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GRIPPER

Tooling Modifications

Analysis and Recommendations

Executive Summary

CPI has encountered variety of problems relating to the quality of the molded Grippers used in Clicker Vial. Inconsistent parts with flash in critical areas and short shots have been the chief concerns. The problems have been identified to be related to tooling and processing issues resulting from tooling. Recommendations have been made to remake critical components of the tool and modify runner and gating system to improve the flow of material into the cavities and thereby reducing part-to-part variations.

Background

Gripper mold is a two-cavity mold with interchangeable inserts to make four different configuration parts. The mold also has the provision to add two more cavities at a later date. The material specified to run is Marlex, HID 9018 High Density Polyethylene. CPI has encountered various dimensional and aesthetic issues with this part. The area of major concern at present is one of part consistency whereby shorts and flash in the same part is observed.

Objective

Objective of this analysis is as follows:

- Evaluate the tooling and each component to pin point the area of concern
- Meet and discuss the issues with Inland personnel
- Recommend necessary changes
- Determine the course of action
- Establish timeline
- Follow up to completion

Discussion

Molded parts and each major component of the mold were carefully evaluated and scrutinized. This lead to determination and conclusion that in order to mold flash free parts the tooling components must be remanufactured and match-burned or match-EDM (A technique where the steel is used as an electrode when burning mating halves together to achieve matched fit). A short shot is occurring consistently at the one of the Gripper legs situated the farthest form the gate location of the part. Material has to travel further to fill this area and it appears to be contributing to the short shot problem. Also, there are no vents at the parting line to remove the air and volatiles. A decision is made to recut the runner, add a second gate positioned 180° apart (Illustration 1) and add vents at parting line.

