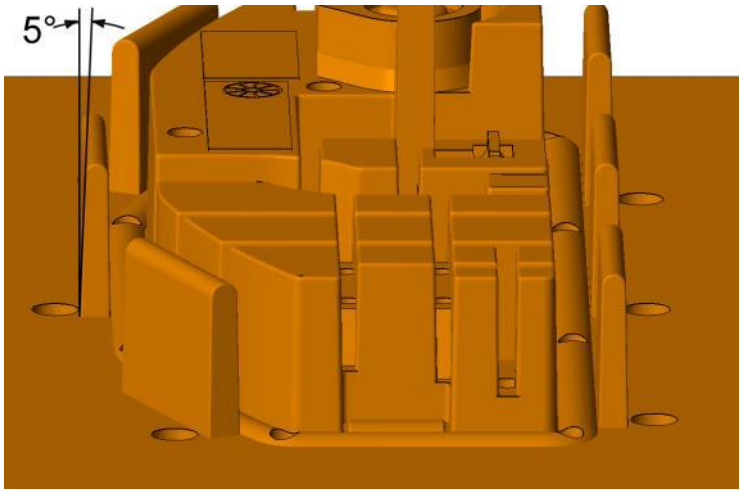
SECTION FOUR

TECHNICAL TIPS & TRICKS FOR SUCCESS

Technical Tips & Tricks for Success

Increase draft angle (2-5°)

- To facilitate ejection
- To reduce stress



Increase draft angle – 5° recommended.

Use sprue bushing

- Avoid direct contact between the molding machine's nozzle and the PolyJet insert
- Incorporate the sprue in the mold base / steel plate
- Undersize the hole by 0.2 – 0.3 mm (0.008 – 0.012 in) and ream to size during mold assembly

Standard sprue bushing.

Bolt Holes

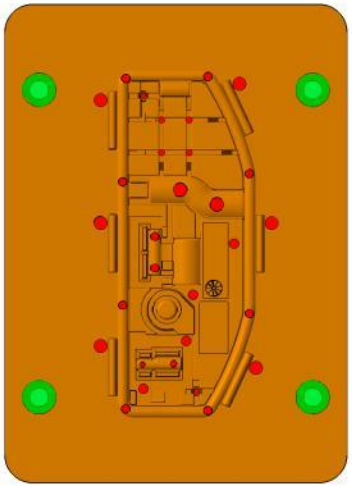
Bolt holes (green)

Ejection system (red)

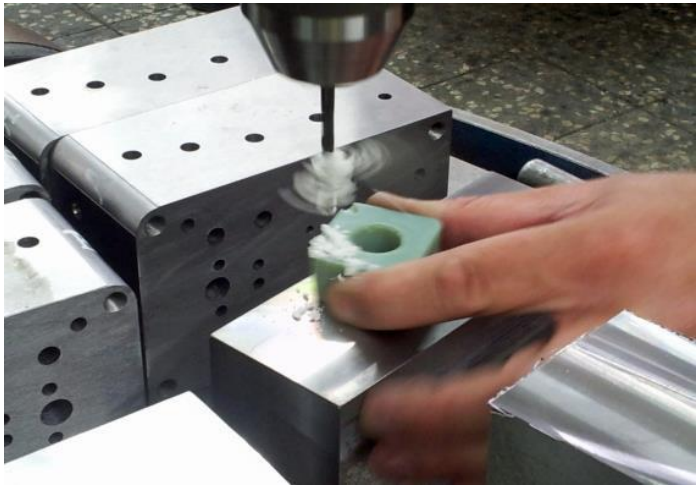
- Add round holes for ejector pins
- Undersize by 0.2 - 0.3 mm (0.008 – 0.012 in)
- Ream to perfect fit
- Keep holes 2 mm (0.08 in) from edges to prevent thin walls

After 3D printing:

- Ream holes
- Confirm snug but smooth movement



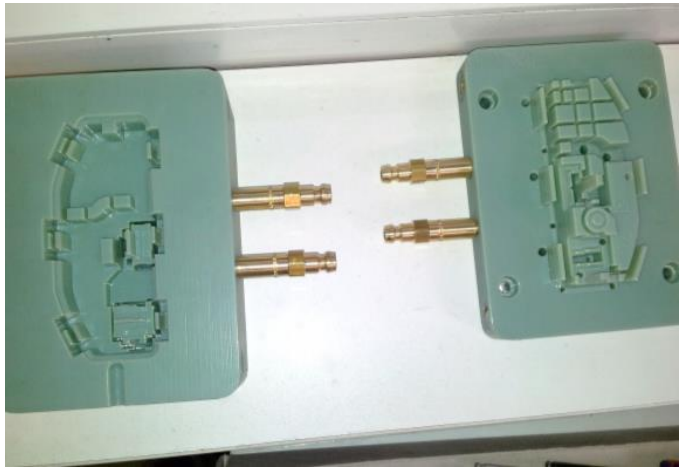
Add holes for ejector pins (red).



