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CRADLE & VIAL

Tooling Modifications

Analysis and Recommendations

September 22, 2003

Executive Summary

Cradle, one of the most important Clicker Vial components has also been one of the most difficult components to mold primarily due to the thin walls in the part and difficulty in providing sufficient cooling in critical areas of the tool. In the current state, maximum injection pressure along with the highest recommended mold temperature is required to fill and pack the part to avoid shorts in the area where the gears rest. Such extreme process parameters have resulted in to the bowed parts due to force of the ejection pins and occasional shorts. Several recommendations have been made to alleviate this condition, which includes increasing gate diameter, improve venting, remake core out of high thermal conductivity material and revamp the cooling and runner system.

VIAL

Most of the issues relating to the tooling and processing have been addressed and results have been satisfactory. Only recommendation of improving venting to improve mold filling is made.

Background

Cradle mold is a single cavity mold with provision to add three more cavities at a later date. The material specified to run is Makrolon Rx-2530 Polycarbonate. Due to the complex geometry the core pin in the mold was constructed without any water lines. The problems encountered during trial runs consist of short shots, and mushrooming of the top portion of the parts.

Objective

Objective of this analysis is as follows:

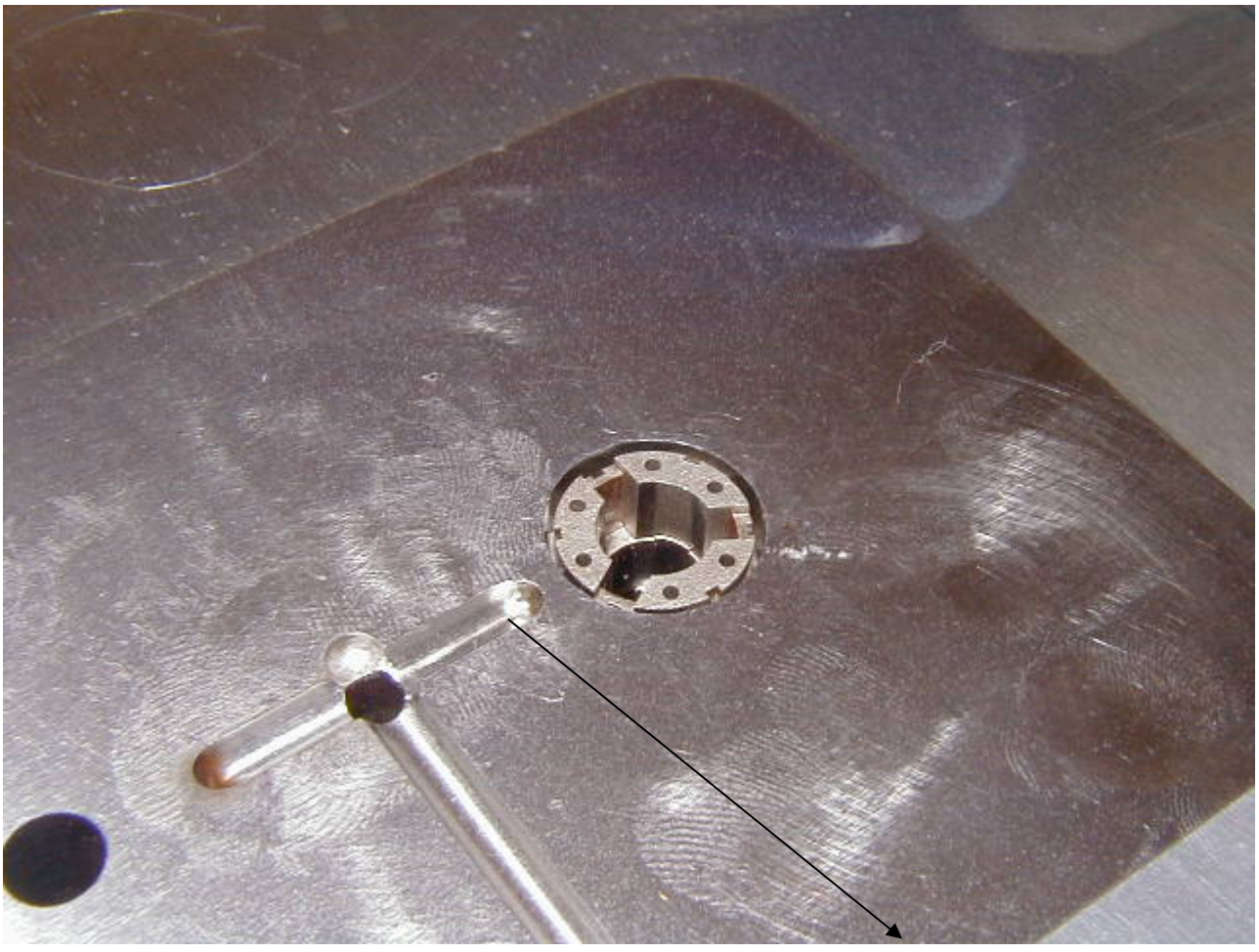
- Evaluate tooling and all of its components to determine the cause and effect.
- Discuss issues with Inland Personnel and come up with solutions.
- Recommend necessary changes
- Determine course of action
- Follow up to completion