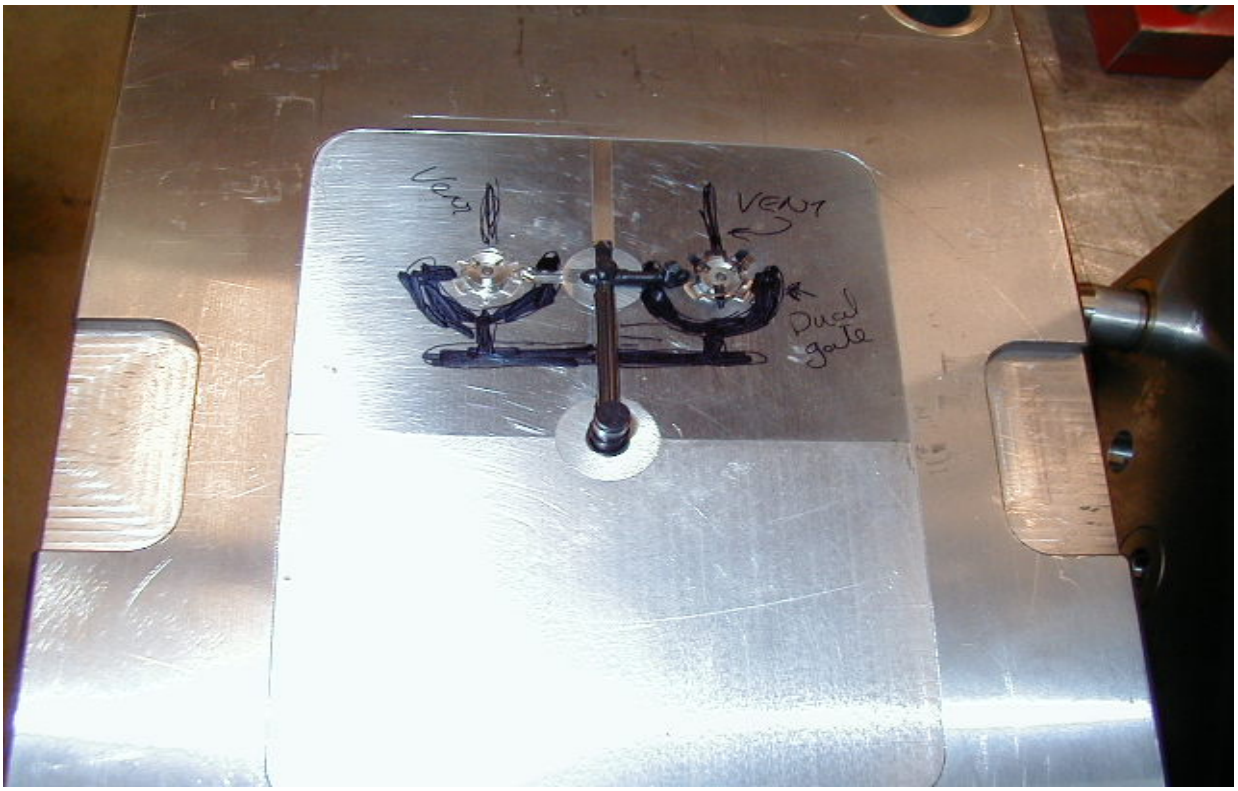
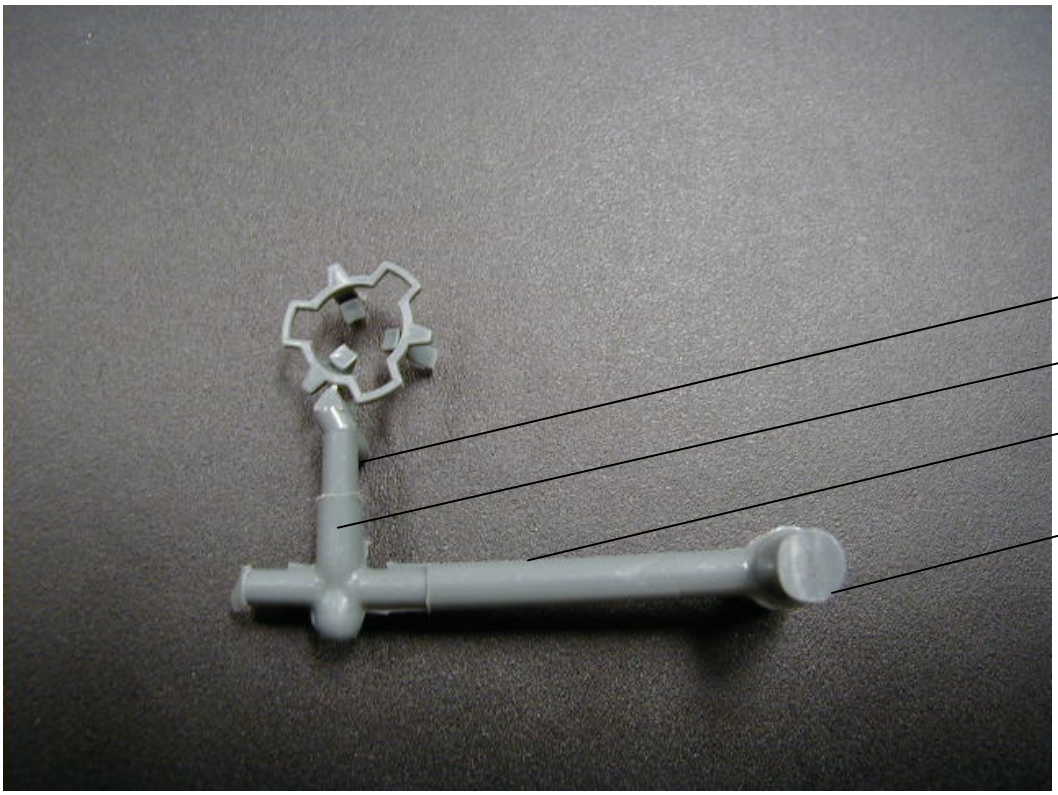


Illustration 1

Sprue/Runner/Gate Issues

As the material flows from the sprue to the primary runner to the secondary runner and tertiary runner and so on, the pressure drops at every transition. This pressure drop also creates a drop in velocity of the material racing through the runner channels at every transition. In order to maintain constant velocity and temperatures throughout the runner system, the diameter of the secondary and subsequent runner branches are reduced. However, if the diameters of subsequent runners are reduced too much, it also creates imbalance condition. Many rules and strategy exist for runner sizing. I most often use 0.050 reductions from sprue diameter to first runner and 0.025 reductions every drop there after. In the current configuration there is also a step and a mismatch (Illustration 2), which should be eliminated.