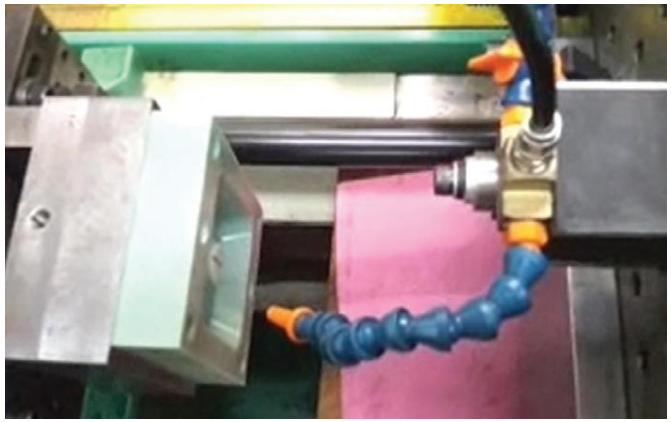
Ream holes for core and ejector pins.

Cooling System

- Increase cooling cycle time between shots to allow the mold to cool to a target temperature of 50 °C (120 °F)
- Accelerate cooling by blowing compressed air onto the core and cavity
- If cooling channels used, locate 8 – 10 mm (0.315 – 0.394 in) below the cavity surface



Cooling system.



Compressed air cools the core and cavity between cycles.

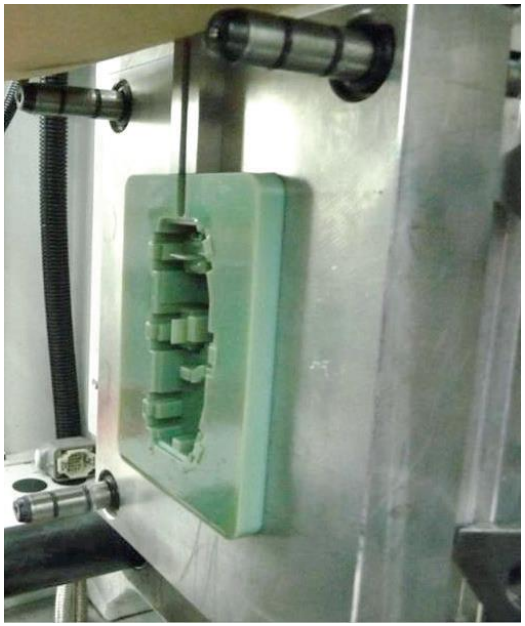
Mold Base Options

MUD base (master unit die – preferred)

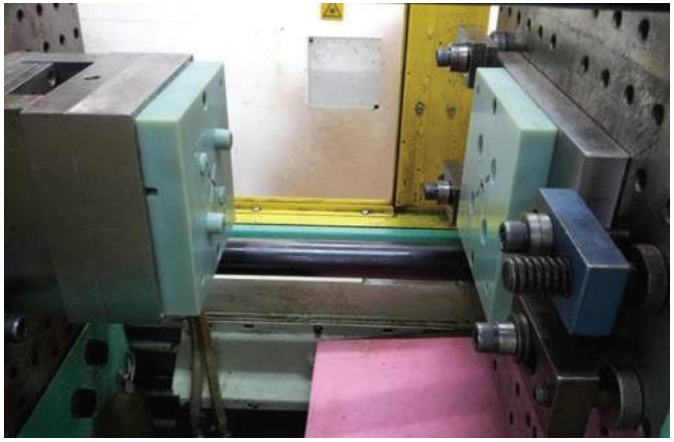
- Seat inserts in mold base pockets
- Confirm 0.2 mm (0.008 in.) beyond mold base
- Mill or add shims to adjust height

Steel plates

- Include or exclude the ejection system
- Confirm the mold is 20 - 25 mm (0.75 - 1.0 in) larger than the mold cavity on all sides



MUD base with PolyJet printed mold insert.