Discussion & Recommendations

Bob Allen, project engineer at Inland Technologies reiterated his concerns regarding molding difficulties in terms of using maximum pressure and mold temperature to mold these parts. Mold was taken apart and each component was analyzed. In order to improve mold filling by reducing injection pressure, we decided to enlarge the gate by 50 percent, improve venting and open up the runner system to reduce pressure drop through the gate. If the maximum plastic pressure available from the machine is 20,000 psi and if the plastic pressure required to fill the cavity is 6000 psi (not unusual for a thin walled part), the pressure loss from the machine nozzle, sprue, runner system and gate cannot exceed 14,000 psi. Therefore, reducing the pressure loss through the runner system and gate makes logical sense (illustration 1). It is quite possible that by reducing injection pressure required to fill the part, we may be able to lower the mold temperature. This should help the part mushrooming situation since the part will be sufficiently cooled to allow ejection at lower pressure. However, a more permanent solution is to find a way to provide better cooling in the core pin. Since it is not feasible to add water in the core pin, the suggestion is made to make the core pin out of highly thermally conductive material such as Ampcoloy®. These copper alloys have six to nine times greater heat transfer than convention mold steels. However, they do exhibit lower wear characteristics. Additional recommendation includes enlarging the mold base pocket (illustration 2) to accommodate a larger insert with waterlines to enhance heat transfer between Ampcoloy® core pin and insert. Also under consideration is application of Poly-Ond®

coating (Nickel phosphorus coating impregnated with Teflon) on core surface to improve release of the part.

	Current	Proposed
Sprue Diameter	.250	.250
Primary Runner Diameter	.156	.200
Secondary Runner Diameter	.141	.175
Gate	.030	.045
Core pin Material	Steel	Ampcoloy
Core pin Plating	None	Poly-Ond