Injection pressure required to fill this part is around 1200 psi. In order to reduce flashing and over packing and stresses that result from over packing it is desirable to reduce the pressures to the lowest level possible. Gate diameter of the current design is .015, which I believe is too small and restrictive. It is quite possible that the gate is freezing off prematurely requiring much higher pressures to fill and pack the parts. I recommend opening up the gate to .029 (width and depth) to improve flow.



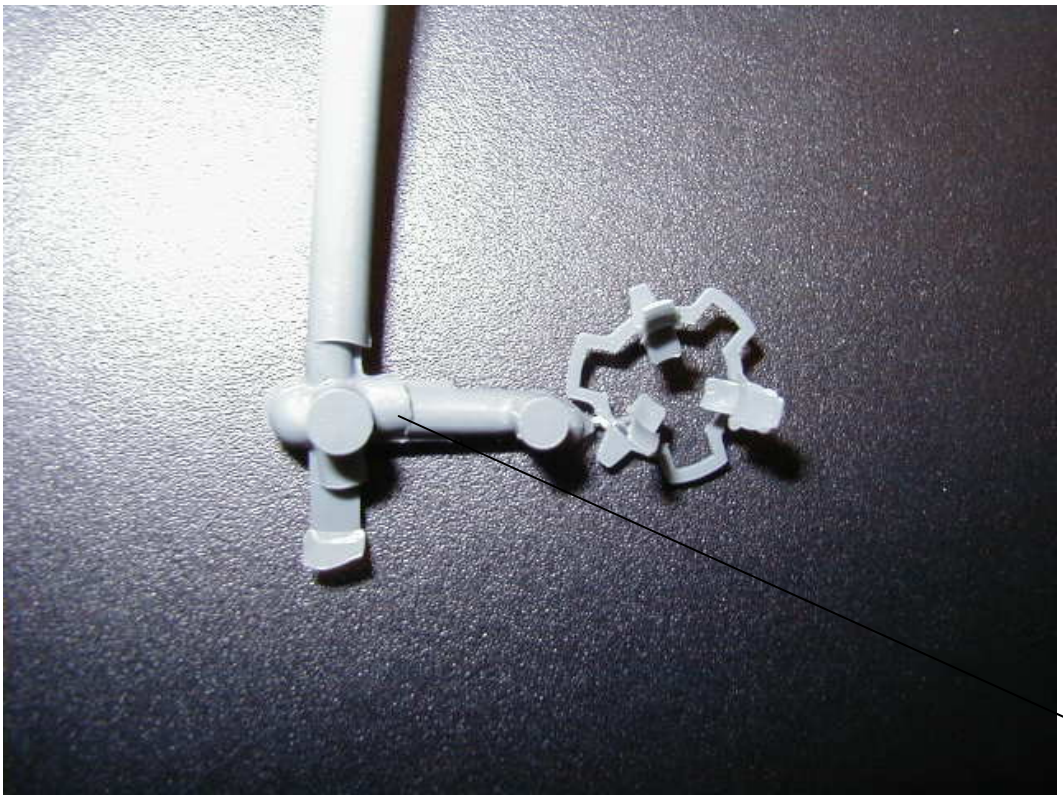


Illustration 2

	Current	Proposed
Sprue Diameter	.250	.250
Primary Runner Diameter	.156	.200
Secondary Runner Diameter	.140	.175
Step	.125	No Step
Gate size (Width & depth)	.015 X .025	.029 X .029
Gate	Single	Dual
Vent @ P/L	None	Add