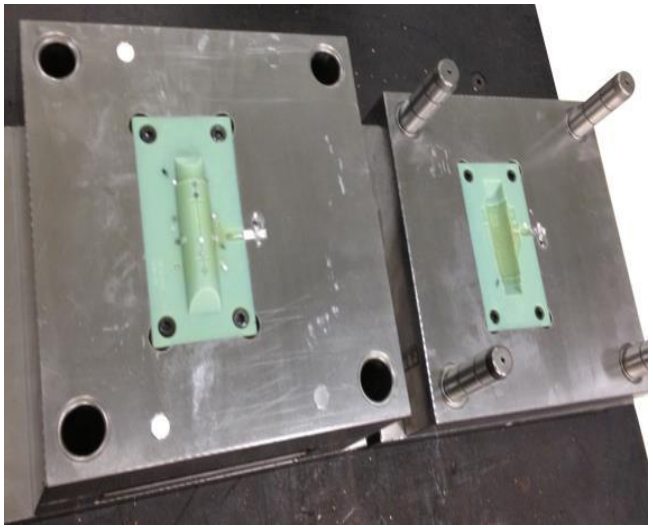


PolyJet molds with steel plates.

Mounting Options

Mold base (recommended)

- Largest investment
- Improved part quality
- Printed inserts can be smaller (no additional frame needed)



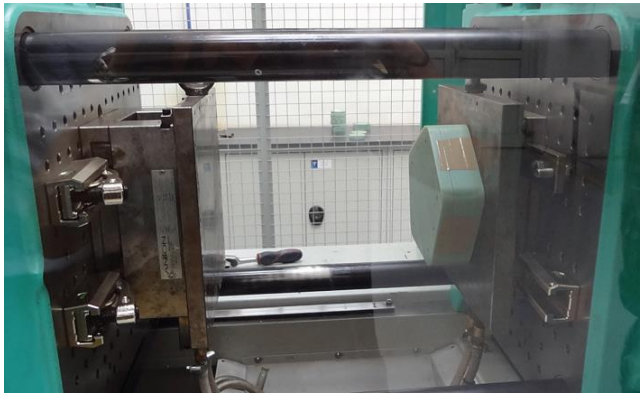
Mold base (recommended).

Steel plate with ejection

- Mid-range investment
- Increased part complexity

Steel plate without ejection

- Smallest investment
- Fastest



PolyJet molds mounted on steel plates.

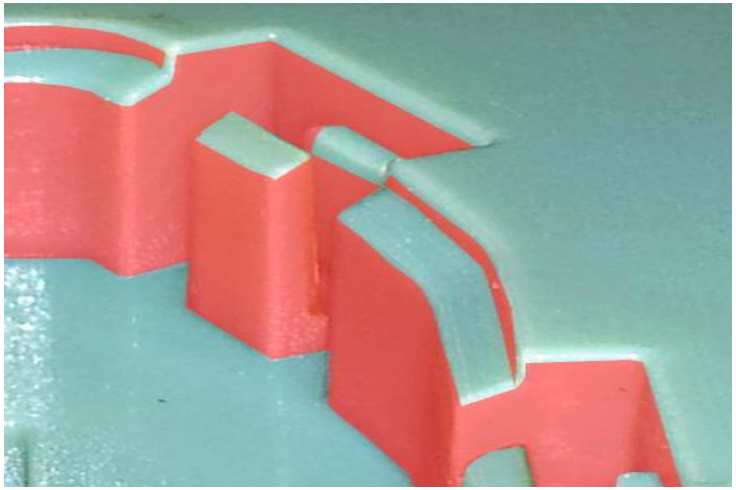
Surface preparation

1. Remove support material

2. Smooth surfaces

- For extraction (optional):
  Lightly sand surfaces that rise in the pull direction with 180/220 grit sandpaper.

- For appearance (optional):
  Lightly sand all surfaces with 180/220 grit followed by 320/400 grit



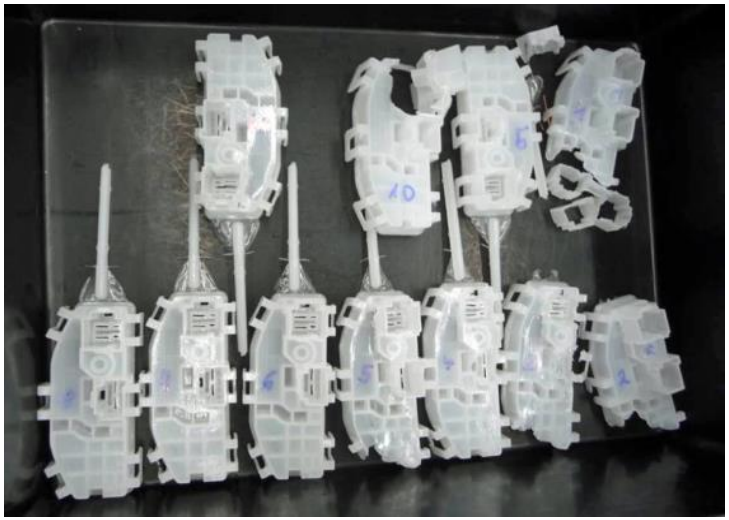
Sand vertical surfaces (red) for extraction.

