From the TMG Solutions Archives:

Snap Fit Failure

Keywords - Failure, Snap Fit, Contamination, FTIR

What Went Wrong?

An injection-molded poly(acrylonitrile:butadiene:styrene) (ABS) component experienced cracking within the retaining arm during a snap fit installation with the mating part. Failure was limited to approximately 1% within a single production lot.

Evaluation

Microscopic examination of the failed parts showed consistency in regards to failure location and appearance of the fracture surface. The parts exhibited a single crack origin within the retaining arm at a location under anticipated tensile stress during the snap fit installation. The fracture presented brittle fracture features indicative of rapid crack extension through overload.

Scanning electron microscopy (SEM) revealed the presence of an inclusion at the crack origin. The inclusion was a discontinuity within the material and acted as a point of severe stress concentration. Energy dispersive X-ray spectroscopy (EDS) revealed that the inclusion had a relatively high sulfur content compared with the surrounding base resin. Further testing through Fourier transform infrared spectroscopy (FTIR) showed the inclusion to be poly(phenylene sulfur) (PPS).

The molded ABS component was found to have undergone molecular degradation during the molding process. The failed parts produced a melt flow rate of 37 g/10 min. versus 24 g/10 min. for the molding resin. This level of degradation reduced the mechanical integrity of the material, rendering the part brittle and susceptible to premature failure.

Conclusion

It was the conclusion of the evaluation that the retaining arm failed through overload via rapid brittle fracture. The cracking initiation at included PPS contamination that acted as a severe point of stress concentration. The material was also significantly embrittled because of molecular degradation from the molding process. Failure occurred within the compromised material when the contamination was located at the point of tensile loading associated with the snap fit installation.

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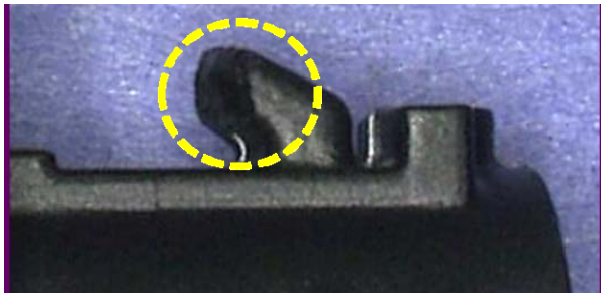

Figure 1: Cracking occurred with the retaining arm during a snap fit installation.

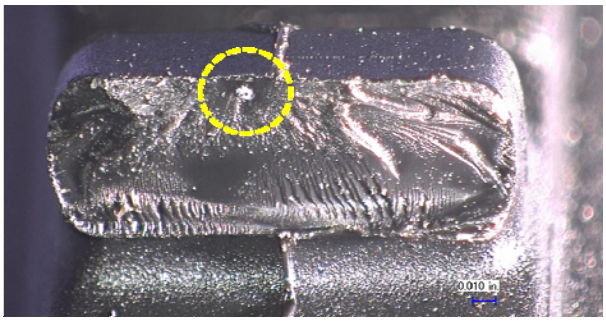

Figure 2: The fracture surface showed features associated with rapid brittle cracking, and a single crack origin.

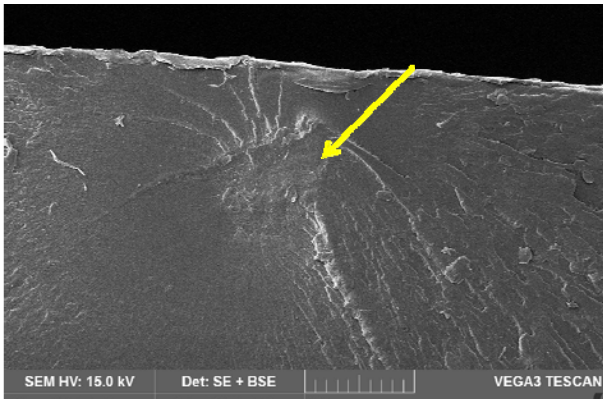

Figure 3: The SEM examination showed the cracking initiated at an inclusion within the material.

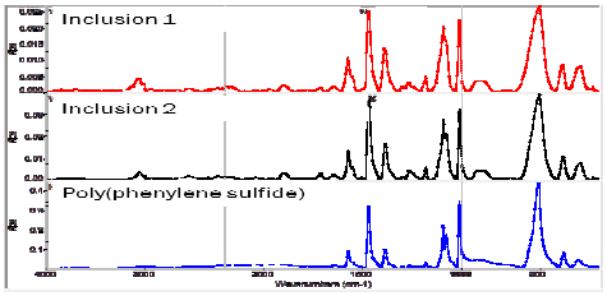

Figure 4: FTIR testing showed the inclusion to be PPS in the ABS molded part.