Conclusions and Recommendations

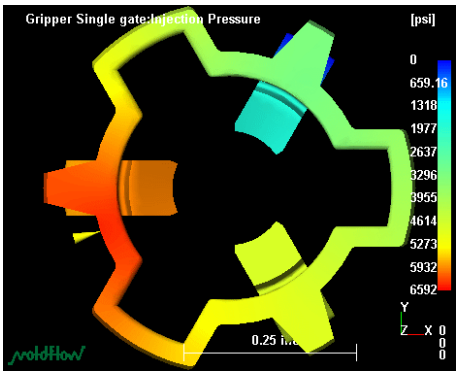
Both tooling and molding related issues appear to have contributed to the shorts and flash conditions along with general inconsistencies in Gripper parts. The tooling modifications such as Match burning the key components and resizing and dual gating should help produce more consistent parts with lower molded-in stresses.

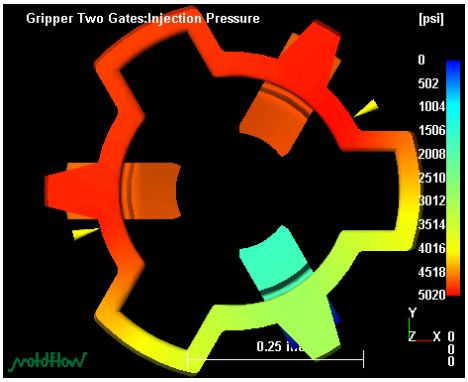
All other parts for the Clicker assembly should go through similar scrutiny in order to improve the overall product quality and predictable and consistent production run prior to cutting additional cavities.

I have made these recommendations based on available information, however, these are only recommendations and I T can only achieve the positive results from these recommendations through proper implementations of them and have the ultimate responsibility of producing acceptable quality parts.

Moldflow Analysis Results (Single gate vs. Two gates)

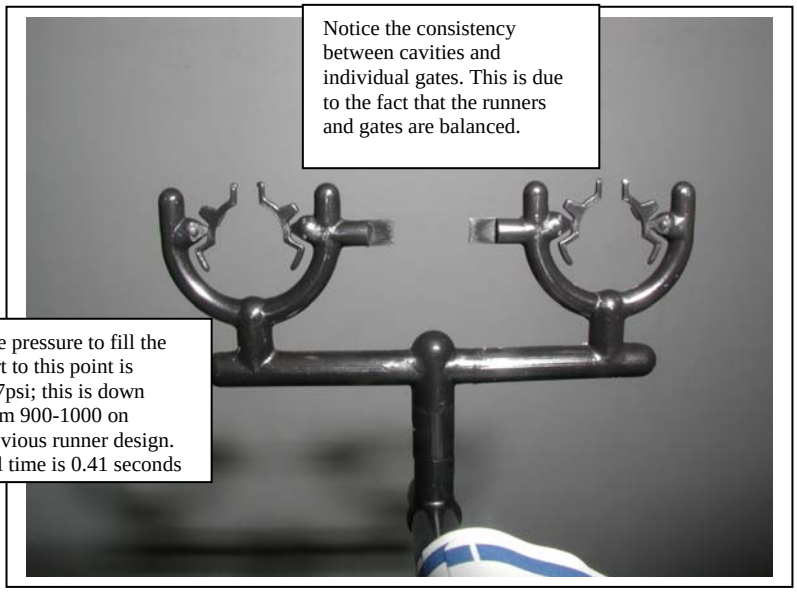
Injection Pressure reduced by 1500 psi
Faster fill in critical area
Fill pattern changed





Actual Molding Trial Results

The following is a summary of the results obtained during testing of the gripper with the new runner and multi-gate configuration. The pictures will help in understanding the fill pattern of the tool and the balance from cavity to cavity. Each picture will be accompanied by a comment on pressure and fill time.