Runners and Gate

Illustration 1

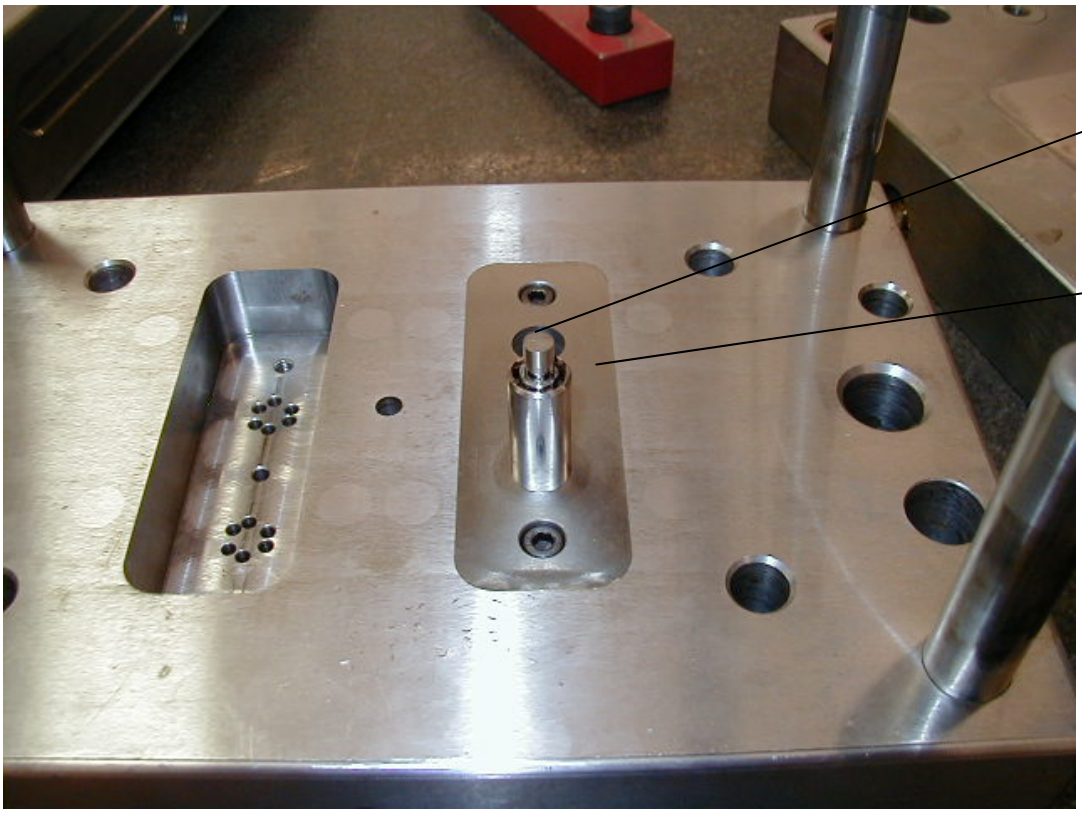


Illustration 2

Vial

A close examination of the insert shows a slight burning (indicated by black mark) indicating gas trap or inadequate venting situation. Tooling will be modified to improve venting as shown in the illustration 3.

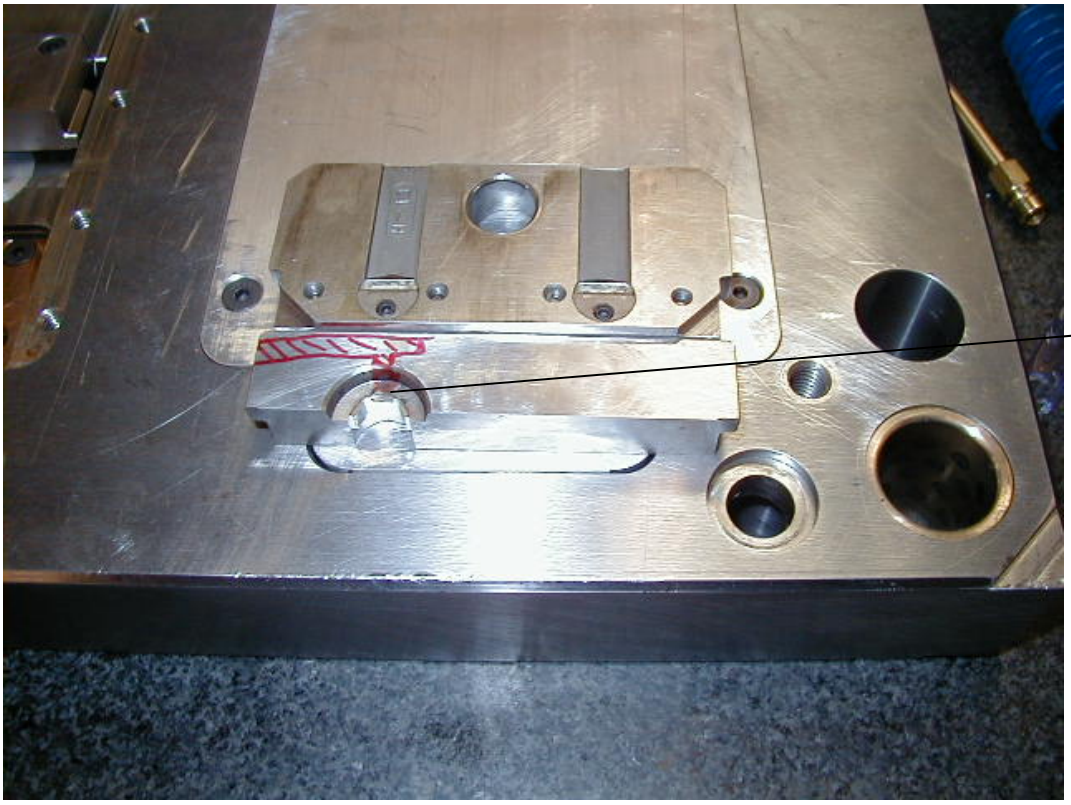


Illustration 3