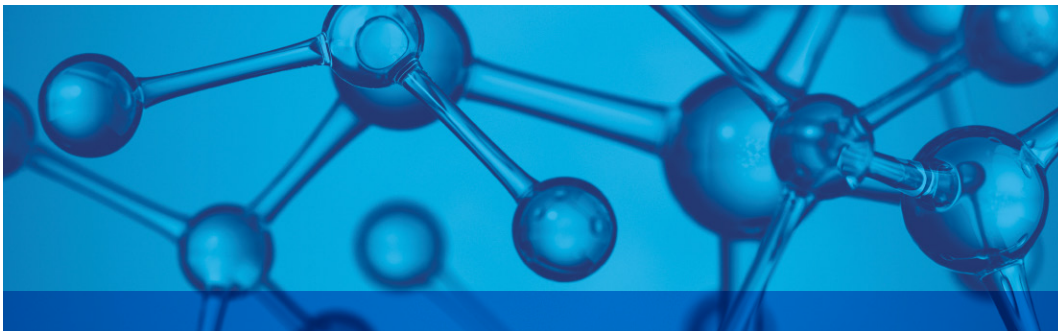

Heat Staking of Ryton® R-4 and Ryton® R-7

Introduction

One of the many assembly methods available through the use of Ryton® PPS is heat staking. With this technique, two components are designed so that a molded post on one part fits through a hole in the mating piece. The head of the post is then deformed to secure the parts together. The strength of the assembly depends on control of that deformation process. This report summarizes a study of staking head temperature and downward pressure on strength and processability of both crystalline and amorphous parts.

Procedure

To control staking head temperature, a tool was constructed with cal-rod heater and thermocouple near the tip. To measure and control downward pressure, the tool was mounted on a Branson Model 4120 ultrasonic welding machine used only for its reciprocating stroke air cylinder.

For this test, parts were molded with a post 3.2 mm (0.125 inches) in diameter and 6.4 mm (0.25 inches) high. Mating plates of both Ryton® PPS and aluminum 1.6 mm (0.062 inches) thick were drilled to produce a 3.2 mm (0.125 inch) hole and fitted over the post. The head of the post was deformed and the assembly mounted in an Instron to measure plate "pull-off" force.

Results

The tables on the following page summarize the "pull-apart" strengths of amorphous and crystalline Ryton® R-4 and Ryton® R-7 using both Ryton® PPS and aluminum plates. Heat staking parameters are optimized for strength and processability.

Crystalline parts, 149°C (300°F) mold

Tip temperature	°C (°F)	327 (620)
Downward force	N (lbs)	178 (40)
Pull-apart force		
Ryton® R-4 to Ryton® PPS	N (lbs)	150 (33.7)
Ryton® R-4 to aluminum	N (lbs)	166 (37.4)
Ryton® R-7 to Ryton® PPS	N (lbs)	199 (44.7)
Ryton® R-7 to aluminum	N (lbs)	206 (46.2)

Amorphous parts, 66°C (150 °C) mold

Tip temperature	°C (°F)	310 (590)
Downward force	N (lbs)	667 (150)
Pull-apart force		
Ryton® R-4 to Ryton® PPS	N (lbs)	247 (55.6)
Ryton® R-4 to aluminum	N (lbs)	364 (81.8)
Ryton® R-7 to Ryton® PPS	N (lbs)	199 (44.7)
Ryton® R-7 to aluminum	N (lbs)	206 (46.2)

Conclusion

Since fastening cycle times are less than two seconds, the rate of head deformation must be controlled by adjusting the interdependent variables of tip temperature and downward pressure. Too much pressure and/or too low a temperature will crack the post before melt-deformation can occur.

Cold-molded amorphous parts are stronger and easier to stake than hot-molded parts. The hot-molded crystalline parts require more heat to stake so tip temperature must be increased from 310 °C to 327 °C (590 °F to 620 °F) and the downward force reduced from 667 N to 178 N (150 lbs to 40 lbs). On the other hand, high crystallinity is crucial to overall performance in high temperature service. Of course, the staked head will be amorphous after melting, regardless of its initial state of crystallinity. For applications requiring full crystallinity, therefore, the complete assembly should be annealed at 204°C (400°F) for two hours to induce a crystalline structure in the staked region.

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