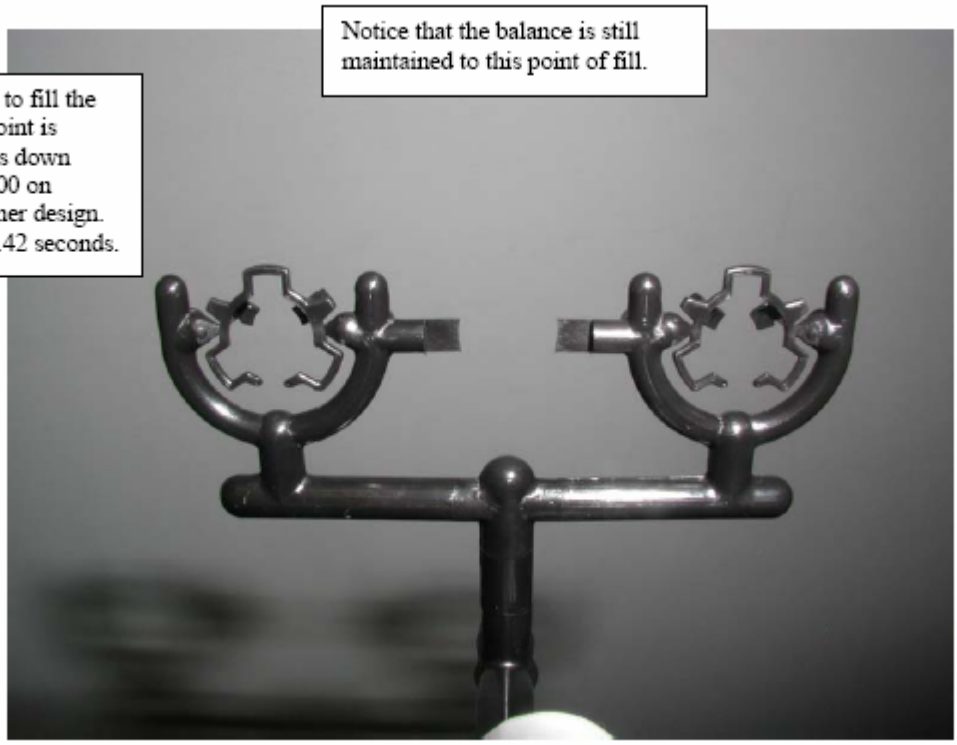


Notice the consistency between cavities and individual gates. This is due to the fact that the runners and gates are balanced.

The pressure to fill the part to this point is 617psi; this is down from 900-1000 on previous runner design. Fill time is 0.41 seconds

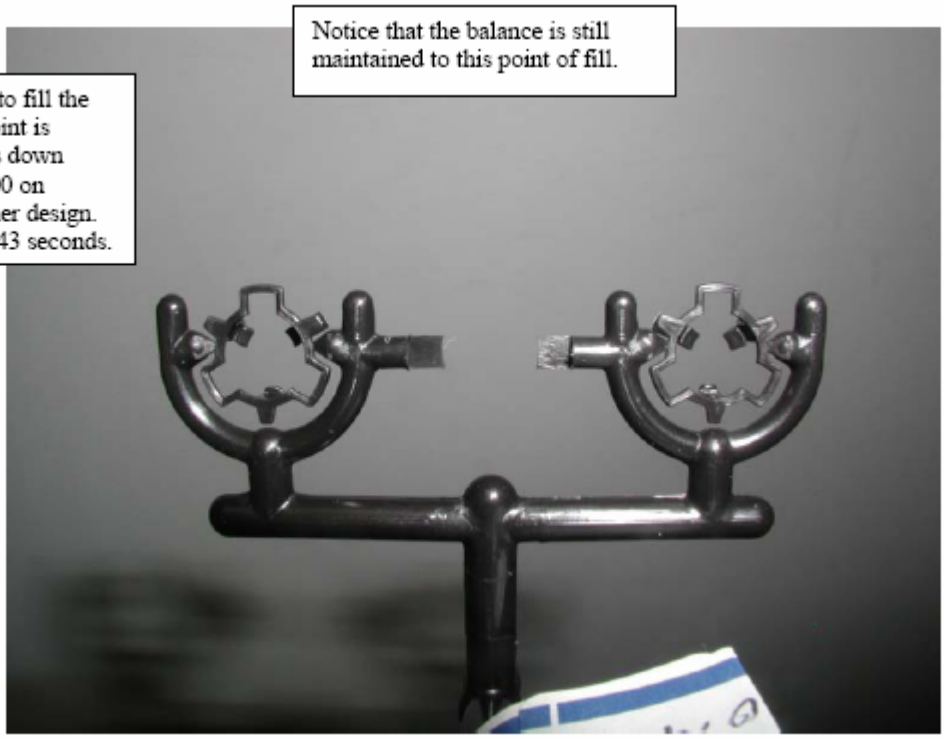
Notice that the balance is still maintained to this point of fill.