Sand cosmetic surfaces (green) for appearance.

Tool Longevity

Goal: Use conservative settings to extend the life of the tool.

- Start with very low pressures and temperatures
- Conduct test runs
- Inspect results
- Adjust as needed



Test shots to dial in injection parameters.

Initial settings

Injection molding time limit: 20 seconds

Pack & hold phase: 0 kPa (0 psi) and 0 seconds

Shot size: 75% of standard volume

Barrel temperatures: Low end of resin recommendation

Injection speed:

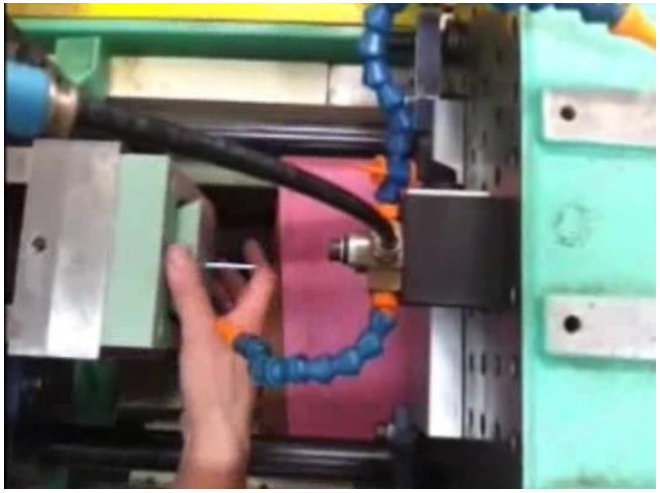
- Low end of resin recommendation
- 10% to 20% of the machine’s maximum screw speed

Cooling cycle:

- Small, thin parts: 40 seconds
- Larger parts or thicker features: 90 seconds

Trial shots

- Increase shot size
  Target: 90% of volume
- Adjust packing pressure:
  30 – 50% of injection pressure
- Increase hold time
- Try to avoid getting flash



If sink marks are present:

- Adjust barrel temperature
- Adjust injection speed
- Do not over-cool part. This will cause part to shrink and grab tool.

Threaded cap from mold.
20% GF PP

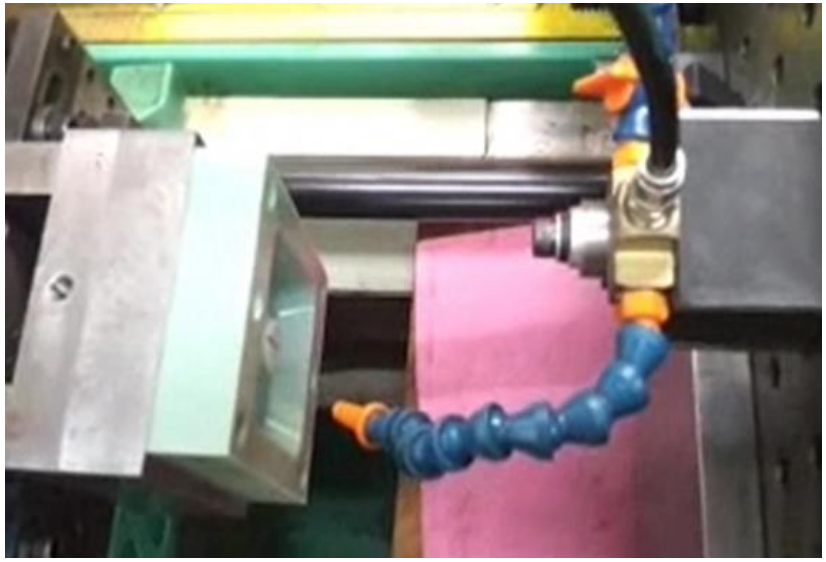
Threaded cap from mold.
20% GF PA 6/6

Mold Temperature

- Mold temperature will rise with continuous operation (undesirable)
- Allow to cool between shots
  Target: 50 °C (122 °F)
- Measure mold temperature with IR gun

Either:

- Use extended dwell between cycles
- Accelerate with compressed air during dwell



Compressed air cools mold to 50 °C (120 °F).

More Information and Resources

www.stratasys.com/webinar-injectionmolding

- Download webinar slides & documents
- View webinar on-demand
- Submit technical questions to engineer

Questions?

www.stratasys.com/webinar-injectionmolding

THANK YOU

Mark Bashor
Applications Engineer
Manufacturing Tools, VBU
Rancho Cucamonga, Ca
Mark.Bashor@stratasys.com

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