The pressure to fill the part to this point is 640psi; this is down from 900-1000 on previous runner design. Fill time is 0.42 seconds.

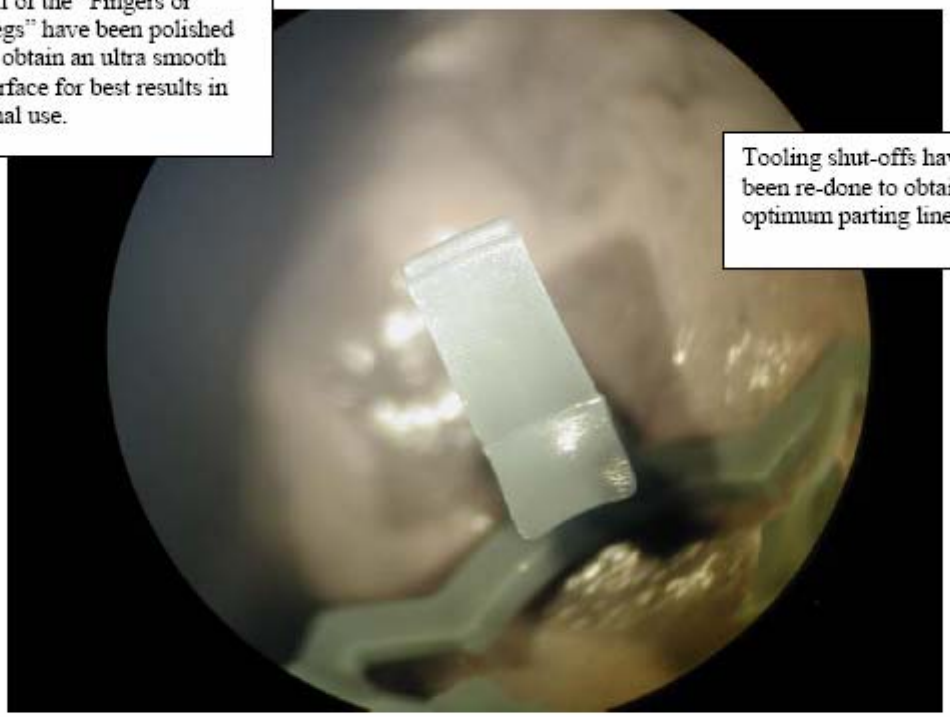


Notice that the balance is still maintained to this point of fill.

The pressure to fill the part to this point is 645psi; this is down from 900-1000 on previous runner design. Fill time is 0.43 seconds.



All of the "Fingers or Legs" have been polished to obtain an ultra smooth surface for best results in final use.



Tooling shut-offs have been re-done to obtain optimum parting lines

Conclusion:

The changes to the mold have proven to have a positive impact on the process ability and quality of the product produced. This improvement will result in consistent product quality through out a production run. The teamwork that was exercised in this project has been very helpful; the assistance by Consultek was appreciated as well.